Annual Report 2018-19

AICRP-National Seed Project (Crops)



ICAR- Indian Institute of Seed Science
(Formerly ICAR-Directorate of Seed Research)
(Indian Council of Agricultural Research)
Kushmaur, Mau 275103 (UP)

AICRP

"National Seed Project (Crops)"

Annual Report

2018-19

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Preface

Quality seed is a vital input in agriculture and farmers' access to quality seed of superior varieties is key in increasing agricultural productivity and production. The pace of progress in food production is largely dependent upon the progress of seed programme with which a country is able to multiply and market good quality seed of high yielding varieties with superior genetics. Role of quality seed is documented and acknowledged across farming systems and ICAR duly acknowledged this fact by the launch of mile stone project *viz*. AICRP- NSP (Crops) during 1979-80. To operate quality seed programme, it is essential to produce sufficient quantity of breeder seed. Similarly, to organize well orchestered seed production programmes, research back up on various aspects of seed production technology, quality maintenance and its fine tuning, storage, seed health care and seed processing *etc*. are vital and found to be indispensable. In order to address issues such as Seed Replacement Rate (SRR) and Varietal Replacement Rate (VRR) and to develop need based technological interventions in seed domain, launching of network project viz. AICRP-NSP (Crops) has been a significant stride under ICAR. AICRP-NSP (Crops) under aegis of ICAR is guiding, coordinating and promoting seed technology research and breeder seed production very systematically with an appropriate research backdrop.

Annual Report 2018-19 is a compilation of progress made by varied co-operating centers under AICRP-National Seed Project (crops) under its two components *viz*., Breeder Seed Production and Seed Technology Research. It is my immense pleasure to gratefully acknowledge the dynamic leadership and path illuminating guidance received from Dr. T. Mohapatra, Hon'ble Secretary, DARE & Director General, ICAR and I hope that under his able stewardship, Indian seed production and research fraternity would excel in the arena of quality seed production and research. I acknowledge gratefully Dr. A.K. Singh, DDG (CS & HS), who is the mission leader of this project, for his kind support, guidance and encouragement. I thank Dr. D.K. Yadava, ADG (Seed) for his tireless help and active co-operation rendered. I also thank Seed Section, DAC&FW, MoA&FW for their cooperation in implementation of BSP programme. I also place on record my sincere thanks to all nodal officers and scientists from various co-operating centers, who did commendable job in successful implementation of the project. I gratefully acknowledge the immense support of Principal Investigators; Dr. G.K. Koutu, Dr. S.K. Yadav, Dr. Karuna VIshunavat, Dr. Amit Bera and Dr. Ashwani Kumar, who have done meticulous compilation of various reports, technical programme and for providing technical guidance to scientists. I also take this opportunity to acknowledge all scientists and staff of IISS primarily Dr. Vijaykumar H.P. and Dr. Sripathy K.V. for their efforts in successful co-ordination of this massive project across the country. I firmly believe that this project, down the line would tread us towards attaining seed sufficiency with adept technological backup for quality seed driven agricultural growth.



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Director's Report

Seed is prime input encompassing the capacity to ensure food security *i.e.* seed security can play a crucial role in ensuring food security. Desired growth rates in agriculture can only be made possible, if the prime input "seed" gets its rightful importance. The pace of progress in food production is largely depend upon innate vibrancy of seed programme upon which it is able to multiply and market quality seed of high yielding varieties with superior genetics. The ICAR, on its part has also taken various initiatives to augment the breeder seed production and seed technology research along with other crop improvement programmes. With the commitment of national seed security, ICAR launched All India Coordinated Research Project on seed i.e. 'National Seed Project- (Crops)' in 1979-80, which in due course became one of the flagship projects of ICAR itself. The AICRP-NSP (Crops) has been strengthened very well over the years and during XII plan the horizons of the project were extended to N-E states, which in turn developed state of art facilities both in respect of infrastructure and capacity building in seed realm. At present, the Breeder Seed Production (BSP) programme is operating at 41 centres and Seed Technology Research (STR) at 24 centres under AICRP-NSP (Crops) at various SAUs and ICAR institutes across the country.

Launch of AICRP – NSP (Crops) was instrumental in strengthening the Indian seed sector, as witnessed by multifold increase in breeder seed production from a meager quantity of 3914 quintals during 1981–82 to a level of **115293.39q** against the indent of **83690.14q** during 2018-19, surpassing the indents received both from DAC&FW and state governments. The NARES system continues to facilitate enhanced availability of breeder seed that constitutes the backbone of quality seed availability of notified varieties and parental lines of hybrids, which in turn multiplied to produce foundation and certified / quality seeds through downstream seed multiplication. Success of quality seed production programme depends upon production of sufficient quantity of seed with appropriate technological back up on various aspects of seed technology *viz*. production research, maintenance, quality assurance, processing, storage, seed protection and seed quality enhancement. Seed Technology Research (STR) component of AICRP –NSP (crops) provides apt platform in this endeavor to devise and standardize varied region specific seed based technologies across the country.

Continuous technological breakthroughs in seed research are vital to meet the demands of global seed market and at the same time for assurance of uninterrupted availability of quality seed at domestic level. Indian Seed Industry is one of the vibrant domains in the world seed market with compound annual growth rate of 17.6% compared to global growth of 6-7%. AICRP-NSP (Crops) aims to address crucial areas in quality seed production and seed research *viz*. Seed Production & Certification; Seed Physiology, Storage & Testing; Seed Pathology and Seed Entomology through nationwide network of cooperating centres. Futuristic strategies should be focused on appropriate maintenance breeding, climate resilient seed production through identification of non-traditional provenances for offseason seed production and inclusion of novel approaches *viz*. DNA based profiling for genetic purity testing, seed bio-priming for effective seed health management and nanotechnology for external & internal designing of seeds. Efforts mounted in streamlining of National Seed Research and Extension System will pay dividends by adjusting skewed anomalies *viz*. SRR and VRR and making Indian seed market, a force to reckon with in international seed domain.

Mission of AICRP-NSP (Crops)

To ameliorate Seed Replacement Rate (SRR) and Varietal Replacement Rate (VRR) through production of adequate quantity of breeder seed and to develop region specific seed technologies for improved yield and production.

Mandate of AICRP-NSP (Crops)

1. To produce adequate quantity of nucleus and breeder seed as per national requirements.
2. To conduct, coordinate and monitor research on different aspects of seed science and technology.
3. To generate basic information on seed certification standards including seed health.
4. To disseminate information and impart training on seed production, processing, storage & packaging, quality control and seed health.
5. To make linkages with crop improvement projects, seed industries, seed certification agencies, NGOs / KGK / KVK *etc*.

Breeder seed production

During the year 2018-19, total breeder seed production in various field crops was 115293.39q against the indent of 83690.14q. Production comprises of 80482.80q against the GoI indent of 62215.57q, 15795.70q against the state indent of 12623.51q, 2806.77q under pulses seed hub against the target of 2386.03q and 16208.12q under ICAR Seed Project & others against the target of 6475.83q. Apart from marginal shortfall in few varieties due to climate vagaries the major requirement has been met as per indents in varied crops. Whereas, with respect to *Rabi* 2018-19, expected breeder seed production figures were used for aforementioned compilation. Perusal of statistics clearly suggests that the present level of breeder seed production is exceeding the national requirement and is sufficient to produce required amount of certified seed for realizing the targeted SRR in varied crops.

Thrust areas in Breeder Seed Production

- Production of adequate quantities of breeder seed as per national requirement.
- Quality maintenance of nucleus and breeder seeds by employing dynamic maintenance breeding and rapid genetic purity testing tools.
- Identification of suitable provenance for offseason seed production to compensate the effects of changing climate.
- Networking for development of national database of DNA profiles for varietal identification.
- Effectively ensure and monitor generation system of seed multiplication at national level through bar code and QR coding module.
- Harnessing the potential of rice fallows for seed production of oilseed and pulses.
- Identification of suitable seed provenance for institution of 'National Seed Reserves', with special emphasis on soybean in states of Maharashtra and Madhya Pradesh.

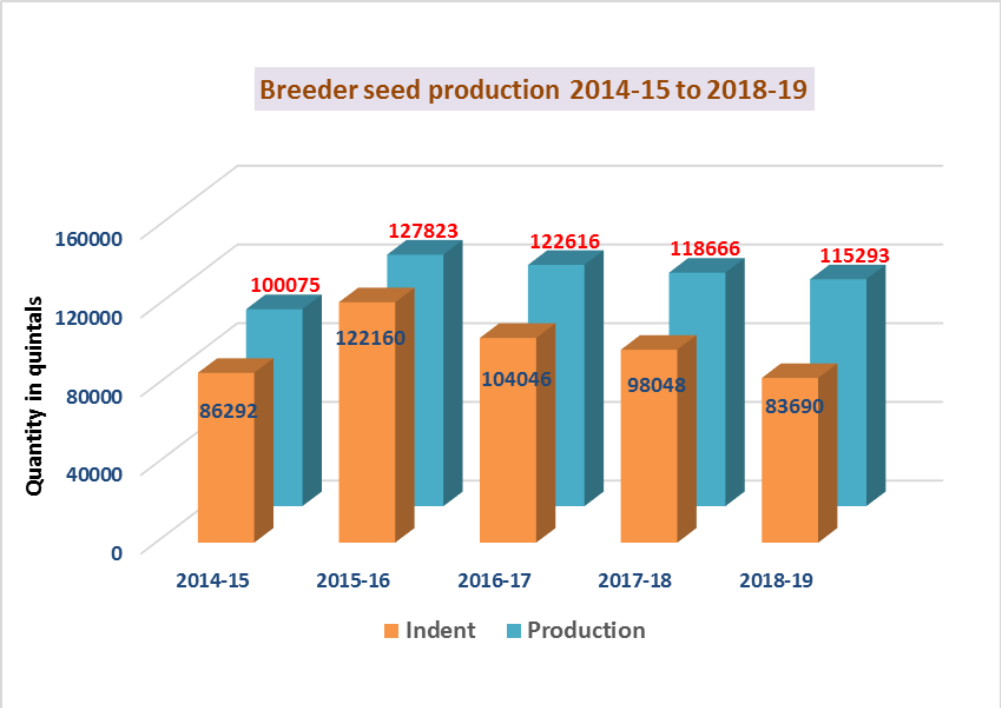


Fig. 1: Breeder Seed of field crops produced during 2014-15 to 2018-19

Thrust areas in Seed Technology Research

a. Seed production and certification

- Identification of suitable alternative areas/ provenances for seed production in a bid to counter the effects of climate change.
- Development and optimization of climate resilient seed production technology.
- Harmonization of seed standards in tune to the needs of global seed certification standards.
- Optimization of micro-nutrients and growth regulators in relation to reproductive behaviour to augment the seed yield.
- Developing alternative methods (self-incompatibility & apomixes systems) for hybrid seed production in a bid to exploit heterosis.
- Development of seed production packages and seed certification standards for underutilized crops.
- To explore upon new planting methodologies/ geometries in a bid to optimize seed rate in tune to realization of higher seed yields (revisiting SMRs).

b. Seed physiology, testing and storage

- Validation/up-gradation of field and seed standards/protocols, isolation distance, sample size, physical purity and ODV's in varied crops.
- Standardization of seed testing procedures in field, vegetable, medicinal and green manure crops.
- Standardization of DNA finger printing/molecular markers tools to supplement GOT.
- Use of second and third generation tools for seed quality enhancement.
- Identification of seed vigour traits as a sensitive measure of seed quality in major crops.

- Identification of suitable seed treatments / materials / methods for safe storage of seed.

c. Seed pathology

- Identification of disease free zones for quality seed production.
- Development of rapid and reliable techniques for detection, identification and screening of seed materials for different seed borne diseases.
- Development of integrated strategies for management of seed borne diseases.
- Development of field and seed standards for seed borne diseases and strengthening of work on biological control of seed borne diseases.
- Revisiting of field and seed standards for seed-borne diseases.
- Monitoring, detection, and management of new seed borne diseases.

d. Seed entomology

- Pest risk analysis for efficient management of insect pests under seed storage.
- Evaluation of new insecticide molecules for management of storage insects.
- Development of integrated management strategies for management of storage insects.
- Management of insect pollinators for increasing pollination efficiency and seed set.
- Determining the efficacy of novel packaging material with new chemistry for management of storage insects.

e. Seed processing

- Standardization of grading sieve sizes (top & bottom sieves) and processing methodologies for new crop varieties/ parental lines.
- Bringing mechanization in seed production to march towards precision farming.

Impact

- Surplus availability of breeder seed with appropriate technological framework
- Availability of quality seed at farmers doorstep
- Increased Seed Replacement Rate (SRR) & Varietal Replacement Rate (VRR) for varied crops
- Enhanced crop productivity
- In raising availability and access of food grains and providing food and nutritional security through seed security
- Increased monetary returns to the farmers *vis-a-vis* farm income.

Linkages:

Linkages of AICRP-NSP (Crops) with other esteemed organizations/ institutes engaged in seed research both in public and private sectors has helped to address the quality seed production, availability and research issues at local, regional, zonal and national level, which in turn facilitated strong and meaningful basic, applied and anticipatory research to support the national strategic seed research plans.

- AICRPs of Field/ Horticultural Crops
- State Agricultural Universities
- ICAR Institutes

- Seed Division of DAC&FW, GOI
- Seed industries of both public and private sector
- National & State Seed Corporations
- Seed Certification Agencies
- PPV and FR Authority

Seed Technology Research Highlights during 2018-19

Research Highlights of experiments conducted in different disciplines / divisions *viz.,* Seed Production & Certification; Seed Physiology, Storage and Testing; Seed Pathology and Seed Entomology under AICRP-NSP (Crops) STR component during 2018-19 at varied cooperating centers are given below:

A. Seed Production and Certification

Under seed production and certification, a number of experiments which includes Standardization of isolation distance for hybrid seed production of mustard; Integrated approach for enhancing seed yield and quality in millets; Identification of best planting date for off season soybean seed production; Optimization of seed rate in soybean (*Glycine max* L.); Redefining isolation distance of IMSCS 2013 in crops such as pigeon pea, cotton and maize; Redefining IMSCS 2013 for seed standard ODV in Rice and Development of seed production technology for *Chenopodium quinoa*, were conducted at different cooperating centers during 2018-19 and highlights of results are given below:

❖ **Experiment on integrated approach for enhancing seed yield and quality in various millets elucidated that;**

1. Finger millet (*Eleusine coracana*): The experiment was conducted at five locations (UAS, Bangalore; UAS, Dharwad; KKV, Dapoli; HPKV, Palampur and IGKV, Raipur) for three years i.e., from 2016 to 2018. Mean data over the locations and years revealed that 20% liquid *Pseudomonas fluorescence* in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha /12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha + Top dressing of urea at 3-4 weeks after transplanting + 2% Borax spray (N_4P_4), was found to be superior and uniformly better in terms of high seed yield (35.8 q/ha).

Average over the locations and over the years (3 years) suggest that, in N_4P_4 there was significant enhancement (76%) in seed yield (q/ha), vigour index-I (16.2%) & percent germination (9.5%), 100 seed weight (6.4%) increase over control. It is concluded that treatment N_4P_4 enhanced germination percentage & seedling vigour and positively induced the development of reproductive sink, which consequently lead to increase in seed yield. The benefit cost ratio for superior treatment is 2.28 which is 40% higher as compared to control (1.63).

Table 3: Illustration of percentage increase over control in seed yield and seed quality attributes due to superior and uniformly better treatment (N_4P_4).

Percent increase over control					
Crop	Seed yield q/ha	Percent germination	Vigour index I	Number of tillers/plant	100 seed weight
Finger millet	76%	9.0%	21%	81%	9%

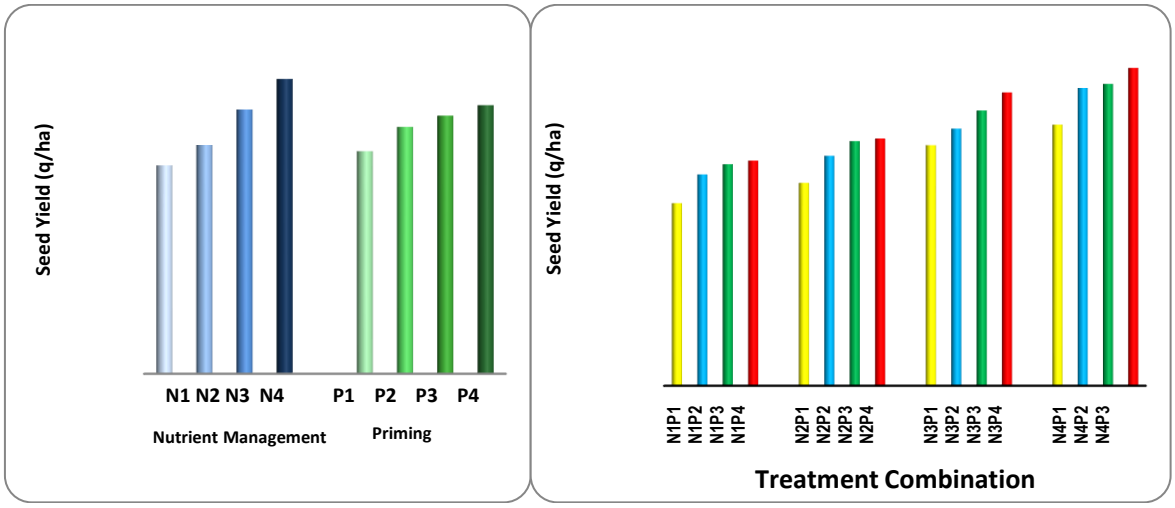


Fig.1 Effect of nutrient management and seed priming on seed yield (q/ha) in Finger Millet (Mean over locations)

Treatment combination N_4P_3 (Seed Priming with 2% KH_2PO_4 in combination of nutrient management with 125 kg Neem + 1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) treatment was found to be **second most** superior with 65% increase in seed yield/ha over control.

2. Foxtail millet (*Setaria italica*): Experiment was conducted at two locations (TNAU, Coimbatore and UAS Dharwad), for three years *i.e.* from 2016 to 2018. Among all the treatment combinations, N_4P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescence* in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha/ 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) was found to be uniformly statistically superior in terms of high seed yield (21 q/ha).

Average over the locations and over the years (3 years) suggested that, in N_4P_4 treatment, there was significant enhancement in seed yield (32%), no. of tillers/plant (90%), vigour index -I (9.6%), per cent germination (3%) & number of panicles/plant (41%) over control. It has been concluded that treatment N_4P_4 increased germination percentage & seedling vigour and seed yield. The benefit cost ratio of superior treatment is 1.92 which is 146% higher as compared to control (0.78).

Table 4: Illustration of percentage increase over control in seed yield and quality attributes due to superior and uniformly better treatment (N_4P_4).

Percent increase over control					
Crop	Seed yield q/ha	Percent germination	Vigour index I	Number of tillers/plant	Number of Panicles/plant
Foxtail millet	32%	3%	9.6%	90%	41%

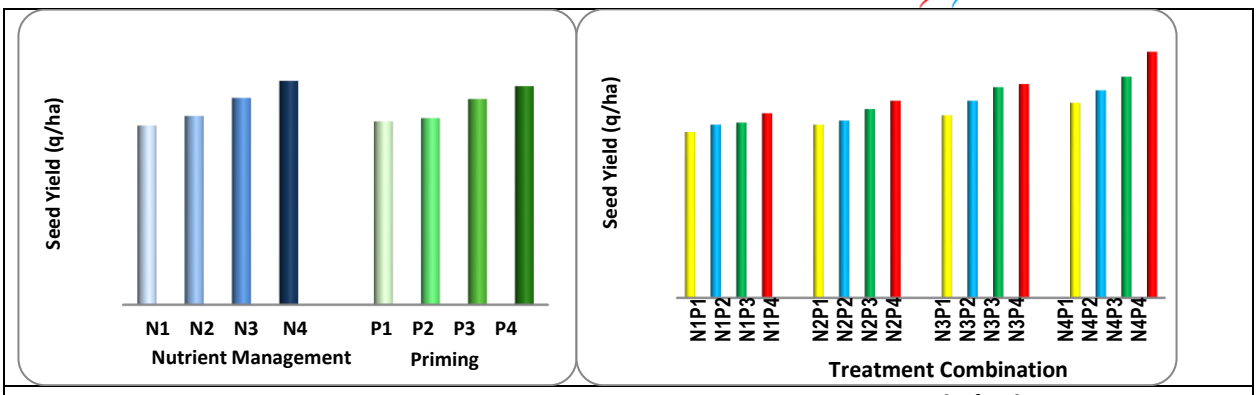


Fig. 2 Effect of nutrient management and seed priming on Seed yield (q/ha)in Foxtail Millet (Mean over locations)

Treatment combination N_4P_3 (Seed Priming with 2 % KH_2PO_4 in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) treatment was found to be **second most** superior with 24% increase in seed yield/ha over control.

3. Kodo millet (*Paspalum scrobiculatum* L.): The experiment was conducted in two locations (JNKVV, Jabalpur and TNAU, Coimbatore) for four years *i.e.* from 2015 to 2018. Among all the treatment combinations, N_4P_3 (Seed Priming with 2 % KH_2PO_4 in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha/ 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) was found to be uniformly statistically superior in terms of high seed yield (18.60 q/ha).

Mean data over the locations and years suggest that, due to N_4P_3 treatment, there was significant enhancement in seed yield (q/ha) (56%), Number of tillers/plant (30 %), Vigour index I (22 %), Percent germination (20%) & 100 seed weight (1.5%) over control. The benefit cost ratio of superior treatment is 1.36 which is 127% higher as compared to control (0.60).

Table 5: Illustration of percentage increase over control in seed yield and quality attributes due to superior and uniformly better treatment (N_4P_4).

Percent increase over control					
Crop	Seed yield/ha	Percent germination	Vigour index I	Number of tillers/plant	100 seed weight
Kodo millet	56%	20%	22%	30%	1.5%

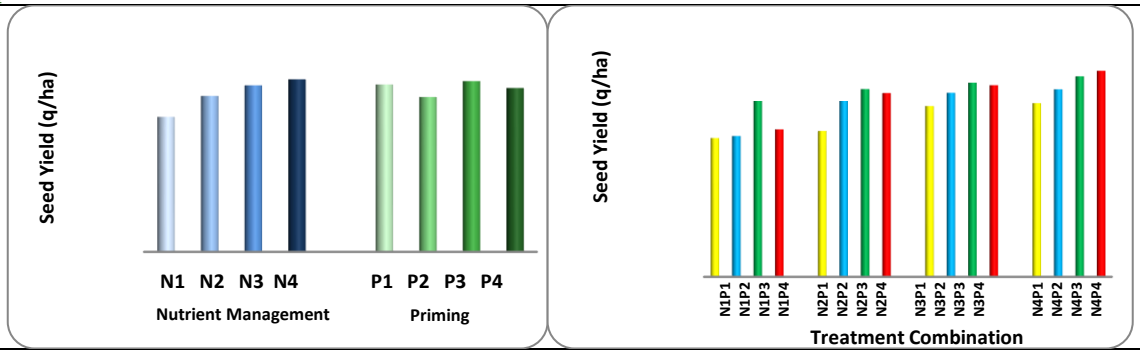


Fig. 3 Effect of nutrient management and seed priming on seed yield (q/ha) in Kodo Millet (Mean over locations)



Field view of kodo millet (Control)



Field view of kodo millet (Best treatment N_4P_3)

Treatment combination N_4P_4 (Seed Priming with 20 % liquid *Pseudomonas fluorescence* in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) treatment was found to be **second most** superior with 55% percent increase in seed yield/ha over control.

❖ **Experiment to identify the best planting date for off-season seed production of soybean was conducted at six locations/centers of the country for three years from 2015 to 2018.**
Best planting dates for different varieties in their location (considering least decrease in seed yield, germination per cent and vigour index among the off-season planting dates studied) recommended are as follows.

Centre	Variety used	Window period	Best planting date	% Change in seed yield, germination(%) & vigour index over normal date of sowing
UAS Dharwad	DB 21	Oct. to Jan	First to fourth week of November	25%, 3% and 12% decrease in yield, germination per cent and vigour index, respectively (Normal date of sowing yield:24.66q/ha; germination: 86.24%; SVI: 2154)
UAS	JS 335	Nov to Jan	First week of	13% decrease, 4% increase and 1.3% decrease

Bengaluru			December	in yield, germination per cent and vigour index, respectively. (Normal date of sowing yield: 19.53q/ha; germination:91.67 %; SVI: 3631)
MAU Parbhani	MAUS 162	Oct to Jan	First to fourth week of November	69% increase in yield and only 4% and 2% decrease in germination per cent and vigour index, respectively. (Normal date of sowing yield: 17.72q/ha; germination:87.65%; SVI: 2583)
PJTSAU, Hyderabad	JS 335	Oct to Jan	Third to fourth week of September	20%, 4% and 2% decrease in yield, germination percent and seed vigour index, respectively.
JNKVV Jabalpur	JS 20-34 JS 20-29	Nov to Jan	December 1st week	26%, 2% and 10% decrease in yield, germination percent and seed vigour index, respectively. (Normal date of sowing yield: 11.34q/ha; germination: 95.35%; SVI:2932)
MPKV, Rahuri	JS 335	Sept to Jan	Third week of January	32%, 2% and 4% decrease in seed yield, germination percent and seed vigour index, respectively. (Normal date of sowing yield: 17.99q /ha; germination: 89.16%; SVI:2753)

❖ **The experiment to identify the best reduced seed rate and sowing method for seed production of soybean was conducted at nine locations (JNKVV, Jabalpur; RVSKVV, Gwalior; VNMKV, Parbhani; UAS, Dharwad; MPKV, Rahuri; AU, Kota; IISR, Indore; PDKV, Akola; PJTSAU, Hyderabad and UAS, Bengaluru) in kharif 2018.**

The study conducted reveals that among the varieties, the highest seed yield is observed for medium duration variety (20.56 q/ha) followed by early varieties (19.23q/ha). With respect to seed sowing method, highest seed yield is observed for Ridges and Furrows (20.15q/ha) as compared to flat bed method (19.64q/ha). With respect to seed rate, highest seed yield is observed for 70 kg/ha (21.14q/ha) which was statistically at par with reduced seed rate 60 kg/ha (19.61 q/ha) and lowest seed yield (18.94 q/ha) is recorded for 50kg/ha seed rate.

With respect to interaction, $V_1S_1T_0$ (medium duration variety with ridge and furrow sowing and seed rate at 70 kg/ha) recorded highest seed yield of (22.32 q/ha) which was at par with $V_1S_2T_0$ (medium duration with flat bed and seed rate at 70 kg/ha). In case of medium duration variety, by following seed rate of 60 kg/ha, pods/plant, vigour index-I increased by 16% and 1.5%, respectively and decrease in seed yield up to 7% was noticed as compared to recommended seed rate of 70 kg/ha. In case of early maturing variety, pods/plant and no. of branches/plant increased by 7% and 11%, respectively and decrease in seed yield up to 7.44% was noticed in case of seed rate of 60kg/ha as compared to recommended seed rate 70 kg/ha. In case of medium maturing variety, average superiority of 60kg/ha seed rate over the locations for seed yield (q/ha) ranged from 10% decrease(UAS, Dharwad) to 4% increase(IISR, Indore) in comparison to seed rate of 70kg/ha. In early variety, average superiority of 60kg/ha seed rate over the locations for seed yield (q/ha) ranged from 10% decrease (PDKV, Akola) to 0.5% increase (UAS, Bengaluru) in comparison to seed rate of 70kg/ha. The benefit cost ratio of reduced seed rate (60kg/ha)

for early maturing variety is 2.44 which is 0.8% lower as compared to benefit cost ratio (2.46) of recommended seed rate (70 kg/ha). The benefit cost ratio of reduced seed rate (60kg/ha) for medium maturing variety is 2.92 which is 0.68% lower as compared to benefit cost ratio (2.94) of recommended seed rate (70 kg/ha).

Table 8: Effect of varieties, sowing method, seed rate and their interaction on seed yield (q/ha) in soybean during *kharif* 2018 (mean over the locations)

Varieties	Sowing Method	Seed Rate			Mean (Sowing method)	Mean (Varieties)
		70 Kg/ha (T_0)	60 kg/ha (T_1)	50 kg/ha (T_2)		
Medium Maturity varieties (V_1)	Ridge & Furrow(S_1)	22.32	20.41	20.51	20.15 (Ridge and Furrow)	20.56 (Medium)
	Flat Bed (S_2)	21.40	20.23	18.51		
Early Maturity varieties (V_2)	Ridge & Furrow (S_1)	20.19	19.19	18.31	19.64 (flat bed)	19.23 (Early)
	Flat Bed (S_2)	20.65	18.61	18.44		
Mean (Seed Rate)		21.14 (T_0)	19.61 (T_1)	18.94 (T_2)		



Field view of 70kg/ha seed rate with Ridge and furrow sowing



Field view of 60kg/ha seed rate with Ridge and furrow sowing

B. Seed Physiology, Storage and Testing

Under seed physiology, storage and testing, several experiments including Confirmation of validity periods of certified seeds of field crops (as per the IMSC regulations); Hybrid purity testing using molecular markers in public sector hybrids of field crops; Physiology studies and development of priming technologies for enhancing planting value of seed in field crops under optimal and sub-optimal conditions; Use of nano-particles in enhancing seed quality and storability of seeds; Influence of terminal heat stress on seed set, seed yield and quality in field crops and Standardization of seed testing protocols and development of seed standards for Jatropha, were conducted at different cooperating centers during 2018-19 and highlights of results are given below:

- **Study on ascertaining validity periods of certified seeds of field crops (as per the IMSC regulations) was conducted in 9 crops *viz.*, wheat, paddy, maize, sorghum, cotton, soybean, chickpea, castor and groundnut.**

Crop: Wheat; Min. germination as per IMSCS, 2013 is 85%

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
SKNAU, Durgapur	Mean germination of 88% was recorded at the end of 22 months of storage in both the varieties studied	High seed vigour was maintained up to 22 months i.e., first count was 77.6% and field emergence was 84.6% after 20 months of storage	Comply up to 22 months of storage.
MPKV, Rahuri (Seeds stored in HDPE bags)	Mean germination of 88.6% was noticed even after 20 months of storage in the four verities tested (Varietal difference is non-significant)	Considerably higher vigour was maintained over long period of storage i.e., field emergence of 85, 80.8 and 75.3% at 14, 26 and 38 months of storage, respectively.	Comply up to 20 months of storage.
CCSHAU, Hisar	85.3% was maintained up to 18 months of storage	considerable vigour i.e., first count of 65.1% up to 18 months of storage	Comply up to 18 months of storage.
CSKHPKV, Palampur	• Fresh seed with germination of 92.8% declined to 76.3% after 7 months of storage. • While, revalidated lot (1st time) having germination of 89.7% yields germination of 72.50% only after 6 months of storage.	Field emergence of fresh lot 83%. Field emergence of RVD-I lot is 75.75% (9 months old seed lot) and after 6 months of storage yields 69% of field emergence.	Comply up to 9 months only

Crop: Rice; Min. germination as per IMSCS, 2013 is 80%

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
UAS, Bengaluru	Fresh, RVD-I and RVD-II lots showed germination of 94, 88 and 80%, respectively	Field emergence of fresh, RVD-I and RVD-II was 92, 87 and 85%, respectively	Meeting the IMSCS (80%) up to second time revalidation
OUAT, Bhubaneswar	Fresh lot recorded 91.75 and 86.6% at initial and after 6 months of storage. While 7 months old lot recorded 81.8 and 68.13% germination at 7 months and 13 months of age.	Field emergence is 81.8% in 6 months age seed and 63% at 13 months age seed	Comply with IMSCS (80%) up to 9 months only. This probably due to storage in cloth bag under higher humidity conditions as prevailed in coastal areas.
KAU, Thrissur	RVD-I seed lot shown germination of 94.8% but after 5 months of storage germination dropped to 6.8%.	Field emergence of fresh seed and RV-I is 97.6% and 95.2%, respectively. But after 5 months of storage, declined to 47.5% and 6.2%, respectively	

Crop: Maize; Min. germination as per IMSCS, 2013 is 90%

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
PAU, Ludhiana	Studied 2 lots (fresh and RVD-I) of hybrid Parkash and PMH-1. Fresh lots of both the hybrids maintained	First count in fresh seeds was 82.5% and 87.3% in hybrid Parkash and PMH-1, respectively; which	More variation among the tested hybrids with respect to seed vigour

	germination of 91% after 5 months of storage while RVD-I lot of both the hybrids with 90% germination at the age of 11 months maintained germination of 90% (in hybrid Parkash) and 50% germination (in PMH 1 hybrid) at 15 months of storage	maintained 81.5 and 84% at 5 months of storage, respectively. While First count of RVD-I was 83 and 82.5% in Parkash and PMH-1, respectively which maintained 78.3 and 42% first count, respectively at 15 months of storage	and viability at the age of 15 months

Crop: Sorghum; Min. germination as per IMSCS, 2013 is 75%

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
MPKV, Rahuri	Fresh, RVD –I and RVD-II seed recorded germination of 90.25, 88 and 81.75% at 0, 13 and 25 months age	Fresh seed shown field emergence of 84% and 79.33% after storage of 5 months; RVD I seed shown field emergence of 81.75 % at 13 months and 74.33% at 17th months; RVD II seed shown field emergence of 75% at 25th months and 68.8% at the age of 29th month.	comply with the IMSCS (75%) up to second time revalidation (RVD-II) if we store the seeds at safe moisture content in HDPE bags and if the insect damage is within permissible limits
UAS, Dharwad	Studied 2 lots i.e., lot 1 (5 months old) and lot 2 (15 months old seed lot) recorded 82.05% and 48.5% germination, respectively. (Lot 1 exhibited germination of 76% at 9 months old) (Lot 2 had 76.5% and 56.65% at 9 and 10 months after harvest, respectively)	Final plant stand of 5 months old lot was 84% (mean of two varieties) while 23% in 15 months old lot	Comply with IMSCS up to 9 months only.

Crop: Cotton; Min. germination as per IMSCS, 2013 is 65% for varieties and 75% for hybrids

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
CICR RS, Coimbatore	Mean seed germination in two cotton varieties was 87% (2 months from date of test/ 5 months after harvest); 79% (after 8 months of initial testing/11 months after harvest); 73.5% (after 15 months from the initial testing/17 months from harvest and 68.5% germination recorded after 21 months from initial testing date/ 23 months from harvest	Fresh lot shown field emergence of 67.5% after 8 months of initial testing while aged lot showing a field emergence of 77.5% after 21 months of initial evaluation which indicates more variation in initial vigour status of two lots.	In case of varieties, comply with IMSCS up to 21 months only.

Crop: Soybean; Min. germination as per IMSCS, 2013 is 70%

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
VNMKV, Parbhani	Seed germination was 85.6% after 8 months of storage; Upon further storage, declined to 76% at 12 months of storage	Field emergence of 84% recorded after 8th months of storage; reduced significantly to 68.5% after 10 months of storage	Comply with IMSCS (70%) up to 12 months
JNKVV, Jabalpur	Seed germination was	Field emergence of 76%	Comply with IMSCS (70%)

	72.67% after 9 months of storage; Upon further storage, declined to 58.6% at 12 months of storage	recorded after 6months after storage; reduced significantly to 68.5% after 10 months of storage	up to 9 months
MPKV, Rahuri (Seeds stored in HDPE bags)	Seed germination was 73.5% germination at 11 months of storage; declined to 64.75% at 14 months of storage	Field emergence of 83.25% recorded at 5 months of storage; reduced significantly to 63.5% at 11 months after	Comply with IMSCS (70%) up to 11 months

Crop- Chickpea (Minimum germination percentage required 85.00%)

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
JNKVV, Jabalpur	Mean germination for revalidated seeds remained 90.33 % for Revalidated seed lot I and 88.07 % for revalidated seed lot II in both varieties i.e. JG16 and JG-63 respectively.	In revalidated seed lot II, seedling vigour I decreased by 35.18 % as compared to fresh seed lot of JG 16. Similarly, in revalidated seed lot I, Seedling vigour I decreased by 16.45 % as compared to fresh seed lot of JG 16. In revalidated seed lot II, seedling vigour I decreased by 25.20 % as compared to fresh seed lot of JG 63. Similarly, in revalidated seed lot I, Seedling vigour I decreased by 12.46 % as compared to fresh seed lot of JG-63. In revalidated seed lot II, field emergence percentage was decreased by 13.90 % as compared to fresh seed lot of JG-16. Whereas in case of revalidated seed lot I, field emergence was decreased by 7.30 % as compared to fresh seed lot.	Seed germination remained well above the Indian minimum seed certification standards, 2013 in revalidated seed lots of chickpea.
SKNAU, Durgapura	When two chickpea varieties (RSG 963 and CSJ 884) were stored for 16 months, germination percentage was 89.00 % and 90.25 % and for 22 months it was 85.50 % and 87.00 % respectively.	In six months old seed lot, seedling vigour index I was reduced by 25.16 % up to 18 months of storage and reduced by 46.92 % up to 22 months of storage in RSG 963. In six months old seed	Comply up to 22 months of storage for both varieties.

		lot, seedling vigour index I was reduced by 22.36 % up to 18 months of storage and reduced by 41.64 % up to 22 months storage in CSG-884. In RSG 93 variety of chickpea, final plant stand was 42.25 per m2 of six months stored seeds and reduced to 36.25 per m^2 in 18 months stored seeds. Similarly, in CSG 884 variety of chickpea, final plant stand in six month stored seed was 44.00 per m^2 which was reduced to 37.50 per m^2 in 18 months stored seeds.	
IARI, New Delhi	In chickpea seed lots, germination percentage observed at 88.00 % (JAKI-9218) and 85.25 % (JG-11) respectively.	-	Both the varieties were able to meet the IMSCS for a period of nine months of storage.

Crop- Castor (Min. Germination % as per IMSCS: 70)

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
JAU, Jamnagar	Fresh seed lot and revalidated seed lot of castor (GCH-7) were stored for 6 months period. The fresh and 9 months old (RVD I) seed lots maintained germination in the range of 88.0 % to 93.7 % and 85.0% to 92.2% (above IMSCS) respectively.	• In fresh seed lot of castor, 23.30 % reduction in seedling vigour I was observed after 6 months of storage. • In Revalidated seed lot of castor, 9.71 % reduction in seedling vigour I was observed after 6 months of storage.	The results revealed that the fresh and RVD I seed lots successfully maintained germination above IMSCS (mean germination of fresh-90.38% & RVD I-86.96%).

Crop- Groundnut (Min. Germination % as per IMSCS: 70)

Centre	Seed germination during storage	Seed Vigour Status	Remarks (comply of germination with IMSCS)
OUAT, Bhubaneswar	Initially in revalidated seed lots germination percentage was 72.75 % (ICGV-91114) and 73.00 % (OG 52-1) respectively.	In 7 months old seed lot of groundnut, 29.18 % reduction in seedling vigour I was observed after 6 months of	The results revealed that germination of 7 months old seed lot declined below IMSCS (70%) after six months of storage.

	After six months of storage it was reduced to 60.50 % in both varieties.	storage.	
UAS, Bengaluru	Initially in revalidated seed lots germination percentage was 72.20 % (TAG 24-16 months old) and 66.20 % (G2-52-13 months old) respectively.	In case of 16 months old seed lot of groundnut, 22.29 % reduction in seedling vigour was observed. 27.79 % of reduction in seedling vigour index I was observed in 13 months old seed lot of G2-52. In 16 months old seed lot, plant stand was reduced from 64.13 plants m^2 to 49.40 plants per m^2.	After six months of storage, 16 months old and 13 months old seed lot failed to comply prescribed germination percentage as per IMSCS, 2013.
RARI, Durgapura	Six month old seed lots of two varieties (RG 425 and RG 510) were stored for 22 months. After 16 months of storage germination was 76.75 % and 75.25 % respectively which is in conformity with IMSCS,2013.	In variety RG-425, after 12 months of storage seedling vigour index I was reduced by 20.32 % and after 16 months of storage it is reduced by 34.53 %. In variety RG-510, after 12 months of storage seedling vigour index I was reduced by 17.80 % and after 16 months of storage it is reduced by 32.19 %.	Both varieties are in compliance with germination percentage up to 22 months of storage period.

❖ Hybrid purity testing using molecular markers in public sector hybrids of field crops

Following SSR markers are identified for hybrid purity assessment in rice and maize.

Crop	Centre	SSR Marker	Hybrid	Parental lines
Rice	JNKVV, Jabalpur	RM276	JRH5 hybrid	IR68897A (Female) and NPT65 (Male)
	AAU, Jorhat	RM234	AAU hybrid 3	IR79156A (Female) and Swarna (Male)
Maize	UAS, Bengaluru	phi053	MAH-14-5	CAL-1443 (Female) and CML-451 (Male)
	UAS, Bengaluru	umcl223	HEMA	NAI-137(Female) and MAI-105(Male)

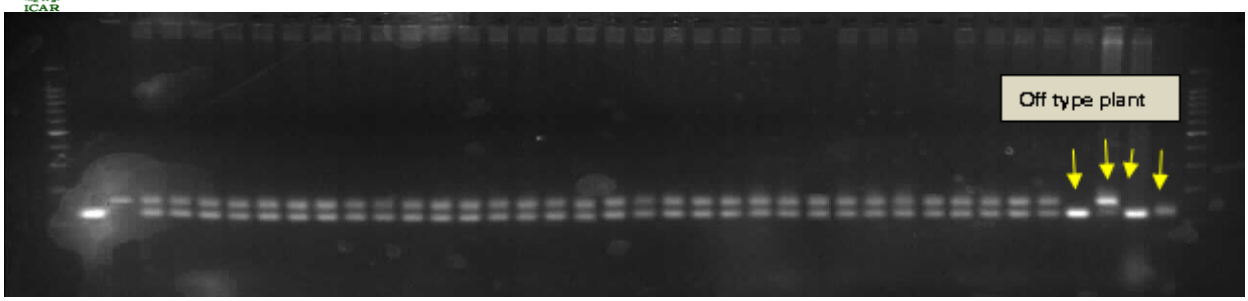


Fig. 6: Molecular DNA Profiling of parents (First well-A Line; second Line- R Line) along with hybrid paddy JRH5

❖ **Experiment on development of seed priming technologies for enhancing planting value of seed under optimal and sub-optimal conditions was initiated and results obtained as per objectives are mentioned below;**

Objective I (Development of priming technology for sub-optimal conditions)

Crop	Centre	Best treatment	Superiority over control
Chickpea	CCSHAU, Hisar	Hydropriming (6h @ 20 ^{O}C) & seed coating with BioNPK	Field Emergence (FE) per cent in cv. HC 1 was 77.0% & 71.0% and cv. HC 2 was 83.0% & 76.0%, respectively for seed lots L_1 & L_2. Enhancement in FE over control was 20.3% & 29.1% and 16.9% & 20.6% in L_1 & L_2 seed lots of cv. HC 1 and HC 2, respectively.
Kabuli Chickpea	UAS, Raichur	Hydropriming (4h @ 20 ^{O}C)	In cv. MNK 1, treatment resulted in germination of 92.0% & 71.0% (L_1- fresh & L_2- one year old). Enhancement in germination was up to 7.6% & 26.2% in L_1 & L_2 seed lots, respectively over control
	MPKV, Rahuri and SKNAU, Jobner	Hydropriming (4h @ 20 ^{O}C) & seed coating with drought alleviating bacteria + Biogrow	Treatment resulted in field emergence of 70.0 – 86.0% for fresh and 68.0 – 80.0% in one year old seed lots, respectively in cv. BDNK 798 and CSJK 6. Mean enhancement in field emergence was in the range of 3.2 - 13.6% in fresh and 6.9 - 9.4% in one year old seed lot over control, respectively in cv. BDNK 798 and CSJK 6.
Rice	UAS, Bengaluru	Hydropriming (30 h @ 25 ^{O}C) + seed coating with Biophos	Treatment lead to Final Plant Stand (FPS) of 99.0- 100.0% in fresh and 97.0- 99.0% in first revalidated seed lots in cv. IR 64 and MTU 1001, respectively. Enhancement in FPS was in the range of 13.6 – 17.6% for fresh (L_1) and 15.5 – 15.1% for first revalidated seed lot (L_2) of cv. IR 64

Off type plant

			and MTU 1001, respectively over control.
Cotton	ICAR-CICR, Nagpur	Hydropriming + seed coating with BioNPK	FPS ranged between 84.0 – 85.0% in fresh seed lots, while in one year old seed lot, it ranged between 74.0 – 81.0% in cv. LRA 5166 and Surabhi, respectively. Enhancement in FPS over control was in range of 9.0 – 13.5% for fresh and 11.0 – 13.8% for one year old seed lot in cv. LRA 5166 and Surabhi, respectively.

❖ ***Objective II (Validation of standardized seed priming technology in pigeonpea)***

Crop	Centre	Best treatment	Superiority over control
Pigeonpea	ICAR-IARI, New Delhi	Exposure of seeds for 24 h at 40 ^{O}C	High temperature treatment resulted in seed yield/ plant of 70.0g in cv. Pusa 991 and 79.2g in cv. Pusa 992. Enhancement in seed yield/ plant (g) was up to 52.8% in cv. Pusa 991 and 2.2% in Pusa 992 in comparison to control under normal date of sowing.

C. Seed Pathology

Under seed pathology, various experiments on Survey and evaluation of seed health status of farmers' own saved seed; Development of rapid and reliable techniques for detection of seed borne pathogens; Development of integrated strategies for management of seed borne diseases; Biological control of seed borne diseases; Monitoring, detection, and management of seed- borne diseases of significance have been taken up during 2018-19 and the highlights of achievements are given below:

❖ The experiment on monitoring and detection of rice bunt, false smut and bacterial leaf blight in processed, unprocessed and farmer's seed samples was conducted at 16 centres. The highest paddy bunt infection of 2.6% (Max. Permissible limit is 0.5% as per IMSCS, 2013) was reported from PAU, Ludhiana, where 91.7% samples were carrying the incidence. At PJTSAU, Hyderabad and MPKV, Rahuri 16.6% and 8.16% samples, respectively exhibited bunt to a maximum infection up to 0.9%. At CCHAU Hissar, 14.56% samples were carrying bunt infection, however the infection was within certification limit. In JNKVV Jabalpur, the highest number of bunt infected samples (15.7%) were reported from Mandla, a tribal dominant belt. Bunt incidence was not observed in samples collected from both seed processing plants and farmers field in Sher-e-Kashmir University, Srinagar; CSKHPKV, Palampur; VNMKV, Parbhani; RPCAU, Dholi, Muzaffarpur (Bihar); PAJANCOA & RI, Karaikal; IARI, New Delhi and AAU, Jorhat.

The incidence of Bacterial leaf blight (BLB) was severe in farmers' fields at Nizamabad and Suryapet districts of Telangana where > 70% leaf area was damaged. BLB was mild at

Nalgonda district and moderate in Karimnagar, Mahabubnagar and Khammam districts. However, no incidence of BLB was observed in farmers' fields of Warangal district. At PAJANCOA & RI, Karaikal, level of BLB field infection was more in farmers' field (40%) as compared to seed production plots (10%). Whereas, about 38% seed production plots a**t** RPCAU**,** Dholi, Muzaffarpur, were carrying BLB infection in the range of 0 – 3 scale. The varieties exhibited maximum incidence of BLB was in Rajendra Sweta, Hybrid 6444, Prabhat followed by PB 71, and Rajshree etc. In JNVKK Jabalpur, BLB incidence was severe at famers and seed production fields in Dindori and Mandla districts of Madhya Pradesh. Mild to moderate BLB incidence was observed both in seed production plots and farmers' fields in different villages of Baraut, Noida, Gurgaon and Meerut. At CSKHPKV, Palampur, there was no incidence of bacterial leaf blight, however a high incidence of grain discoloration was observed in 73 samples with an incidence of 5.0 - 70.0 per cent. No panicle blight was found at any of the locations except in farmers' fields monitored by GBPUA&T, Pantnagar.

❖ Under the experiment on 'monitoring of emerging new diseases of seed borne nature', Potato Virus Y (PVY) and Corm rot of Saffron are reported at Sher-e-Kashmir University, Srinagar**;** Bacterial Panicle Blight of Paddy *Burkholderia glumae* and Bacterial canker and wilt of tomato *Clavibacter michiganensis ssp. michiganensis* are being reported at GBPUA&T, Pantnagar as emerging seed- borne diseases affecting seed quality.

❖ Experiment conducted to know the health status of farmers' own saved seed revealed that seed health status of farmers' own seed samples was comparatively poor. In paddy, majority of seed samples at certain locations were having very poor germination *viz.,* 37.7% of samples at TNAU, Coimbatore, 50% of samples at PAJAN COA&RI, Kariakal and 36 % of samples at AAU, Jorhat exhibited germination much below IMSCS in Paddy. At PAU Ludhiana, 80% of severely discoloured seed samples were recorded germination below Indian Minimum Seed Certification Standards. Discoloured seeds resulted in seed rot, produced stunted and blighted seedlings. Mycoflora responsible for seed discolouration was *C. lunata*, *Alternaria alternata, Drechslera oryzae, Aspergillus flavus, Chaetomium globosum, A. niger* and *Penicillium* sp. to varying percentage at different locations.

❖ For detection of seed-borne infection of important pathogens of significance, methods have been standardized, protocols developed and validated at different centres are mentioned below.

Centre	**Method**	**Pathogen**	**Crop**	**Protocol standardized**
AAU, Anand	Molecular diagnosis	BCMV	Mung bean	Standardized molecular method for detection of Seed borne infection of BCMV and **Nucleotide sequenced**
CSKHPKV, Palampur	Molecular diagnosis	*Pepper mild mottle virus* (PMMoV)	Capsicum	RT- PCR based protocol designed and standardized. It has to be validated for its authenticity and robustness
SKUAS&T, Srinagar	Molecular diagnosis	*Potato Virus Y*	Potato	Universal Primers have been designed for detection of all the strains of PVY. The conserved regions of different PVY strains in

				coat protein region were used to design oligonucleotides for detection of PVY infection. The primers used are: **Forward-** TATGAATTCCACCATCAAGCAAATGA **Reverse-** ATCGTCCGGCTCGAGACTACATCA
	Agar Plate Method	*Corm rot (Fusarium sp.* *Rizotonia spp* *Aspergillus sp.* *Penicillum sp)*	Saffron	Corms plated on PDA and incubated for 5-7 days at 22± 1°C under alternate cycles of 12 hour light and 12 hour darkness
	Molecular diagnostics	BCMV	Mung bean and Common bean.	The primers for coat protein detection have been designed and its molecular detection is being carried out. CPF5'- TCCATGTCAGGAC/TCTGGACAGCC-3' CP R 5'- CTAGACTGCGAAGGACCCATGCC-3'
GBPUA&T, Pantnagar	Serological and Molecular diagnosis	*Clavibacter michiganensis* subsp *michiganensis*	Tomato	• ELISA technique at OD value ranging from 0.445nm to 0.629nm. • Specific primer for *Clavibacter* giving an amplicon of size 1.45kb and also by sub sp specific primer giving an amplicon of size 614bp.
	Molecular diagnosis	*Burkholderia glumae*	Paddy	The bacterium has been detected by 16s ribosomal DNA sequencing by universal primer pair 27F (5' AGTTTGATCCTGGCTCAG 3') and 1492R (5' ACCTTGTTACGACTT3').
	Standard Blotter	*Alternaria sesami*	Sesame	Sterilized culture plates consisting of three layers of blotters soaked in sterilized water having 25 seeds

	method			/plates and incubated at 25±2ºC at 12h alternate light (NUV) and 12 h dark period for eight days on standard blotters
JNKVV, Jabalpur	Deep Freeze blotter	*Macrophomina phaseolina*	Soybean	Seed dip in antibiotics (200ppm) before plating proved better over standard deep freeze method
OUAT, Bhubaneswar	Blotter method	*Sarocladium oryzae*	Paddy	Blotter paper dipped in sterilized water of pH 6.5(needs revalidation)
PAU, Ludhiana	Standard blotter method	Fusarium *fujikuroi*	Paddy	Incubation of plates at 28^0C at 12 hours darkness and 12 hours light (needs revalidation)
TNAU, Coimbatore	Standard blotter method	*Fusarium sp*	blackgram	Modified as Blotter sheets soaked in NaOH 0.4% and incubated at 25^0C at 12h alternate light and dark period
		Macrophomina sp		Modified as Blotter sheets soaked in KOH 0.2% and incubated at 25^0C at 12h alternate light and dark period (needs revalidation)

D. Seed Entomology

Under seed entomology, six experiments *viz.* Survey and evaluation of seed health status of farmers' saved seed with respect to insect infestation; Modified atmospheric storage for maintenance of seed quality and seed health through management of storage insect pests; Evaluation of new insecticide molecules & botanicals for management of storage insects of seed; Management of pulse beetle (*Callosobruchus sp.*) through pre-harvest spraying of insecticides and botanical; Evaluation of solarization on bruchids (pulse beetle) infestation and quality of pulse seeds, and Survey & monitoring of insecticide resistance in storage insect pests infesting seeds in storage godowns were taken up during 2018-19.

❖ Survey and evaluation of seed health status of farmers' saved seed was carried out by 13 cooperating centres in eight states and one union territory across the country and about 2154 nos. of farmers' saved seed samples have been collected and analysed for seed quality. The survey revealed that about 37.1% seed samples had germination bellow IMSCS and about 55.8% seed samples were infested with various storage pests. About 47.1% samples had insect damage beyond permissible limit. The intensity of damaged seed usually varied from 0.25-5.0%. Therefore, there is ample scope of improvement of seed health status of farmers' saved seed.

❖ Various botanicals *viz*. Karanj oil @ 5 ml/kg seed, Citronella oil @ 5 ml/kg seed and neem formulation (neemazal 10000ppm) @ 5 ml/kg seed were tested along with *Acorus calamus* TNAU formulation @ 10 ml/kg seed to evaluate the efficacy against major storage

insect-pests damaging seeds in paddy, pigeonpea, chickpea, black gram, green gram and field pea. In most of the crops, *Acorus calamus* formulation recorded least insect damage and was on par with neem formulation. Hence, *Acorus calamus* formulation @ 10 ml/kg seed can be used for management of storage insects for 3-6 months without affecting seed germination.

Table 14: Effective seed treatment botanicals and storage periods for different crops

Crop	Centre	Safe period of storage (months)	Effective botanicals
Paddy	AAU, Jorhat	9	Neemazal, *Acorus calamus* TNAU formulation
	PJTSAU, Hyderabad	6	*Karanj* oil, *Acorus calamus* TNAU formulation
	PAJANCOA,Karaikal	3	*Karanj oil, Acorus calamus* TNAU formulation
Pigeon pea	NDUA&T, Faizabad	3	Neemazal
	PDKV, Akola	12	All treatments
Green gram	OUA&T, Bhubaneswar	3	All botanicals
Chick pea	PJTSAU, Hyderabad	6	*Acorus calamus* formulation
	JAU, Jamnagar	6	*Acorus calamus* formulation
Black gram	TNAU, Coimbatore	3	All treatments
	PAJANCOA,Karaikal	9	All botanicals except neemazal
Field pea	CSAUA&T, Kanpur	6	*Acorus calamus* formulation

* Insect damage within permissible limit (0.5% for cereals and 1% for pulses) and seed germination above IMSCS

❖ Investigation to identify suitable insecticide for pre-harvest spraying for management of pulse beetle among pulses *viz*. greengram, blackgram, chickpea and pigeonpea revealed that spraying of emamectin benzoate (5 SG)@ 0.3ml/L /profenofos (50EC) @ 1ml/L at 50% pod maturity and maturity stage were effective in controlling infestation at both field and storage conditions.

Table 15: Effective pre-harvest spraying schedule of insecticides/ botanicals for different crops

Crop	Centre	Insecticide/ Botanical	Spraying schedule	Remarks
Green gram	JAU, Jamnagar	Profenofos, emamectin benzoate	Profenofos spraying at maturity, Profenofos/ emamectin benzoate spraying at 50% pod maturity and maturity	No adult emergence
	OUAT, Bhubaneswar	Emamectin benzoate, neemazal	Spraying at 50% pod maturity and maturity	Insect damage within permissible limit

Black gram	AAU, Assam	Profenofos/ Emamectin benzoate	Profenofos spraying at maturity, Profenofos/ emamectin benzoate spraying at 50% pod maturity and maturity	No adult emergence
Chickpea	MPK, Rahuri	Profenofos	Spraying at 50% pod maturity and maturity	Insect damage within permissible limit
	NDUAT, Faizabad	Emamectin benzoate	Spraying at 50% pod maturity and maturity	Lowest insect damage (2.67%)
Pigeon pea	UAS, Bangalore	Emamectin benzoate	Spraying at 50% pod maturity and maturity	Lowest insect damage (1.75%)
	PDKV, Akola	Emamectin benzoate	Spraying at 50% pod maturity and maturity	Insect damage within permissible limit
	PJTSAU, Hyderabad	Profenofos	Spraying at 50% pod maturity and maturity	Insect damage within permissible limit

❖ Experiment on effect of solarization on bruchids (pulse beetle) infestation and quality of pulse seeds (Chickpea, cowpea, green gram and black gram) has been conducted in nine centres. Solarization of seeds was carried out in clear polythene (700 gauge) packet (5cm thick seed layer) for different duration. Solarization for 6 days (3 h on each day) was quite effective in reducing insect damage/adult emergence in most of the centres.

Table 16: Effective solarization schedule for different crops at various centres

Crop	Centre	Solarization schedule	Remarks
Chickpea	JAU, Jamnagar	Solarization of seeds in clear polythene (700 gauge) packet for 2 days (3 h on each day)	No adult emergence in both fresh seeds and inoculated seeds
	MPKV,Rahuri	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	No adult emergence in fresh seeds and least insect damage in inoculated seeds (0.33%) compared to control with fresh seed (1.0%) and inoculated seed (7.0%)
Green gram	OUAT, Bhubaneswar	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	Lowest insect damage in both fresh seeds (0.33%) and inoculated seeds (0.67%) compared to control with fresh seed (9.2%) and inoculated seed (30.7%)
	PJTSAU, Hyderabad	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	Lowest insect damage in both fresh seeds (0.49%) and inoculated seeds (2.12%) compared to control with fresh seed (4.23%) and inoculated seed (8.17%)
Black gram	TNAU, Coimbatore	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	No adult emergence in fresh seeds and least insect damage in inoculated seeds (0.90%) compared to control with inoculated seed (7.6%)

	AAU,Assam	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	No adult emergence in fresh seeds and least insect damage in inoculated seeds (0.25%) compared to control with fresh seed (0.33%) and inoculated seed (3.37%)
Cowpea	UAS, Bangalore	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	Lowest insect damage in both fresh seeds (0.08%) and inoculated seeds (1.25%) compared control with fresh seed (2.42%) and inoculated seed (3.0%)

E. Seed Processing

Under seed processing, experiment on 'finding optimum sieve size and type of screen for grading seeds of different crop varieties and hybrids including their parents' and 'management of Karnal Bunt through mechanical seed processing' have been taken up by different cooperating centres during 2018-19. The highlights of findings are given below.

- Optimum sieve size for thickness grading in three paddy varieties *viz.*, Pusa 44 (Non-Basmati), Pusa Basmati 1121 and Pusa Basmati 1509 was found to be 1.8mm (s) against recommended 1.85mm (s) for non-basmati varieties and 1.7mm (s) for basmati varieties with maximum seed recovery of 90.88, 91.26 and 94.31%, respectively. For another coarse paddy variety CO-52, optimum sieve size for grading was 2.82mm.
- In chickpea varieties, small seeded (Pragti and Radhey), medium seeded (JG 11 & Jaki-9218), bold seeded (AKS 1109, Digvijay and Vishal) and very bold seeded (BGD 103), grading sieve (round) of size 5.0mm, 6.0mm, 6.5mm and 6.75mm were found optimum as these sieve sizes exhibited best seed quality parameters in comparison to the general recommended sieve sizes (5.0, 5.5, 6.0mm). But for one *Kabuli* variety, Virat grading sieve size of 7.0mm (round) was found optimum.
- Optimum grading sieve size was found to be 3.75mm (s) against recommended size of 4.0mm (s) for soybean varieties *viz.*, DSb-21, JS 335, P. Agrani, JS 93-05 and P. Kalyani. This optimum grading sieve size has exhibited higher seed recovery and better seed quality.
- Optimum grading sieve size was found to be 8.0mm (r) against recommended size of 7.0mm (r) for maize hybrid COH (M) 8 and its female parent (UMI 1201) as it exhibited higher seed recovery and better seed quality.
- Optimum sieve size for seed grading in pigeonpea cultivar BRG 5 was found to be 5.00 mm (r) against recommended size of 4.75mm (r) as it showed maximum seed recovery (93.38%) and physically pure seed (98.70%).

Capacity Building, Awards and Publications

During 2018-19, *in toto* 46 training programmes were organized for varied stakeholders of seed industry. Similarly, 12 exhibitions/ *kisan melas*, 18 seed day/ field day/ demonstration were organized on diverse themes related to seed by different cooperating centres. Scientific staffs of AICRP-NSP (Crops) published 107 research papers in the varied

journals of national and international repute, received 9 awards for contributions made in seed domain and 01 patent was also being filed by TNAU, Coimbatore for botanical formulation '*Acorus Calamus* TNAU formulation', which is effective in protecting seed from storage insect pests upto 8 months without affecting seed viability.

S. No.	Centres	Training (No's)	Exhibition/ *kisan mela* (No's)	Seed day/ Field day/ FLD's (No's)	Research paper (No's)	Awards (No's)	Patent filed (No's)
1	SKUAST, Srinagar	11	2	3	12	2	-
2	CSKHPKV, Palampur	5	1	5	8	2	-
3	CCSHAU, Hisar	-	3	-	10	-	-
4	AAU, Jorhat	-	-	-	3	-	-
5	OUAT, Bhubaneswar	3	-	-	10	-	-
6	JAU, Jamnagar	3	1	-	2	-	-
7	AAU, Anand	2	2	-	3	-	-
8	SKNAU, Jobner	2	-	1	6	-	-
9	JNKVV, Jabalpur	6	1	1	3	1	-
10	MPKV, Rahuri	7	-	-	19	-	-
11	UAS, Bengaluru	4	2	5	20	2	-
12	PJTSAU, Rajendranagar	1	-	1	10	1	-
13	TNAU, Coimbatore	2	-	2	1	1	1
	Total	**46**	**12**	**18**	**107**	**9**	**1**

Monitoring

Monitoring Teams for different zones (Northern Zone I, Northern Zone II, Western Zone I, Western Zone II, Eastern Zone I, Eastern Zone II, Central Zone I, Central Zone II, North Eastern Zone, Southern Zone I and Southern Zone II) were constituted during the last workshop have visited different centres and the observations made by different monitoring teams have been presented (monitoring report section). Director, ICAR-IISS, Mau has also monitored the progress of BSP and conduct of the STR research activities by various centres during 2018-19.

Breeder Seed Production during 2018-19

During the year 2018-19, total breeder seed production in various field crops was 115293.39q against the indent of 83690.14q. Production comprises of 80482.80q against the GoI indent of 62215.57q, 15795.70q against the state indent of 12623.51q, 2806.77q under pulses seed hub against the target of 2386.03q and 16208.12q under ICAR Seed Project & others against the target of 6475.83q, apart from marginal shortfall in few varieties due to climate vagaries the major requirement has been met as per indents in varied crops. Whereas, with respect to *Rabi* 2018-19, expected breeder seed production figures were used for aforementioned compilation. Perusal of statistics clearly suggests that the present level of breeder seed production is exceeding the national requirement and is sufficient to produce required amount of certified seed for realizing the targeted SRR in varied crops.

Crop-wise Breeder Seed Production during 2018-19

Out of the total breeder seed produced, the major share belongs to cereal crops i.e., 61976.63q in which maximum breeder seed was produced for wheat (42494.36q) followed by paddy (17151.28q). Under pulse crops a total of 23530.37q breeder seed was produced out of which 16600.50q was alone contributed by chickpea followed by mungbean (1672.78q), lentil (1382.74q), and urdbean (1362.37q). In oilseeds, total breeder seed production was 28871.69q; soybean and groundnut together have contributed to 27614.63q out of total breeder seed produced in oilseeds. Breeder seed produced in case of fiber crops was 121.18q against the indent of 90.42q in which, cotton had the major share of 98.88q. In case of forage crops, breeder seed production was 793.52q against the indent of 520.06q, out of which 456.55q alone was contributed from forage oats followed by fodder maize (185.10q) and berseem (66.10q).

Conclusion

After reviewing the progress of breeder seed production of different centres, following conclusions were made;

1. Over the years, there has been significant improvement in production of breeder seed, execution of GOT to ensure purity and regarding utilization of revolving fund. Most of the centers are using molecular markers in addition to GOT to ensure genetic purity.
2. The value of total breeder seed production at the existing sale price is more than Rs.100 crore and is exceedingly adequate to produce sufficient quantity of quality seed through downstream seed multiplication chain to achieve the delineated SRR in field crops.
3. GBPUAT, Pantnagar; JNKVV, Jabalpur; UAS, Dharwad; MPKV, Rahuri; IGKV, Raipur; VNMKV, Parbhani and UAS. Bengaluru were rated as very good performing centres. Special mention need to be made of GBPUAT, Pantnagar which has recorded highest cumulative profit under AICRP-NSP (Crops) Revolving Fund.

Table -1: Centre-wise and crop-wise information on breeder seed production during 2018-19

(in quintals)

S. No. Center	Crop/Variety	GOI		State		Pulses Seed Hub		Additional (ISP & Others)		Grand Total	
		Indent	Production	Indent	Production	Target	Production	Indent	Production	Indent	Production
1. NAU, Navsari											
Cereal Crops	**Paddy**										
	GNR-3	0.00	0.00	38.00	0.00	0.00	0.00	0.00	0.00	38.00	0.00
	NAUR-1	0.00	0.00	0.00	0.00	0.00	0.00	3.00	10.00	3.00	10.00
	GNR-2	0.00	0.00	0.00	0.00	0.00	0.00	2.00	10.50	2.00	10.50
	GNR-4	0.00	0.00	0.00	0.00	0.00	0.00	2.00	9.00	2.00	9.00
	GNR-5	0.00	0.00	0.00	0.00	0.00	0.00	2.00	10.00	2.00	10.00
	GNR-7	0.00	0.00	0.00	0.00	0.00	0.00	2.00	3.50	2.00	3.50
	GR-15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	9.00	1.00	9.00
	Purna	0.00	0.00	0.00	0.00	0.00	0.00	2.00	4.50	2.00	4.50
	Total	**0.00**	**0.00**	**38.00**	**0.00**	**0.00**	**0.00**	**14.00**	**56.50**	**52.00**	**56.50**
	Wheat										
	LOK 1	0.00	0.00	0.00	0.00	0.00	0.00	50.00	60.80	50.00	60.80
	GW 496	0.00	0.00	0.00	0.00	0.00	0.00	20.00	29.20	20.00	29.20
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**70.00**	**90.00**	**70.00**	**90.00**
	Sorghum										
	GNJ 1	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.50	2.00	2.50
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**2.50**	**2.00**	**2.50**
	Finger Millet										
	GN-5	0.00	0.00	0.00	0.00	0.00	0.00	11.00	23.80	11.00	23.80
	GNN-6	0.00	0.00	0.00	0.00	0.00	0.00	11.00	22.30	11.00	22.30
	GNN-7	0.00	0.00	0.00	0.00	0.00	0.00	11.00	26.70	11.00	26.70
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**33.00**	**72.80**	**33.00**	**72.80**
	Little Millet										
	GV-2	0.00	0.00	0.00	0.00	0.00	0.00	11.00	13.00	11.00	13.00

	GNV-3	0.00	0.00	0.00	0.00	0.00	0.00	11.00	18.70	11.00	18.70
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**22.00**	**31.70**	**22.00**	**31.70**
	Total Cereal Crops	**0.00**	**0.00**	**38.00**	**0.00**	**0.00**	**0.00**	**141.00**	**253.50**	**179.00**	**253.50**
Pulses Crops	**Pigeonpea**										
	Vaishali	0.00	0.00	13.10	0.00	0.00	0.00	0.00	0.00	13.10	0.00
	Total	**0.00**	**0.00**	**13.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**13.10**	**0.00**
	Total Pulse Crops	**0.00**	**0.00**	**13.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**13.10**	**0.00**
	Grand Total (Navsari)	**0.00**	**0.00**	**51.10**	**0.00**	**0.00**	**0.00**	**141.00**	**253.50**	**192.10**	**253.50**
2. UAHS, Shivamogga											
Cereal Crop	**Paddy**										
	MO 4	0.00	0.00	5.00	4.00	0.00	0.00	0.00	0.00	5.00	4.00
	KHP-11	0.00	0.00	30.00	28.00	0.00	0.00	0.00	0.00	30.00	28.00
	KHP-13	0.00	0.00	16.00	15.00	0.00	0.00	0.00	0.00	16.00	15.00
	KHP-2	0.00	0.00	3.50	3.00	0.00	0.00	0.00	0.00	3.50	3.00
	KHP-10	0.00	0.00	8.00	6.00	0.00	0.00	0.00	0.00	8.00	6.00
	KHP-5	0.00	0.00	3.50	3.00	0.00	0.00	0.00	0.00	3.50	3.00
	IET-7191	0.00	0.00	3.50	3.00	0.00	0.00	0.00	0.00	3.50	3.00
	Intan	0.00	0.00	3.50	3.00	0.00	0.00	0.00	0.00	3.50	3.00
	KHP-9	0.00	0.00	3.50	3.00	0.00	0.00	0.00	0.00	3.50	3.00
	Tunga	0.00	0.00	16.00	15.00	0.00	0.00	0.00	0.00	16.00	15.00
	JGL-1798	0.00	0.00	16.00	15.00	0.00	0.00	0.00	0.00	16.00	15.00
	KPR-1	0.00	0.00	12.00	10.00	0.00	0.00	0.00	0.00	12.00	10.00
	KKP-5	0.00	0.00	16.00	15.00	0.00	0.00	0.00	0.00	16.00	15.00
	KKP-5	0.00	0.00	5.00	4.00	0.00	0.00	0.00	0.00	5.00	4.00
	Total	**0.00**	**0.00**	**141.50**	**127.00**	**0.00**	**0.00**	**0.00**	**0.00**	**141.50**	**127.00**
	Ragi										
	ML-365	**0.00**	**0.00**	**22.00**	**20.00**	**0.00**	**0.00**	**0.00**	**0.00**	**22.00**	**20.00**
	Total	**0.00**	**0.00**	**22.00**	**20.00**	**0.00**	**0.00**	**0.00**	**0.00**	**22.00**	**20.00**

	Total Cereal Crops	**0.00**	**0.00**	**163.50**	**147.00**	**0.00**	**0.00**	**0.00**	**0.00**	**163.50**	**147.00**
Pulses Crops	**Blackgram**										
	Rashmi	0.00	0.00	8.00	6.00	0.00	0.00	0.00	0.00	8.00	6.00
	Total	**0.00**	**0.00**	**8.00**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.00**	**6.00**
	Greengram										
	KKM -3	0.00	0.00	5.00	4.00	0.00	0.00	0.00	0.00	5.00	4.00
	Total	**0.00**	**0.00**	**5.00**	**4.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**4.00**
	Total Pulses Crops	**0.00**	**0.00**	**13.00**	**10.00**	**0.00**	**0.00**	**0.00**	**0.00**	**13.00**	**10.00**
Oil Seed Crops	**Soybean**										
	JS-335	0.00	0.00	10.00	8.00	0.00	0.00	0.00	0.00	10.00	8.00
	Total	**0.00**	**0.00**	**10.00**	**8.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.00**	**8.00**
	Groundnut										
	GKVK-5	0.00	0.00	30.00	25.00	0.00	0.00	0.00	0.00	30.00	25.00
	Total	**0.00**	**0.00**	**30.00**	**25.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.00**	**25.00**
	Total Oil Seed Crops	**0.00**	**0.00**	**40.00**	**33.00**	**0.00**	**0.00**	**0.00**	**0.00**	**40.00**	**33.00**
	Grand Total (Shivamogga)	**0.00**	**0.00**	**216.50**	**190.00**	**0.00**	**0.00**	**0.00**	**0.00**	**216.50**	**190.00**
3. IGKV, Raipur											
Cereal Crop	**Paddy**										
	IGKV R1	90.00	120.00	10.00	28.60	0.00	0.00	0.00	0.00	100.00	148.60
	Chandrahasini	30.00	30.84	0.00	0.00	0.00	0.00	0.00	0.00	30.00	30.84
	IGKV R 1244	58.00	60.60	10.00	10.20	0.00	0.00	0.00	0.00	68.00	70.80
	Indira Aerobic 1	16.00	16.20	0.00	0.00	0.00	0.00	0.00	0.00	16.00	16.20
	Jaldubi	1.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.10
	Karma Mahsuri	20.00	29.10	0.00	0.00	0.00	0.00	0.00	0.00	20.00	29.10
	IR-36	16.00	27.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	27.00
	Poornima	5.50	6.90	0.00	0.00	0.00	0.00	0.00	0.00	5.50	6.90
	IR-64	58.50	64.50	0.00	0.00	0.00	0.00	0.00	0.00	58.50	64.50

	Indira Barani Dhan 1	35.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	45.00
	CGZR 1	1.00	3.30	2.00	4.80	0.00	0.00	0.00	0.00	3.00	8.10
	Bamleshwari	20.00	22.50	0.00	0.00	0.00	0.00	0.00	0.00	20.00	22.50
	Danteshwari	10.00	11.40	0.00	0.00	0.00	0.00	0.00	0.00	10.00	11.40
	Mahamaya	26.60	27.00	50.00	51.00	0.00	0.00	0.00	0.00	76.60	78.00
	Vishnubhog Selection 1	1.50	2.30	0.00	0.00	0.00	0.00	0.00	0.00	1.50	2.30
	Dubraj Selection 1	4.00	6.00	2.00	2.00	0.00	0.00	0.00	0.00	6.00	8.00
	Badshabhog Selection 1	4.50	6.00	3.00	4.20	0.00	0.00	0.00	0.00	7.50	10.20
	IGKV R2	52.00	54.90	5.00	7.50	0.00	0.00	0.00	0.00	57.00	62.40
	Tarunbhog Selection 1	4.00	4.50	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.50
	Shyamala	0.00	0.00	2.50	2.70	0.00	0.00	0.00	0.00	2.50	2.70
	Swarna	0.00	0.00	10.00	14.80	0.00	0.00	0.00	0.00	10.00	14.80
	MTU 1010	0.00	0.00	30.00	33.30	0.00	0.00	0.00	0.00	30.00	33.30
	DRR Dhan 42	0.00	0.00	20.00	21.00	0.00	0.00	0.00	0.00	20.00	21.00
	Madhuraj	0.00	0.00	3.00	5.10	0.00	0.00	0.00	0.00	3.00	5.10
	MTU 1010	0.00	0.00	0.00	0.00	0.00	0.00	20.00	25.00	20.00	25.00
	Paddy Organic										
	Dubraj Selection 1	0.00	0.00	1.00	2.10	0.00	0.00	0.00	0.00	1.00	2.10
	Tarunbhog Selection 1	0.00	0.00	1.00	1.20	0.00	0.00	0.00	0.00	1.00	1.20
	Badshabhog Selection 1	0.00	0.00	1.00	1.80	0.00	0.00	0.00	0.00	1.00	1.80
	Vishnubhog Selection 1	0.00	0.00	1.00	2.10	0.00	0.00	0.00	0.00	1.00	2.10
	CG Sugandhit Bhog Selection 1	0.00	0.00	0.30	0.39	0.00	0.00	0.00	0.00	0.30	0.39

	Total	**453.60**	**539.14**	**151.80**	**192.79**	**0.00**	**0.00**	**20.00**	**25.00**	**625.40**	**756.93**
	Finger Millet										
	CG Ragi 2	0.50	0.60	0.00	0.00	0.00	0.00	8.00	8.00	8.50	8.60
	Indira Ragi 1	1.00	2.00	0.00	0.00	0.00	0.00	8.00	8.00	9.00	10.00
	Total	**1.50**	**2.60**	**0.00**	**0.00**	**0.00**	**0.00**	**16.00**	**16.00**	**17.50**	**18.60**
	Kodo millet										
	BK 2	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
	Indira Kodo 1	4.00	4.10	0.00	0.00	0.00	0.00	20.00	5.00	24.00	9.10
	Total	**4.00**	**4.60**	**0.00**	**0.00**	**0.00**	**0.00**	**20.00**	**5.00**	**24.00**	**9.60**
	Little Millet										
	BL 4	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
	BL 6	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70
	Total	**0.00**	**1.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.30**
	Wheat										
	Ratan	135.00	160.00	0.00	0.00	0.00	0.00	15.00	20.00	150.00	180.00
	Sujata	60.00	70.00	0.00	0.00	0.00	0.00	20.00	30.00	80.00	100.00
	CG Gehu 4	0.00	0.00	0.00	0.00	0.00	0.00	25.00	40.00	25.00	40.00
	JW 3288	0.00	0.00	0.00	0.00	0.00	0.00	5.00	7.00	5.00	7.00
	JW 3211	0.00	0.00	0.00	0.00	0.00	0.00	5.00	8.00	5.00	8.00
	JW 3336	0.00	0.00	0.00	0.00	0.00	0.00	5.00	6.00	5.00	6.00
	CG Gehu 3	0.00	0.00	0.00	0.00	0.00	0.00	10.00	15.00	10.00	15.00
	CG Amber Wheat	0.00	0.00	0.00	0.00	0.00	0.00	10.00	15.00	10.00	15.00
	Total	**195.00**	**230.00**	**0.00**	**0.00**	**0.00**	**0.00**	**95.00**	**141.00**	**290.00**	**371.00**
	Total Cereal Crops	**654.10**	**777.64**	**151.80**	**192.79**	**0.00**	**0.00**	**151.00**	**187.00**	**956.90**	**1157.43**
Pulses Crops	**Urdbean**										
	Indira Urd Pratham	17.50	37.60	0.00	0.00	0.00	0.00	0.00	0.00	17.50	37.60
	Total	**17.50**	**37.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**17.50**	**37.60**
	Mung										

	Pairy Mung	4.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	6.00
	HUM - 16	0.00	0.00	0.00	0.00	0.00	0.00	10.00	15.00	10.00	15.00
	Total	**4.00**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.00**	**15.00**	**14.00**	**21.00**
	Pigeon pea										
	Rajeev Lochan	31.00	32.00	0.00	0.00	0.00	0.00	0.00	0.00	31.00	32.00
	Asha	5.00	6.40	0.00	0.00	0.00	0.00	0.00	0.00	5.00	6.40
	Pigeon pea (Organic)										
	Rajeev Lochan	0.00	0.00	0.20	0.40	0.00	0.00	0.00	0.00	0.20	0.40
	Asha	0.00	0.00	1.00	1.60	0.00	0.00	0.00	0.00	1.00	1.60
	Total	**36.00**	**38.40**	**1.20**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**37.20**	**40.40**
	Chickpea										
	Vaibhav	46.60	80.00	0.00	0.00	0.00	0.00	10.00	20.00	56.60	100.00
	Indira Chana 1	51.80	65.00	0.00	0.00	0.00	0.00	10.00	15.00	61.80	80.00
	JG - 14	0.00	0.00	0.00	0.00	0.00	0.00	20.00	22.00	20.00	22.00
	RVG 202	0.00	0.00	0.00	0.00	0.00	0.00	10.00	15.00	10.00	15.00
	Total	**98.40**	**145.00**	**0.00**	**0.00**	**0.00**	**0.00**	**50.00**	**72.00**	**148.40**	**217.00**
	Lathyrus										
	Pratik	53.30	70.00	0.00	0.00	0.00	0.00	10.00	15.00	63.30	85.00
	Mahateora	85.00	92.00	0.00	0.00	0.00	0.00	0.00	0.00	85.00	92.00
	Total	**138.30**	**162.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.00**	**15.00**	**148.30**	**177.00**
	Fieldpea										
	Indira Matar 1	10.00	12.00	0.00	0.00	0.00	0.00	5.00	6.00	15.00	18.00
	Paras	10.00	15.00	0.00	0.00	0.00	0.00	10.00	15.00	20.00	30.00
	IPFD 10-12	5.00	6.00	0.00	0.00	0.00	0.00	1.00	2.00	6.00	8.00
	Aman	5.00	6.00	0.00	0.00	0.00	0.00	2.00	2.00	7.00	8.00
	Prakash	5.00	6.00	0.00	0.00	0.00	0.00	2.00	2.00	7.00	8.00
	Ambika	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
	Total	**40.00**	**50.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20.00**	**27.00**	**60.00**	**77.00**
	Lentil										

	RVL 31	0.00	0.00	0.00	0.00	0.00	0.00	0.60	1.00	0.60	1.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.60**	**1.00**	**0.60**	**1.00**
	Total Pulses Crops	**334.20**	**439.00**	**1.20**	**2.00**	**0.00**	**0.00**	**90.60**	**130.00**	**426.00**	**571.00**
Oil Seed Crops	**Soybean**										
	JS 97-52	500.00	503.20	0.00	0.00	0.00	0.00	0.00	0.00	500.00	503.20
	JS 93-05	200.00	163.20	0.00	0.00	0.00	0.00	0.00	0.00	200.00	163.20
	CG Soya 1	50.00	75.60	0.00	0.00	0.00	0.00	0.00	0.00	50.00	75.60
	JS 93-05	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00
	Total	**750.00**	**792.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**750.00**	**792.00**
	Linseed										
	Deepika	2.00	4.00	0.00	0.00	0.00	0.00	2.00	3.00	4.00	7.00
	Indira Alsi 32	6.00	8.00	0.00	0.00	0.00	0.00	6.00	7.00	12.00	15.00
	RLC 92	4.00	6.00	0.00	0.00	0.00	0.00	6.00	9.00	10.00	15.00
	Kartika	2.50	3.00	0.00	0.00	0.00	0.00	2.00	4.00	4.50	7.00
	RLC 133	5.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	7.00
	Total	**19.50**	**28.00**	**0.00**	**0.00**	**0.00**	**0.00**	**16.00**	**23.00**	**35.50**	**51.00**
	Musterd										
	CG Sarson 1	5.00	6.00	0.00	0.00	0.00	0.00	1.00	2.00	6.00	8.00
	Total	**5.00**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**2.00**	**6.00**	**8.00**
	Total Oilseed Crops	**774.50**	**826.00**	**0.00**	**0.00**	**0.00**	**0.00**	**17.00**	**25.00**	**791.50**	**851.00**
	Grand Total (Raipur)	**1762.80**	**2042.64**	**153.00**	**194.79**	**0.00**	**0.00**	**258.60**	**342.00**	**2174.40**	**2579.43**
4. AAU, Anand											
Cereal Crop	**Paddy**										
	GR-3	0.00	0.00	2.25	3.00	0.00	0.00	0.00	0.00	2.25	3.00
	GR-4	0.00	0.00	4.50	6.00	0.00	0.00	0.00	0.00	4.50	6.00
	GR-7	0.00	0.00	3.50	5.00	0.00	0.00	0.00	0.00	3.50	5.00
	GR-11	0.00	0.00	7.85	10.00	0.00	0.00	0.00	0.00	7.85	10.00

	GAR-13	0.10	0.15	36.20	50.00	0.00	0.00	0.00	0.00	36.30	50.15
	JAYA	0.00	0.00	9.35	10.00	0.00	0.00	0.00	0.00	9.35	10.00
	MASURI	0.00	0.00	6.00	7.00	0.00	0.00	0.00	0.00	6.00	7.00
	GURJARI	0.00	0.00	52.45	75.00	0.00	0.00	0.00	0.00	52.45	75.00
	IR-28	0.00	0.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	2.00
	Mahisagar	0.00	0.00	7.25	10.00	0.00	0.00	0.00	0.00	7.25	10.00
	Total	**0.10**	**0.15**	**130.35**	**178.00**	**0.00**	**0.00**	**0.00**	**0.00**	**130.45**	**178.15**
	Maize										
	Inbred Lines										
	IGI 1102 (Inbred female)	0.00	0.00	0.50	0.60	0.00	0.00	0.00	0.00	0.50	0.60
	IGI 1104 (Inbred male)	0.00	0.00	1.00	1.20	0.00	0.00	0.00	1.50	1.00	2.70
	GYL – 2 (female)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.19
	GM - 6	0.00	0.00	4.50	6.20	0.00	0.00	0.00	0.00	4.50	6.20
	IGI 1101 (Inbred female)	0.00	0.00	4.00	5.00	0.00	0.00	0.00	0.00	4.00	5.00
	IGI 1103(Inbred male)	0.00	0.00	2.00	2.10	0.00	0.00	0.00	1.50	2.00	3.60
	GM-3	0.00	0.00	0.30	5.00	0.00	0.00	0.00	15.00	0.30	20.00
	GM-4	0.00	0.00	1.00	5.00	0.00	0.00	0.00	0.00	1.00	5.00
	Narmada Moti	0.00	0.00	0.00	0.00	0.00	0.00	20.00	21.00	20.00	21.00
	Total	**0.00**	**0.00**	**13.30**	**25.10**	**0.00**	**0.00**	**20.00**	**39.19**	**33.30**	**64.29**
	Wheat										
	LOK 1	0.00	0.00	0.00	0.00	0.00	0.00	30.00	35.00	30.00	35.00
	GW 322	0.00	0.00	0.00	0.00	0.00	0.00	70.00	75.00	70.00	75.00
	GW 496	0.00	0.00	0.00	0.00	0.00	0.00	35.00	35.00	35.00	35.00
	GW 11	0.00	0.00	0.00	0.00	0.00	0.00	60.00	70.00	60.00	70.00
	GW 173	0.00	0.00	0.00	0.00	0.00	0.00	40.00	50.00	40.00	50.00
	GW 496	0.00	0.00	0.00	0.00	0.00	0.00	40.00	50.00	40.00	50.00

	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**275.00**	**315.00**	**275.00**	**315.00**
	Total Cereal Crops	**0.10**	**0.15**	**143.65**	**203.10**	**0.00**	**0.00**	**295.00**	**354.19**	**438.75**	**557.44**
Pulses Crops	**Green gram**										
	GAM 5	0.00	0.00	0.00	0.00	0.00	0.00	12.45	19.00	12.45	19.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**12.45**	**19.00**	**12.45**	**19.00**
	Pigeon pea										
	AGT 2	0.00	0.00	0.00	0.00	0.00	0.00	5.00	12.00	5.00	12.00
	Total	0.00	0.00	0.00	0.00	0.00	0.00	5.00	12.00	5.00	12.00
	Gram:										
	GG-5	0.00	0.00	0.00	0.00	0.00	0.00	20.00	25.00	20.00	25.00
	GG-2	0.00	0.00	0.00	0.00	0.00	0.00	5.00	6.00	5.00	6.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**25.00**	**31.00**	**25.00**	**31.00**
	Total Pulses Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**42.45**	**62.00**	**42.45**	**62.00**
Oil Seed Crops	**Soybean**										
	NRC-37	54.00	61.50	0.00	0.00	0.00	0.00	0.00	0.00	54.00	61.50
	Total	**54.00**	**61.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**54.00**	**61.50**
	Ground nut										
	GG 34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	2.00
	GG 20	0.00	0.00	65.00	70.00	0.00	0.00	0.00	0.00	65.00	70.00
	GJG 22	0.00	0.00	65.00	70.00	0.00	0.00	0.00	0.00	65.00	70.00
	Total	0.00	0.00	130.00	140.00	0.00	0.00	0.00	2.00	130.00	142.00
	Total Oil Seed Crops	**54.00**	**61.50**	**130.00**	**140.00**	**0.00**	**0.00**	**0.00**	**2.00**	**184.00**	**203.50**
Fibre crops	**Cotton**										
	V 797	0.00	0.00	6.60	6.60	0.00	0.00	0.00	0.00	6.60	6.60
	G Cot 13	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.25	0.25
	G Cot 21	0.00	0.00	44.00	53.00	0.00	0.00	0.00	0.00	44.00	53.00
	ADC 1	0.00	0.00	0.02	0.15	0.00	0.00	0.00	0.00	0.02	0.15

	GADC 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	2.00
	Total	**0.00**	**0.00**	**50.87**	**60.00**	**0.00**	**0.00**	**0.00**	**2.00**	**50.87**	**62.00**
	Total Fiber Crops	**0.00**	**0.00**	**50.87**	**60.00**	**0.00**	**0.00**	**0.00**	**2.00**	**50.87**	**62.00**
Forage Crops	**Lucerne**										
	Anand-2	6.40	6.50	0.80	1.00	0.00	0.00	0.00	6.50	7.20	14.00
	AL-3	0.60	0.60	0.65	0.65	0.00	0.00	0.00	0.00	1.25	1.25
	Total	7.00	7.10	1.45	1.65	0.00	0.00	0.00	6.50	8.45	15.25
	Oat										
	Kent	50.00	55.00	10.00	10.00	0.00	0.00	0.00	0.00	60.00	65.00
	Total	50.00	55.00	10.00	10.00	0.00	0.00	0.00	0.00	60.00	65.00
	Tota Forage Crops	**57.00**	**62.10**	**11.45**	**11.65**	**0.00**	**0.00**	**0.00**	**6.50**	**68.45**	**80.25**
	Grand Total (Anand)	**111.10**	**123.75**	**335.97**	**414.75**	**0.00**	**0.00**	**337.45**	**426.69**	**784.52**	**965.19**
5 . ICAR-DGR, Junagadh											
Oil Seed Crops	**Groundnut**										
	Girnar 2	4.00	42.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	42.00
	Girnar 3	117.68	90.00	0.00	0.00	0.00	0.00	0.00	0.00	117.68	90.00
	Total	**121.68**	**132.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**121.68**	**132.00**
	Total Oil Seed Crops	**121.68**	**132.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**121.68**	**132.00**
	Grand Total (Junagadh)	**121.68**	**132.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**121.68**	**132.00**
6 . UAS. Raichur											
Cereal Crops	**Paddy**										
	GGV 0501	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	5.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**0.00**	**5.00**
	Total Cereal Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**0.00**	**5.00**
Pulses Crops	**Pigeonpea**										

	TS3R	5.10	8.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10	8.00
	GRG 811	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00	10.00
	BSMR 736	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	5.00
	ICP 8863 (Maruthi)	8.20	18.75	0.00	0.00	0.00	0.00	0.00	0.00	8.20	18.75
	ICPL 87119 (Asha)	3.50	5.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	5.00
	Total	**16.80**	**31.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**15.00**	**16.80**	**46.75**
	Blackgram										
	TAU-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	0.00	3.50
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.50**	**0.00**	**3.50**
	Green Gram										
	BGS-9	6.22	14.00	0.00	0.00	0.00	0.00	0.00	0.00	6.22	14.00
	Total	**6.22**	**14.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.22**	**14.00**
	Bengalgram										
	JG 11	200.00	250.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	250.00
	A-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	5.00
	GBM-2	0.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00
	BGD-103	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	25.00
	MNK-1	7.10	7.50	0.00	0.00	0.00	0.00	0.00	0.00	7.10	7.50
	Total	**207.10**	**272.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.00**	**207.10**	**302.50**
	Total Pulses Crops	**230.12**	**318.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**48.50**	**230.12**	**366.75**
Oil Seed Crops	**Soybean**										
	JS-335	100.00	142.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	142.00
	Total	100.00	142.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	142.00
	Sunflower										
	CMS38A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.10	0.00	2.10
	R 630 R (RSFH 130 Male)	0.01	0.01	0.00	0.00	0.00	0.00	0.00	2.10	0.01	2.11
	R127-1 (RSFH	0.01	0.01	0.00	0.00	0.00	0.00	0.00	1.00	0.01	1.01

	1887 Male)										
	Total	**0.02**	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.20**	**0.02**	**5.22**
	Total Oil Seed Crops	**100.02**	**142.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.20**	**100.02**	**147.22**
	Grand Total (Raichur)	**330.14**	**460.27**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**58.70**	**330.14**	**518.97**
7. OUAT, Bhubaneswar											
Cereal Crops	**Paddy**										
	Khandagiri	9.70	9.70	0.00	0.00	0.00	0.00	0.00	14.10	9.70	23.80
	Parijat	6.10	4.40	0.00	0.00	0.00	0.00	0.00	0.00	6.10	4.40
	Parijat	6.10	6.10	0.00	0.00	0.00	0.00	0.00	0.00	6.10	6.10
	Udayagiri	0.30	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.30	2.60
	Mandakini	10.30	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.30	10.00
	Surendra	1.40	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	2.00
	Mrunalini	5.00	18.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	18.00
	Manaswini	5.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	6.00
	Lalat	46.00	46.00	0.00	0.00	0.00	0.00	0.00	0.00	46.00	46.00
	Ranidhan	13.20	20.00	0.00	0.00	0.00	0.00	0.00	0.00	13.20	20.00
	Pratikhya	60.70	89.00	0.00	0.00	0.00	0.00	0.00	0.00	60.70	89.00
	Jajati	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	Improved Lalat	15.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.70	0.00
	Pankaj	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00
	Kalachampa	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00
	Upahar	0.00	0.00	0.00	0.00	0.00	0.00	9.00	9.00	9.00	9.00
	Total	**190.90**	**223.80**	**0.00**	**0.00**	**0.00**	**0.00**	**9.00**	**23.10**	**199.90**	**246.90**
	Finger Millet										
	Arjuna(OEB 526)	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00	20.00	20.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20.00**	**20.00**	**20.00**	**20.00**
	Little Millet										
	Saura(OLM-208)	0.00	0.00	0.00	0.00	0.00	0.00	4.00	2.00	4.00	2.00

	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.00**	**2.00**	**4.00**	**2.00**
	Total Cereal Crops	**190.90**	**223.80**	**0.00**	**0.00**	**0.00**	**0.00**	**33.00**	**45.10**	**223.90**	**268.90**
Pulses Crops	**Arhar**										
	PRG 176	10.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	6.00
	Total	**10.00**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.00**	**6.00**
	Mung										
	IPM 2-3	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
	IPM 2-14	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.00
	Total	**40.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**40.00**	**0.00**
	Urd										
	Prasad	5.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	1.00
	Pant U 31	28.15	28.15	0.00	0.00	0.00	0.00	0.00	0.00	28.15	28.15
	IPU 02-43 (BS)	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00
	Total	**43.15**	**39.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**43.15**	**39.15**
	Chickpea										
	NBeG3 (CS)	0.00	0.00	0.00	0.00	150.00	100.00	0.00	0.00	150.00	100.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**150.00**	**100.00**	**0.00**	**0.00**	**150.00**	**100.00**
	Total Pulses Crops	**93.15**	**45.15**	**0.00**	**0.00**	**150.00**	**100.00**	**0.00**	**0.00**	**243.15**	**145.15**
Oil Seed Crops	**Sesamum**										
	Amrit	1.45	0.35	0.00	0.00	0.00	0.00	0.00	0.00	1.45	0.35
	Prachi	1.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.20
	Smarak	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15	0.15	0.15
	Total	**2.45**	**0.55**	**0.00**	**0.00**	**0.00**	**0.00**	**0.15**	**0.15**	**2.60**	**0.70**
	Groundnut										
	ICGV 91114	500.00	500.00	0.00	0.00	0.00	0.00	0.00	0.00	500.00	500.00
	Total	**500.00**	**500.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**500.00**	**500.00**
	Niger										
	Utkal Niger 150	6.40	2.35	0.00	0.00	0.00	0.00	0.00	0.00	6.40	2.35

	Total	**6.40**	**2.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.40**	**2.35**
	Linseed										
	Arpita	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
	Total	**5.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**5.00**
	Toria										
	Anuradha	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
	Sushree	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
	Total	**2.50**	**2.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.50**	**2.50**
	Total Oil Seed Crops	**516.35**	**510.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.15**	**0.15**	**516.50**	**510.55**
	Grand Total (Bhubaneswar)	**800.40**	**779.35**	**0.00**	**0.00**	**150.00**	**100.00**	**33.15**	**45.25**	**983.55**	**924.60**
8 . CSKHPKV, Palampur											
Cereal Crops	**Paddy**										
	HPR 2612	2.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	10.00
	HPR 2143	8.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	8.00	1.50
	HPR 1068	5.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	8.00
	RP 2421	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.80	0.50	0.80
	Kasturi	0.00	0.00	0.00	0.00	0.00	0.00	7.00	7.12	7.00	7.12
	HPR 2720	2.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.50
	HPR 1156	9.90	1.20	2.00	2.00	0.00	0.00	0.00	0.00	11.90	3.20
	Pusa 1121	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.79	2.00	2.79
	HPR 2795	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.80	0.50	0.80
	HPR 2880	3.00	1.80	0.00	0.00	0.00	0.00	0.00	0.00	3.00	1.80
	HPR 2656	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.50	1.50	1.50
	Total	**29.90**	**23.00**	**2.00**	**2.00**	**0.00**	**0.00**	**11.50**	**13.01**	**43.40**	**38.01**
	Maize										
	BajMakka	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.80	1.50	1.80
	Girija	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.80	1.50	1.80
	E. Comp	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.30	1.00	1.30

	BajPopcorn	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.10	0.20
	PalamSankar Makka2	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.10	0.20
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.20**	**5.30**	**4.20**	**5.30**
	Wheat										
	HPW 236	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	HPW 249	0.00	0.00	0.00	0.00	0.00	0.00	50.00	53.00	50.00	53.00
	HPW 349	76.00	80.00	20.00	25.00	0.00	0.00	150.00	165.00	246.00	270.00
	HPW 360	40.00	43.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	43.00
	HPW 368	0.00	0.00	30.00	40.00	0.00	0.00	200.00	250.00	230.00	290.00
	HPW 373	0.00	0.00	0.00	0.00	0.00	0.00	50.00	57.00	50.00	57.00
	HS 507	0.00	0.00	10.00	15.00	0.00	0.00	0.00	0.00	10.00	15.00
	HS 562	0.00	0.00	10.00	15.00	0.00	0.00	0.00	0.00	10.00	15.00
	WH 1080	0.00	0.00	40.00	45.00	0.00	0.00	10.00	10.00	50.00	55.00
	DBW 88	0.00	0.00	0.00	0.00	0.00	0.00	70.00	80.00	70.00	80.00
	Total	**116.00**	**123.00**	**110.00**	**140.00**	**0.00**	**0.00**	**531.00**	**616.00**	**757.00**	**879.00**
	Barley										
	HBL 713	0.00	0.00	0.00	0.00	0.00	0.00	8.00	9.00	8.00	9.00
	HBL 113	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50	1.00	1.50
	HBL 380	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.40	0.30	0.40
	HBL316	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	HBL276	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	HBL391	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	BHS 400	0.00	0.00	0.50	1.00	0.00	0.00	0.20	0.20	0.70	1.20
	VLB 118	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	Total	**0.00**	**0.00**	**0.50**	**1.00**	**0.00**	**0.00**	**12.00**	**13.60**	**12.50**	**14.60**
	Total Cereal Crops	**145.90**	**146.00**	**112.50**	**143.00**	**0.00**	**0.00**	**558.70**	**647.91**	**817.10**	**936.91**
Pulses Crops	**Urd/ Mash**										
	Plp 93	2.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	2.00	3.50

	Him Mash1	1.50	3.00	0.00	0.00	0.00	0.00	10.00	14.00	11.50	17.00
	UG 218	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.55	3.00	3.55
	PDU1	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.21	0.10	0.21
	Kullu 4	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	Pant U 19	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.24	0.20	0.24
	PB 114	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.16	0.10	0.16
	Total	**3.50**	**6.50**	**0.00**	**0.00**	**0.00**	**0.00**	**13.90**	**18.66**	**17.40**	**25.16**
	Cowpea										
	C 475	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.10
	C 519	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.10
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.20**	**0.20**	**0.20**	**0.20**
	Moong										
	Suketi	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40	0.40	0.40
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.40**	**0.40**	**0.40**	**0.40**
	Rajmash										
	Him 1	0.00	0.00	1.00	1.00	0.00	0.00	1.50	1.61	2.50	2.61
	Kanchan	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.14	1.00	1.14
	Jwala	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.85	0.50	0.85
	Baspa	0.00	0.00	1.00	1.00	0.00	0.00	4.00	4.70	5.00	5.70
	Kailash	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.25	0.20	0.25
	Total	**0.00**	**0.00**	**2.00**	**2.00**	**0.00**	**0.00**	**7.20**	**8.55**	**9.20**	**10.55**
	Gram										
	HC 1	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.40	0.20	0.40
	HC 2	8.00	8.30	0.00	0.00	0.00	0.00	0.00	0.00	8.00	8.30
	GPF 2	0.00	0.00	2.00	2.30	0.00	0.00	0.00	0.00	2.00	2.30
	HPG 17	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50	1.00	1.50
	DKG 986	0.00	0.00	0.00	0.00	0.00	0.00	2.50	3.00	2.50	3.00
	GNG 1581	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.30	0.20	0.30
	Total	**8.00**	**8.30**	**2.00**	**2.30**	**0.00**	**0.00**	**3.90**	**5.20**	**13.90**	**15.80**

	Lentil										
	Vipasha	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.50	5.00	5.50
	Markandey	1.50	1.50	0.00	0.00	0.00	0.00	1.50	1.50	3.00	3.00
	Total	**1.50**	**1.50**	**0.00**	**0.00**	**0.00**	**0.00**	**6.50**	**7.00**	**8.00**	**8.50**
	Total Pulses Crops	**13.00**	**16.30**	**4.00**	**4.30**	**0.00**	**0.00**	**32.10**	**40.01**	**49.10**	**60.61**
Oil Seed Crops	**Soybean**										
	Him Soya	0.00	4.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.94
	Shivalik	0.00	12.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.13
	Palam Soya	1.00	11.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	11.00
	Hara Soya	2.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	8.00
	Palam Early Soya -1	0.00	4.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.40
	Total	**3.00**	**40.47**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.00**	**40.47**
	Til										
	LTK 4	0.05	0.05	0.05	0.10	0.00	0.00	19.00	19.20	19.10	19.35
	Total	**0.05**	**0.05**	**0.05**	**0.10**	**0.00**	**0.00**	**19.00**	**19.20**	**19.10**	**19.35**
	B Sarson										
	KBS 3	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	HPBS 1	0.00	0.00	0.15	0.20	0.00	0.00	0.20	0.30	0.35	0.50
	Total	**0.00**	**0.00**	**0.15**	**0.20**	**0.00**	**0.00**	**1.20**	**1.30**	**1.35**	**1.50**
	G Sarson										
	ONK1(HS1)	0.00	0.00	0.10	0.20	0.00	0.00	1.00	1.55	1.10	1.75
	Neelam	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00	3.00	5.00
	GSC7	0.00	0.00	0.10	0.20	0.00	0.00	1.50	2.00	1.60	2.20
	Sheetal	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.50	0.30	0.50
	Total	**0.00**	**0.00**	**0.20**	**0.40**	**0.00**	**0.00**	**5.80**	**9.05**	**6.00**	**9.45**
	Toria										
	Bhawani	0.00	0.00	0.15	0.20	0.00	0.00	0.00	0.00	0.15	0.20
	Total	**0.00**	**0.00**	**0.15**	**0.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.15**	**0.20**

	Karan Rai										
	Jayanti	0.00	0.00	0.05	0.10	0.00	0.00	0.30	0.40	0.35	0.50
	Total	**0.00**	**0.00**	**0.05**	**0.10**	**0.00**	**0.00**	**0.30**	**0.40**	**0.35**	**0.50**
	Raya										
	RCC 4	0.00	0.00	0.05	0.10	0.00	0.00	2.00	2.20	2.05	2.30
	Total	**0.00**	**0.00**	**0.05**	**0.10**	**0.00**	**0.00**	**2.00**	**2.20**	**2.05**	**2.30**
	Linseed										
	Nagarkot	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.60	0.50	0.60
	Binwa	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.10
	Baner	0.00	0.00	0.00	0.00	0.00	0.00	0.80	1.00	0.80	1.00
	Himani	1.32	1.50	0.10	0.20	0.00	0.00	1.00	1.40	2.42	3.10
	Him Alsi 1	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.50	0.40	0.50
	Him Alsi 2	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.60	1.00	1.60
	Bhagsu	0.12	0.15	0.10	0.20	0.00	0.00	0.20	0.25	0.42	0.60
	Surbhi (KL1)	0.60	0.75	0.00	0.00	0.00	0.00	0.50	0.55	1.10	1.30
	Total	**2.04**	**2.40**	**0.20**	**0.40**	**0.00**	**0.00**	**4.50**	**6.00**	**6.74**	**8.80**
	Total Oilseed Crops	**5.09**	**42.92**	**0.85**	**1.50**	**0.00**	**0.00**	**32.80**	**38.15**	**38.74**	**82.57**
Fodder Crops	**Oats**										
	Plp 1	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00	20.00	20.00
	Kent	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.00**	**30.00**	**30.00**	**30.00**
	Maize										
	African Tall	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**	**1.00**	**1.00**
	Setaria grass										
	PSS 1	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.12	0.10	0.12
	S-18	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.08	0.05	0.08
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.15**	**0.20**	**0.15**	**0.20**
	W. Clover										

	Plp. Comp	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.15	0.10	0.15
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**	**0.15**	**0.10**	**0.15**
	Total Fodder Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**31.25**	**31.35**	**31.25**	**31.35**
	Grand Total (Palampur)	**163.99**	**205.22**	**117.35**	**148.80**	**0.00**	**0.00**	**654.85**	**757.42**	**936.19**	**1111.44**
9. PJTSAU - Hyderabad											
Cereal Crops	**Paddy**										
	RNR-15048	10.30	11.00	99.70	100.00	0.00	0.00	0.00	30.00	110.00	141.00
	JGL-18047	6.50	6.50	32.35	33.00	0.00	0.00	0.00	27.00	38.85	66.50
	KNM-118	16.20	16.20	44.20	45.00	0.00	0.00	0.00	19.60	60.40	80.80
	JGL-11118	0.00	0.00	0.40	0.40	0.00	0.00	0.00	0.00	0.40	0.40
	JGL-11470	0.00	0.00	0.30	0.50	0.00	0.00	0.00	0.00	0.30	0.50
	JGL-17004	0.00	0.00	1.80	1.80	0.00	0.00	0.00	0.00	1.80	1.80
	JGL-1798	4.70	4.70	50.90	51.00	0.00	0.00	0.00	10.40	55.60	66.10
	JGL-384	0.00	0.00	21.00	21.00	0.00	0.00	0.00	0.00	21.00	21.00
	MTU-1001	0.00	0.00	33.60	35.00	0.00	0.00	6.40	6.50	40.00	41.50
	MTU-1010	0.00	0.00	152.80	155.00	0.00	0.00	0.00	0.00	152.80	155.00
	MTU-7029	0.00	0.00	41.80	43.00	0.00	0.00	0.00	0.00	41.80	43.00
	BPT-5204	0.00	0.00	28.00	30.00	0.00	0.00	50.00	50.00	78.00	80.00
	RDR-763	0.00	0.00	0.40	0.40	0.00	0.00	5.00	5.00	5.40	5.40
	RNR-12392	0.00	0.00	1.30	1.30	0.00	0.00	1.00	1.00	2.30	2.30
	RNR-10754	2.70	2.70	27.10	27.10	0.00	0.00	0.00	0.00	29.80	29.80
	RNR-1446	0.00	0.00	5.45	5.50	0.00	0.00	0.00	0.00	5.45	5.50
	RNR-2458	0.00	0.00	1.00	1.00	0.00	0.00	2.00	2.00	3.00	3.00
	RNR-2465	0.00	0.00	0.80	1.00	0.00	0.00	2.00	2.00	2.80	3.00
	Shobini	0.00	0.00	0.30	0.30	0.00	0.00	1.00	1.00	1.30	1.30
	WGL-14	0.30	4.00	18.40	21.00	0.00	0.00	0.00	0.00	18.70	25.00
	WGL-32100	10.00	10.00	8.50	8.50	0.00	0.00	0.00	11.50	18.50	30.00
	Erra Mallelu	6.10	6.10	26.50	27.00	0.00	0.00	1.00	1.00	33.60	34.10

	(WGL 20471)										
	Kavya (WGL 48684)	0.50	0.50	0.90	1.00	0.00	0.00	0.50	0.50	1.90	2.00
	WGL-347	0.00	0.00	1.30	1.50	0.00	0.00	0.50	1.50	1.80	3.00
	WGL-3825	0.00	0.00	3.00	3.00	0.00	0.00	1.00	2.00	4.00	5.00
	WGL-44	0.00	0.00	1.30	2.00	0.00	0.00	5.00	29.23	6.30	31.23
	JGL-11727	0.00	0.00	0.10	0.20	0.00	0.00	0.00	0.00	0.10	0.20
	JGL-3828	0.00	0.00	0.90	1.00	0.00	0.00	0.00	0.00	0.90	1.00
	JGL-3844	0.00	0.00	1.60	1.60	0.00	0.00	0.00	0.00	1.60	1.60
	JGL-3855	0.00	0.00	0.60	0.60	0.00	0.00	0.00	0.00	0.60	0.60
	WGL-13400	0.00	0.00	1.60	1.60	0.00	0.00	2.00	2.00	3.60	3.60
	WGL-283	0.00	0.00	1.50	1.50	0.00	0.00	2.00	2.00	3.50	3.50
	WGL-48684	0.00	0.00	5.60	6.00	0.00	0.00	0.50	0.50	6.10	6.50
	Total	**57.30**	**61.70**	**615.00**	**628.80**	**0.00**	**0.00**	**79.90**	**204.73**	**752.20**	**895.23**
	Maize										
	BML-6 (Female DHM 117)	6.90	6.90	0.00	0.00	0.00	0.00	0.50	0.50	7.40	7.40
	BML-7 (Male DHM 117))	3.42	3.42	0.00	0.00	0.00	0.00	0.50	0.50	3.92	3.92
	BML-45 (Female DHM 121)	4.39	4.39	0.00	0.00	0.00	0.00	1.00	1.00	5.39	5.39
	BML- 6 (Male DHM 121)	2.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.17	0.00
	Amber Popcorn	0.00	0.00	0.10	0.10	0.00	0.00	1.00	1.00	1.10	1.10
	Priya	0.00	0.00	0.10	0.10	0.00	0.00	0.40	0.40	0.50	0.50
	Madhuri	0.00	0.00	0.10	0.10	0.00	0.00	1.00	1.00	1.10	1.10
	Total	**16.88**	**14.71**	**0.30**	**0.30**	**0.00**	**0.00**	**4.40**	**4.40**	**21.58**	**19.41**
	Sorghum										
	PSV-56	0.00	0.00	0.60	0.60	0.00	0.00	1.20	1.20	1.80	1.80
	MJ-278	0.00	0.00	0.50	0.50	0.00	0.00	2.50	2.50	3.00	3.00
	CSV-31	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00

	Total	**0.00**	**0.00**	**1.10**	**1.10**	**0.00**	**0.00**	**5.70**	**5.70**	**6.80**	**6.80**
	Total Cereal Crops	**74.18**	**76.41**	**616.40**	**630.20**	**0.00**	**0.00**	**90.00**	**214.83**	**780.58**	**921.44**
Pulses Crops	**Redgram**										
	ICPL-87119	2.50	2.50	0.25	0.50	0.00	0.00	1.00	2.00	3.75	5.00
	PRG-158	0.00	0.00	0.40	0.40	0.00	0.00	0.50	0.50	0.90	0.90
	PRG-176	1.50	1.50	0.00	0.00	0.00	0.00	5.00	5.00	6.50	6.50
	TDRG-4	0.15	0.15	0.00	0.00	0.00	0.00	0.55	0.55	0.70	0.70
	Total	**4.15**	**4.15**	**0.65**	**0.90**	**0.00**	**0.00**	**7.05**	**8.05**	**11.85**	**13.10**
	Blackgram										
	PU-31	0.00	0.00	0.85	1.00	0.00	0.00	0.00	0.00	0.85	1.00
	Total	**0.00**	**0.00**	**0.85**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.85**	**1.00**
	Greengram						-				
	WGG 42	0.24	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	2.00
	MGG-295	0.00	0.00	0.00	0.00	8.00	8.00	0.00	0.00	8.00	8.00
	Total	**0.24**	**2.00**	**0.00**	**0.00**	**8.00**	**8.00**	**0.00**	**0.00**	**8.24**	**10.00**
	Total Pulses Crops	**4.39**	**6.15**	**1.50**	**1.90**	**8.00**	**8.00**	**7.05**	**8.05**	**20.94**	**24.10**
Oil Seed Crops	**Soybean**										
	Basara (ADB-22)	18.00	68.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00	68.00
	JS-335	400.00	410.00	0.00	0.00	0.00	0.00	0.00	0.00	400.00	410.00
	Total	**418.00**	**478.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**418.00**	**478.00**
	Sesame										
	Swetha Til	0.02	0.10	0.20	0.20	0.00	0.00	0.00	0.00	0.22	0.30
	Total	**0.02**	**0.10**	**0.20**	**0.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.22**	**0.30**
	Castor										
	PCS - 4	0.00	0.00	0.30	0.40	0.00	0.00	0.00	0.00	0.30	0.40
	PCS 262	0.00	0.00	1.00	1.00	0.00	0.00	2.00	2.00	3.00	3.00
	Total	**0.00**	**0.00**	**1.30**	**1.40**	**0.00**	**0.00**	**2.00**	**2.00**	**3.30**	**3.40**
	Total Oil Seed	**418.02**	**478.10**	**1.50**	**1.60**	**0.00**	**0.00**	**2.00**	**2.00**	**421.52**	**481.70**

	Crops										
Fodder Crops	**Pearlmillet**										
	Moti	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.50**	**0.50**	**0.50**
	Cowpea										
	Vijaya	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.50**	**0.50**	**0.50**
	Total Fodder Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**	**1.00**	**1.00**
	Grand Total (PJTSAU)	**496.59**	**560.66**	**619.40**	**633.70**	**8.00**	**8.00**	**100.05**	**225.88**	**1224.04**	**1428.24**
10. TNAU, Coimbatore											
Cereal Crops	**Paddy**										
	ADT 36	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.90	1.00	0.90
	ADT 37	12.00	12.00	1.20	1.20	0.00	0.00	15.00	15.00	28.20	28.20
	ADT 38	0.00	0.00	0.00	0.00	0.00	0.00	25.00	25.83	25.00	25.83
	ADT 39	6.00	6.00	0.00	0.00	0.00	0.00	0.00	37.45	6.00	43.45
	ADT 42	0.00	0.00	0.00	0.00	0.00	0.00	25.00	24.50	25.00	24.50
	ADT 43	0.00	0.00	0.90	0.90	0.00	0.00	79.00	79.34	79.90	80.24
	ADT (R) 45	0.10	0.10	0.50	0.50	0.00	0.00	88.00	88.00	88.60	88.60
	ADT (R) 46	0.00	0.00	0.00	0.00	0.00	0.00	36.50	36.46	36.50	36.46
	ADT (R) 50	0.00	0.00	0.00	0.00	0.00	0.00	1.30	1.30	1.30	1.30
	CO 43	0.00	0.00	0.00	0.00	0.00	0.00	14.50	14.50	14.50	14.50
	CO 43 Sub 1	4.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	3.00
	CO (R) 50	0.00	0.00	15.00	19.20	0.00	0.00	45.00	45.00	60.00	64.20
	CO (R) 51	11.80	11.80	24.45	24.45	0.00	0.00	11.20	11.20	47.45	47.45
	CO 52	0.00	0.00	6.00	31.00	0.00	0.00	9.00	11.70	15.00	42.70
	CR 1009 sub1	0.00	0.00	13.00	19.30	0.00	0.00	0.00	81.62	13.00	100.92
	IR 20	0.00	0.00	0.00	0.00	0.00	0.00	46.00	46.10	46.00	46.10
	IR 36	0.00	0.00	0.00	0.00	0.00	0.00	2.00	17.90	2.00	17.90

	IR 50	0.00	0.00	0.00	0.00	0.00	0.00	12.40	12.40	12.40	12.40
	ASD 16	0.00	0.00	1.00	1.00	0.00	0.00	105.00	105.00	106.00	106.00
	ASD 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ASD 19	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00
	I. W. Ponni	0.00	0.00	0.00	0.00	0.00	0.00	45.50	45.58	45.50	45.58
	TRY 1	0.00	0.00	0.00	0.00	0.00	0.00	6.60	6.65	6.60	6.65
	TRY 3	0.00	0.00	10.00	12.00	0.00	0.00	0.00	0.00	10.00	12.00
	TPS 5	0.00	0.00	0.00	60.00	0.00	0.00	0.60	0.60	0.60	60.60
	TKM 9	0.00	0.00	0.00	0.00	0.00	0.00	50.00	50.00	50.00	50.00
	TKM 13	0.00	0.00	25.00	27.90	0.00	0.00	9.50	9.50	34.50	37.40
	Anna (R) 4	0.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00	3.00	3.00
	COMS 23A	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.08	0.08
	COMS 23A	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04
	CB 174R	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04
	MDU 6	0.00	0.00	0.80	0.80	0.00	0.00	1.25	1.25	2.05	2.05
	Total	**33.90**	**32.90**	**100.85**	**201.25**	**0.00**	**0.00**	**631.51**	**769.94**	**766.26**	**1004.09**
	Sorghum										
	CO (S) 30	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
	K 12	0.00	0.00	2.00	2.50	0.00	0.00	0.32	0.50	2.32	3.00
	Total	**0.00**	**0.00**	**4.00**	**4.50**	**0.00**	**0.00**	**0.32**	**0.50**	**4.32**	**5.00**
	Maize										
	CO 6 Parental Line										
	Female UMI 1200	12.00	12.00	1.80	1.30	0.00	0.00	0.23	0.23	14.03	13.53
	Male UMI 1230	6.00	7.00	0.24	0.24	0.00	0.00	0.14	0.14	6.38	7.38
	COH (M) 8 Parental Line										
	Female UMI 1201	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.01	0.20	0.21
	Male UMI 1230	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.07	0.12	0.19
	COH (M) 9										

	Parental Line										
	Female UMI 1205	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.05
	Male UMI 1230	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
	Total	**18.38**	**19.38**	**2.04**	**1.54**	**0.00**	**0.00**	**0.37**	**0.46**	**20.79**	**21.38**
	Cumbu										
	CO (Cu) 10	0.00	0.00	2.00	2.00	0.00	0.00	0.30	0.30	2.30	2.30
	Total	**0.00**	**0.00**	**2.00**	**2.00**	**0.00**	**0.00**	**0.30**	**0.30**	**2.30**	**2.30**
	Ragi										
	CO (Ra) 15	0.00	0.00	0.50	0.50	0.00	0.00	0.10	0.10	0.60	0.60
	Paiyur 2	0.00	0.00	0.50	0.90	0.00	0.00	0.00	0.00	0.50	0.90
	Total	**0.00**	**0.00**	**1.00**	**1.40**	**0.00**	**0.00**	**0.10**	**0.10**	**1.10**	**1.50**
	Barnyard millet										
	Kudiravali 0 CO (Kv) 2	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
	Total	**0.00**	**0.00**	**2.00**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**2.00**
	Little millet										
	Samai 0 CO 4	0.00	0.00	0.50	0.50	0.00	0.00	0.10	0.10	0.60	0.60
	Total	**0.00**	**0.00**	**0.50**	**0.50**	**0.00**	**0.00**	**0.10**	**0.10**	**0.60**	**0.60**
	Kodo millet										
	Varagu 0 CO 3	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.10	0.10
	Total	**0.00**	**0.00**	**0.10**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**	**0.10**
	Foxtail millet										
	Tenai 0 CO (Te) 7	0.00	0.00	0.30	0.30	0.00	0.00	0.00	0.00	0.30	0.30
	Total	**0.00**	**0.00**	**0.30**	**0.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.30**	**0.30**
	Prosomillet										
	CO (Pv) 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	MDU 1	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.04	0.50	0.54
	Total	**0.00**	**0.00**	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.04**	**0.50**	**0.54**
	Total Cereals Crops	**52.28**	**52.28**	**113.29**	**214.09**	**0.00**	**0.00**	**632.70**	**771.44**	**798.27**	**1037.81**

Pulses Crops	**Redgram**										
	VBN 3	0.00	0.00	2.00	2.00	0.00	0.00	0.38	0.38	2.38	2.38
	CO (Rg) 7	0.00	0.00	2.50	2.30	0.00	0.00	0.00	0.00	2.50	2.30
	CO 8	0.00	0.00	4.00	4.20	0.10	0.10	0.00	0.00	4.10	4.30
	Total	**0.00**	**0.00**	**8.50**	**8.50**	**0.10**	**0.10**	**0.38**	**0.38**	**8.98**	**8.98**
	Blackgram										
	ADT 3	0.00	0.00	0.00	0.00	0.00	0.00	3.48	3.48	3.48	3.48
	ADT 5	0.00	0.00	0.00	0.00	0.04	0.04	3.13	3.13	3.17	3.17
	VBN 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VBN (Bg) 4	0.40	0.40	0.00	0.00	0.00	0.00	7.60	7.60	8.00	8.00
	VBN (Bg) 5	0.00	0.00	14.00	14.00	0.00	0.00	0.00	0.00	14.00	14.00
	VBN (Bg) 6	0.00	0.00	15.00	15.00	0.29	0.29	2.20	2.20	17.49	17.49
	VBN (Bg) 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CO 6	5.00	5.00	3.00	3.00	0.00	0.00	0.32	0.32	8.32	8.32
	MDU 1	0.00	0.00	1.00	1.00	0.00	0.00	0.66	0.66	1.66	1.66
	VBN (BG) 8	0.00	0.00	3.40	3.40	2.80	2.80	5.92	5.92	12.12	12.12
	ADT 6	0.00	0.00	3.00	3.00	0.20	0.20	0.00	0.00	3.20	3.20
	KKM 1	0.00	0.00	1.70	1.70	0.00	0.00	0.00	0.00	1.70	1.70
	Total	**5.40**	**5.40**	**41.10**	**41.10**	**3.33**	**3.33**	**23.31**	**23.31**	**73.14**	**73.14**
	Greengram										
	VBN 2	0.00	0.00	0.00	0.00	0.00	0.00	1.12	1.12	1.12	1.12
	VBN 3	0.00	0.00	8.00	7.96	0.00	0.00	0.60	0.60	8.60	8.56
	VRM (Gg) 1	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40	0.40	0.40
	CO (Gg) 912 (CO 7)	0.50	0.50	9.50	9.50	0.00	0.00	4.74	4.74	14.74	14.74
	CO 8	0.00	0.00	4.00	4.00	0.10	0.10	0.16	0.16	4.26	4.26
	CO 6	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.70	0.70	0.70
	Total	**0.50**	**0.50**	**21.50**	**21.46**	**0.10**	**0.10**	**7.72**	**7.72**	**29.82**	**29.78**
	Cowpea										
	CO (Cp) 7	0.00	0.00	5.20	5.20	0.00	0.00	1.98	1.98	7.18	7.18

	Total	**0.00**	**0.00**	**5.20**	**5.20**	**0.00**	**0.00**	**1.98**	**1.98**	**7.18**	**7.18**
	Horsegram										
	Paiyur 2	0.00	0.00	6.00	6.00	0.00	0.00	0.00	0.00	6.00	6.00
	Total	**0.00**	**0.00**	**6.00**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.00**	**6.00**
	Total Pulses Crops	**5.90**	**5.90**	**82.30**	**82.26**	**3.53**	**3.53**	**33.39**	**33.39**	**125.12**	**125.08**
Oil Seed Crops	**Groundnut**										
	VRI (Gn) 6	0.00	0.00	20.00	26.20	0.00	0.00	6.00	6.00	26.00	32.20
	VRI (Gn) 7	0.00	0.00	40.00	44.00	0.00	0.00	0.00	0.00	40.00	44.00
	VRI 8	0.00	0.00	130.00	125.90	0.00	0.00	9.60	9.60	139.60	135.50
	CO 6	0.00	0.00	60.00	63.25	0.00	0.00	3.00	7.10	63.00	70.35
	CO 7	50.00	40.00	30.00	37.80	0.00	0.00	0.00	0.00	80.00	77.80
	ALG-06-320	0.00	0.00	30.00	26.30	0.00	0.00	13.20	13.20	43.20	39.50
	TMV 14	0.00	0.00	25.00	24.00	0.00	0.00	0.00	0.00	25.00	24.00
	Total	**50.00**	**40.00**	**335.00**	**347.45**	**0.00**	**0.00**	**31.80**	**35.90**	**416.80**	**423.35**
	Til										
	SVPR1	0.00	0.00	0.46	0.46	0.00	0.00	0.18	0.18	0.64	0.64
	TMV (Sv) 7	0.00	0.00	2.50	2.50	0.00	0.00	0.00	0.00	2.50	2.50
	Total	**0.00**	**0.00**	**2.96**	**2.96**	**0.00**	**0.00**	**0.18**	**0.18**	**3.14**	**3.14**
	Sunflower										
	CO (SFV) 5	0.00	0.00	1.60	1.60	0.00	0.00	0.00	0.00	1.60	1.60
	Total	**0.00**	**0.00**	**1.60**	**1.60**	**0.00**	**0.00**	**0.00**	**0.00**	**1.60**	**1.60**
	Castor										
	TMV 5	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	TMV 6	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50
	Total	**0.00**	**0.00**	**0.50**	**0.50**	**0.00**	**0.00**	**0.50**	**0.50**	**1.00**	**1.00**
	Total Oil Seed Crops	**50.00**	**40.00**	**340.06**	**352.51**	**0.00**	**0.00**	**32.48**	**36.58**	**422.54**	**429.09**
Fiber Crops	**Cotton**										
	MCU 5	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.20	0.20

	SVPR 2	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.60	0.60	0.60
	SVPR 4	0.00	0.00	0.10	0.10	0.00	0.00	0.20	1.00	0.30	1.10
	SVPR 4	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	CO 14	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.00	0.20	0.20
	K 12	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.00	0.20	0.20
	K 12	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.10
	MCU 7	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.24	0.24	0.24
	SVP 3	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.06
	Total	**0.00**	**0.00**	**0.50**	**0.50**	**0.00**	**0.00**	**2.40**	**3.20**	**2.90**	**3.70**
	Total fiber Crops	**0.00**	**0.00**	**0.50**	**0.50**	**0.00**	**0.00**	**2.40**	**3.20**	**2.90**	**3.70**
Forage Crops	**Sorghum**										
	CO (FS) 29	1.45	1.45	0.00	0.00	0.00	0.00	0.00	0.00	1.45	1.45
	CO (FS) 31	3.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	1.00
	CSV 33 MF	8.25	5.50	0.00	0.00	0.00	0.00	0.55	0.55	8.80	6.05
	Total	**12.70**	**7.95**	**0.00**	**0.00**	**0.00**	**0.00**	**0.55**	**0.55**	**13.25**	**8.50**
	Total Forage Crop	**12.70**	**7.95**	**0.00**	**0.00**	**0.00**	**0.00**	**0.55**	**0.55**	**13.25**	**8.50**
	Grand Total (Coimbatore)	**120.88**	**106.13**	**536.15**	**649.36**	**3.53**	**3.53**	**701.52**	**845.16**	**1362.08**	**1604.18**
11 . SKUAS&T,(K) Srinagar											
Cereal Crops	**Paddy**										
	Jehlum	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	4.00
	Chenab	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
	Shalimar Rice -2	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00
	Shalimar Rice -3	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	5.00
	Shalimar Rice -4	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	5.00
	Total	**1.00**	**1.00**	**0.00**	**17.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**18.00**
	Maize										
	Shalimar Popcorn-1	1.00	1.45	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.45

	KG-2	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00
	Shalimar Maize Composite- 4	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	5.00
	Shalimar Maize Composite-7	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00
	Total	**1.00**	**1.45**	**0.00**	**9.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**10.45**
	Wheat										
	Shalimar Wheat-2	0.00	0.00	14.00	14.00	0.00	0.00	0.00	0.00	14.00	14.00
	Total	**0.00**	**0.00**	**14.00**	**14.00**	**0.00**	**0.00**	**0.00**	**0.00**	**14.00**	**14.00**
	Total Cereal Crops	**2.00**	**2.45**	**14.00**	**40.00**	**0.00**	**0.00**	**0.00**	**0.00**	**16.00**	**42.45**
Pulses Crops	**Moong**										
	Shalimar Moong-1	0.00	0.00	0.00	1.50	0.00	0.00	0.00	0.00	0.00	1.50
	Total	**0.00**	**0.00**	**0.00**	**1.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.50**
	Cowpea										
	Shalimar Cowpea-1	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
	Total	**0.00**	**0.00**	**0.00**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**
	Rajmash										
	Shalimar Rajmash-1	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20
	Shalomar Rajmash-2	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.80
	Total	**0.00**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**
	Pea										
	Shalimar Pea-1	0.00	0.00	2.00	0.86	0.00	0.00	0.00	0.00	2.00	0.86
	Total	**0.00**	**0.00**	**2.00**	**0.86**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**0.86**
	Lentil/Masoor										
	Shalimar Masoor-1	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.72

	Shalimar Masoor-2	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.42
	Total	**0.00**	**0.00**	**0.00**	**1.14**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.14**
	Total Pulses Crops	**0.00**	**0.00**	**2.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**5.00**
Oilseesd Crops	**B Sarson**										
	KOS-1	0.00	0.00	0.40	0.45	0.00	0.00	0.00	0.00	0.40	0.45
	Shalimar Brown Sarson-1	0.00	0.00	1.20	1.55	0.00	0.00	0.00	0.00	1.20	1.55
	Total	**0.00**	**0.00**	**1.60**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.60**	**2.00**
	Total Oilseed Crops	**0.00**	**0.00**	**1.60**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.60**	**2.00**
Forage Crops	**Oats**										
	Sabzar	0.00	0.00	21.50	21.55	0.00	0.00	0.00	0.00	21.50	21.55
	Shalimar Fodder Oats-1	0.00	0.00	10.20	10.20	0.00	0.00	0.00	0.00	10.20	10.20
	Shalimar Fodder Oats-3	0.00	0.00	1.50	1.75	0.00	0.00	0.00	0.00	1.50	1.75
	Shalimar Fodder Oats-4	0.00	0.00	10.80	10.85	0.00	0.00	0.00	0.00	10.80	10.85
	Total	**0.00**	**0.00**	**44.00**	**44.35**	**0.00**	**0.00**	**0.00**	**0.00**	**44.00**	**44.35**
	Total Forage Crops	**0.00**	**0.00**	**44.00**	**44.35**	**0.00**	**0.00**	**0.00**	**0.00**	**44.00**	**44.35**
	Grand Total (Srinagar)	**2.00**	**2.45**	**61.60**	**91.35**	**0.00**	**0.00**	**0.00**	**0.00**	**63.60**	**93.80**
12. DRPCAU, Pusa											
Cereal Crops	**Paddy**										
	R. Bhagwati	81.00	90.50	0.00	0.00	0.00	0.00	0.00	34.50	81.00	125.00
	R. Sweta	32.60	32.60	0.00	0.00	0.00	0.00	0.00	17.40	32.60	50.00
	R. Suwasini	1.50	2.00	0.00	0.00	0.00	0.00	0.00	3.00	1.50	5.00
	R. Mahsuri-1	64.00	63.88	0.00	0.00	0.00	0.00	0.00	0.00	64.00	63.88
	RajendraKasturi	1.50	2.20	0.00	0.00	0.00	0.00	0.00	2.80	1.50	5.00

	Rajshree	0.40	0.40	0.00	0.00	0.00	0.00	0.00	29.60	0.40	30.00
	Prabhat	30.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	30.00
	Sahbhagi Dhan	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	Swarna Sub-1	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	R. Neelam	0.00	0.00	12.00	12.00	0.00	0.00	0.00	0.00	12.00	12.00
	Sudha	0.00	0.00	12.00	12.00	0.00	0.00	0.00	0.00	12.00	12.00
	Vaidehi	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	R. Sarswati	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	Total	**211.00**	**221.58**	**49.00**	**49.00**	**0.00**	**0.00**	**0.00**	**87.30**	**260.00**	**357.88**
	Maize										
	Shaktiman 2 (F) CML 176	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
	Shaktiman 2 (M) CML 186	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	Total	**0.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.06**	**0.00**
	Fingermillet										
	RAU 8	0.25	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.25	1.50
	Total	**0.25**	**1.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.25**	**1.50**
	Prosomillet										
	BR 7	1.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.50
	Total	**1.00**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.50**
	Wheat										
	DBW-39	20.00	20.00	10.00	10.00	0.00	0.00	510.00	510.00	540.00	540.00
	HD-2967	150.00	150.00	50.00	50.00	0.00	0.00	1035.00	1035.00	1235.00	1235.00
	HI-1563	174.00	174.00	6.00	6.00	0.00	0.00	0.00	0.00	180.00	180.00
	WR 544	26.74	26.74	0.00	0.00	0.00	0.00	0.00	0.00	26.74	26.74
	HD-2733	0.00	0.00	50.00	50.00	0.00	0.00	1080.00	1080.00	1130.00	1130.00
	DBW-107	0.00	0.00	10.00	10.00	0.00	0.00	100.00	100.00	110.00	110.00

	K-307	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	Total	**370.74**	**370.74**	**136.00**	**136.00**	**0.00**	**0.00**	**2725.0**	**2725.00**	**3231.74**	**3231.74**
	Total Cereal Crops	**583.05**	**594.32**	**185.00**	**185.00**	**0.00**	**0.00**	**2725.0 0**	**2812.30**	**3493.05**	**3591.62**
Pulses Crops	**Arhar**										
	NDA-1	10.00	15.00	5.00	5.00	0.00	0.00	0.00	0.00	15.00	20.00
	NDA-2	0.00	0.00	0.00	0.00	30.00	30.00	0.00	0.00	30.00	30.00
	MAL-13	0.00	0.00	24.00	24.00	0.00	0.00	0.00	0.00	24.00	24.00
	Bahar	3.61	5.00	3.00	3.00	0.00	0.00	0.00	0.00	6.61	8.00
	Total	**13.61**	**20.00**	**32.00**	**32.00**	**30.00**	**30.00**	**0.00**	**0.00**	**75.61**	**82.00**
	Urd										
	PU-31	0.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00	3.00	3.00
	Uttara	0.00	0.00	3.60	3.60	0.00	0.00	0.00	0.00	3.60	3.60
	Uttra	0.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00	3.00	3.00
	PU-31	0.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00	3.00	3.00
	Total	**0.00**	**0.00**	**12.60**	**12.60**	**0.00**	**0.00**	**0.00**	**0.00**	**12.60**	**12.60**
	Mungbean										
	HUM-16	0.00	0.00	9.00	9.00	100.00	110.00	9.00	9.00	118.00	128.00
	IPM2-3	0.00	0.00	6.00	6.00	0.00	0.00	167.00	167.00	173.00	173.00
	TMB-37	0.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00	3.00	3.00
	PDM-139	0.00	0.00	6.00	6.00	0.00	0.00	9.00	9.00	15.00	15.00
	Total	**0.00**	**0.00**	**24.00**	**24.00**	**100.00**	**110.00**	**185.00**	**185.00**	**309.00**	**319.00**
	Pea										
	HUDP-15	7.50	7.50	4.50	4.50	0.00	0.00	18.00	18.00	30.00	30.00
	HFP-4	4.00	4.00	0.00	0.00	0.00	0.00	4.00	4.00	8.00	8.00
	GDFP-1	4.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00
	Total	**15.50**	**15.50**	**4.50**	**4.50**	**0.00**	**0.00**	**22.00**	**22.00**	**42.00**	**42.00**
	Lentil										
	HUL-57	15.00	15.00	8.00	8.00	400.00	400.00	0.00	0.00	423.00	423.00
	KLS-218	0.00	0.00	8.00	8.00	0.00	0.00	0.00	0.00	8.00	8.00

	IPL-406	0.00	0.00	8.00	8.00	0.00	0.00	0.00	0.00	8.00	8.00
	IPL-316	0.00	0.00	8.00	8.00	0.00	0.00	0.00	0.00	8.00	8.00
	Total	**15.00**	**15.00**	**32.00**	**32.00**	**400.00**	**400.00**	**0.00**	**0.00**	**447.00**	**447.00**
	Rajmash										
	Utkarsh	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
	Total	**0.00**	**0.00**	**2.00**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**2.00**
	Gram										
	BG-372	0.00	0.00	0.00	0.00	0.00	0.00	16.00	16.00	16.00	16.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**16.00**	**16.00**	**16.00**	**16.00**
	Total Pulses Crops	**44.11**	**50.50**	**107.10**	**107.10**	**530.00**	**540.00**	**223.00**	**223.00**	**904.21**	**920.60**
Oilseed Crops	**Sesame**										
	Krishna	0.50	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.35
	Total	**0.50**	**0.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.35**
	Sarson										
	NRCYS-05-02	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00
	Total	**0.00**	**0.00**	**1.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**
	Total Oilseeds	**0.50**	**0.35**	**1.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.50**	**1.35**
	Grand Total (DRPCAU)	**627.66**	**645.17**	**293.10**	**293.10**	**530.00**	**540.00**	**2948.00**	**3035.30**	**4398.76**	**4513.57**
13. AU, Kota											
Cereal Crops	**Paddy**										
	Pratap-1	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
	Imp. PB-1	0.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50
	Pusa Sug. 4	0.00	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.20
	Pusa Sug. 5	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
	Pusa 1509	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
	Total	**0.10**	**10.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**	**10.80**
	Wheat										
	C-306	45.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	100.00

	HI 8498	46.60	75.00	0.00	0.00	0.00	0.00	0.00	0.00	46.60	75.00
	Raj 3077	73.80	200.00	0.00	0.00	0.00	0.00	0.00	0.00	73.80	200.00
	Raj 3765	29.40	180.00	0.00	0.00	0.00	0.00	0.00	0.00	29.40	180.00
	Raj 4238	405.00	600.00	0.00	0.00	0.00	0.00	0.00	0.00	405.00	600.00
	Raj 1482	72.60	80.00	0.00	0.00	0.00	0.00	0.00	0.00	72.60	80.00
	Raj 4079	101.60	280.00	0.00	0.00	0.00	0.00	0.00	0.00	101.60	280.00
	HI 1544	100.00	120.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	120.00
	HI 8713	150.00	160.00	0.00	0.00	0.00	0.00	0.00	0.00	150.00	160.00
	HI 8759	100.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	10.00
	HI 8737	0.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00
	Raj 4037	0.00	250.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	250.00
	Raj 4120	0.00	120.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	120.00
	WH 147	0.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00
	GW 322	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00
	GW 173	0.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00
	GW 273	0.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00
	PBW 502	0.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00
	PBW 343	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00
	GW 496	0.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00
	WH 711	0.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.00
	HD 3086	0.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.00
	Lok 1	0.00	105.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	105.00
	Total	**1124.00**	**2900.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1124.00**	**2900.00**
	Total Cereal Crops	**1124.10**	**2910.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1124.10**	**2910.80**
Pulses Crops	**Urdbean**										
	Pratap Urd 1	28.50	60.00	0.00	0.00	10.00	60.00	0.00	0.00	38.50	120.00
	KPU 405	4.00	30.00	0.00	0.00	20.00	40.00	0.00	0.00	24.00	70.00
	Total	**32.50**	**90.00**	**0.00**	**0.00**	**30.00**	**100.00**	**0.00**	**0.00**	**62.50**	**190.00**
	Mungbean										

	IPM 02-03	30.00	35.00	0.00	0.00	15.00	4.00	0.00	0.00	45.00	39.00
	Virat	0.00	0.00	0.00	0.00	5.00	2.70	0.00	0.00	5.00	2.70
	Shikha	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
	Virat	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
	Total	**30.00**	**55.00**	**0.00**	**0.00**	**20.00**	**6.70**	**0.00**	**0.00**	**50.00**	**61.70**
	Pigeon Pea										
	ICPL 88039	0.00	0.00	0.00	0.00	20.00	20.00	0.00	0.00	20.00	20.00
	PA 291	0.00	0.00	0.00	0.00	20.00	30.00	0.00	0.00	20.00	30.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**40.00**	**50.00**	**0.00**	**0.00**	**40.00**	**50.00**
	Gram										
	JG 14	200.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	200.00
	GNG 1958	100.00	100.00	0.00	0.00	5.00	20.00	0.00	0.00	105.00	120.00
	RVG 203	250.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	250.00	0.00
	RVG 201	172.50	260.00	0.00	0.00	0.00	0.00	0.00	0.00	172.50	260.00
	GNG 1581	0.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00
	CSJ 515	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00
	RSG 974	0.00	0.00	0.00	0.00	5.00	20.00	0.00	0.00	5.00	20.00
	Pratap C-1	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
	Total	**722.50**	**650.00**	**0.00**	**0.00**	**10.00**	**40.00**	**0.00**	**0.00**	**732.50**	**690.00**
	Field Pea										
	IPFD 10-12	0.00	0.00	0.00	0.00	15.00	20.00	0.00	0.00	15.00	20.00
	RFP-4	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	10.00	10.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**25.00**	**30.00**	**0.00**	**0.00**	**25.00**	**30.00**
	Lentil										
	Kota Masoor1	19.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	19.00	25.00
	Kota Masoor2	17.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00	20.00
	Total	**36.00**	**45.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**36.00**	**45.00**
	Total Pulses Crops	**821.00**	**840.00**	**0.00**	**0.00**	**125.00**	**226.70**	**0.00**	**0.00**	**946.00**	**1066.70**
Oil Seed Crops	**Soybean**										

	JS 2034	700.00	400.00	0.00	0.00	0.00	0.00	0.00	0.00	700.00	400.00
	JS 2029	300.00	115.00	0.00	0.00	0.00	0.00	0.00	0.00	300.00	115.00
	JS 93-05	200.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	200.00
	JS 95-60	200.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	80.00
	RKS 45	20.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	30.00
	Raj Soya 18	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00
	RKS 24	10.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	25.00
	RKS 113	10.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	20.00
	Total	**1450.00**	**870.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1450.00**	**870.00**
	Linseed										
	Pratap Alsi 2	7.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	12.00
	Pratap Alsi 1	0.70	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	6.00
	KBA-4	3.20	9.00	0.00	0.00	0.00	0.00	0.00	0.00	3.20	9.00
	KBA-3	0.50	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	3.00
	Total	**11.40**	**30.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.40**	**30.00**
	Total Oil Seed Crops	**1461.40**	**900.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1461.40**	**900.00**
	Grand Total (Kota)	**3406.50**	**4650.80**	**0.00**	**0.00**	**125.00**	**226.70**	**0.00**	**0.00**	**3531.50**	**4877.50**
14. CRIJAF, Barrackpore											
Fiber Crops	**Jute**										
	JRO 128	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
	JBO 2003 H	1.07	1.20	0.00	0.00	0.00	0.00	0.00	0.00	1.07	1.20
	JRC 321	0.02	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.20
	JRO 632	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10
	S 19	0.17	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.50
	JRO 204	2.56	3.58	0.00	0.00	0.00	0.00	0.00	0.00	2.56	3.58
	JROG 1	0.04	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.10
	JRO 524	2.20	3.54	0.00	0.00	0.00	0.00	0.00	0.00	2.20	3.54
	JRC 532	0.29	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.58

	CO 58	0.39	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.92
	JRO 878	0.27	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.18
	JRC 517	0.08	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.48
	JRC 212	0.06	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.20
	JRO 2407	0.36	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.48
	JRCM 2	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
	Total	**8.60**	**14.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.60**	**14.10**
	Mesta										
	HC 583	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.90	1.00	0.90
	AMC 108	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	HS 4288	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.10	1.00	1.10
	HS 7910	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.40	0.50	0.40
	JBMP 2	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.40	0.50	0.40
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.00**	**3.80**	**4.00**	**3.80**
	Sunhemp										
	SUIN 037	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	SUIN 053	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
	JRJ 610	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40
	Total	**0.90**	**0.90**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.50**	**1.40**	**1.40**
	Total Fiber Crops	**9.50**	**15.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.50**	**4.30**	**14.00**	**19.30**
	Grand Total (Barrackpore)	**9.50**	**15.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.50**	**4.30**	**14.00**	**19.30**
15 . SVPUA&T, Meerut											
Cereal crops	**Paddy**										
	Vallabh Basmati 24	2.00	2.25	2.00	0.00	0.00	0.00	0.00	0.00	4.00	2.25
	Total	2.00	2.25	2.00	0.00	0.00	0.00	0.00	0.00	4.00	2.25
	Wheat										
	WB -02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00	20.00
	DBW -90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	25.00

	DBW -71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	0.00	55.00
	DBW -88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	0.00	60.00
	DBW -17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	25.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**185.00**	**0.00**	**185.00**
	Total Cereal Crops	**2.00**	**2.25**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**185.00**	**4.00**	**187.25**
	Grand Total`(Meerut)	**2.00**	**2.25**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**185.00**	**4.00**	**187.25**
16. BCKV ,West Bengal											
Cereal Crops	**Paddy**										
	Gontra Bidhan - 1 (IET - 17430)	77.00	77.00	5.00	7.00	0.00	0.00	0.00	19.00	82.00	103.00
	Gontra Bidhan - 3 (IET - 22752)	20.70	21.00	5.00	7.00	0.00	0.00	0.00	16.00	25.70	44.00
	Total	**97.70**	**98.00**	**10.00**	**14.00**	**0.00**	**0.00**	**0.00**	**35.00**	**107.70**	**147.00**
	Total Cereal Crops	**97.70**	**98.00**	**10.00**	**14.00**	**0.00**	**0.00**	**0.00**	**35.00**	**107.70**	**147.00**
Pulses Crops	**Chickpea**										
	Bidisha	0.00	0.00	2.00	2.50	0.00	0.00	0.00	0.00	2.00	2.50
	Total	**0.00**	**0.00**	**2.00**	**2.50**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**2.50**
	Lentil										
	HUL-57	0.00	0.00	3.00	5.00	0.00	0.00	0.00	0.00	3.00	5.00
	L-4727	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50
	Total	**0.00**	**0.00**	**3.50**	**5.50**	**0.00**	**0.00**	**0.00**	**0.00**	**3.50**	**5.50**
	Total Pulses Crops	**0.00**	**0.00**	**5.50**	**8.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.50**	**8.00**
Forage Crops	**Ricebean**										
	Bidhan Ricebean 4	0.25	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25	1.25
	Total	**0.25**	**1.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.25**	**1.25**
	Total Forages	**0.25**	**1.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.25**	**1.25**

	Grand Total (West Bengal)	**97.95**	**99.25**	**15.50**	**22.00**	**0.00**	**0.00**	**0.00**	**35.00**	**113.45**	**156.25**
17. NDUA & T, Faizabad											
Cereal Crops	**Paddy**										
	NDR-2065	1.10	54.65	0.00	0.00	0.00	0.00	0.00	0.00	1.10	54.65
	NDR-2064	1.10	58.50	0.00	0.00	0.00	0.00	0.00	0.00	1.10	58.50
	Sarju-52	5.90	16.00	0.00	0.00	0.00	0.00	0.00	0.00	5.90	16.00
	NDR-8002	1.10	34.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	34.00
	NDR-359	1.10	16.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	16.00
	NDR 97	1.10	5.40	0.00	0.00	0.00	0.00	0.00	0.00	1.10	5.40
	Sushk Samrat	0.30	6.80	0.00	0.00	0.00	0.00	0.00	0.00	0.30	6.80
	NUD 2008	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.00
	BPT-5204	0.00	0.00	0.00	0.00	0.00	0.00	0.00	115.90	0.00	115.90
	Swarna Sub-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.70	0.00	38.70
	Sambha Sub-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.80	0.00	20.80
	NDR-3112-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.05	0.00	40.05
	Narendra Lalmati	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.80
	MTU-7029	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.45	0.00	27.45
	Sugandha-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00	0.00	14.00
	Barani Deep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.84	0.00	3.84
	Beena-11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.00	0.00	28.00
	Total	**12.80**	**191.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**289.54**	**12.80**	**480.89**
	Wheat										
	DBW 17	34.38	18.00	0.00	0.00	0.00	0.00	0.00	0.00	34.38	18.00
	DBW 107	0.00	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00
	PBW 154	0.00	470.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	470.00
	PBW 550	0.00	105.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	105.00
	HD 2967	0.00	90.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00
	K 7903	0.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00

	NW 1014	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
	NW 5054	30.00	145.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	145.00
	NW 4018	0.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00
	Total	**64.38**	**924.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**64.38**	**924.00**
	Barley										
	NDB 1445	20.00	135.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	135.00
	Total	**20.00**	**135.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20.00**	**135.00**
	Total Cereal crops	**97.18**	**1250.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**289.54**	**97.18**	**1539.89**
Pulses Crops	**Arhar**										
	NDA 2	4.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.71	0.00
	NDA 1	11.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.16	0.00
	Total	**15.87**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**15.87**	**0.00**
	Lentil										
	NDL-1	7.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	6.00
	Total	**7.00**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.00**	**6.00**
	Total Pulse Crops	**22.87**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**22.87**	**6.00**
	Grand Total(NDUA&T)	**120.05**	**1256.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**289.54**	**120.05**	**1545.89**
18. SDAU, Sardar Krushinagar											
Cereal crops	**Wheat**										
	GW 496	206.00	200.00	590.00	611.00	0.00	0.00	0.00	0.00	796.00	811.00
	GW 1255	0.00	0.00	50.00	62.00	0.00	0.00	0.00	0.00	50.00	62.00
	GW 322	100.00	87.00	4.00	5.00	0.00	0.00	0.00	0.00	104.00	92.00
	GW 451	10.00	10.00	300.00	325.00	0.00	0.00	0.00	0.00	310.00	335.00
	LOK 1	0.00	0.00	135.00	150.00	0.00	0.00	0.00	0.00	135.00	150.00
	GW 273	0.00	0.00	110.00	125.00	0.00	0.00	0.00	0.00	110.00	125.00
	GW 173	32.80	37.00	182.00	200.00	0.00	0.00	0.00	0.00	214.80	237.00
	GW 11	0.00	0.00	20.00	25.00	0.00	0.00	0.00	0.00	20.00	25.00
	GW 503	0.00	0.00	1.00	3.00	0.00	0.00	0.00	0.00	1.00	3.00

	Total	**348.80**	**334.00**	**1392.00**	**1506.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1740.80**	**1840.00**
	Total cereal crops	**348.80**	**334.00**	**1392.00**	**1506.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1740.80**	**1840.00**
Pulses Crops	**Mungbean**										
	K 851	0.00	0.00	1.00	0.00	0.00	0.00	0.00	5.00	1.00	5.00
	GM 4	0.20	1.20	44.25	21.65	0.00	0.00	0.00	56.95	44.45	79.80
	GM-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.20**	**1.20**	**45.25**	**21.65**	**0.00**	**0.00**	**0.00**	**61.95**	**45.45**	**84.80**
	Urdbean										
	T 9	0.00	0.00	33.00	15.45	0.00	0.00	0.00	8.90	33.00	24.35
	GU 1	3.20	4.50	27.55	1.50	0.00	0.00	0.00	25.00	30.75	31.00
	Total	**3.20**	**4.50**	**60.55**	**16.95**	**0.00**	**0.00**	**0.00**	**33.90**	**63.75**	**55.35**
	Guar										
	GG 1	0.00	0.00	0.50	0.00	0.00	0.00	0.00	4.30	0.50	4.30
	GG 2	0.00	0.00	0.75	1.30	0.00	0.00	0.00	0.00	0.75	1.30
	Total	**0.00**	**0.00**	**1.25**	**1.30**	**0.00**	**0.00**	**0.00**	**4.30**	**1.25**	**5.60**
	Cowpea										
	GC 4	3.75	5.00	0.00	0.00	0.00	0.00	0.00	1.91	3.75	6.91
	Total	**3.75**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.91**	**3.75**	**6.91**
	Pigeonpea										
	BDN 2	0.00	0.00	8.90	10.00	0.00	0.00	0.00	13.00	8.90	23.00
	ICPL 87	0.00	0.00	0.75	0.00	0.00	0.00	0.00	2.21	0.75	2.21
	Total	**0.00**	**0.00**	**9.65**	**10.00**	**0.00**	**0.00**	**0.00**	**15.21**	**9.65**	**25.21**
	Moth Bean										
	GMO-1	0.00	0.00	0.50	0.41	0.00	0.00	0.00	0.00	0.50	0.41
	GMO-2	0.00	0.00	0.40	0.41	0.00	0.00	0.00	0.00	0.40	0.41
	Total	**0.00**	**0.00**	**0.90**	**0.82**	**0.00**	**0.00**	**0.00**	**0.00**	**0.90**	**0.82**
	Horsegram										
	GDH-1	1.70	6.03	0.00	0.00	0.00	0.00	0.00	0.00	1.70	6.03
	Total	**1.70**	**6.03**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.70**	**6.03**

	Total Pulses Crops	**8.85**	**16.73**	**117.60**	**50.72**	**0.00**	**0.00**	**0.00**	**117.27**	**126.45**	**184.72**
Oil Seed Crops	**Castor**										
	VP-1 (C)	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	VI 9	0.00	0.00	0.24	0.32	0.00	0.00	0.00	0.00	0.24	0.32
	48-1	0.00	0.00	1.26	6.54	0.00	0.00	0.00	0.00	1.26	6.54
	JI 35	0.00	0.00	0.92	1.73	0.00	0.00	0.00	0.00	0.92	1.73
	VP 1 (M)	0.00	0.00	4.92	5.78	0.00	0.00	0.00	0.00	4.92	5.78
	SKP 84 (GCH 7 Female)	0.50	0.75	4.74	5.00	0.00	0.00	0.00	0.00	5.24	5.75
	SKI 215 (GCH 7 Male)	0.25	0.40	1.41	5.29	0.00	0.00	0.00	0.00	1.66	5.69
	DCS 94	0.00	0.00	0.04	0.20	0.00	0.00	0.00	0.00	0.04	0.20
	JP 96 (GCH 8 Female)	0.70	0.80	0.70	5.00	0.00	0.00	0.00	0.00	1.40	5.80
	DCS 89 (GCH 8 Male)	0.35	0.40	0.00	2.50	0.00	0.00	0.00	0.00	0.35	2.90
	Total	**1.80**	**2.35**	**14.73**	**32.36**	**0.00**	**0.00**	**0.00**	**0.00**	**16.53**	**34.71**
	Mustard										
	GDM-1	0.00	0.00	0.40	0.45	0.00	0.00	0.00	0.00	0.40	0.45
	GDM-2	0.00	0.00	0.50	0.55	0.00	0.00	0.00	0.00	0.50	0.55
	GDM-3	0.00	0.00	0.50	0.55	0.00	0.00	0.00	0.00	0.50	0.55
	GDM-4	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.90	0.90
	GDM-5	0.00	0.00	0.40	0.40	0.00	0.00	0.00	0.00	0.40	0.40
	Total	**0.00**	**0.00**	**2.70**	**2.85**	**0.00**	**0.00**	**0.00**	**0.00**	**2.70**	**2.85**
	Total Oil Seed Crops	**1.80**	**2.35**	**17.43**	**35.21**	**0.00**	**0.00**	**0.00**	**0.00**	**19.23**	**37.56**
	Grand Total (SK Nagar)	**359.45**	**353.08**	**1527.03**	**1591.93**	**0.00**	**0.00**	**0.00**	**117.27**	**1886.48**	**2062.28**
19. IARI, New Delhi											
Cereal Crops	**Paddy#**										

	Pusa1592	1.20	8.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	8.00
	Pusa-6	1.90	8.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90	8.00
	Pusa Sugandh-5	40.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	80.00
	Total	**43.10**	**96.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**43.10**	**96.00**
	Maize										
	CM 150 (Female of Pusa Extra Early Hybrid Makka-5 (AH-421))	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
	CM 151 (Male of Pusa Extra Early Hybrid Makka-5 (AH-421))	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	Pusa Composite 4	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
	Pusa composite-3	5.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.15	0.00
	Total	**5.61**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.61**	**0.00**
	Wheat										
	HD-2967	117.00	185.00	0.00	0.00	0.00	0.00	0.00	0.00	117.00	185.00
	HD-3043	64.80	65.00	0.00	0.00	0.00	0.00	0.00	0.00	64.80	65.00
	HD-3059#	209.40	80.00	0.00	0.00	0.00	0.00	0.00	0.00	209.40	80.00
	HD-3086	1238.30	1400.00	0.00	0.00	0.00	0.00	0.00	0.00	1238.30	1400.00
	HDCSW-18	59.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00	59.00	75.00
	HD-3117	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00
	HI-1620	0.00	0.00	0.00	0.00	0.00	0.00	8.50	10.00	8.50	10.00
	HD-3237	0.00	0.00	0.00	0.00	0.00	0.00	8.50	10.00	8.50	10.00
	HD-3226	0.00	0.00	0.00	0.00	0.00	0.00	195.00	200.00	195.00	200.00
	Total	**1688.50**	**1805.00**	**0.00**	**0.00**	**0.00**	**0.00**	**217.00**	**225.00**	**1905.50**	**2030.00**
	Total Creal Crops	**1737.21**	**1901.00**	**0.00**	**0.00**	**0.00**	**0.00**	**217.00**	**225.00**	**1954.21**	**2126.00**
Pulses Crops	**Arhar#**										
	Pusa 991	3.50	5.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	5.00

	Pusa 992	1.70	6.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70	6.00
	Pusa Arhar-16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	0.00	12.00
	Pusa 9 (RS Pusa Bihar)	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00
	Total	**10.20**	**11.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**12.00**	**10.20**	**23.00**
	Guar										
	Pusa Navbahar	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.00
	Total	**2.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.50**	**0.00**
	Moong										
	Pusa-0672	2.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	3.00
	Pusa vishal	3.71	4.00	0.00	0.00	0.00	0.00	0.00	0.00	3.71	4.00
	Pusa 9531	0.30	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	5.00
	Pusa-1371	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
	Total	**6.01**	**18.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.01**	**18.00**
	Lentil										
	PusaVaibhav	0.60	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	2.00
	PusaShivalik	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00
	PusaAgeti (L 4717)	10.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	15.00
	L-4727	4.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	5.00
	Total	**24.60**	**32.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**24.60**	**32.00**
	Total Pulses Crops	**43.31**	**61.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**12.00**	**43.31**	**73.00**
Oilseed Crops	**Soybean**										
	Pusa 12	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
	Total	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.50**
	Mustard										
	PM-25	2.65	5.00	0.00	0.00	0.00	0.00	0.00	0.00	2.65	5.00
	PM-26	1.60	3.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60	3.00
	PM-27	3.95	5.00	0.00	0.00	0.00	0.00	0.00	0.00	3.95	5.00

	PM-28	2.45	5.00	0.00	0.00	0.00	0.00	0.00	0.00	2.45	5.00
	PM-30	6.40	6.50	0.00	0.00	0.00	0.00	0.00	0.00	6.40	6.50
	PDZM-31	0.65	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65	3.00
	Pusa Vijay	2.20	3.00	0.00	0.00	0.00	0.00	0.00	0.00	2.20	3.00
	Total	**19.90**	**30.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**19.90**	**30.50**
	Total Oilseeds	**20.40**	**31.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20.40**	**31.00**
	Grand Total (New Delhi)	**1800.92**	**1993.00**	**0.00**	**0.00**	**0.00**	**0.00**	**217.00**	**237.00**	**2017.92**	**2230.00**
20. IARI, RS Karnal											
Cereal Crops	**Paddy**										
	Pusa 44	35.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	35.00
	Pusa Basmati 1121*§	54.00	54.00	0.00	0.00	0.00	0.00	0.00	0.00	54.00	54.00
	Pusa Basmati 1509	26.00	26.00	0.00	0.00	0.00	0.00	0.00	0.00	26.00	26.00
	Pusa Basmati 6*§	20.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00
	Pusa Basmati 1	13.00	14.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	14.00
	Pusa Basmati 1637	20.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00
	Improved Pusa Basmati 1	2.10	2.50	0.00	0.00	0.00	0.00	0.00	0.00	2.10	2.50
	Pusa Basmati 1728	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00
	Pusa Sugandh 2^	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
	Pusa Sugandh 3^	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	Total	181.00	181.50	0.00	0.00	0.00	0.00	0.00	0.00	181.00	181.50
	Pearl millet										
	Pusa Composite 701	0.57	0.8	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.80
	Pusa Composite 612	0.12	4.45	0.00	0.00	0.00	0.00	0.00	0.00	0.12	4.45

	Pusa Composite 433	0.22	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.35
	MS 411 A (Pusa 1201 A line)	0.1	1.1	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.10
	MS 411 B (Pusa 1201 A line)	0.05	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.15
	ICMR 07333 (Pusa 1201 R line)	0.05	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10
	Total	**1.11**	**6.95**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.11**	**6.95**
	Wheat										
	HD 2851	223.20	235.00	0.00	0.00	0.00	0.00	0.00	0.00	223.20	235.00
	HD 2967	557.40	575.00	0.00	0.00	0.00	0.00	0.00	0.00	557.40	575.00
	HD 3086	698.00	710.00	0.00	0.00	0.00	0.00	0.00	0.00	698.00	710.00
	HS 542	50.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	50.00
	HS 562	60.00	65.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	65.00
	HS 507	30.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	30.00
	Total	**1618.60**	**1665.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1618.60**	**1665.00**
	Barley										
	BHS 400	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
	BHS 380	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
	Total	**1.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**
	Total Cereal Crops	**1801.71**	**1854.45**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1801.71**	**1854.45**
Pulses Crops	**Arhar (Pigeonpea)**										
	Pusa 2001	0.40	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	2.00
	Pusa 2002	2.70	3.00	0.00	0.00	0.00	0.00	0.00	0.00	2.70	3.00
	Total	**3.10**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.10**	**5.00**
	Lathyrus										
	P Rattan (Bio L-	4.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.00

	212)										
	Total	**4.00**	**4.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.00**	**4.00**
	Total Pulses Crops	**7.10**	**9.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.10**	**9.00**
Oilseed Crops	**Mustard**										
	P Bold	2.56	5.00	0.00	0.00	0.00	0.00	0.00	0.00	2.56	5.00
	P Jaikisan	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00
	P Mustard 24	2.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	5.00
	P Mahak	3.05	4.00	0.00	0.00	0.00	0.00	0.00	0.00	3.05	4.00
	P Vijay	2.20	5.00	0.00	0.00	0.00	0.00	0.00	0.00	2.20	5.00
	P Agrani	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00
	Total	**10.90**	**19.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.90**	**19.00**
	Total Oilseed Crops	**10.90**	**19.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.90**	**19.00**
Forage Crops	**Sorghum**										
	PC 23	5.30	5.30	0.00	0.00	0.00	0.00	0.00	0.00	5.30	5.30
	PC 9	3.30	1.00	0.00	0.00	0.00	0.00	0.00	0.00	3.30	1.00
	Total	**8.60**	**6.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.60**	**6.30**
	Total Forage Crops	**8.60**	**6.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.60**	**6.30**
	Grand Total (RS Karnal)	**1828.31**	**1888.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1828.31**	**1888.75**
21. VNMKV, Parbhani											
Cereal Crops	**Pearlmillet**										
	ABPC 4-3	0.79	12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.79	12.50
	AUBI 1101 (R Line of ABH 1200)	0.07	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.21
	Total	**0.86**	**12.71**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.86**	**12.71**
	Sorghum										
	PMS 71 A	0.10	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	5.00

	PMS 71 B	0.07	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	2.00
	CR 196	0.05	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.20
	CSV 18	0.30	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	32.00
	Parbhani Moti	0.65	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65	80.00
	PVK 809	0.04	0.15	0.00	0.00	0.00	0.00	1.00	1.00	1.04	1.15
	Total	**1.21**	**119.35**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**	**2.21**	**120.35**
	Wheat										
	NIAW 301	21.20	21.20	0.00	0.00	0.00	0.00	0.00	0.00	21.20	21.20
	NIAW 1415	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	NIAW 1994	31.60	31.60	0.00	0.00	0.00	0.00	0.00	0.00	31.60	31.60
	Total	**52.80**	**52.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**52.80**	**52.80**
	Total Cereal Crops	**54.87**	**184.86**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**	**55.87**	**185.86**
Pulses Crops	**Moong**										
	BM 2003-2	6.50	10.00	0.00	0.00	38.00	50.09	5.00	5.23	49.50	65.32
	BM-2002-1	1.60	5.00	0.00	0.00	10.00	1.00	0.00	0.00	11.60	6.00
	Total	**8.10**	**15.00**	**0.00**	**0.00**	**48.00**	**51.09**	**5.00**	**5.23**	**61.10**	**71.32**
	Chickpea										
	BDNGK 798	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00
	BDNG 797	5.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.80	0.00
	Total	**7.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.00**	**0.00**
	Pigeon Pea										
	BDN 711	6.50	6.50	0.00	0.00	20.00	30.00	0.00	0.00	26.50	36.50
	BDN 708	2.65	3.31	0.00	0.00	0.00	0.00	0.00	0.00	2.65	3.31
	BSMR 853	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
	BSMR 736	5.15	6.40	0.00	0.00	0.00	0.00	2.00	3.00	7.15	9.40
	Total	**14.35**	**16.21**	**0.00**	**0.00**	**20.00**	**30.00**	**2.00**	**3.00**	**36.35**	**49.21**
	Total Pulses Crops	**29.45**	**31.21**	**0.00**	**0.00**	**68.00**	**81.09**	**7.00**	**8.23**	**104.45**	**120.53**
Oil Seed Crops	**Groundnut**										

	TLG 45	5.50	5.50	0.00	0.00	0.00	0.00	0.00	0.00	5.50	5.50
	Total	**5.50**	**5.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.50**	**5.50**
	Soybean										
	JS 20-34	30.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	30.00
	JS 20-29	80.00	105.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00	105.00
	JS 93-05	300.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	300.00	100.00
	MAUS 71	505.00	514.40	0.00	0.00	0.00	0.00	0.00	0.00	505.00	514.40
	MAUS 162	105.75	1037.60	0.00	0.00	0.00	0.00	0.00	0.00	105.75	1037.60
	MAUS 612	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00
	MAUS 81	0.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00
	MAUS 158	537.25	261.08	0.00	0.00	0.00	0.00	0.00	0.00	537.25	261.08
	Total	**1558.00**	**2153.08**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1558.00**	**2153.08**
	Sunflower										
	RHA 1-1	0.01	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	2.00
	Total	**0.01**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**2.00**
	Safflower										
	PBNS 12	42.00	42.00	0.00	0.00	0.00	0.00	0.00	0.00	42.00	42.00
	PBNS 40	24.71	24.71	0.00	0.00	0.00	0.00	0.00	0.00	24.71	24.71
	PBNS 86	83.30	83.30	0.00	0.00	0.00	0.00	0.00	0.00	83.30	83.30
	Total	**150.01**	**150.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**150.01**	**150.01**
	Total Oil Seed Crops	**1713.52**	**2310.59**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1713.52**	**2310.59**
	Grand Total (Parbhani)	**1797.84**	**2526.66**	**0.00**	**0.00**	**68.00**	**81.09**	**8.00**	**9.23**	**1873.84**	**2616.98**
22. GBPUAT, Pantnagar											
Cereal Crops	**Paddy**										
	Pant Dhan 24	10.00	44.12	0.00	0.00	0.00	0.00	0.00	0.00	10.00	44.12
	Pant Dhan 10	0.30	12.42	0.00	0.00	0.00	0.00	0.00	0.00	0.30	12.42
	Pant Dhan 18	1.00	13.80	0.00	0.00	0.00	0.00	0.00	0.00	1.00	13.80
	Pant Dhan 12	1.10	7.92	0.00	0.00	0.00	0.00	0.00	0.00	1.10	7.92

	Pant Dhan 19	0.30	24.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30	24.30
	Pant Dhan 11	0.30	25.70	0.00	0.00	0.00	0.00	0.00	0.00	0.30	25.70
	Govind	0.40	11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.40	11.09
	Pusa 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.68	0.00	14.68
	PR 113	0.00	0.00	0.00	0.00	0.00	0.00	0.00	96.92	0.00	96.92
	NDR 359	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.88	0.00	48.88
	Pant Basmati 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.37	0.00	37.37
	Pant Dhan 26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.37	0.00	32.37
	Pant Sugandh Dhan 27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.23	0.00	4.23
	Pant Sugandh Dhan 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.15	0.00	4.15
	Pusa Basmati 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.81	0.00	14.81
	Pusa Sugandh 4 (Pusa 1121)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	72.72	0.00	72.72
	PR 114	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.57	0.00	15.57
	PR 121	0.00	0.00	0.00	0.00	0.00	0.00	0.00	96.09	0.00	96.09
	HKR 47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79.96	0.00	79.96
	PR 124	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.01	0.00	17.01
	MTU 7029	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.78	0.00	39.78
	BPT 5204	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.98	0.00	26.98
	Type 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.37	0.00	5.37
	Type 3 (Organic)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.72	0.00	6.72
	Pant Dhan 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.98	0.00	4.98
	Pant Dhan 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.73	0.00	10.73
	Pusa Sugandh 5 (Pusa 2511)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.34	0.00	11.34
	HKR 127	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.10	0.00	31.10
	Total	**13.40**	**139.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**671.76**	**13.40**	**811.11**
	Maize										
	Pant Sankul	2.20	4.00	0.00	0.00	0.00	0.00	0.00	4.00	2.20	8.00

	Makka 3										
	Total	**2.20**	**4.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.00**	**2.20**	**8.00**
	Wheat										
	HD 2894	11.20	35.00	0.00	0.00	0.00	0.00	0.00	0.00	11.20	35.00
	PBW 154	116.00	411.00	0.00	0.00	0.00	0.00	0.00	0.00	116.00	411.00
	PBW 226	65.00	201.00	0.00	0.00	0.00	0.00	0.00	0.00	65.00	201.00
	UP 262	11.30	55.00	0.00	0.00	0.00	0.00	0.00	0.00	11.30	55.00
	UP 2338	11.60	25.00	0.00	0.00	0.00	0.00	0.00	0.00	11.60	25.00
	UP 2572	7.00	105.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	105.00
	UP 2425	8.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	45.00
	UP 2628	70.00	102.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00	102.00
	UP 2784	50.00	85.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	85.00
	CBW 38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	0.00	90.00
	DBW 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	150.00	0.00	150.00
	DBW 88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	0.00	40.00
	DPW 621-50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00	0.00	70.00
	HD 2329	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.00	30.00
	HD 2733	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95.00	0.00	95.00
	HD 2967	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1817.00	0.00	1817.00
	PBW 343	0.00	0.00	0.00	0.00	0.00	0.00	0.00	636.00	0.00	636.00
	PBW 373	0.00	0.00	0.00	0.00	0.00	0.00	0.00	204.00	0.00	204.00
	PBW 502	0.00	0.00	0.00	0.00	0.00	0.00	0.00	196.00	0.00	196.00
	PBW 550	0.00	0.00	0.00	0.00	0.00	0.00	0.00	120.00	0.00	120.00
	UP 2526	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	0.00	45.00
	UP 2554	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	0.00	45.00
	UP 2565	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	0.00	32.00
	WH 1105	0.00	0.00	0.00	0.00	0.00	0.00	0.00	176.00	0.00	176.00
	WH 711	0.00	0.00	0.00	0.00	0.00	0.00	0.00	240.00	0.00	240.00
	WH 1021	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	0.00	40.00

	DBW 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	0.00	45.00
	HD 2851	0.00	0.00	0.00	0.00	0.00	0.00	0.00	125.00	0.00	125.00
	Total	**350.10**	**1064.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4196.00**	**350.10**	**5260.00**
	Total Cereal Crops	**365.70**	**1207.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4871.76**	**365.70**	**6079.11**
Pulses Crops	**Urd**										
	Pant Urd 31	25.00	114.95	0.00	0.00	0.00	183.00	0.00	0.00	25.00	297.95
	Pant Urd 35	8.24	32.03	0.00	0.00	0.00	0.00	0.00	0.00	8.24	32.03
	Pant Urd 40	7.02	8.80	0.00	0.00	0.00	0.00	0.00	0.00	7.02	8.80
	Pant Urd 19	5.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.20	0.00
	Pant Urd 30	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
	Total	**46.46**	**155.78**	**0.00**	**0.00**	**0.00**	**183.00**	**0.00**	**0.00**	**46.46**	**338.78**
	Moong										
	Pant Moong 5	45.50	31.61	0.00	0.00	0.00	0.00	0.00	0.00	45.50	31.61
	Pant Moong 6	2.00	9.52	0.00	0.00	0.00	0.00	0.00	0.00	2.00	9.52
	Pant Moong 8	0.20	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.57
	Total	**47.70**	**41.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**47.70**	**41.70**
	Arhar										
	UPAS 120	10.00	12.00	0.00	0.00	0.00	20.00	0.00	0.00	10.00	32.00
	PA 291	11.39	12.00	0.00	0.00	0.00	44.00	0.00	0.00	11.39	56.00
	Total	**21.39**	**24.00**	**0.00**	**0.00**	**0.00**	**64.00**	**0.00**	**0.00**	**21.39**	**88.00**
	Lentil										
	PL 6	18.00	25.00	0.00	0.00	100.00	100.00	0.00	0.00	118.00	125.00
	PL 7	22.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	22.00	30.00
	PL 8	34.00	57.00	0.00	0.00	0.00	0.00	0.00	0.00	34.00	57.00
	PL 9	7.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	35.00
	PL 406	6.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	2.00
	Total	**87.00**	**149.00**	**0.00**	**0.00**	**100.00**	**100.00**	**0.00**	**0.00**	**187.00**	**249.00**
	Pea										
	Pant Pea 14	34.00	35.00	0.00	0.00	50.00	50.00	0.00	0.00	84.00	85.00

	Pant Pea 13	27.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	27.00	1.00
	Pant Sabji Matar 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	0.00	45.00
	Pant Pea 42	24.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	30.00
	Pant Pea 243	7.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	6.00
	Pant Pea 250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	0.00	1.50
	Total	**92.00**	**72.00**	**0.00**	**0.00**	**50.00**	**50.00**	**0.00**	**46.50**	**142.00**	**168.50**
	Gram										
	Pant Kabuli Chana 1	2.00	20.00	0.00	0.00	150.00	150.00	0.00	0.00	152.00	170.00
	PG 186	8.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	60.00
	PG 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	25.00
	PG 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	0.00	37.00
	PG 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	25.00
	Total	**10.00**	**80.00**	**0.00**	**0.00**	**150.00**	**150.00**	**0.00**	**87.00**	**160.00**	**317.00**
	Total Pulses Crops	**304.55**	**522.48**	**0.00**	**0.00**	**300.00**	**547.00**	**0.00**	**133.50**	**604.55**	**1202.98**
Oil Seed Crops	**Soybean**										
	PS 1347	9.50	42.94	0.00	0.00	0.00	0.00	0.00	0.00	9.50	42.94
	PS 1225	22.00	80.50	0.00	0.00	0.00	0.00	0.00	0.00	22.00	80.50
	PK 262	0.60	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.10
	Total	**32.10**	**123.54**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**32.10**	**123.54**
	Rai/Sarson										
	PR 15 (Kranti)	0.11	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	6.00
	PR 19	0.20	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	3.00
	Pant Pili Sarson 1	1.82	15.00	0.00	0.00	0.00	0.00	0.00	0.00	1.82	15.00
	Pant Shweta	0.05	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	5.00
	Total	**2.18**	**29.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.18**	**29.00**
	Toria										
	PT 303	0.39	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	5.00

	Uttara	5.22	10.00	0.00	0.00	0.00	0.00	0.00	0.00	5.22	10.00
	Total	**5.61**	**15.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.61**	**15.00**
	Total Oil Seed Crops	**39.89**	**167.54**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**39.89**	**167.54**
Forage Crops	**Sorghum**										
	Pant Chari 5	3.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	1.00
	Pant Chari 6 (UPMC 503)	4.74	6.00	0.00	0.00	0.00	0.00	0.00	0.00	4.74	6.00
	467A	0.42	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	5.00
	467B	0.24	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.50
	2219A	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05
	2219B	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03
	Total	**8.43**	**12.58**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.43**	**12.58**
	Cowpea										
	UPC 8705	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
	Total	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.50**
	Total Forage Crops	**8.93**	**13.08**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.93**	**13.08**
	Grand Total (GBPUAT)	**719.07**	**1910.45**	**0.00**	**0.00**	**300.00**	**547.00**	**0.00**	**5005.26**	**1019.07**	**7462.71**
23. RVSKVV, Gwalior											
Cereal Crops	**Bajara**										
	JBV 4	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	JBV 2	0.20	9.50	0.00	0.00	0.00	0.00	0.00	0.00	0.20	9.50
	Total	**0.70**	**9.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.70**	**9.50**
	Sorghum										
	RVJ 1862	0.10	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	12.00
	JJ 104	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.20	0.00	3.20
	Total	**0.10**	**12.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.20**	**0.10**	**15.20**
	Wheat										

	LOK-1	0.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00
	MP1202	0.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00
	RVW4106	260.00	1060.00	0.00	0.00	0.00	0.00	0.00	0.00	260.00	1060.00
	HI 1605	0.00	280.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	280.00
	MP 3336	0.00	420.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	420.00
	MP 3382	0.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00
	HI 8713	0.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00
	Total	**260.00**	**2440.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**260.00**	**2440.00**
	Total Cereal Crops	**260.80**	**2461.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.20**	**260.80**	**2464.70**
Pulses Crops	**Mungbean**										
	IPM 205-7 (Virat)	0.00	0.00	0.00	0.00	15.00	34.90	0.00	0.00	15.00	34.90
	IPM 410-3 (Shikha)	0.00	0.00	0.00	0.00	15.00	19.10	0.00	0.00	15.00	19.10
	TJM 3	0.00	0.00	0.00	0.00	15.00	51.10	0.00	0.00	15.00	51.10
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**45.00**	**105.10**	**0.00**	**0.00**	**45.00**	**105.10**
	Urdbean										
	IU 1	0.00	0.00	0.00	0.00	5.00	4.10	0.00	0.00	5.00	4.10
	PU 31	0.00	0.00	0.00	0.00	20.00	31.20	0.00	0.00	20.00	31.20
	T 9	0.00	0.00	0.00	0.00	5.00	3.60	0.00	0.00	5.00	3.60
	IPU 2-43	0.00	0.00	0.00	0.00	5.00	4.50	0.00	0.00	5.00	4.50
	IPU 94-2	0.00	0.00	0.00	0.00	5.00	4.30	0.00	0.00	5.00	4.30
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**40.00**	**47.70**	**0.00**	**0.00**	**40.00**	**47.70**
	Pigeonpea										
	PUSA 16	0.00	0.00	0.00	0.00	10.00	7.00	0.00	0.00	10.00	7.00
	PUSA 992	0.00	0.00	0.00	0.00	10.00	8.00	0.00	0.00	10.00	8.00
	JKM 189	4.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.10	0.00
	ICP 2043-A	0.00	0.00	0.00	0.00	2.00	2.00	0.00	0.00	2.00	2.00
	ICP 2043-B	0.00	0.00	0.00	0.00	2.00	2.00	0.00	0.00	2.00	2.00
	ICP 2671-R	0.00	0.00	0.00	0.00	4.00	2.00	0.00	0.00	4.00	2.00

	Total	**4.10**	**0.00**	**0.00**	**0.00**	**28.00**	**21.00**	**0.00**	**0.00**	**32.10**	**21.00**
	Gram										
	JAKI9218	256.50	170.00	0.00	0.00	0.00	0.00	0.00	0.00	256.50	170.00
	RVG201	655.50	1370.00	0.00	0.00	0.00	0.00	0.00	0.00	655.50	1370.00
	RVG202	1155.80	2570.00	0.00	0.00	0.00	0.00	0.00	0.00	1155.80	2570.00
	RVG203	837.20	1500.00	0.00	0.00	0.00	0.00	0.00	0.00	837.20	1500.00
	JG130	100.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	40.00
	JG 14	0.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00
	JG 11	432.40	400.00	0.00	0.00	0.00	0.00	0.00	0.00	432.40	400.00
	JG6	345.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	345.00	40.00
	JGK 3	28.80	40.00	0.00	0.00	0.00	0.00	0.00	0.00	28.80	40.00
	Total	**3811.20**	**6190.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3811.20**	**6190.00**
	Lentil										
	RVL 31	10.00	28.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	28.00
	RVL 13-15	0.00	7.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.50
	RVL 13-17	0.00	7.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.50
	RVL 11-6	15.00	38.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	38.00
	Total	**25.00**	**81.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**25.00**	**81.00**
	Pea										
	Kashi Nandini	0.00	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.00
	Total	**0.00**	**26.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**26.00**
	Total Pulses Crops	**3840.30**	**6297.00**	**0.00**	**0.00**	**113.00**	**173.80**	**0.00**	**0.00**	**3953.30**	**6470.80**
Oil Seed Crops	**Soybean**										
	RVS2001-4	1187.00	1530.00	0.00	0.00	0.00	0.00	0.00	0.00	1187.00	1530.00
	JS 20-29	200.00	241.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	241.00
	JS 95-60	1200.00	964.00	0.00	0.00	0.00	0.00	0.00	0.00	1200.00	964.00
	JS 93-05	200.00	41.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	41.00
	JS 335	100.00	70.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	70.00
	JS 20-34	100.00	89.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	89.00

	JS 20-69	0.00	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.00
	Total	**2987.00**	**3004.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2987.00**	**3004.00**
	Til										
	TKG 308	0.00	13.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.60
	TKG 55	0.00	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80
	Total	**0.00**	**15.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**15.40**
	Mustard										
	RVM 2	0.00	66.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.00
	RVM 1	0.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00
	Total	**0.00**	**81.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**81.00**
	Toria										
	RVT 1	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
	Total	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**
	Total Oil Seed Crops	**2987.00**	**3101.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2987.00**	**3101.40**
	Grand Total (Gwalior)	**7088.10**	**11859.90**	**0.00**	**0.00**	**113.00**	**173.80**	**0.00**	**3.20**	**7201.10**	**12036.90**
24. IISR, Indore											
Oil Seed Crops	**Soybean**										
	NRC 86	60.50	75.00	0.00	0.00	0.00	0.00	0.00	0.00	60.50	75.00
	NRC 37	30.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	25.00
	NRC 7	20.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	1.00
	JS 93-05	250.00	250.00	0.00	0.00	0.00	0.00	0.00	0.00	250.00	250.00
	JS 95-60	120.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	120.00	150.00
	Total	**480.50**	**501.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**480.50**	**501.00**
	Total Oil seed Crops	**480.50**	**501.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**480.50**	**501.00**
	Grand Total (IISR, Indore)	**480.50**	**501.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**480.50**	**501.00**
25. SKRAU, Bikaner											

Pulses crops	**Moth Bean**										
	RMO-257	15.10	16.50	0.00	0.00	0.00	0.00	0.00	0.00	15.10	16.50
	RMO-435	5.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	4.00
	RMO-40	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50	0.00
	RM-225	0.10	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.25
	RMO-2251	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	8.00
	Total	**24.70**	**20.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.00**	**24.70**	**28.75**
	Mung										
	MH-421	45.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	50.00
	Ganga 1	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	Ganga 8	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	Total	**46.00**	**50.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**46.00**	**50.00**
	Cluster bean										
	HG 2-20	0.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00
	RGC-1033	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00
	RGC-936	4.60	4.00	0.00	0.00	0.00	0.00	0.00	0.00	4.60	4.00
	Total	**4.60**	**41.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.60**	**41.00**
	Gram										
	GNG-1581	89.50	120.00	0.00	0.00	0.00	0.00	0.00	0.00	89.50	120.00
	GNG-1958	118.00	145.00	0.00	0.00	0.00	0.00	0.00	0.00	118.00	145.00
	GNG-2144	208.00	265.00	0.00	0.00	0.00	0.00	0.00	0.00	208.00	265.00
	GNG 663	3.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.70	0.00
	GNG-2171	395.00	410.00	0.00	0.00	0.00	0.00	0.00	0.00	395.00	410.00
	GNG-1969	50.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	5.00
	GNG-2207	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00	20.00
	Total	**864.20**	**945.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20.00**	**864.20**	**965.00**
	Total Pulses Crops	**939.50**	**1056.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**28.00**	**939.50**	**1084.75**
Oil Seed Crops	**Groundnut**										
	HNG-123	55.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	60.00

	HNG-69	10.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	12.00
	Mallika	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
	Total	**66.00**	**73.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**66.00**	**73.00**
	Mustard										
	RGN-229	0.02	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.50
	RGN-236	0.10	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.50
	RGN-298	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
	RGN-303	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
	Total	**1.62**	**2.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.62**	**2.50**
	Total Oilseed crops	**67.62**	**75.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**67.62**	**75.50**
Fibre Crops	**Cotton**										
	RG 542	1.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	3.50
	RS 2013	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	RS 810	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	RST 9	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
	RG 8	4.35	5.50	0.00	0.00	0.00	0.00	0.00	0.00	4.35	5.50
	Total	**7.55**	**9.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.55**	**9.00**
	Total Fibres	**7.55**	**9.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.55**	**9.00**
	Grand Total (Bikaner)	**1014.67**	**1141.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**28.00**	**1014.67**	**1169.25**
26. UAS, Dharwad											
Cereal Crops	**Paddy**										
	Abhilash	1.20	4.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	4.00
	Jaya	0.00	0.00	2.00	8.30	0.00	0.00	0.00	0.00	2.00	8.30
	Siri-1253	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50
	Intan	2.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	3.00
	MGD-103	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50
	Total	**3.20**	**7.00**	**3.00**	**9.30**	**0.00**	**0.00**	**0.00**	**0.00**	**6.20**	**16.30**
	Wheat										

	DWR-162	26.60	12.00	30.00	18.00	0.00	0.00	0.00	0.00	56.60	30.00
	UAS 304	20.60	10.00	20.00	10.00	0.00	0.00	0.00	0.00	40.60	20.00
	UAS 415	3.20	3.50	8.20	8.50	0.00	0.00	0.00	0.00	11.40	12.00
	UAS 428	8.00	8.00	10.00	10.00	0.00	0.00	0.00	0.00	18.00	18.00
	UAS 446	0.00	0.00	2.00	3.00	0.00	0.00	0.00	0.00	2.00	3.00
	DDK 1025	0.00	0.00	10.00	15.00	0.00	0.00	0.00	0.00	10.00	15.00
	DDK 1029	0.00	0.00	15.00	20.00	0.00	0.00	0.00	0.00	15.00	20.00
	UAS 375	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	UAS 334	0.00	0.00	5.00	6.00	0.00	0.00	0.00	0.00	5.00	6.00
	MACS 6222	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	UAS 347	0.00	0.00	2.00	3.00	0.00	0.00	0.00	0.00	2.00	3.00
	Total	**58.40**	**33.50**	**117.20**	**108.50**	**0.00**	**0.00**	**0.00**	**0.00**	**175.60**	**142.00**
	Sorghum										
	CSV 29R	10.00	10.00	1.00	2.00	0.00	0.00	0.00	0.00	11.00	12.00
	SPV 2217	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00
	Muguti (5-4-1)	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00
	M 35-1	8.00	8.00	1.00	1.00	0.00	0.00	0.00	0.00	9.00	9.00
	Total	**18.00**	**18.00**	**4.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**22.00**	**23.00**
	Maize										
	CI-4	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.00	0.20	0.20
	CI-5	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.10	0.10
	KDMI 15	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.10	0.10
	KDMI 16	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.10	0.10
	African Tall	0.00	0.00	4.00	2.00	0.00	0.00	0.00	0.00	4.00	2.00
	Total	**0.00**	**0.00**	**4.50**	**2.50**	**0.00**	**0.00**	**0.00**	**0.00**	**4.50**	**2.50**
	Foxtail millet										
	HMT 100-1	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	DHFT-109-3	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
	Total	**0.02**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**5.00**
	Littlemillet										

	DHLM-36-3	0.00	2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.24
	Total	**0.00**	**2.24**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.24**
	Prosomillet										
	DHPM-2769	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
	Total	**0.00**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**
	Barnyard Millet										
	DHBM-93-2	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
	Total	**0.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**
	Finger millet										
	DHFM-78-3	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
	Total	**0.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**
	Total Cereal Crops	**79.62**	**77.74**	**128.70**	**125.30**	**0.00**	**0.00**	**0.00**	**0.00**	**208.32**	**203.04**
Pulses Crops	**Blackgram**										
	DU-1	0.00	0.00	2.00	2.00	10.00	14.00	0.00	0.00	12.00	16.00
	DBGV-5	1.75	2.00	1.00	1.00	20.00	22.00	0.00	0.00	22.75	25.00
	IPU-2-43	0.00	0.00	0.00	0.00	10.00	1.00	0.00	0.00	10.00	1.00
	TAU-1	0.00	0.00	2.00	5.00	0.00	0.00	0.00	0.00	2.00	5.00
	Total	**1.75**	**2.00**	**5.00**	**8.00**	**40.00**	**37.00**	**0.00**	**0.00**	**46.75**	**47.00**
	Greengram										
	DGGV-2	2.00	3.00	3.00	4.00	15.00	21.00	0.00	0.00	20.00	28.00
	DGGV-1	0.00	0.00	2.00	17.00	0.00	0.00	0.00	0.00	2.00	17.00
	IPM-2-14	0.00	0.00	0.00	0.00	20.00	8.00	0.00	0.00	20.00	8.00
	Virat	0.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00	5.00	5.00
	Total	**2.00**	**3.00**	**5.00**	**21.00**	**40.00**	**34.00**	**0.00**	**0.00**	**47.00**	**58.00**
	Cowpea										
	DC-15	4.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	6.00
	DC-16	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50
	Total	**5.00**	**7.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**7.50**
	Bengal Gram										

	JG-11	300.00	300.00	150.00	200.00	0.00	0.00	0.00	0.00	450.00	500.00
	JAKI-9218	200.00	200.00	300.00	345.00	0.00	0.00	0.00	0.00	500.00	545.00
	BGD-103	1.00	1.00	4.00	4.00	0.00	0.00	0.00	0.00	5.00	5.00
	BGD-111-01	0.00	0.00	1.00	2.00	0.00	0.00	0.00	0.00	1.00	2.00
	BG-1105	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00
	GBM-2	20.00	20.00	0.00	5.00	0.00	0.00	0.00	0.00	20.00	25.00
	Total	**521.00**	**521.00**	**456.00**	**557.00**	**0.00**	**0.00**	**0.00**	**0.00**	**977.00**	**1078.00**
	Redgram										
	TS-3R	0.00	0.00	2.00	4.00	10.00	22.00	0.00	0.00	12.00	26.00
	BRG-2	0.00	0.00	0.00	0.00	10.00	6.00	0.00	0.00	10.00	6.00
	BRG-4	0.00	0.00	0.00	0.00	20.00	20.00	0.00	0.00	20.00	20.00
	BRG-5	0.00	0.00	0.00	0.00	20.00	15.00	0.00	0.00	20.00	15.00
	Total	**0.00**	**0.00**	**2.00**	**4.00**	**60.00**	**63.00**	**0.00**	**0.00**	**62.00**	**67.00**
	Total Pulses Crops	**529.75**	**533.50**	**468.00**	**590.00**	**140.00**	**134.00**	**0.00**	**0.00**	**1137.75**	**1257.50**
Oil Seed Crops	**Groundnut**										
	GPBD-4	490.00	665.00	0.00	0.00	0.00	0.00	0.00	0.00	490.00	665.00
	TAG-24	271.40	305.00	15.00	17.60	0.00	0.00	0.00	0.00	286.40	322.60
	TG-37A	96.50	105.00	20.00	22.00	0.00	0.00	0.00	0.00	116.50	127.00
	TDG-39 (TGLPS-3)	10.50	18.00	0.00	0.00	0.00	0.00	0.00	0.00	10.50	18.00
	G 2-52	150.50	850.00	50.00	50.00	0.00	0.00	0.00	0.00	200.50	900.00
	GPBD-5	95.85	120.00	6.00	6.00	0.00	0.00	0.00	0.00	101.85	126.00
	Dh-101	2.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	5.00
	Dh-86	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	Dh-245	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	Dh-232	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	Total	**1116.75**	**2068.00**	**116.00**	**120.60**	**0.00**	**0.00**	**0.00**	**0.00**	**1232.75**	**2188.60**
	Soybean										
	JS-335	600.00	1066.00	0.00	0.00	0.00	0.00	0.00	0.00	600.00	1066.00
	JS-9305	500.00	750.00	0.00	0.00	0.00	0.00	0.00	0.00	500.00	750.00

	DSB 23	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	DSb-21	150.00	300.00	0.00	0.00	0.00	0.00	0.00	0.00	150.00	300.00
	Total	**1250.00**	**2116.00**	**5.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1255.00**	**2121.00**
	Sesamum										
	DS-5	1.00	1.00	2.00	1.00	0.00	0.00	0.00	0.00	3.00	2.00
	Total	**1.00**	**1.00**	**2.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.00**	**2.00**
	Safflower										
	A-1	2.20	2.20	0.30	0.70	0.00	0.00	0.00	0.00	2.50	2.90
	A-300	0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00
	Total	**2.78**	**2.20**	**0.30**	**0.70**	**0.00**	**0.00**	**0.00**	**0.00**	**3.08**	**2.90**
	Niger										
	DNS-4	0.40	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.90	1.00
	Total	**0.40**	**0.50**	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.90**	**1.00**
	Sunflower										
	Parents of DFSH-3 R line	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50
	Total	**0.00**	**0.00**	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.50**
	Total Oil Seed Crops	**2370.93**	**4187.70**	**124.30**	**128.30**	**0.00**	**0.00**	**0.00**	**0.00**	**2495.23**	**4316.00**
	Grand Total (Dharwad)	**2980.30**	**4798.94**	**721.00**	**843.60**	**140.00**	**134.00**	**0.00**	**0.00**	**3841.30**	**5776.54**
27. IIOR, Hyderabad											
Oil Seed Crops	**Castor**										
	DCS-107	**0.19**	**1.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.19**	**1.50**
	Total	**0.19**	**1.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.19**	**1.50**
	Sunflower*										
	DRSF-113	**0.05**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.05**	**0.10**
	DRSF-108	**0.01**	**0.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.05**
	Total	**0.06**	**0.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.06**	**0.15**
	Total Oil Seed	**0.25**	**1.65**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.25**	**1.65**

	Crops										
	Grand Total (IIOR)	**0.25**	**1.65**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.25**	**1.65**
28. CCS HAU, HISAR											
Cereal Crops	**Paddy**										
	HKR 47	4.10	10.40	0.00	0.00	0.00	0.00	0.00	0.00	4.10	10.40
	HKR 127	2.60	10.40	0.00	0.00	0.00	0.00	0.00	0.00	2.60	10.40
	HKR 48	1.10	3.20	0.00	0.00	0.00	0.00	0.00	0.00	1.10	3.20
	HKR 128	0.00	0.00	5.00	7.60	0.00	0.00	0.00	0.00	5.00	7.60
	Basmati 370	0.00	0.00	2.00	3.60	0.00	0.00	0.00	0.00	2.00	3.60
	Taraori Bas.	0.00	0.00	2.00	3.20	0.00	0.00	0.00	0.00	2.00	3.20
	CSR 30	0.00	0.00	5.00	3.00	0.00	0.00	0.00	0.00	5.00	3.00
	Pusa Basmati 1121	0.00	0.00	5.00	6.80	0.00	0.00	0.00	0.00	5.00	6.80
	PB 1	0.00	0.00	2.00	4.00	0.00	0.00	0.00	0.00	2.00	4.00
	Haryana Bas 2	0.00	0.00	4.00	6.80	0.00	0.00	0.00	0.00	4.00	6.80
	Total	**7.80**	**24.00**	**25.00**	**35.00**	**0.00**	**0.00**	**0.00**	**0.00**	**32.80**	**59.00**
	Maize										
	HKI 193-1 (Female of HQPM-1)	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00
	HKI 163 (Male of HQPM-1)	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.30
	HKI-193-2 (Female of HQPM-4)	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06
	HKI-161 (Male of HQPM-4)	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
	HKI 161 (Male of HQPM-5)	0.55	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.55
	HKI 163 (Female	1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.00

	of HQPM-5)										
	#HK1-193-1 (Female of HQPM-7)	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
	HKI 161 (Male of HQPM-7)	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03
	Total	**2.97**	**0.98**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.97**	**0.98**
	Pearl Millet			-	-						
	HBL-11 (R line HHB 226)	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.85	0.02	0.90
	H 77/833-2-202 (R line HHB 67 Imp. & HHB 234)	0.07	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.07	1.00
	H 13/0001 (R line HHB 256)	0.07	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.10
	H 1305 (R line HHB 256)	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	HMS 47A (A line HHB 272)	0.20	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.01
	HMS 47B (B line HHB 272)	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.01
	AC 04/13 (R line HHB 272)	0.10	0.15	0.00	0.00	0.00	0.00	0.00	1.35	0.10	1.50
	HMS 7A (A line HHB 234)**	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
	HMS 7B (B line HHB 234)**	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	ICMA 843-22 (A line of HHB 67 Imp.)	0.00	0.00	0.45	0.72	0.00	0.00	0.00	0.00	0.45	0.72
	Total	**0.74**	**0.42**	**0.45**	**0.72**	**0.00**	**0.00**	**0.00**	**3.10**	**1.19**	**4.24**
	Wheat										
	C 306	20.00	22.00	3.00	6.00	0.00	0.00	0.00	0.00	23.00	28.00

	WH 283	26.20	30.00	7.00	10.00	0.00	0.00	0.00	0.00	33.20	40.00
	WH 711	163.20	170.00	20.00	26.00	0.00	0.00	0.00	0.00	183.20	196.00
	WH 1021	10.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	12.00
	WH 1025	10.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	12.00
	WH 1080	68.20	72.20	9.00	11.80	0.00	0.00	0.00	0.00	77.20	84.00
	WH 1105	352.60	360.00	70.00	88.00	0.00	0.00	0.00	0.00	422.60	448.00
	WH 1124	57.60	60.00	48.00	52.00	0.00	0.00	0.00	0.00	105.60	112.00
	WH 1142	34.80	40.00	14.00	16.00	0.00	0.00	0.00	0.00	48.80	56.00
	Total	**742.60**	**778.20**	**171.00**	**209.80**	**0.00**	**0.00**	**0.00**	**0.00**	**913.60**	**988.00**
	Barley										
	BH 75	1.50	3.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	3.00
	BH 946	25.00	26.00	18.00	22.00	0.00	0.00	0.00	0.00	43.00	48.00
	BH 393	71.20	80.00	35.00	40.00	0.00	0.00	0.00	0.00	106.20	120.00
	BH 902	9.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	BH 959	25.00	28.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	28.00
	Total	**132.20**	**137.00**	**53.00**	**62.00**	**0.00**	**0.00**	**0.00**	**0.00**	**175.70**	**199.00**
	Total Cereal Crops	**886.31**	**940.60**	**249.45**	**307.52**	**0.00**	**0.00**	**0.00**	**3.10**	**1126.26**	**1251.22**
Pulses Crops	**Urdbean**										
	UH-1	10.00	8.75	0.00	0.00	0.00	0.00	0.00	0.00	10.00	8.75
	Total	10.00	8.75	0.00	0.00	0.00	0.00	0.00	0.00	10.00	8.75
	Guar										
	HG-563	10.41	1.00	0.00	0.00	0.00	0.00	0.00	0.00	10.41	1.00
	HG-365	14.01	18.22	0.00	0.00	0.00	0.00	0.00	0.00	14.01	18.22
	HG 2-20	42.00	36.80	0.00	0.00	0.00	0.00	0.00	0.00	42.00	36.80
	HG 2-3	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
	HG 870	0.06	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.10
	Total	**66.68**	**56.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**66.68**	**56.12**
	Mungbean										
	Basanti (MH-125)	5.00	1.56	0.00	0.00	0.00	0.00	0.00	0.00	5.00	1.56

	MH-421	58.80	38.22	0.00	0.00	0.00	0.00	0.00	0.00	58.80	38.22
	Sattya (MH-2-15)	0.50	12.62	0.00	0.00	0.00	0.00	0.00	0.00	0.50	12.62
	MH-318	0.00	0.00	0.00	0.00	0.00	0.00	1.50	0.15	1.50	0.15
	Total	**64.30**	**52.40**	**0.00**	**0.00**	**0.00**	**0.00**	**1.50**	**0.15**	**65.80**	**52.55**
	Cowpea										
	HC 98-46	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
	Total	**2.00**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**2.00**
	Arhar										
	Paras	0.20	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.56
	Manak	1.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72	0.00
	Total	**1.92**	**0.56**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.92**	**0.56**
	Gram										
	HC 1	1.20	3.00	1.50	3.00	0.00	0.00	0.00	0.00	2.70	6.00
	HC 5	0.20	2.00	2.00	4.00	0.00	0.00	0.00	0.00	2.20	6.00
	HK 2	18.40	22.00	3.00	6.00	0.00	0.00	0.00	0.00	21.40	28.00
	HK 4	20.70	24.00	2.00	4.00	0.00	0.00	0.00	0.00	22.70	28.00
	Total	**40.50**	**51.00**	**8.50**	**17.00**	**0.00**	**0.00**	**0.00**	**0.00**	**49.00**	**68.00**
	Field pea										
	HFP 529	11.00	15.00	3.00	6.00	0.00	0.00	0.00	0.00	14.00	21.00
	HFP 715	9.00	25.00	75.00	80.00	0.00	0.00	0.00	0.00	84.00	105.00
	Total	**20.00**	**40.00**	**78.00**	**86.00**	**0.00**	**0.00**	**0.00**	**0.00**	**98.00**	**126.00**
	Lentil										
	Garima	0.50	2.00	0.50	1.00	0.00	0.00	0.00	0.00	1.00	3.00
	HM 1	0.50	2.00	0.50	1.00	0.00	0.00	0.00	0.00	1.00	3.00
	Total	**1.00**	**4.00**	**1.00**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**6.00**
	Total Pulses Crops	**206.40**	**214.83**	**87.50**	**105.00**	**0.00**	**0.00**	**1.50**	**0.15**	**295.40**	**319.98**
Oil Seed Crops	**Sesame**										
	HT-1	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
	HT-2	0.32	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.40

	Total	**0.34**	**0.42**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.34**	**0.42**
	Raya										
	RH 8812 (Laxmi)	2.13	4.00	1.50	3.50	0.00	0.00	0.00	0.00	3.63	7.50
	RH 406	1.60	3.00	3.00	4.50	0.00	0.00	0.00	0.00	4.60	7.50
	RH 0749	1.76	4.50	1.50	3.00	0.00	0.00	0.00	0.00	3.26	7.50
	Total	**5.49**	**11.50**	**6.00**	**11.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.49**	**22.50**
	Total Oil Seed Crops	**5.83**	**11.92**	**6.00**	**11.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.83**	**22.92**
Fiber Crops	**Cotton**										
	AAH-1 (DESI COTTON HYBRID-1) (M)	0.04	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.08
	AAH-1 (DESI COTTON HYBRID-1) (F)	0.10	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.15
	H-1098	0.10	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.50
	HD-123	0.80	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.80	1.20
	Total	**1.04**	**1.93**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.04**	**1.93**
	Total Fiber Crops	**1.04**	**1.93**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.04**	**1.93**
Forage Crops	**Sorghum**										
	HJ-541	1.00	1.15	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.15
	Total	**1.00**	**1.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.15**
	Oats										
	HJ 8	8.40	13.00	6.00	8.00	0.00	0.00	0.00	0.00	14.40	21.00
	OS-377	2.30	3.00	0.00	0.00	0.00	0.00	0.00	0.00	2.30	3.00
	OS-6	5.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	6.00
	Total	**15.70**	**22.00**	**6.00**	**8.00**	**0.00**	**0.00**	**0.00**	**0.00**	**21.70**	**30.00**
	Berseem										
	HB-2	1.40	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	2.00
	Mascavi	7.30	8.00	0.00	0.00	0.00	0.00	0.00	0.00	7.30	8.00
	Total	**8.70**	**10.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.70**	**10.00**

	Total Forage Crops	**25.40**	**33.15**	**6.00**	**8.00**	**0.00**	**0.00**	**0.00**	**0.00**	**31.40**	**41.15**
	Grand Total (Hisar)	**1124.98**	**1202.43**	**348.95**	**431.52**	**0.00**	**0.00**	**1.50**	**3.25**	**1465.93**	**1637.20**
29. VPKAS, Almora											
Cereal Crops	**Paddy**										
	VL Dhan 68	7.30	6.50	0.00	0.00	0.00	0.00	0.00	0.00	7.30	6.50
	VL Dhan 157	0.40	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.20
	VL Dhan 86	0.30	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.80	1.00
	VL Dhan 85	0.30	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.90
	VL Dhan 65	0.30	1.00	0.50	0.60	0.00	0.00	0.00	0.00	0.80	1.60
	Total	**8.60**	**9.10**	**1.00**	**1.10**	**0.00**	**0.00**	**0.00**	**0.00**	**9.60**	**10.20**
	Maize										
	Vivek Sankul Makka 31	1.20	2.50	0.00	0.00	0.00	0.00	0.00	0.00	1.20	2.50
	V 373** (VMH 45 F)	0.45	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.30
	V 390 (VMH 45 F)	0.15	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.10
	V 407 (VMH 53 F)	0.00	0.00	0.50	0.90	0.00	0.00	0.00	0.00	0.50	0.90
	V 409 (VMH 53 M)	0.00	0.00	0.30	0.50	0.00	0.00	0.00	0.00	0.30	0.50
	V 335 (CMVLBC2 F)	0.00	0.00	0.30	0.50	0.00	0.00	0.00	0.00	0.30	0.50
	Total	**1.80**	**3.90**	**1.10**	**1.90**	**0.00**	**0.00**	**0.00**	**0.00**	**2.90**	**5.80**
	Finger Millet										
	VL Mandua 352	1.75	1.80	0.00	0.00	0.00	0.00	8.00	13.60	9.75	15.40
	VL Mandua 347	0.75	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.75
	VL Mandua 315	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.50	0.75	0.75
	VL Mandua 376	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.50	3.00	5.50
	VL Mandua 379	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00	1.00	2.00

	VL Mandua 348	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
	Total	**2.75**	**3.70**	**0.00**	**0.00**	**0.00**	**0.00**	**12.50**	**21.60**	**15.25**	**25.30**
	Barnyard Millet										
	VL Madira 207	1.00	1.00	0.00	0.00	0.00	0.00	2.00	2.00	3.00	3.00
	Total	**1.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**2.00**	**3.00**	**3.00**
	Buckwheat										
	VL Ugal 7	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00	0.10	0.10
	Total	**0.00**	**0.00**	**0.10**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**	**0.10**
	Amaranth										
	VL Chua 44	0.05	0.10	0.10	0.25	0.00	0.00	0.00	0.00	0.15	0.35
	Total	**0.05**	**0.10**	**0.10**	**0.25**	**0.00**	**0.00**	**0.00**	**0.00**	**0.15**	**0.35**
	Wheat										
	VL Gehun 907	40.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	45.00
	VL Gehun 892	4.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	10.00
	VL Gehun 953	26.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	26.00	30.00
	VL Gehun 829	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
	VL Gehun 832	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
	VL Gehun 967	3.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00
	VL Gehun 3004	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
	Total	**85.00**	**100.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**85.00**	**100.00**
	Barley										
	VL Jau 130	0.50	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.60
	Total	**0.50**	**0.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.60**
	Total Cereal Crops	**99.70**	**118.40**	**2.30**	**3.35**	**0.00**	**0.00**	**14.50**	**23.60**	**116.50**	**145.35**
Pulses Crops	**Pigeonpea**										
	VL Arhar 1	2.70	1.10	0.00	0.00	0.00	0.00	0.00	0.00	2.70	1.10
	Total	**2.70**	**1.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.70**	**1.10**
	Horse gram										
	VL Gahat 19	1.00	1.30	0.50	0.50	0.00	0.00	0.00	0.00	1.50	1.80

	Total	**1.00**	**1.30**	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**1.50**	**1.80**
	Lentil										
	VL Masoor 126	3.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	4.00
	VL Masoor 133	10.00	11.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	11.00
	VL Masoor 129	2.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	3.00
	VL Masoor 514	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
	Total	**15.20**	**18.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**15.20**	**18.20**
	Total Pulses Crops	**18.90**	**20.60**	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**19.40**	**21.10**
Oil Seed Crops	**Soybean**										
	VL Soya 65	3.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00
	VL Soya 63	3.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00
	Total	**6.00**	**8.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.00**	**8.00**
	Toria										
	VL Toria 3	0.10	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.12
	Total	**0.10**	**0.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**	**0.12**
	Total Oil Seed Crops	**6.10**	**8.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.10**	**8.12**
	Grand Total (Almora)	**124.70**	**147.12**	**2.80**	**3.85**	**0.00**	**0.00**	**14.50**	**23.60**	**142.00**	**174.57**
30. RARS, KAU, Pattambi											
Cereal Crops	**Paddy**										
	Jyothi	12.50	35.00	0.00	0.00	0.00	0.00	0.00	0.00	12.50	35.00
	Aathira	0.60	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.60	2.50
	Matta Triveni	2.00	5.00	0.40	0.00	0.00	0.00	0.00	0.00	2.40	5.00
	Jaya	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.37	3.00	3.37
	Varsha	0.30	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.10
	Bhadra	3.80	2.00	0.00	0.00	0.00	0.00	0.00	0.00	3.80	2.00
	Uma	6.80	8.00	0.00	0.00	0.00	0.00	3.00	3.37	9.80	11.37
	Uma	0.00	0.00	0.00	0.00	0.00	0.00	2.50	3.00	2.50	3.00

	Harsha	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.50	1.50	1.50
	Aiswarya	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.50	2.00	2.50
	K.K.Varna	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.50	2.00	2.50
	Annapoorna	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	Kanchana	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.50	2.00	2.50
	Swarnaprabha	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	Samyuktha	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	Anaswara	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	Karuna	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00	3.00	3.00
	Neeraja	0.00	0.00	0.00	0.00	0.00	0.00	2.50	3.00	2.50	3.00
	Ponmani	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.50	2.50	2.50
	MangalaMahsuri RM1	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.50	2.50	2.50
	Prathyasa	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00
	Sampada	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50	1.00	1.50
	Jeerakasala	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50
	Makaram	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.50	2.50	2.50
	Swetha	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50	1.00	1.50
	Shreyas	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.50	2.50	2.50
	Supriya	0.00	0.00	0.00	0.00	0.00	0.00	2.50	3.00	2.50	3.00
	Akshaya	0.00	0.00	0.00	0.00	0.00	0.00	2.50	3.00	2.50	3.00
	Total	**26.00**	**52.60**	**0.40**	**0.00**	**0.00**	**0.00**	**44.00**	**49.24**	**70.40**	**101.84**
	Total Cereal Crops	**26.00**	**52.60**	**0.40**	**0.00**	**0.00**	**0.00**	**44.00**	**49.24**	**70.40**	**101.84**
	Grand Total (Pattambi)	**26.00**	**52.60**	**0.40**	**0.00**	**0.00**	**0.00**	**44.00**	**49.24**	**70.40**	**101.84**
31. BAU Sabour											
Cereal Ctops	**Paddy**										
	Sabour Surbhit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	0.00	35.00
	Sabour Shree	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	0.00	35.00

	Sabour Deep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	15.00
	Sabour Ardjal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.00	30.00
	Rajendra Sweta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	120.00	0.00	120.00
	Rajendra Kasturi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	25.00
	Rajendra Mahsuri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	0.00	40.00
	R Suvasani	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.00	10.00
	Sahbhagi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	15.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**325.00**	**0.00**	**325.00**
	Wheat										
	Sabour Samridhi	90.00	107.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	107.00
	Sabour Shrestha	20.00	37.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	37.00
	Sabour Nirjal	15.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	17.00
	HD-2733	15.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	15.00
	HD-2967	15.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	15.00
	DBW-14	25.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	25.00
	HD-3086	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	DBW-107	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	DBW-187	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**180.00**	**216.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**180.00**	**216.00**
	Total Cereal Crops	**180.00**	**216.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**325.00**	**180.00**	**541.00**
Pulses Crops	**Urdbean**										
	IPU 2-43	0.00	0.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00	20.00
	PU-35	0.00	0.00	0.00	0.00	0.00	4.50	0.00	0.00	0.00	4.50
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**24.50**	**0.00**	**0.00**	**0.00**	**24.50**
	Gram										
	PG-186	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	10.00	10.00
	GCP-105	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	10.00	10.00
	Shubra	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	10.00	10.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**30.00**	**30.00**	**0.00**	**0.00**	**30.00**	**30.00**

	Lentil										
	HUL-57	0.00	0.00	0.00	0.00	35.00	40.00	0.00	0.00	35.00	40.00
	IPL 316	0.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00	5.00	5.00
	IPL 406	0.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00	5.00	5.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**45.00**	**50.00**	**0.00**	**0.00**	**45.00**	**50.00**
	Total Pulses Crops	**0.00**	**0.00**	**0.00**	**0.00**	**75.00**	**104.50**	**0.00**	**0.00**	**75.00**	**104.50**
Oilseed Crops	**Linseed**										
	Sabour Tisi-1	8.00	9.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	9.00
	Total	**8.00**	**9.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.00**	**9.00**
	Total Oil Seed Crops	**8.00**	**9.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.00**	**9.00**
	Grand Total (Sabour)	**188.00**	**225.00**	**0.00**	**0.00**	**75.00**	**104.50**	**0.00**	**325.00**	**263.00**	**654.50**
32. CSAUAT, Kanpur											
Cereal Crops	**Maize**										
	Azad Kamal	0.20	2.00	0.00	2.50	0.00	0.00	0.00	0.00	0.20	4.50
	Total	**0.20**	**2.00**	**0.00**	**2.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.20**	**4.50**
	Sorghum										
	Bundela	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	1.60
	Total	**0.00**	**0.00**	**0.00**	**1.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.60**
	Wheat										
	DBW -107	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00
	HUW-234	0.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00
	K-307	17.34	25.00	0.00	0.00	0.00	0.00	0.00	0.00	17.34	25.00
	K-402	50.00	86.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	86.00
	K-607	20.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	40.00
	K-1006	20.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	80.00
	K-7903	27.60	155.00	0.00	0.00	0.00	0.00	0.00	0.00	27.60	155.00
	K-9123	20.19	35.00	0.00	0.00	0.00	0.00	0.00	0.00	20.19	35.00

	K-9423	2.50	18.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	18.00
	PBW-343	12.34	90.00	0.00	0.00	0.00	0.00	0.00	0.00	12.34	90.00
	WH-147	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
	K-1317	2.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	40.00
	Total	**171.97**	**626.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**171.97**	**626.00**
	Barley										
	K-508 (Pragati)	9.72	17.00	0.00	0.00	0.00	0.00	0.00	0.00	9.72	17.00
	K-551	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
	K-1149 (Gitanjali)	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
	K-560	8.28	12.00	0.00	0.00	0.00	0.00	0.00	0.00	8.28	12.00
	Prakhar	10.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	25.00
	Total	**28.00**	**67.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**28.00**	**67.00**
	Total Cereal Crops	**200.17**	**695.00**	**0.00**	**4.10**	**0.00**	**0.00**	**0.00**	**0.00**	**200.17**	**699.10**
Pulses Crops	**Urd**										
	Shekhar 1(KU 301)	0.00	0.00	0.00	6.60	0.00	0.00	0.00	0.00	0.00	6.60
	Shekhar 2 (KU 300)	14.00	20.00	0.00	19.50	0.00	0.00	0.00	0.00	14.00	39.50
	Shekhar 3 (KU 309)	17.50	14.25	0.00	0.00	0.00	0.00	0.00	0.00	17.50	14.25
	Azad 1 (KU 91-2)	2.00	5.00	0.00	7.00	0.00	0.00	0.00	0.00	2.00	12.00
	Azad 2 (KU 91)	0.10	2.00	0.00	4.00	0.00	0.00	0.00	0.00	0.10	6.00
	Azad 3 (KU 96-3)	7.10	15.00	0.00	29.60	0.00	0.00	0.00	0.00	7.10	44.60
	Total	**40.70**	**56.25**	**0.00**	**66.70**	**0.00**	**0.00**	**0.00**	**0.00**	**40.70**	**122.95**
	Moong										
	K 851	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00
	IPM 2-3	0.00	0.00	0.00	52.50	0.00	0.00	0.00	0.00	0.00	52.50
	Swati K 2195	8.50	0.30	0.00	0.00	0.00	0.00	0.00	0.00	8.50	0.30
	Sweta K 2241	2.00	5.00	0.00	20.30	0.00	0.00	0.00	0.00	2.00	25.30

	PDM 139	5.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	5.00	0.80
	Total	**16.20**	**5.30**	**0.00**	**73.60**	**0.00**	**0.00**	**0.00**	**0.00**	**16.20**	**78.90**
	Gram										
	Udai (KPG-59)	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
	KWR-108	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
	Radhey	0.30	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	3.00
	Pragati	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
	Total	**0.30**	**20.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.30**	**20.00**
	Field Pea										
	KPMR-400 (jai)	0.00	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00
	KPMR-522(Indra)	0.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00
	Sapana	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
	Rachana	0.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00
	Total	**0.00**	**70.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**70.00**
	Pigeonpea										
	Amar	0.40	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	70.00
	Total	**0.40**	**70.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.40**	**70.00**
	Lentil										
	Azad Masoor-1 (KLS-218)	31.50	50.00	0.00	0.00	0.00	0.00	0.00	0.00	31.50	50.00
	Masoor-KLS-122	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
	Malika (K-75)	7.50	12.00	0.00	0.00	0.00	0.00	0.00	0.00	7.50	12.00
	Shekhar-2 (KLS-303)	9.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	35.00
	Masoor (KLB-345)	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
	KLS 09-03	12.50	25.00	0.00	0.00	0.00	0.00	0.00	0.00	12.50	25.00
	Masoor -KLS-2008-04	17.00	19.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00	19.00
	Total	**77.50**	**150.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**77.50**	**150.00**
	Total Pulses	**135.10**	**371.55**	**0.00**	**140.30**	**0.00**	**0.00**	**0.00**	**0.00**	**135.10**	**511.85**

	Crops										
Oil seed Crops	**Sesame**										
	Shekhar	0.27	0.30	0.00	2.30	0.00	0.00	0.00	0.00	0.27	2.60
	Pragati	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.35
	Total	**0.27**	**0.30**	**0.00**	**2.65**	**0.00**	**0.00**	**0.00**	**0.00**	**0.27**	**2.95**
	Groundnut										
	Divya	5.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	12.00
	Total	**5.00**	**12.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**12.00**
	Toria										
	T-9	0.10	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.20
	Bhawani	0.55	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.55	1.50
	Tapeswari	0.20	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.90
	Total	**0.85**	**3.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.85**	**3.60**
	Rai										
	Varuna (T-59)	1.77	16.00	0.00	0.00	0.00	0.00	0.00	0.00	1.77	16.00
	Rohini	1.24	11.00	0.00	0.00	0.00	0.00	0.00	0.00	1.24	11.00
	Urvashi	0.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
	Maya	0.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00
	Kanti	0.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00
	Pitambari	1.42	15.00	0.00	0.00	0.00	0.00	0.00	0.00	1.42	15.00
	Total	**4.43**	**75.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.43**	**75.00**
	Linseed										
	Shekhar	2.40	7.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	7.00
	Ruchi	3.24	7.00	0.00	0.00	0.00	0.00	0.00	0.00	3.24	7.00
	Uma	0.54	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.54	3.50
	Indu	0.54	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.54	3.50
	Total	**6.72**	**21.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.72**	**21.00**
	Total Oil Seed Crops	**17.27**	**111.90**	**0.00**	**2.65**	**0.00**	**0.00**	**0.00**	**0.00**	**17.27**	**114.55**
	Grand Total	**352.54**	**1178.45**	**0.00**	**147.05**	**0.00**	**0.00**	**0.00**	**0.00**	**352.54**	**1325.50**

	(CSAUAT)										
33. JNKVV, Jabalpur											
Cereal crops	**Paddy**										
	Kranti	19.10	2872.20	0.00	0.00	0.00	0.00	0.00	0.00	19.10	2872.20
	MTU-1010	0.00	0.00	115.00	905.56	0.00	0.00	0.00	0.00	115.00	905.56
	IR-64	0.00	0.00	20.00	820.36	0.00	0.00	0.00	0.00	20.00	820.36
	JR-81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	376.99	0.00	376.99
	PS-1460	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.90	0.00	44.90
	PS-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.00	0.00	66.00
	MR-219	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.50	0.00	25.50
	WGL-32183	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	0.00	32.00
	JR-206	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.21	0.00	22.21
	PS-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74.15	0.00	74.15
	JR-767	10.00	124.97	0.00	0.00	0.00	0.00	0.00	0.00	10.00	124.97
	JRB-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	292.22	0.00	292.22
	JR-201	10.00	19.40	0.00	0.00	0.00	0.00	0.00	0.00	10.00	19.40
	Sahbhagi	0.00	0.00	5.00	40.85	0.00	0.00	0.00	0.00	5.00	40.85
	Imp. Chhinor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76.44	0.00	76.44
	Imp. Jera Shankar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	124.30	0.00	124.30
	IR-36	0.00	0.00	5.00	7.70	0.00	0.00	0.00	0.00	5.00	7.70
	JR-267	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.90
	Danteshwari	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	Total	**39.10**	**3016.57**	**155.00**	**1784.47**	**0.00**	**0.00**	**0.00**	**1135.61**	**194.10**	**5936.65**
	Kodo										
	JK-41	0.00	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.28
	JK-439	0.45	4.51	0.00	0.00	0.00	0.00	0.00	0.00	0.45	4.51
	JK 390-25	0.00	4.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.65
	JK-155	1.50	0.05	0.00	0.00	0.00	0.00	0.00	0.00	1.50	0.05
	JK-137	0.00	7.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.02
	JK-13	0.30	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.05

	JK-106	0.50	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.05
	Total	**2.75**	**17.61**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.75**	**17.61**
	Little millet										
	JK-8	0.00	2.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.95
	JK-36	0.20	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	1.00
	JK-4	0.20	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.51
	Total	**0.40**	**4.46**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.40**	**4.46**
	Maize										
	JM 216	13.02	100.00	0.00	0.00	0.00	0.00	0.00	0.00	13.02	100.00
	Total	**13.02**	**100.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**13.02**	**100.00**
	Wheat										
	GW-322	2350.00	2410.00	0.00	0.00	0.00	0.00	0.00	0.00	2350.00	2410.00
	GW-273	87.00	90.00	0.00	0.00	0.00	0.00	0.00	0.00	87.00	90.00
	LOK-1	0.00	0.00	249.00	265.00	0.00	0.00	0.00	0.00	249.00	265.00
	JW-3288	250.00	2811.20	0.00	0.00	0.00	0.00	0.00	0.00	250.00	2811.20
	JW-3173	10.00	13.00	25.00	35.00	0.00	0.00	0.00	0.00	35.00	48.00
	JW-3336	377.00	380.00	42.00	55.00	0.00	0.00	0.00	0.00	419.00	435.00
	JW-3020	25.00	26.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	26.00
	JW-3211	160.00	163.00	0.00	0.00	0.00	0.00	0.00	0.00	160.00	163.00
	GW-366	0.00	0.00	431.00	455.00	0.00	0.00	0.00	0.00	431.00	455.00
	C-306	0.00	0.00	101.00	120.00	0.00	0.00	0.00	0.00	101.00	120.00
	MP-1203	70.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00	75.00
	MP-1202	170.00	172.00	0.00	0.00	0.00	0.00	0.00	0.00	170.00	172.00
	MP-1201	250.00	185.00	0.00	0.00	0.00	0.00	0.00	0.00	250.00	185.00
	JW-1142	20.00	23.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	23.00
	MP-1215	140.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	140.00	80.00
	MP-1255	0.00	0.00	16.00	20.00	0.00	0.00	0.00	0.00	16.00	20.00
	MP-1106	0.00	0.00	7.00	8.00	0.00	0.00	0.00	0.00	7.00	8.00
	Total	**3909.00**	**6428.20**	**871.00**	**958.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4780.00**	**7386.20**

	Barley										
	JB-1	15.00	17.00	125.00	133.00	0.00	0.00	0.00	0.00	140.00	150.00
	JB-58	5.00	6.50	90.00	93.50	0.00	0.00	0.00	0.00	95.00	100.00
	Total	**20.00**	**23.50**	**215.00**	**226.50**	**0.00**	**0.00**	**0.00**	**0.00**	**235.00**	**250.00**
	Total Cereal Crops	**3984.27**	**9590.34**	**1241.00**	**2968.97**	**0.00**	**0.00**	**0.00**	**1135.61**	**5225.27**	**13694.92**
Pulses Crops	**Pigeonpea**										
	TJT 501	30.72	35.00	0.00	0.00	50.00	50.00	0.00	0.00	80.72	85.00
	ICPL 87	2.30	1.40	0.00	0.00	0.00	0.00	0.00	0.00	2.30	1.40
	ICPL 87119	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
	ICPL-151	0.00	0.00	0.50	0.75	0.00	0.00	0.00	0.00	0.50	0.75
	Total	**39.02**	**36.40**	**0.50**	**0.75**	**50.00**	**50.00**	**0.00**	**0.00**	**89.52**	**87.15**
	Mung										
	Sikha	0.00	0.00	4.99	5.51	20.00	20.00	0.00	0.00	24.99	25.51
	TJM 3	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
	TMB 37	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.30	0.00
	Total	**8.30**	**0.00**	**4.99**	**5.51**	**20.00**	**20.00**	**0.00**	**0.00**	**33.29**	**25.51**
	Urdbean										
	T-9	0.00	0.00	33.10	34.48	0.00	0.00	0.00	0.00	33.10	34.48
	JU-3	5.02	3.50	0.00	0.00	0.00	0.00	0.00	0.00	5.02	3.50
	TU 40	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	PU-35	0.00	0.00	12.90	13.69	0.00	0.00	0.00	0.00	12.90	13.69
	IPU 2-43	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	10.00	10.00
	Total	**5.52**	**3.50**	**46.00**	**48.17**	**10.00**	**10.00**	**0.00**	**0.00**	**61.52**	**61.67**
	Gram										
	JG-315	86.00	87.00	0.00	0.00	0.00	0.00	0.00	0.00	86.00	87.00
	JG-322	86.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	86.00	20.00
	JG-63	109.00	21.00	0.00	0.00	0.00	0.00	0.00	0.00	109.00	21.00
	JG-14	224.90	227.00	40.50	41.80	20.00	24.00	0.00	0.00	285.40	292.80
	JAKI-9218	100.00	115.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	115.00

	JG-12	784.30	790.00	2041.50	2062.00	20.00	35.00	0.00	0.00	2845.80	2887.00
	JKG-5	0.00	0.00	0.00	0.00	10.00	10.00	0.00	0.00	10.00	10.00
	JG-36	28.00	30.00	30.00	32.50	0.00	0.00	0.00	0.00	58.00	62.50
	JG-11	100.00	106.50	0.00	0.00	0.00	0.00	0.00	0.00	100.00	106.50
	JG-130	84.20	51.00	0.00	0.00	0.00	0.00	0.00	0.00	84.20	51.00
	Total	**1602.40**	**1447.50**	**2112.00**	**2136.30**	**50.00**	**69.00**	**0.00**	**0.00**	**3764.40**	**3652.80**
	Pea										
	PSM-3	40.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	45.00
	Aman	28.00	31.00	0.00	0.00	30.00	35.00	0.00	0.00	58.00	66.00
	Arkel	10.50	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.50	12.00
	JM-6	5.00	7.50	0.00	0.00	0.00	0.00	0.00	0.00	5.00	7.50
	KashiNandani	0.00	0.00	68.00	72.00	0.00	0.00	0.00	0.00	68.00	72.00
	Total	**83.50**	**95.50**	**68.00**	**72.00**	**30.00**	**35.00**	**0.00**	**0.00**	**181.50**	**202.50**
	Lentil										
	JL-3	9.00	9.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	9.00
	RVL 11-06	10.00	18.00	101.00	111.00	0.00	0.00	0.00	0.00	111.00	129.00
	RVL-31	10.00	15.00	8.50	10.40	0.00	0.00	0.00	0.00	18.50	25.40
	IPL-316	10.00	15.00	12.00	15.00	0.00	0.00	0.00	0.00	22.00	30.00
	Total	**39.00**	**57.00**	**121.50**	**136.40**	**0.00**	**0.00**	**0.00**	**0.00**	**160.50**	**193.40**
	Total Pulse Crop	**1777.74**	**1639.90**	**2352.99**	**2399.13**	**160.00**	**184.00**	**0.00**	**0.00**	**4290.73**	**4223.03**
Oil Seed Crops	**Groundnut**										
	TG 37 A	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.90	0.90
	TG-27	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.00	0.90	0.90
	Total	**0.00**	**0.00**	**1.80**	**1.80**	**0.00**	**0.00**	**0.00**	**0.00**	**1.80**	**1.80**
	Niger										
	JNC-6	1.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.80
	JNC-9	3.10	1.70	5.00	5.00	0.00	0.00	0.00	0.00	8.10	6.70
	JNS 28	0.00	0.70	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.70
	JNS 30	0.00	1.30	5.00	5.00	0.00	0.00	0.00	0.00	5.00	6.30

	Total	**4.10**	**4.50**	**15.00**	**15.00**	**0.00**	**0.00**	**0.00**	**0.00**	**19.10**	**19.50**
	Sesame										
	TKG-308	1.35	7.50	0.00	0.00	0.00	0.00	0.00	0.00	1.35	7.50
	TKG-306	3.20	3.80	0.00	0.00	0.00	0.00	0.00	0.00	3.20	3.80
	TKG-55	0.50	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.05
	TKG-21	0.10	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.30
	JTS-22	0.15	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.50
	JTS-11	3.65	3.71	0.40	0.47	0.00	0.00	0.00	0.00	4.05	4.18
	JTS-8	0.00	0.00	3.10	3.33	0.00	0.00	0.00	0.00	3.10	3.33
	Total	**8.95**	**15.86**	**3.50**	**3.80**	**0.00**	**0.00**	**0.00**	**0.00**	**12.45**	**19.66**
	Soybean										
	JS-2069	967.00	1117.70	0.00	0.00	0.00	0.00	0.00	0.00	967.00	1117.70
	JS-2029	700.00	219.20	0.00	0.00	0.00	0.00	0.00	0.00	700.00	219.20
	JS-2098	12.00	14.80	0.00	0.00	0.00	0.00	0.00	0.00	12.00	14.80
	JS-2034	700.00	4.80	0.00	0.00	0.00	0.00	0.00	0.00	700.00	4.80
	JS-9752	30.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.20
	RVS 2001-4	0.00	40.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.84
	Rabi										
	JS 20-29	0.00	107.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	107.50
	JS 20-98	0.00	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00
	JS 20-34	0.00	210.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	210.00
	JS 97-52	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
	Total	**2409.00**	**1789.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2409.00**	**1789.04**
	Linseed										
	JLS-27	0.60	1.20	24.50	25.80	0.00	0.00	0.00	0.00	25.10	27.00
	JLS-95	0.00	0.00	18.20	20.30	0.00	0.00	0.00	0.00	18.20	20.30
	JLS-66	1.20	1.90	88.00	89.80	0.00	0.00	0.00	0.00	89.20	91.70
	JLS-69	0.00	0.00	18.30	20.00	0.00	0.00	0.00	0.00	18.30	20.00
	JLS-79	0.60	1.48	44.00	46.52	0.00	0.00	0.00	0.00	44.60	48.00
	JLS-73	6.00	8.50	72.00	75.50	0.00	0.00	0.00	0.00	78.00	84.00

	JLS-67	3.00	4.65	8.00	9.35	0.00	0.00	0.00	0.00	11.00	14.00
	PKDL-41	7.20	9.10	3.70	4.90	0.00	0.00	0.00	0.00	10.90	14.00
	Total	**18.60**	**26.83**	**276.70**	**292.17**	**0.00**	**0.00**	**0.00**	**0.00**	**295.30**	**319.00**
	Mustard										
	Varuna	0.00	0.00	6.50	8.00	0.00	0.00	0.00	0.00	6.50	8.00
	PusaTarak	0.00	0.00	4.20	4.80	0.00	0.00	0.00	0.00	4.20	4.80
	PusaJaikisan	0.00	0.00	30.40	32.30	0.00	0.00	0.00	0.00	30.40	32.30
	Total	**0.00**	**0.00**	**41.10**	**45.10**	**0.00**	**0.00**	**0.00**	**0.00**	**41.10**	**45.10**
	Total Oilseed Crop	**2440.65**	**1836.23**	**338.10**	**357.87**	**0.00**	**0.00**	**0.00**	**0.00**	**2778.75**	**2194.10**
Forage Crops	**Sorghum**										
	MP Chari	0.40	3.80	0.00	0.00	0.00	0.00	0.00	0.00	0.40	3.80
	Total	**0.40**	**3.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.40**	**3.80**
	Berseem										
	JB-1	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50
	JB-5	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50
	Total	**2.00**	**3.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**3.00**
	Oats										
	JO-1	0.00	0.00	14.00	16.00	0.00	0.00	0.00	0.00	14.00	16.00
	JO 03-91	2.50	3.00	4.50	5.20	0.00	0.00	0.00	0.00	7.00	8.20
	Total	**2.50**	**3.00**	**18.50**	**21.20**	**0.00**	**0.00**	**0.00**	**0.00**	**21.00**	**24.20**
	Total Forages	**4.90**	**9.80**	**18.50**	**21.20**	**0.00**	**0.00**	**0.00**	**0.00**	**23.40**	**31.00**
	Grand Total (Jabalpur)	**8207.56**	**13076.27**	**3950.59**	**5747.17**	**160.00**	**184.00**	**0.00**	**1135.61**	**12318.15**	**20143.05**
34. CAZRI, Jodhpur											
Pulse Crops	**Mothbean**										
	CAZRI Moth 2 (CZM 45)	5.10	9.76	0.00	0.00	0.00	0.00	0.00	0.00	5.10	9.76
	Total	**5.10**	**9.76**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.10**	**9.76**
	Total Pulses	**5.10**	**9.76**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.10**	**9.76**

	Crops										
	Grand Total (Jodhpur)	**5.10**	**9.76**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.10**	**9.76**
35. IIPR, Kanpur											
Pulse Crops	**Mung**										
	Samrat	13.62	14.13	0.00	0.00	0.00	0.00	0.00	0.00	13.62	14.13
	IPM 2-3	24.29	25.25	0.00	0.00	0.00	0.00	0.00	0.00	24.29	25.25
	IPM 2-14	8.50	16.20	0.00	0.00	0.00	0.00	0.00	0.00	8.50	16.20
	Virat	13.36	11.06	0.00	0.00	0.00	0.00	0.00	0.00	13.36	11.06
	Sikha	7.70	11.39	0.00	0.00	0.00	0.00	0.00	0.00	7.70	11.39
	Meha	9.65	10.65	0.00	0.00	0.00	0.00	0.00	0.00	9.65	10.65
	Total	**77.12**	**88.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**77.12**	**88.68**
	Urd										
	IPU 2-43	16.00	21.30	0.00	0.00	10.00	16.15	0.00	0.00	26.00	37.45
	Uttara	13.02	14.24	0.00	0.00	0.00	0.00	0.00	0.00	13.02	14.24
	Total	**29.02**	**35.54**	**0.00**	**0.00**	**10.00**	**16.15**	**0.00**	**0.00**	**39.02**	**51.69**
	Pigeonpea										
	IPA 203	4.60	45.00	0.00	0.00	0.00	0.00	0.00	0.00	4.60	45.00
	UPAS 120	2.36	3.75	0.00	0.00	0.00	0.00	0.00	0.00	2.36	3.75
	Total	**6.96**	**48.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.96**	**48.75**
	Chickpea										
	Shubhra	25.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	35.00
	Ujjawal	25.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	35.00
	RVG 202	25.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	30.00
	RVG 203	50.00	75.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	75.00
	Total	**125.00**	**175.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**125.00**	**175.00**
	Field Pea										
	Adarsh	1.60	5.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60	5.00
	Aman	30.40	45.00	0.00	0.00	0.00	0.00	0.00	0.00	30.40	45.00
	Vikash	10.50	25.00	0.00	0.00	0.00	0.00	0.00	0.00	10.50	25.00

	IPF 4-9	20.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	30.00
	IPFD10-12	38.10	45.00	0.00	0.00	0.00	0.00	0.00	0.00	38.10	45.00
	IPFD 12-2	20.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00
	IPFD 11-5	10.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	12.00
	IPFD 14-2	5.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	7.00
	Prakash	15.60	20.00	0.00	0.00	0.00	0.00	0.00	0.00	15.60	20.00
	Total	**151.20**	**209.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**151.20**	**209.00**
	Lentil										
	IPL 406	5.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	7.00
	IPL 316	22.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	22.00	35.00
	IPL526	6.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	7.00
	IPL 220	5.10	6.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10	6.00
	Total	**38.10**	**55.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**38.10**	**55.00**
	Rajmash										
	Amber	5.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	7.00
	Total	**5.00**	**7.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**7.00**
	Total Pulse Crops	**432.40**	**618.97**	**0.00**	**0.00**	**10.00**	**16.15**	**0.00**	**0.00**	**442.40**	**635.12**
	Grand Total (IIPR)	**432.40**	**618.97**	**0.00**	**0.00**	**10.00**	**16.15**	**0.00**	**0.00**	**442.40**	**635.12**
36. UAS , Bangalore											
Cereal Crops	**Paddy**										
	Thanu	3.00	4.00	0.50	1.00	0.00	0.00	8.00	10.00	11.50	15.00
	BR-2655	5.00	6.00	0.50	2.00	0.00	0.00	10.00	12.00	15.50	20.00
	IR-30864	0.00	0.00	0.25	1.00	0.00	0.00	6.00	7.00	6.25	8.00
	Hy. Paddy (KRH 4)										
	CRMS-32A	0.23	1.00	2.00	5.00	0.00	0.00	10.00	14.00	12.23	20.00
	CRMS-32B	0.06	0.50	0.00	0.00	0.00	0.00	0.00	1.50	0.06	2.00
	MSN-36	0.06	0.20	1.30	2.00	0.00	0.00	0.50	2.00	1.86	4.20
	Total	**8.35**	**11.70**	**4.55**	**11.00**	**0.00**	**0.00**	**34.50**	**46.50**	**47.40**	**69.20**

	Finger Millet										
	L-5	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
	MR-1	0.10	0.50	0.50	1.00	0.00	0.00	4.00	4.50	4.60	6.00
	MR-6	0.95	1.50	0.00	0.00	0.00	0.00	3.00	5.50	3.95	7.00
	KMR-301	0.00	2.50	0.00	0.00	0.00	0.00	2.00	17.50	2.00	20.00
	KMR-204	0.00	2.00	0.00	0.00	0.00	0.00	2.00	6.00	2.00	8.00
	KMR-340	0.00	0.00	0.00	0.00	0.00	0.00	2.00	6.00	2.00	6.00
	Indaf-5	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.50	0.10	1.50
	Indaf-7	0.05	0.20	0.50	1.00	0.00	0.00	2.00	5.50	2.55	6.70
	Indaf-8	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.00	0.10	1.00
	Indaf-9	0.05	0.30	0.20	0.50	0.00	0.00	0.50	1.20	0.75	2.00
	GPU-28	2.69	3.00	1.00	2.00	0.00	0.00	1.00	2.00	4.69	7.00
	GPU-48	0.55	1.00	1.50	2.00	0.00	0.00	2.00	3.00	4.05	6.00
	GPU-67	6.78	8.00	3.00	4.00	0.00	0.00	3.00	5.00	12.78	17.00
	ML-365	5.10	7.00	3.00	4.00	0.00	0.00	2.00	2.50	10.10	13.50
	Total	**16.27**	**27.00**	**9.70**	**14.50**	**0.00**	**0.00**	**23.70**	**61.20**	**49.67**	**102.70**
	Maize*										
	MAI-105 (M)	0.00	0.00	0.80	1.00	0.00	0.00	0.50	1.00	1.30	2.00
	Hema (NAH-1137)										
	NAI-137 (F)	0.00	0.00	0.80	1.00	0.00	0.00	0.50	1.00	1.30	2.00
	Nithyashree (NAH-2049)										
	SKV-50 (F)	0.00	0.00	0.80	1.00	0.00	0.00	0.50	1.00	1.30	2.00
	Composites										
	NAC-6002	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00	1.00	2.00
	NAC-6004	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00	1.00	2.00
	African Tall	0.00	0.00	0.00	0.00	0.00	0.00	1.00	3.00	1.00	3.00
	MAH-14-5										
	CAL-14-43	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.50	1.00

	CML-451	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.50	0.30	0.50
	Total	**0.00**	**0.00**	**2.40**	**3.00**	**0.00**	**0.00**	**5.30**	**11.50**	**7.70**	**14.50**
	Total Cereal Crops	**24.62**	**38.70**	**16.65**	**28.50**	**0.00**	**0.00**	**63.50**	**119.20**	**104.77**	**186.40**
Pulses Crops	**Redgram**										
	BRG-1	0.95	1.50	1.00	1.50	2.00	3.00	0.00	0.00	3.95	6.00
	BRG-2	3.80	4.50	0.50	0.75	1.50	2.00	0.00	0.00	5.80	7.25
	BRG-3	0.00	0.00	0.00	0.00	8.00	10.00	0.00	0.00	8.00	10.00
	BRG-4	1.70	3.00	1.00	2.00	3.00	3.00	0.00	0.00	5.70	8.00
	BRG-5	4.30	6.00	2.00	4.00	8.00	10.00	0.00	0.00	14.30	20.00
	Total	**10.75**	**15.00**	**4.50**	**8.25**	**22.50**	**28.00**	**0.00**	**0.00**	**37.75**	**51.25**
	Cowpea										
	KBC-2	0.00	0.00	1.00	1.50	1.00	2.00	0.00	0.00	2.00	3.50
	KBC-9	0.00	0.00	0.00	0.00	2.00	2.00	0.00	2.00	2.00	4.00
	KM-5	0.00	0.00	1.00	1.50	2.00	4.00	0.00	0.00	3.00	5.50
	C-152	0.00	0.00	1.00	1.00	2.00	2.00	7.25	7.00	10.25	10.00
	IT-38956-1	0.00	0.00	2.00	3.00	3.00	7.00	0.00	0.00	5.00	10.00
	PKB-6	5.00	6.00	1.00	2.00	1.00	3.00	0.00	0.00	7.00	11.00
	MFC-08-14	0.00	0.00	1.00	2.00	2.00	4.00	0.00	0.00	3.00	6.00
	MFC-09-1	0.00	0.00	1.00	2.00	2.00	4.00	0.00	0.00	3.00	6.00
	AV-5	0.00	0.00	1.00	2.00	1.00	2.00	0.00	0.00	2.00	4.00
	Total	**5.00**	**6.00**	**9.00**	**15.00**	**16.00**	**30.00**	**7.25**	**9.00**	**37.25**	**60.00**
	Mung										
	KKM-3	0.35	1.00	0.65	1.00	1.00	2.00	0.00	0.00	2.00	4.00
	Total	**0.35**	**1.00**	**0.65**	**1.00**	**1.00**	**2.00**	**0.00**	**0.00**	**2.00**	**4.00**
	Urd										
	Rashmi	0.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00	2.00	2.00
	Total	**0.00**	**0.00**	**1.00**	**1.00**	**1.00**	**1.00**	**0.00**	**0.00**	**2.00**	**2.00**
	Fieldbean										
	HA-3	0.00	0.00	3.00	4.00	0.00	0.00	0.00	0.00	3.00	4.00

	HA-4	0.00	0.00	3.00	5.00	3.00	5.00	0.00	0.00	6.00	10.00
	Total	**0.00**	**0.00**	**6.00**	**9.00**	**3.00**	**5.00**	**0.00**	**0.00**	**9.00**	**14.00**
	Total Pulse Crops	**16.10**	**22.00**	**21.15**	**34.25**	**43.50**	**66.00**	**7.25**	**9.00**	**88.00**	**131.25**
Oilseed Crops	**Soybean**										
	JS-335	400.00	550.00	0.00	0.00	0.00	0.00	0.00	0.00	400.00	550.00
	Total	**400.00**	**550.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**400.00**	**550.00**
	Sunflower*										
	CMS-234A	0.10	0.20	1.00	1.50	0.00	0.00	5.50	6.00	6.60	7.70
	CMS-234B	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10
	RHA 6D-1	0.00	0.00	0.50	1.00	0.00	0.00	0.00	0.00	0.50	1.00
	CMS-17A	0.04	0.10	0.50	1.00	0.00	0.00	7.40	8.00	7.94	9.10
	CMS-17B	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05
	RHA-95C-1	0.19	0.25	2.00	3.00	0.00	0.00	3.00	3.00	5.19	6.25
	CMS-335A	0.34	0.50	3.50	4.00	0.00	0.00	0.00	0.00	3.84	4.50
	CMS-335B	0.12	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.15
	Total	**0.86**	**1.35**	**7.50**	**10.50**	**0.00**	**0.00**	**15.90**	**17.00**	**24.26**	**28.85**
	Groundnut**										
	KCG-6	275.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	275.00	40.00
	GKVK-5	275.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	275.00	0.00
	Total	**550.00**	**40.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**550.00**	**40.00**
	Total Oilseed Crops	**950.86**	**591.35**	**7.50**	**10.50**	**0.00**	**0.00**	**15.90**	**17.00**	**974.26**	**618.85**
	Grand Total (Bangalore)	**991.58**	**652.05**	**45.30**	**73.25**	**43.50**	**66.00**	**86.65**	**145.20**	**1167.03**	**936.50**
37. PAU, Ludhiana											
Cereal Crops	**Paddy**										
	PR 111	8.04	9.00	0.00	0.00	0.00	0.00	0.00	0.00	8.04	9.00
	PR 113	9.10	11.00	0.00	0.00	0.00	0.00	0.00	0.00	9.10	11.00
	PR 114	19.10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	19.10	28.00
	PR 116	2.20	4.30	0.00	0.00	0.00	0.00	0.00	0.00	2.20	4.30

	PR 118	13.60	25.00	0.00	0.00	0.00	0.00	0.00	0.00	13.60	25.00
	PR 121	28.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	28.00	30.00
	PR 122	17.40	20.00	0.00	0.00	0.00	0.00	0.00	0.00	17.40	20.00
	PR 123	4.70	6.00	0.00	0.00	0.00	0.00	0.00	0.00	4.70	6.00
	PR 124	10.70	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.70	12.00
	PR 126	34.10	40.00	0.00	0.00	0.00	0.00	0.00	0.00	34.10	40.00
	PAU 201	2.40	6.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	6.00
	Pb Bas. 2	0.10	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.00
	Pb Bas. 3	1.10	4.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	4.00
	Pb Bas. 4	0.25	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	1.00
	Pb Bas. 5	5.70	5.70	0.00	0.00	0.00	0.00	0.00	0.00	5.70	5.70
	PR 127	0.00	0.00	20.00	40.00	0.00	0.00	0.00	0.00	20.00	40.00
	Pusa 1121	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	5.00
	Pusa 1509	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	3.00
	Total	**156.49**	**203.00**	**20.00**	**40.00**	**0.00**	**0.00**	**0.00**	**8.00**	**176.49**	**251.00**
	Maize										
	CM 139	0.12	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.15
	CM 140	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
	LM 13	4.00	4.20	0.00	0.00	0.00	0.00	0.00	0.00	4.00	4.20
	LM 14	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
	LM 15	0.12	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.12	1.20
	LM 16	0.06	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.60
	LM 17	0.06	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.55
	LM 18	0.12	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.20
	LM 19	0.06	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.10
	LM 20	0.06	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.20
	LM 23	0.12	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.12	2.50
	LM 24	0.06	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.20
	Vijay Comp.	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00

	Total	**7.38**	**12.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.38**	**12.10**
	Pearlmillet										
	FBC 16	0.55	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.60
	Total	**0.55**	**0.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.55**	**0.60**
	Wheat										
	PBW 343	60.00	72.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	72.00
	PBW 443	4.40	10.00	0.00	0.00	0.00	0.00	0.00	0.00	4.40	10.00
	PBW 502	60.00	110.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	110.00
	PBW 509	2.60	11.00	0.00	0.00	0.00	0.00	0.00	0.00	2.60	11.00
	PBW 533	6.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	10.00
	PBW 550	60.00	350.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	350.00
	PBW 590	26.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	26.00	30.00
	PBW 621 (DPW 621-50)	65.00	68.00	0.00	0.00	0.00	0.00	0.00	0.00	65.00	68.00
	PBW 644	11.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00	12.00
	PBW 658	18.20	20.00	0.00	0.00	0.00	0.00	0.00	0.00	18.20	20.00
	PBW 660	17.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00	20.00
	PBW 677	128.00	190.00	0.00	0.00	0.00	0.00	0.00	0.00	128.00	190.00
	PBW 725	746.20	800.00	0.00	0.00	0.00	0.00	0.00	0.00	746.20	800.00
	PBW 723 (Unnat PBW 343)	1019.40	1300.00	0.00	0.00	0.00	0.00	0.00	0.00	1019.40	1300.00
	PBW 761 (Unnat PBW 550)	120.00	130.00	0.00	0.00	0.00	0.00	0.00	0.00	120.00	130.00
	HPBW 01 (PBW 1 Zn)	152.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	152.00	200.00
	PBW 373	0.00	0.00	0.00	0.00	0.00	0.00	20.00	24.00	20.00	24.00
	PDW 291	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00
	Total	**2495.80**	**3333.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.00**	**34.00**	**2525.80**	**3367.00**
	Barley										
	PL 172	7.10	9.00	0.00	0.00	0.00	0.00	0.00	0.00	7.10	9.00
	PL 426	83.25	100.00	0.00	0.00	0.00	0.00	0.00	0.00	83.25	100.00

	PL 807	5.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	10.00
	DWRUB 52	0.00	0.00	2.00	2.50	0.00	0.00	0.00	0.00	2.00	2.50
	Total	**95.35**	**119.00**	**2.00**	**2.50**	**0.00**	**0.00**	**0.00**	**0.00**	**97.35**	**121.50**
	Total Cereal Crops	**2755.57**	**3667.70**	**22.00**	**42.50**	**0.00**	**0.00**	**30.00**	**42.00**	**2807.57**	**3752.20**
Pulses Crops	**Arhar**										
	PAU 881	1.68	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.68	2.00
	AL 201	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.50	0.50
	Total	**1.68**	**2.00**	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**2.18**	**2.50**
	Moong										
	SML 668	45.00	120.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	120.00
	SML 832	30.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	60.00
	ML 818	1.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.08
	ML 2056	7.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	7.00
	SML 1115	1.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	3.00
	Total	**84.08**	**190.08**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**84.08**	**190.08**
	Urd										
	Mash 1008	7.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	10.00
	Mash 114	0.40	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.50
	Mash 338	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
	Mash 479	14.60	50.00	0.00	0.00	0.00	0.00	0.00	0.00	14.60	50.00
	Total	**22.20**	**60.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**22.20**	**60.70**
	Gram										
	PBG 7	2.50	12.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	12.00
	PBG 5	1.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.50
	GPF 2	11.00	13.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00	13.00
	L 552	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00
	Total	**14.50**	**27.50**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**2.00**	**16.50**	**29.50**
	Lentil										
	LL 931	0.85	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	3.00

	LL 699	0.15	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	3.00
	Total	**1.00**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**6.00**
	Total Pulses Crops	**123.46**	**286.28**	**0.50**	**0.50**	**0.00**	**0.00**	**2.00**	**2.00**	**125.96**	**288.78**
Oil Seed Crops	**Groundnut**										
	SG 99	1.10	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	2.00
	Total	**1.10**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.10**	**2.00**
	Sunflower										
	P 93 R (PSH 1962 Male)	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
	Total	**0.01**	**0.02**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.02**
	Til										
	Pb Til No. 1	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
	Pb Til No. 2	0.00	0.00	0.02	0.10	0.00	0.00	0.00	0.00	0.02	0.10
	Total	**0.02**	**0.02**	**0.02**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.12**
	Soybean										
	SL 958	0.40	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.40	4.50
	Total	**0.40**	**4.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.40**	**4.50**
	Toria										
	TL 17	0.05	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.60
	TL 15	0.05	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.60
	Total	**0.10**	**1.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**	**1.20**
	Raya										
	RLM 619	0.02	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.00
	PBR 91	0.05	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.00
	PBR 357	0.05	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.00
	RLC 3	0.05	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	4.00
	Total	**0.17**	**7.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.17**	**7.00**
	G. Sarson										
	GSC 7	0.05	8.50	0.00	0.00	0.00	0.00	0.00	0.00	0.05	8.50

	GSC 6	0.05	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.00
	Total	**0.10**	**9.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**	**9.50**
	Linseed										
	BL-1	6.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	6.00
	Total	**6.00**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.00**	**6.00**
	Total Oil Seed Crops	**7.90**	**30.24**	**0.02**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**7.92**	**30.34**
Fiber Crops	**Cotton**										
	FDK 124	0.10	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20
	F 846	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40
	F 1861	0.30	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.40
	F 2228	2.20	2.50	0.00	0.00	0.00	0.00	0.00	0.00	2.20	2.50
	F 2383	3.30	3.30	0.00	0.00	0.00	0.00	0.00	0.00	3.30	3.30
	LH 2076	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
	LH 2108	0.10	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20
	LD 327	0.10	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.30
	LD 949	2.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00
	F 1378	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00
	PAU BT 1	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.00
	Total	**9.92**	**9.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**9.92**	**9.40**
	Total Fiber Crops	**9.92**	**9.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**9.92**	**9.40**
Forage Crops	**F. Maize**										
	J 1006	44.58	79.50	0.00	0.00	0.00	0.00	0.00	0.00	44.58	79.50
	Total	**44.58**	**79.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**44.58**	**79.50**
	Sorghum										
	Pb. Sudex Chari 1										
	94012 A	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
	94012 B	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
	SGL 87	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
	Total	**0.40**	**0.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.40**	**0.40**

	Guar										
	Guara 80	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
	Ageta Guara 112	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
	HG 365	0.00	0.00	0.10	0.30	0.00	0.00	0.00	0.00	0.10	0.30
	Total	**0.00**	**0.00**	**0.10**	**0.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.30**
	Cowpea										
	CL 367	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.00	0.20	0.20
	Total	**0.00**	**0.00**	**0.20**	**0.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.20**	**0.20**
	G. Grass										
	PGG 518	0.00	0.00	0.30	0.30	0.00	0.00	0.00	0.00	0.30	0.30
	Total	**0.00**	**0.00**	**0.30**	**0.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.30**	**0.30**
	Pearl Millet										
	PCB 164	0.00	0.00	0.20	1.00	0.00	0.00	0.00	0.00	0.20	1.00
	Total	**0.00**	**0.00**	**0.20**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.20**	**1.00**
	Berseem										
	BL 1	6.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	6.00
	BL 10	6.10	7.00	0.00	0.00	0.00	0.00	0.00	0.00	6.10	7.00
	BL 42	7.46	17.00	0.00	0.00	0.00	0.00	0.00	0.00	7.46	17.00
	BL 43	0.48	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	2.00
	BL 180	0.40	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	2.00
	Total	**20.44**	**34.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20.44**	**34.00**
	Oat										
	Kent	30.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	45.00
	OL 10	13.50	20.00	0.00	0.00	0.00	0.00	0.00	0.00	13.50	20.00
	OL 11	0.50	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	4.50
	OL 12	0.00	0.00	4.00	4.50	0.00	0.00	0.00	0.00	4.00	4.50
	Total	**44.00**	**69.50**	**4.00**	**4.50**	**0.00**	**0.00**	**0.00**	**0.00**	**48.00**	**74.00**
	Metha										
	ML-150	0.00	0.00	1.00	1.20	0.00	0.00	0.00	0.00	1.00	1.20
	Total	**0.00**	**0.00**	**1.00**	**1.20**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.20**

	Total Forage Crops	**109.42**	**183.40**	**5.80**	**7.50**	**0.00**	**0.00**	**0.00**	**0.00**	**115.62**	**190.90**
	Grand Total (PAU)	**3006.27**	**4177.02**	**28.32**	**50.60**	**0.00**	**0.00**	**32.00**	**44.00**	**3066.99**	**4271.62**
38. JAU, Junagadh											
Cereal crops	**Pearlmillet**										
	J 2454 (GHB 905 R line)	0.04	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.80
	Total	**0.04**	**0.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.80**
	Wheat										
	GW 366	235.00	240.00	22.60	25.00	0.00	0.00	0.00	0.00	257.60	265.00
	GW 463	0.00	0.00	35.00	37.00	0.00	0.00	0.00	0.00	35.00	37.00
	Total	**235.00**	**240.00**	**57.60**	**62.00**	**0.00**	**0.00**	**0.00**	**0.00**	**292.60**	**302.00**
	Total Cereals	**235.04**	**240.80**	**57.60**	**62.00**	**0.00**	**0.00**	**0.00**	**0.00**	**292.64**	**302.80**
Pulses Crops	**Pigeonpea**										
	GJP 1	0.00	0.00	5.00	10.00	0.00	0.00	0.00	0.00	5.00	10.00
	Total	**0.00**	**0.00**	**5.00**	**10.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**10.00**
	Chickpea										
	GG-1	0.00	0.00	11.00	6.00	0.00	0.00	0.00	0.00	11.00	6.00
	GG-2	0.00	0.00	18.25	21.00	0.00	0.00	0.00	0.00	18.25	21.00
	GJG-3	0.00	0.00	73.60	75.00	0.00	0.00	0.00	0.00	73.60	75.00
	GG-4	10.40	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.40	10.00
	GG-5	57.00	55.00	109.00	110.00	0.00	0.00	0.00	0.00	166.00	165.00
	Total	**67.40**	**65.00**	**211.85**	**212.00**	**0.00**	**0.00**	**0.00**	**0.00**	**279.25**	**277.00**
	Total Pulses Crops	**67.40**	**65.00**	**216.85**	**222.00**	**0.00**	**0.00**	**0.00**	**0.00**	**284.25**	**287.00**
Oil Seed Crops	**Groundnut**										
	GG-2	0.50	3.00	40.20	45.00	0.00	0.00	0.00	0.00	40.70	48.00
	GG-5	0.00	0.00	20.50	40.60	0.00	0.00	0.00	0.00	20.50	40.60
	GG-7	0.00	0.00	20.50	22.00	0.00	0.00	0.00	0.00	20.50	22.00

	GJG-9	50.00	55.00	25.50	50.00	0.00	0.00	0.00	0.00	75.50	105.00
	GJG-31	30.00	36.00	2.00	0.00	0.00	0.00	0.00	0.00	32.00	36.00
	GJG-32	40.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	60.00
	GAUG-10	0.00	0.00	57.10	40.00	0.00	0.00	0.00	0.00	57.10	40.00
	GG-11	0.00	0.00	106.20	100.00	0.00	0.00	0.00	0.00	106.20	100.00
	GJG-17	0.00	0.00	70.50	50.00	0.00	0.00	0.00	0.00	70.50	50.00
	GG-20	61.50	66.00	860.10	1400.00	0.00	0.00	0.00	0.00	921.60	1466.00
	GG-21	4.00	6.00	0.00	4.00	0.00	0.00	0.00	0.00	4.00	10.00
	GJG-22	0.00	0.00	271.00	300.00	0.00	0.00	0.00	0.00	271.00	300.00
	GJG HPS-1	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
	Total	**186.00**	**226.00**	**1475.60**	**2053.60**	**0.00**	**0.00**	**0.00**	**0.00**	**1661.60**	**2279.60**
	Sesame										
	G.Til 1	0.14	3.00	0.52	4.20	0.00	0.00	0.00	0.00	0.66	7.20
	G.Til 2	5.35	10.00	6.36	15.60	0.00	0.00	0.00	0.00	11.71	25.60
	G.Til 3	1.65	2.00	2.72	4.30	0.00	0.00	0.00	0.00	4.37	6.30
	G.Til 4	1.90	2.50	2.66	6.40	0.00	0.00	0.00	0.00	4.56	8.90
	GJT 5	0.00	0.00	2.25	1.84	0.00	0.00	0.00	0.00	2.25	1.84
	G.Til 10	7.05	8.00	0.62	0.90	0.00	0.00	0.00	0.00	7.67	8.90
	Total	**16.09**	**25.50**	**15.13**	**33.24**	**0.00**	**0.00**	**0.00**	**0.00**	**31.22**	**58.74**
	Total Oil Seed Crops	**202.09**	**251.50**	**1490.73**	**2086.84**	**0.00**	**0.00**	**0.00**	**0.00**	**1692.82**	**2338.34**
	Grand Total (Junagadh)	**504.53**	**557.30**	**1765.18**	**2370.84**	**0.00**	**0.00**	**0.00**	**0.00**	**2269.71**	**2928.14**
39. AAU, Jorhat											
Cereal Crops	**Paddy**										
	Bahadur (IET-13358)	0.20	0.25	0.00	0.00	0.00	0.00	0.00	42.55	0.20	42.80
	Ranjit (IET-12554)	20.70	22.80	0.00	0.00	0.00	0.00	0.00	190.00	20.70	212.80
	Swarna Sub 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.40	0.00	37.40

	Ranjit Sub 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.70	0.00	24.70
	Gitesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.80	0.00	22.80
	Bahadur Sub 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.60	0.00	19.60
	Ketekijoha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.30	0.00	16.30
	Luit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.50	0.00	14.50
	Mahsuri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.70	0.00	7.70
	Swarna	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.30	0.00	4.30
	Manoharsali	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.80
	Aghoni	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.00	1.30
	Lachit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.40
	Total	**20.90**	**23.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**382.35**	**20.90**	**405.40**
	Total Cereal Crops	**20.90**	**23.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**382.35**	**20.90**	**405.40**
Oil Seed Crops	**Toria**										
	M- 27	0.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	2.50
	TS- 36	7.00	2.20	0.00	0.00	0.00	0.00	0.00	0.00	7.00	2.20
	TS- 38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50	0.00	6.50
	TS- 46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.50	0.00	7.50
	TS- 67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00	4.00
	Total	**7.50**	**4.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**18.00**	**7.50**	**22.70**
	Total Oil Seed Crops	**7.50**	**4.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**18.00**	**7.50**	**22.70**
	Grand Total(Jorhat)	**28.40**	**27.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**400.35**	**28.40**	**428.10**
40. BHU, Varnasi											
Cereal Crops	**Paddy**										
	Imp. Shambha	0.00	24.00	40.00	24.00	0.00	0.00	0.00	0.00	40.00	48.00
	Swarna Sub 1	0.00	27.00	47.00	27.00	0.00	0.00	0.00	0.00	47.00	54.00
	HUR 917	16.00	32.40	0.00	0.00	0.00	0.00	0.00	0.00	16.00	32.40
	Sahbhagi Dhan	0.00	1.20	2.10	1.20	0.00	0.00	0.00	0.00	2.10	2.40

	HUR 105	0.00	7.20	11.00	7.20	0.00	0.00	0.00	0.00	11.00	14.40
	HUBR 2-1	0.00	2.00	1.50	2.00	0.00	0.00	0.00	0.00	1.50	4.00
	HUR 3022	0.00	1.25	2.10	1.25	0.00	0.00	0.00	0.00	2.10	2.50
	HUR 4-3	0.00	1.40	2.50	1.40	0.00	0.00	0.00	0.00	2.50	2.80
	HUBR 10-9	0.00	3.50	5.00	3.50	0.00	0.00	0.00	0.00	5.00	7.00
	Total	**16.00**	**99.95**	**111.20**	**67.55**	**0.00**	**0.00**	**0.00**	**0.00**	**127.20**	**167.50**
	Wheat										
	HUW 234	**38.54**	**40.00**	**30.00**	**40.00**	**0.00**	**0.00**	**0.00**	**0.00**	**68.54**	**80.00**
	HUW 468	**12.34**	**14.00**	**3.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**15.34**	**19.00**
	Total	**50.88**	**54.00**	**33.00**	**45.00**	**0.00**	**0.00**	**0.00**	**0.00**	**83.88**	**99.00**
	Barley										
	HUB 113	60.00	64.00	5.00	8.00	0.00	0.00	0.00	0.00	65.00	72.00
	Total	**60.00**	**64.00**	**5.00**	**8.00**	**0.00**	**0.00**	**0.00**	**0.00**	**65.00**	**72.00**
	Total Cereal Cropa	**126.88**	**217.95**	**149.20**	**120.55**	**0.00**	**0.00**	**0.00**	**0.00**	**276.08**	**338.50**
Pulses Crops	**Mung**										
	HUM 16	25.70	25.70	6.00	6.00	0.00	0.00	0.00	0.00	31.70	31.70
	HUM 12	1.70	1.70	2.60	2.60	0.00	0.00	0.00	0.00	4.30	4.30
	Total	**27.40**	**27.40**	**8.60**	**8.60**	**0.00**	**0.00**	**0.00**	**0.00**	**36.00**	**36.00**
	Pigeonpea										
	MAL 13	16.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.60	0.00
	Total	**16.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**16.60**	**0.00**
	Pea										
	HUDP 15	15.00	16.00	6.00	8.00	0.00	0.00	0.00	0.00	21.00	24.00
	Total	**15.00**	**16.00**	**6.00**	**8.00**	**0.00**	**0.00**	**0.00**	**0.00**	**21.00**	**24.00**
	Lentil										
	HUL 57	20.00	22.00	5.50	6.00	0.00	0.00	0.00	0.00	25.50	28.00
	Total	**20.00**	**22.00**	**5.50**	**6.00**	**0.00**	**0.00**	**0.00**	**0.00**	**25.50**	**28.00**
	Total Pulses Crops	**79.00**	**65.40**	**20.10**	**22.60**	**0.00**	**0.00**	**0.00**	**0.00**	**99.10**	**88.00**

	Grand Total(BHU)	**205.88**	**283.35**	**169.30**	**143.15**	**0.00**	**0.00**	**0.00**	**0.00**	**375.18**	**426.50**
41. MPKV, Rahuri											
Cereal Crops	**Pearl Millet**										
	DHLB-8A (Adishakti A line)	0.06	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.23
	DHLB-8B (Adishakti B line)	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05
	DHLBI-967 (Adishakti R line)	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.10
	Dhanshakti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.16	0.00	3.16
	Total	**0.12**	**0.38**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.16**	**0.12**	**3.54**
	Paddy										
	indrayani	16.00	38.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	38.00
	P.Radha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.60	0.00	1.60
	Bhogawati	4.70	10.80	0.00	0.00	0.00	0.00	0.00	0.00	4.70	10.80
	Samrudhi	6.00	21.50	0.00	0.00	0.00	0.00	0.00	0.00	6.00	21.50
	Total	**26.70**	**70.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.60**	**26.70**	**71.90**
	Sorghum										
	P.Ruchira	0.00	0.00	0.00	0.00	0.00	0.00	0.70	1.00	0.70	1.00
	P.Revati	2.75	4.00	0.00	0.00	0.00	0.00	20.00	30.00	22.75	34.00
	P.Anuradha	0.70	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	4.00
	P. Vasudha	1.80	8.00	0.00	0.00	0.00	0.00	0.00	0.00	1.80	8.00
	P.Amruta	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
	P.Panchmi	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.50	0.30	0.50
	P.Godhan	0.00	0.00	0.00	0.00	0.00	0.00	3.00	4.00	3.00	4.00
	P.Suchitra	0.55	2.00	0.00	0.00	0.00	0.00	20.00	32.00	20.55	34.00
	P.Rohini (RPAS-3)	0.00	0.00	0.00	0.00	0.00	0.00	1.50	2.00	1.50	2.00
	P.Madhur(RSSGV -46)	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.10	0.20

	185A	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.10	0.20
	185B	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.10	0.20
	RSSV-260(R)	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.10	0.20
	P.Yashoda	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.10	0.20
	Total	**5.90**	**18.10**	**0.00**	**0.00**	**0.00**	**0.00**	**46.00**	**70.50**	**51.90**	**88.60**
	Maize										
	Female of Phule Madhu (QMHSC-1182)	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	Male of Phule Madhu (QMHSC-1182)	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
	Female of Phule Maharshi (QMH-1025)	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	Male of Phule Maharshi (QMH-1025)	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
	GPM-456 (Female of Rajashree)	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	GPM-342 (Male of Rajashree)	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
	Total	**0.29**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.29**	**0.00**
	Finger Millet										
	Dapoli 1	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
	P.Nachani	0.03	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.70
	Total	**0.03**	**0.97**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.03**	**0.97**
	Little Millet										
	P. Ekadashi	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
	Total	**0.00**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**

	Wheat										
	HD-2189	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00	3.00	5.00
	Thrimbak (NIAW-301)	4.40	8.00	0.00	0.00	0.00	0.00	0.00	0.00	4.40	8.00
	Tapovan (NIAW-917)	3.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00
	Netrawati (NIAW-1415)	19.20	32.00	0.00	0.00	0.00	0.00	0.00	0.00	19.20	32.00
	P.Samadhan(NIAW-1994)	26.00	40.00	0.00	0.00	0.00	0.00	30.00	40.00	56.00	80.00
	Total	**52.60**	**85.00**	**0.00**	**0.00**	**0.00**	**0.00**	**33.00**	**45.00**	**85.60**	**130.00**
	Total Cereal Crops	**85.64**	**174.85**	**0.00**	**0.00**	**0.00**	**0.00**	**79.00**	**120.26**	**164.64**	**295.11**
Pulses Crops	**Pigeonpea**										
	ICPL-87	1.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	3.50
	Vipula	4.95	3.50	0.00	0.00	0.00	0.00	0.00	0.00	4.95	3.50
	Rajeshwari	8.00	28.00	0.00	0.00	10.00	0.00	0.00	0.00	18.00	28.00
	BDN-711	0.00	40.00	0.00	0.00	30.00	0.00	0.00	0.00	30.00	40.00
	Total	**13.95**	**75.00**	**0.00**	**0.00**	**40.00**	**0.00**	**0.00**	**0.00**	**53.95**	**75.00**
	Greengram										
	Vaibhav	0.50	2.35	0.00	0.00	0.00	0.00	0.00	0.00	0.50	2.35
	BM-2003-02	0.00	0.00	0.00	0.00	10.00	7.50	0.00	0.00	10.00	7.50
	Total	**0.50**	**2.35**	**0.00**	**0.00**	**10.00**	**7.50**	**0.00**	**0.00**	**10.50**	**9.85**
	Blackgram										
	TAU-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	IPU-2-43	0.00	0.00	0.00	0.00	10.00	9.00	0.00	0.00	10.00	9.00
	PKV-Blackgram	0.00	0.00	0.00	0.00	10.00	5.50	0.00	0.00	10.00	5.50
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**20.00**	**14.50**	**0.00**	**0.00**	**20.00**	**14.50**
	Chickpea										
	Vijay	98.00	70.00	0.00	0.00	0.00	0.00	0.00	0.00	98.00	70.00
	Vishal	73.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	73.00	50.00

	Digvijay	152.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	152.00	200.00
	Virat	7.20	20.00	0.00	0.00	0.00	0.00	0.00	0.00	7.20	20.00
	Vikram	225.00	300.00	20.00	30.00	10.00	20.00	40.00	50.00	295.00	400.00
	Vikrant	17.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00	15.00
	Kripa	16.10	10.00	0.00	0.00	0.00	0.00	0.00	0.00	16.10	10.00
	Total	**588.30**	**665.00**	**20.00**	**30.00**	**10.00**	**20.00**	**40.00**	**50.00**	**658.30**	**765.00**
	Rajmash										
	Varun	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00	3.00	5.00
	P. Rajama	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00	1.00	2.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.00**	**7.00**	**4.00**	**7.00**
	Total Pulses Crops	**602.75**	**742.35**	**20.00**	**30.00**	**80.00**	**42.00**	**44.00**	**57.00**	**746.75**	**871.35**
Oilseed Crops	**Sesame**										
	PT-1	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.15
	JLT-408	0.02	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.40
	Total	**0.02**	**0.40**	**0.00**	**0.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.55**
	Soybean										
	JS-335	500.00	640.00	0.00	0.00	0.00	0.00	0.00	0.00	500.00	640.00
	Phule Kalyani	37.80	358.00	0.00	0.00	0.00	0.00	0.00	0.00	37.80	358.00
	Phule Agrani	97.50	108.00	0.00	0.00	0.00	0.00	0.00	0.00	97.50	108.00
	KDS-753	0.00	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00
	JS-93-05	0.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00
	P.Sangam (KDS-123)	0.00	148.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	148.00
	Total	**635.30**	**1294.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**635.30**	**1294.00**
	Groundnut										
	SB-XI	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	JL-501	0.00	0.00	0.00	1.50	0.00	0.00	0.00	0.00	0.00	1.50
	P. Bharti (JL-776)	8.00	9.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	9.00
	P.Morana (KDG-	0.00	3.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.25

	123)										
	P.Unatti	8.50	20.00	0.00	0.00	0.00	0.00	0.00	0.00	8.50	20.00
	P.Warana (KDG-128)	0.00	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00
	KDG-160	0.00	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50
	Total	**16.50**	**49.75**	**10.00**	**11.50**	**0.00**	**0.00**	**0.00**	**0.00**	**26.50**	**61.25**
	Sunflower										
	P.Bhaskar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.07
	Bhanu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.09**	**0.00**	**0.09**
	Niger										
	P.Karala	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.00	0.05	0.01
	P.Vaitarana	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.08
	Total	**0.00**	**0.00**	**0.05**	**0.09**	**0.00**	**0.00**	**0.00**	**0.00**	**0.05**	**0.09**
	Safflower										
	P.Kusuma	0.10	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.30
	SSF-708	5.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	7.00
	P.Chandrabhaga	0.10	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.30
	Total	**5.20**	**7.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.20**	**7.60**
	Total OilSeed Crops	**657.02**	**1351.75**	**10.05**	**11.74**	**0.00**	**0.00**	**0.00**	**0.09**	**667.07**	**1363.58**
Fibre Crops	**Cotton**										
	NH 615	0.20	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	2.00
	Phule LJA 794	0.50	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.72
	JLA 505	0.10	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.24
	NHH 44 BN 1A	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05
	NHH 44 AC 738R	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
	Total	**0.88**	**3.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.88**	**3.04**
	Total Fibre Crops	**0.88**	**3.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.88**	**3.04**
Forage Crops	**Maize**										

	A.Tall	14.46	10.50	0.00	0.00	0.00	0.00	0.00	0.00	14.46	10.50
	Total	**14.46**	**10.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**14.46**	**10.50**
	Bajra										
	Giant Bajra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.00	30.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.00**	**0.00**	**30.00**
	Stylo										
	P. Kranti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.00**	**0.04**
	Cowpea										
	Sweta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10
	P.Vithai	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.90
	EC-4216	4.00	1.80	0.00	0.00	0.00	0.00	0.00	0.00	4.00	1.80
	Total	**4.00**	**1.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**4.00**	**2.80**
	Lucerene										
	RL-88	0.40	0.40	0.00	0.00	0.00	0.00	0.60	0.80	1.00	1.20
	Total	**0.40**	**0.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.60**	**0.80**	**1.00**	**1.20**
	Berseem										
	Vardan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Oat										
	P.Harita	5.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	6.00
	P.Surbhi	0.00	0.00	0.00	0.00	0.00	0.00	3.00	4.00	3.00	4.00
	Kent	20.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00
	Total	**25.00**	**26.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.00**	**4.00**	**28.00**	**30.00**
	Total Forage Crops	**43.86**	**38.70**	**0.00**	**0.00**	**0.00**	**0.00**	**3.60**	**35.84**	**47.46**	**74.54**
	Grand Total (Rahuri)	**1390.15**	**2310.69**	**30.05**	**41.74**	**80.00**	**42.00**	**126.60**	**213.19**	**1626.80**	**2607.62**
42. MPUAT, Udaipur											
Cereals Crops	**Sorghum**										

	CSV 17	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20
	CSV 23	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00
	Total	**0.75**	**0.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.75**	**0.20**
	Maize										
	EI-586-2 (Female of Pratap Hybrid Maize-3 (PH-1974))	6.30	12.60	0.00	0.00	0.00	0.00	0.00	0.00	6.30	12.60
	EI-670-2 (Male of Pratap Hybrid Maize-3 (PH-1974))	3.10	6.20	0.00	0.00	0.00	0.00	0.00	0.00	3.10	6.20
	Praptap Makka-3 (EC-3108)	0.50	8.89	0.00	0.00	0.00	0.00	0.00	0.00	0.50	8.89
	Pratap Makka-5	0.00	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00
	Pratap Kanchan-2 WC-236 (Y)	0.22	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.40
	Total	**10.12**	**39.09**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.12**	**39.09**
	Wheat										
	Raj 4079	30.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	40.00
	Raj 4238	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Raj 4037	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	JW 3336	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GW 451	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	JW 3288	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**30.00**	**40.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.00**	**40.00**
	Total Cereals	**40.87**	**79.29**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**40.87**	**79.29**
Pulse Crops	**Horse Gram**										
	Pratap Kulthi 1	4.00	1.75	0.00	0.00	0.00	0.00	0.00	0.00	4.00	1.75
	Total	**4.00**	**1.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.00**	**1.75**
	Gram										

	Pratap Chana-1	25.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	25.00
	GNG-1958	105.00	105.00	0.00	0.00	0.00	0.00	0.00	0.00	105.00	105.00
	CSJ-515	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00
	GNG-1581	30.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	30.00
	Total	**170.00**	**170.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**170.00**	**170.00**
	Total Pulse Crops	**174.00**	**171.75**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**174.00**	**171.75**
Oilseed Crops	**Soybean**										
	JS-20-29	200.00	137.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	137.00
	JS-20-34	100.00	55.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	55.00
	Total	**300.00**	**192.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**300.00**	**192.00**
	Total Oilsed Crops	**300.00**	**192.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**300.00**	**192.00**
Forage Crops	**Maize**										
	Pratap Makka Chari 6	4.10	94.10	0.00	0.00	0.00	0.00	0.00	0.00	4.10	94.10
	Total	**4.10**	**94.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.10**	**94.10**
	Total Forage Crops	**4.10**	**94.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.10**	**94.10**
	Grand Total (Udaipur)	**518.97**	**537.14**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**518.97**	**537.14**
43. PDKV, Akola											
Cereal Crops	**Sorghum**										
	SPH 468 (CSH 14) MS-14 A	0.16	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.21
	SPH 468 (CSH 14) MS-14 B	0.09	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.12
	SPH 468 (CSH 14) AKR-150	0.07	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.14
	PKV ASHWINI	0.52	0.66	0.00	0.00	0.00	0.00	0.00	1.01	0.52	1.67
	AKSV 181	0.04	0.23	0.00	0.00	0.00	0.00	0.00	0.25	0.04	0.48

	SPH 1635 AKR-456	0.05	0.74	0.00	0.00	0.00	0.00	0.00	1.30	0.05	2.04
	CSH 35-A LINE (AKMS 30A)	0.15	0.32	0.00	0.00	0.00	0.00	0.00	0.61	0.15	0.93
	CSH 35-B LINE (AKMS 30B)	0.10	0.31	0.00	0.00	0.00	0.00	0.00	0.80	0.10	1.11
	CSH 35-R LINE (AKR 504)	0.03	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.13
	PKV Kranti (AKSV 13R)	0.10	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.50
	Total	**1.31**	**3.36**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.97**	**1.31**	**7.33**
	Wheat										
	AKW -4210-6 (PDKV Sardar)	2.00	10.00	0.00	0.00	0.00	0.00	0.00	54.40	2.00	64.40
	AKW -4627	4.00	15.00	0.00	0.00	0.00	0.00	0.00	102.60	4.00	117.60
	WSM-1472 (PDKV WASHIM)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	0.00	24.00
	Total	**6.00**	**25.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**181.00**	**6.00**	**206.00**
	Paddy										
	PKV-HMT	79.60	116.89	0.00	0.00	0.00	0.00	0.00	0.00	79.60	116.89
	PKV Kisan	0.50	1.40	0.00	0.00	0.00	0.00	0.00	9.00	0.50	10.40
	Total	**80.10**	**118.29**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**9.00**	**80.10**	**127.29**
	Bajra										
	PKV-Raj- A line (BMS-5-23A)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PKV-Raj-B Line (BMS-5-23B)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PKV-Raj-R Line (BR 333)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Total Cereal Crops	**87.41**	**146.65**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**193.97**	**87.41**	**340.62**

Pulses Crops	**Tur**										
	PKV TARA	8.65	10.00	0.00	0.00	0.00	0.00	0.00	0.00	8.65	10.00
	ICPL-87119	2.00	19.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	19.00
	Total	**10.65**	**29.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.65**	**29.00**
	Gram										
	JAKI-9218	100.00	150.00	50.00	75.00	0.00	0.00	0.00	275.00	150.00	500.00
	PKV KABULI 2	17.00	20.00	0.00	0.00	0.00	0.00	0.00	23.20	17.00	43.20
	PKV KABULI 4	254.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	254.00	1.00
	AKG-1109 (PDKV Kanchan)	11.50	16.60	10.00	15.00	0.00	0.00	0.00	0.00	21.50	31.60
	PKV Harita	0.90	2.00	0.00	0.00	0.00	0.00	0.00	5.60	0.90	7.60
	Total	**383.40**	**189.60**	**60.00**	**90.00**	**0.00**	**0.00**	**0.00**	**303.80**	**443.40**	**583.40**
	Mung										
	PKV AKM 4 (AKM 9904)	1.00	3.90	0.00	0.00	0.00	0.00	0.00	4.56	1.00	8.46
	PKV MOONG 8802	1.00	3.25	0.00	0.00	0.00	0.00	0.00	1.29	1.00	4.54
	TARM 1	1.02	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	1.00
	KOPERGAON	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.20	3.00	3.20
	Total	**3.02**	**8.15**	**0.00**	**0.00**	**0.00**	**0.00**	**3.00**	**9.05**	**6.02**	**17.20**
	Udid										
	PDKV BLACK GOLD (AKU 10-1)	3.00	6.30	1.00	1.50	0.00	0.00	0.00	4.85	4.00	12.65
	AKU 15	3.05	7.77	0.00	0.00	0.00	0.00	0.00	5.72	3.05	13.49
	TAU 1	17.65	22.60	0.00	0.00	0.00	0.00	0.00	0.00	17.65	22.60
	Total	**23.70**	**36.67**	**1.00**	**1.50**	**0.00**	**0.00**	**0.00**	**10.57**	**24.70**	**48.74**
	Total Pulses Crops	**420.77**	**263.42**	**61.00**	**91.50**	**0.00**	**0.00**	**3.00**	**323.42**	**484.77**	**678.34**
Oilseed Crops	**Soybean**										
	JS-335	500.00	271.32	0.00	0.00	0.00	0.00	0.00	0.00	500.00	271.32
	JS·9305	400.00	110.86	0.00	0.00	0.00	0.00	0.00	0.00	400.00	110.86

	NRC 37	20.00	54.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	54.00
	MAUS 162	0.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00
	MAUS 71	0.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	80.00
	Total	**920.00**	**541.18**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**920.00**	**541.18**
	Safflower										
	AKS-207	5.50	0.80	0.00	0.00	0.00	0.00	0.00	0.00	5.50	0.80
	PKV PINK (AKS 311)	0.40	1.00	0.00	0.00	0.00	0.00	0.00	4.60	0.40	5.60
	Total	**5.90**	**1.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.60**	**5.90**	**6.40**
	Linseed										
	NL-260	0.12	0.40	0.00	0.00	0.00	0.00	0.00	1.00	0.12	1.40
	NL-97	0.12	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.40
	Total	**0.24**	**0.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.24**	**1.80**
	Sesame										
	PKV NT-11	0.02	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.10
	Total	**0.02**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.10**
	Total Oilseed Crops	**926.16**	**543.88**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.60**	**926.16**	**549.48**
Fiber Crops	**Imp. Cotton**										
	AKA 8	0.50	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.90
	AKA-7	1.00	2.50	0.50	0.87	0.00	0.00	0.00	0.00	1.50	3.37
	AKH-081	0.20	1.00	0.00	0.00	0.00	0.00	0.00	0.87	0.20	1.87
	AKA 5	1.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.60
	PKV HY-2-AK-32	0.04	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	2.00
	PKV HY-2-DHY-286-1	0.02	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.07
	Total	**2.76**	**8.07**	**0.50**	**0.87**	**0.00**	**0.00**	**0.00**	**0.87**	**3.26**	**9.81**
	Total Fiber Crops	**2.76**	**8.07**	**0.50**	**0.87**	**0.00**	**0.00**	**0.00**	**0.87**	**3.26**	**9.81**
	Grand Total (Akola)	**1437.10**	**962.02**	**61.50**	**92.37**	**0.00**	**0.00**	**3.00**	**523.86**	**1501.60**	**1578.25**

44. BAU, Ranchi											
Cereal Crops	**Paddy**										
	Birsa Vikas Dhan-109	5.70	1.20	0.00	0.00	0.00	0.00	0.00	0.00	5.70	1.20
	Birsa Vikas Dhan 108	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Birsa Vikas Dhan-110	1.70	1.10	0.00	0.00	0.00	0.00	0.00	0.00	1.70	1.10
	Birsamati	1.70	2.30	0.00	0.00	0.00	0.00	0.00	0.00	1.70	2.30
	Lalat (IET 9947)	0.00	0.00	6.00	6.10	0.00	0.00	0.00	0.00	6.00	6.10
	Naveen	0.00	0.00	5.00	3.80	0.00	0.00	0.00	0.00	5.00	3.80
	Sahbagi	0.00	0.00	10.00	12.10	0.00	0.00	0.00	0.00	10.00	12.10
	MTU-1010	0.00	0.00	5.00	4.25	0.00	0.00	0.00	0.00	5.00	4.25
	Rajendera Mansuri	0.00	0.00	4.00	3.55	0.00	0.00	0.00	0.00	4.00	3.55
	Swarna (MTU-7029)	0.00	0.00	4.00	10.35	0.00	0.00	0.00	0.00	4.00	10.35
	IR64 Drt-1	0.00	0.00	4.00	4.00	0.00	0.00	0.00	0.00	4.00	4.00
	Total	**10.80**	**4.60**	**38.00**	**44.15**	**0.00**	**0.00**	**0.00**	**0.00**	**47.10**	**48.75**
	Maize										
	Suwan-1	0.88	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.90
	BVM-2	1.76	1.20	0.00	0.00	0.00	0.00	0.00	0.00	1.76	1.20
	Total	**2.64**	**2.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.64**	**2.10**
	Fingermillet										
	A-404	0.11	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.20
	Birsa Marua-2	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08
	Total	**0.19**	**0.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.19**	**0.28**
	Wheat										
	DBW 187	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	K 1006	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
	Total	**0.00**	**0.00**	**12.00**	**12.00**	**0.00**	**0.00**	**0.00**	**0.00**	**12.00**	**12.00**

	Barley										
	DWRB 137	0.00	0.00	5.00	3.00	0.00	0.00	0.00	0.00	5.00	3.00
	Total	**0.00**	**0.00**	**5.00**	**3.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**3.00**
	Total Cereal Crops	**13.63**	**6.98**	**55.00**	**59.15**	**0.00**	**0.00**	**0.00**	**0.00**	**66.93**	**66.13**
Pulses Crops	**Pigeonpea**										
	Birsa Arhar-1	1.29	1.30	0.00	0.00	0.00	0.00	0.00	0.00	1.29	1.30
	Total	**1.29**	**1.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.29**	**1.30**
	Urd										
	Birsa Urd-1	7.39	7.10	0.00	0.00	0.00	0.00	0.00	0.00	7.39	7.10
	Total	**7.39**	**7.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.39**	**7.10**
	Horse Gram										
	Birsa Kulthi-1	0.70	4.80	0.00	0.00	0.00	0.00	0.00	0.00	0.70	4.80
	Total	**0.70**	**4.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.70**	**4.80**
	Chickpea										
	Birsa Chana 3	10.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	3.00
	Total	**10.00**	**3.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.00**	**3.00**
	Total Pulses Crops	**19.38**	**16.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**19.38**	**16.20**
Oil Seed Crops	**Groundnut**										
	Birsa Gold	64.18	4.00	0.00	0.00	0.00	0.00	0.00	0.00	64.18	4.00
	Total	**64.18**	**4.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**64.18**	**4.00**
	Sesame										
	Kanke White	0.08	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.40
	Total	**0.08**	**0.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.08**	**0.40**
	Niger										
	Birsa Niger-3	6.14	2.32	0.00	0.00	0.00	0.00	0.00	0.00	6.14	2.32
	BNS 9	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12	0.00
	Pooja (BNS-10)	2.11	0.90	0.00	0.00	0.00	0.00	0.00	0.00	2.11	0.90
	Total	**9.37**	**3.22**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**9.37**	**3.22**

	Soybean										
	JS 97-52	20.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	15.00
	Birsa Soybean-1	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	2.00
	Total	**21.00**	**17.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**21.00**	**17.00**
	Mustard										
	Shivani	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10
	Total	**0.05**	**0.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.05**	**0.10**
	Linseed										
	Divya	0.00	0.00	0.50	2.00	0.00	0.00	0.00	0.00	0.50	2.00
	Priyam	0.00	0.00	0.50	2.00	0.00	0.00	0.00	0.00	0.50	2.00
	Total	**0.00**	**0.00**	**1.00**	**4.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**4.00**
	Total Oil Seed Crops	**94.68**	**24.72**	**1.00**	**4.00**	**0.00**	**0.00**	**0.00**	**0.00**	**95.68**	**28.72**
	Grand Total (Ranchi)	**127.69**	**47.90**	**56.00**	**63.15**	**0.00**	**0.00**	**0.00**	**0.00**	**181.99**	**111.05**
45. BSKKV, Dapoli											
Cereal Crops	**Paddy**										
	Ratnagiri-1	0.60	60.70	0.00	0.00	0.00	0.00	6.90	10.00	7.50	70.70
	Ratnagiri-2	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50
	Ratnagiri-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.00	1.35
	Ratnagiri-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.65	0.00	7.65
	Ratnagiri-5	2.00	17.50	0.00	0.00	0.00	0.00	0.00	0.00	2.00	17.50
	Ratnagiri-6	0.00	0.00	0.00	0.00	0.00	0.00	9.00	22.80	9.00	22.80
	Ratnagiri-7	0.00	0.00	0.00	0.00	0.00	0.00	4.00	7.60	4.00	7.60
	Ratnagiri-8	0.00	0.00	0.00	0.00	0.00	0.00	6.80	23.70	6.80	23.70
	Ratnagiri-24	3.00	11.50	0.00	0.00	0.00	0.00	3.00	3.00	6.00	14.50
	Ratnagiri-73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	0.00	1.62
	Ratnagiri-711	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.75	0.00	6.75
	Karjat-2	1.32	4.80	0.00	0.00	0.00	0.00	0.00	3.30	1.32	8.10
	Karjat-3	5.00	5.44	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.44

	Karjat-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.30	0.00	6.30
	Karjat-5	2.80	4.48	0.00	0.00	0.00	0.00	0.00	4.52	2.80	9.00
	Karjat-6	1.88	5.12	0.00	0.00	0.00	0.00	0.00	0.00	1.88	5.12
	Karjat-7	3.00	7.36	0.00	0.00	0.00	0.00	0.00	0.00	3.00	7.36
	Karjat-8	1.00	7.36	0.00	0.00	0.00	0.00	0.00	0.00	1.00	7.36
	Karjat-9	0.00	0.00	0.30	12.60	0.00	0.00	0.00	0.00	0.30	12.60
	Karjat-10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	0.00	9.00
	Karjat-184	1.00	3.60	0.00	0.00	0.00	0.00	0.00	2.70	1.00	6.30
	BARCKKV-13 (Trombay Karjat Kolam)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60	0.00	3.60
	Panvel-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.95	0.00	3.95
	Panvel-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.00	1.35
	Panvel-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.12	0.00	2.12
	Palghar-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.00	1.35
	Palghar-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0.00	1.35
	Phondaghat-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.22
	Hybrid Paddy										
	***Sahyadri-3**										
	IR 58025 A line	0.10	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.41
	IR 58025 B line	0.03	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.17
	KJTR-4 R line	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.10
	***Sahyadri-4**										
	IR 58025 A line	0.15	0.40	0.00	0.00	0.00	0.00	4.00	2.12	4.15	2.52
	IR 58025 B line	0.05	0.15	0.00	0.00	0.00	0.00	1.00	1.50	1.05	1.65
	KJTR-4 R line	0.03	0.05	0.05	0.00	0.00	0.00	2.00	0.28	2.08	0.33
	***Sahyadri-5**										
	RTN 13 A	0.15	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.18
	RTN 13 B	0.05	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.27
	SSR 5 R	0.05	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.41

	Sahyadri Series R lines										
	KJTR-1	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.40	1.00	0.40
	KJTR-2	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.35	1.00	0.35
	KJTR-3	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.45	1.00	0.45
	Total	**23.24**	**131.50**	**0.35**	**12.60**	**0.00**	**0.00**	**39.70**	**129.33**	**63.29**	**273.43**
	Finger Millet (Nagli)										
	Dapoli-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.27
	Dapoli Safed-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.22
	Dapoli-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.18
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.67**	**0.00**	**0.67**
	Total Cereal Crops	**23.24**	**131.50**	**0.35**	**12.60**	**0.00**	**0.00**	**39.70**	**130.00**	**63.29**	**274.10**
Pulses Crops	**Pigeonpea**										
	Konkan Tur	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.00**	**0.02**
	Cowpea										
	Konkan Sadabahar	0.00	0.00	0.00	0.00	0.00	0.00	0.40	1.00	0.40	1.00
	Konkan Safed	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.40**	**2.00**	**1.40**	**2.00**
	Lablab Bean										
	Konkan Wal-2	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50	1.00	1.50
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.50**	**1.00**	**1.50**
	Horsegram										
	Dapoli Kulathi-1	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.80	0.50	0.80
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.80**	**0.50**	**0.80**
	Total Pulses Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.90**	**4.32**	**2.90**	**4.32**
Oilseed Crops	**Groundnut**										

	Konkan Tapora (TKG Bold)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	0.00	5.50
	Konkan Gaurav	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90	0.00	2.90
	Konkan Bhuratn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.00	0.00	22.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.40**	**0.00**	**30.40**
	Total Oilseed Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.40**	**0.00**	**30.40**
Forage Crops	**Cowpea**										
	Konkan Fodder Cowpea-1	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.35	1.00	0.35
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.35**	**1.00**	**0.35**
	Ricebean										
	Konkan Rice bean-1	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.10
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.10**	**0.10**	**0.10**	**0.10**
	Total forage Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.10**	**0.45**	**1.10**	**0.45**
	Grand Total (Dapoli)	**23.24**	**131.50**	**0.35**	**12.60**	**0.00**	**0.00**	**43.70**	**165.17**	**67.29**	**309.27**
46. ICAR-CCARI, Goa											
Cereal Crops	**Paddy**										
	Goa dhan-1	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	Goa dhan-2	0.00	0.00	5.00	4.00	0.00	0.00	0.00	0.00	5.00	4.00
	Total	**0.00**	**0.00**	**10.00**	**9.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.00**	**9.00**
	Total Cereal Crops	**0.00**	**0.00**	**10.00**	**9.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.00**	**9.00**
Pulses Crops	**Cowpea**										
	Goa Cowpea	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	Total	**0.00**	**0.00**	**5.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**5.00**
	Total Pulses Crops	**0.00**	**0.00**	**5.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.00**	**5.00**

	Grand Total (Goa)	**0.00**	**0.00**	**15.00**	**14.00**	**0.00**	**0.00**	**0.00**	**0.00**	**15.00**	**14.00**
47. SKUAST Jammu											
Cereal Crops	**Paddy**										
	PB 1612	0.00	0.00	0.50	0.60	0.00	0.00	0.00	0.00	0.50	0.60
	SJR 129	0.00	0.00	5.00	10.00	0.00	0.00	0.00	0.00	5.00	10.00
	B 370	0.00	0.00	10.00	10.00	0.00	0.00	0.00	0.00	10.00	10.00
	PB 1121	0.00	0.00	2.00	2.25	0.00	0.00	0.00	0.00	2.00	2.25
	P B1728	0.00	0.00	0.25	0.40	0.00	0.00	0.00	0.00	0.25	0.40
	K 343	0.00	0.00	2.00	2.15	0.00	0.00	0.00	0.00	2.00	2.15
	K 39	0.00	0.00	1.00	1.15	0.00	0.00	0.00	0.00	1.00	1.15
	K 448	0.00	0.00	1.00	1.15	0.00	0.00	0.00	0.00	1.00	1.15
	Giza 14	0.30	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.30	1.70
	SJR 5	10.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	12.00
	Total	**10.30**	**13.70**	**21.75**	**27.70**	**0.00**	**0.00**	**0.00**	**0.00**	**32.05**	**41.40**
	Wheat										
	WH 1105	30.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	35.00
	WH 1080	25.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00	30.00
	WH 1021	5.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	10.00
	WB 02	5.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	10.00
	HPW 349	30.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	35.00
	JAUW 584	0.00	0.00	20.00	20.00	0.00	0.00	0.00	0.00	20.00	20.00
	JAUW 598	0.00	0.00	20.00	20.00	0.00	0.00	0.00	0.00	20.00	20.00
	Total	**95.00**	**120.00**	**40.00**	**40.00**	**0.00**	**0.00**	**0.00**	**0.00**	**135.00**	**160.00**
	Total Cereal Crops	**105.30**	**133.70**	**61.75**	**67.70**	**0.00**	**0.00**	**0.00**	**0.00**	**167.05**	**201.40**
	Grand Total (Jammu)	**105.30**	**133.70**	**61.75**	**67.70**	**0.00**	**0.00**	**0.00**	**0.00**	**167.05**	**201.40**
48. ANGRAU, Guntur											
Cereal Crops	**Paddy**										

	Amara (MTU-1064)	7.60	7.60	31.00	33.00	0.00	0.00	0.00	0.00	38.60	40.60
	Bharani (NLR 30491)	7.00	8.40	2.60	2.60	0.00	0.00	0.00	0.00	9.60	11.00
	Bhavapuri Sannalu	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00
	BPT-3291 (Sonamasuri)	8.60	8.60	0.00	0.00	0.00	0.00	0.00	0.00	8.60	8.60
	Chandra (MTU-1153)	3.30	3.30	27.80	12.20	0.00	0.00	0.00	0.00	31.10	15.50
	Cottondora Sannalu (MTU-1010)	330.00	330.00	196.00	0.00	0.00	0.00	0.00	0.00	526.00	330.00
	Indra (MTU - 1061)	7.00	7.00	57.00	20.00	0.00	0.00	0.00	0.00	64.00	27.00
	Maruteru sannalu (MTU-1006)	1.30	1.30	1.44	0.00	0.00	0.00	0.00	0.00	2.74	1.30
	MTU 1075 (IET 18482)	18.00	18.00	45.00	48.00	0.00	0.00	0.00	0.00	63.00	66.00
	MTU-1031 (Tholakuri)	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.30
	MTU-1032 (Godavari)	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.30
	MTU-1038	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
	MTU-1081	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	MTU-1156	0.30	0.30	58.64	29.72	0.00	0.00	0.00	0.00	58.94	30.02
	MTU-1210	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
	MTU-7029	237.20	237.50	218.00	70.00	0.00	0.00	0.00	0.00	455.20	307.50
	Nellore Mahsuri (NLR-34449)	34.50	50.00	135.60	140.00	0.00	0.00	0.00	0.00	170.10	190.00
	NLR-145	7.00	8.40	6.60	6.60	0.00	0.00	0.00	0.00	13.60	15.00
	Pardhiva (NLR -	3.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00

	33892)										
	Samba Mahsuri (BPT-5204)	91.60	91.60	380.00	443.00	0.00	0.00	0.00	0.00	471.60	534.60
	Sri Dhruthi (MTU-1121)	2.30	2.30	21.24	48.60	0.00	0.00	0.00	0.00	23.54	50.90
	Srikakulam Sannalu (RGL 2537)	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00
	Vijetha (MTU-1001)	124.00	124.00	99.00	118.30	0.00	0.00	0.00	0.00	223.00	242.30
	Krishanveni (MTU 2077)	0.00	0.00	5.00	5.00	0.00	0.00	0.00	0.00	5.00	5.00
	Deepthi (MTU 4870)	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
	Badava mahsuri (PLA 1100)	0.00	0.00	44.00	30.00	0.00	0.00	0.00	0.00	44.00	30.00
	Bheema (MTU 1140)	0.00	0.00	3.00	6.61	0.00	0.00	0.00	0.00	3.00	6.61
	Prabath (MTU 3626)	0.00	0.00	14.00	0.00	0.00	0.00	0.00	0.00	14.00	0.00
	Ksheera (MTU 1172)	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00
	Varam (MTU 1190)	0.00	0.00	0.00	3.55	0.00	0.00	0.00	0.00	0.00	3.55
	Samvrudhi (MTU1155)	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
	IR 64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	78.50	0.00	78.50
	NDLR 7	0.00	0.00	5.00	166.00	0.00	0.00	0.00	0.00	5.00	166.00
	NDLR 8	0.00	0.00	3.00	5.10	0.00	0.00	0.00	0.00	3.00	5.10
	BPT 2231	0.00	0.00	4.00	15.00	0.00	0.00	0.00	15.00	4.00	30.00
	Total	**897.70**	**911.90**	**1359.92**	**1208.78**	**0.00**	**0.00**	**0.00**	**93.50**	**2257.62**	**2214.18**
	Ragi										
	Sri Chaitanya	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.50	0.00	9.50

	(VR847)										
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**9.50**	**0.00**	**9.50**
	Foxtail Millet										
	SiA 3156	0.00	0.00	10.00	80.00	0.00	0.00	0.00	0.00	10.00	80.00
	Suryanandi	0.00	0.00	20.00	24.00	0.00	0.00	0.00	0.00	20.00	24.00
	SiA 3085	4.50	4.50	10.50	67.50	0.00	0.00	0.00	0.00	15.00	72.00
	Total	**4.50**	**4.50**	**40.50**	**171.50**	**0.00**	**0.00**	**0.00**	**0.00**	**45.00**	**176.00**
	Total Cereal Crops	**902.20**	**916.40**	**1400.42**	**1380.28**	**0.00**	**0.00**	**0.00**	**103.00**	**2302.62**	**2399.68**
Pulses Crops	**Red Gram**										
	ICPL-85063	3.50	6.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	6.00
	ASHA	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
	Lam 41	17.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.12	0.00
	LRG-52	0.40	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	20.00
	Total	**21.02**	**26.00**	**2.00**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**23.02**	**28.00**
	Bengalgram										
	NBeG 3	233.50	250.00	0.00	0.00	0.00	0.00	0.00	0.00	233.50	250.00
	NBeG 47	58.70	60.00	0.00	0.00	0.00	0.00	0.00	0.00	58.70	60.00
	NBeG 49	63.30	12.00	0.00	0.00	0.00	0.00	0.00	0.00	63.30	12.00
	NBeG 119	0.00	0.00	0.00	0.00	5.00	5.00	0.00	0.00	5.00	5.00
	JG 11	0.00	0.00	0.00	0.00	575.00	575.00	0.00	0.00	575.00	575.00
	Total	**355.50**	**322.00**	**0.00**	**0.00**	**580.00**	**580.00**	**0.00**	**0.00**	**935.50**	**902.00**
	Blackgram										
	LBG 752	26.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	26.00	40.00
	LBG 787	6.00	17.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	17.00
	LBG 645	0.00	0.00	2.00	2.00	0.00	0.00	0.00	0.00	2.00	2.00
	LBG 648	0.00	0.00	3.00	3.00	0.00	0.00	0.00	0.00	3.00	3.00
	PU - 31	12.00	4.50	0.00	0.00	0.00	0.00	0.00	0.00	12.00	4.50
	Total	**44.00**	**61.50**	**5.00**	**5.00**	**0.00**	**0.00**	**0.00**	**0.00**	**49.00**	**66.50**
	Greengram										

	LAM 460	13.20	19.00	0.00	0.00	0.00	0.00	0.00	0.00	13.20	19.00
	Madhira 295	6.00	31.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	31.00
	IPM- 2-14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.90	0.00	8.90
	Total	**19.20**	**50.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.90**	**19.20**	**58.90**
	Total Pulses Crops	**439.72**	**459.50**	**7.00**	**7.00**	**580.00**	**580.00**	**0.00**	**8.90**	**1026.72**	**1055.40**
Oil Seed Crops	**Groundnut**										
	Kadiri Harithandra	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00
	Kadiri-9	727.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00	727.00	200.00
	Kadiri-7	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00
	Kadiri-6	4028.00	3469.00	0.00	0.00	0.00	0.00	0.00	0.00	4028.00	3469.00
	Dharani	1164.00	1164.00	0.00	0.00	0.00	0.00	0.00	0.00	1164.00	1164.00
	Narayani	173.00	173.00	0.00	0.00	0.00	0.00	0.00	0.00	173.00	173.00
	Total	**6112.00**	**5026.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6112.00**	**5026.00**
	Sesamum										
	YLM-66	0.00	0.00	1.80	0.00	0.00	0.00	0.00	0.00	1.80	0.00
	YLM-11	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	1.40	0.00
	YLM-17	0.00	0.00	2.30	0.00	0.00	0.00	0.00	0.00	2.30	0.00
	Gowri	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	1.40	0.00
	Total	**0.00**	**0.00**	**6.90**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6.90**	**0.00**
	Total Oil Seed Crops	**6112.00**	**5026.00**	**6.90**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**6118.90**	**5026.00**
Fiber Crops	**Mesta**										
	AMV-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	3.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.00**	**0.00**	**3.00**
	Total Fiber Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.00**	**0.00**	**3.00**
	Grand Total (Guntur)	**7453.92**	**6401.90**	**1414.32**	**1387.28**	**580.00**	**580.00**	**0.00**	**114.90**	**9448.24**	**8484.08**
49. PAJNCOA & RI, Karaikal											
Cereal Crops	**Paddy**										

	CR 1009 Sub 1	0.00	0.00	2.40	7.50	0.00	0.00	0.00	0.00	2.40	7.50
	ADT (R) 50	0.00	0.00	0.40	6.00	0.00	0.00	0.00	0.00	0.40	6.00
	I. W. Ponni	0.00	0.00	2.40	5.70	0.00	0.00	0.00	0.00	2.40	5.70
	ADT (R) 46	0.00	0.00	0.60	9.50	0.00	0.00	0.00	0.00	0.60	9.50
	ADT 39	0.00	0.00	0.30	8.70	0.00	0.00	0.00	0.00	0.30	8.70
	CO 52	0.00	0.00	0.90	8.40	0.00	0.00	0.00	0.00	0.90	8.40
	Total	**0.00**	**0.00**	**7.00**	**45.80**	**0.00**	**0.00**	**0.00**	**0.00**	**7.00**	**45.80**
	Total Cereal Crops	**0.00**	**0.00**	**7.00**	**45.80**	**0.00**	**0.00**	**0.00**	**0.00**	**7.00**	**45.80**
	Grand Total (Karaikal)	**0.00**	**0.00**	**7.00**	**45.80**	**0.00**	**0.00**	**0.00**	**0.00**	**7.00**	**45.80**
50. CAU, Imphal											
Cereal Crops	**Paddy**										
	CAU-R1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.70	0.00	5.70
	CAU-R2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
	CAU-R3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
	CAU-R4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	1.20
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.40**	**0.00**	**8.40**
	Total Cereal Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.40**	**0.00**	**8.40**
	Grand Total (Imphal)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.40**	**0.00**	**8.40**
51. IGFRI, Jhansi											
Forage crops	**Cowpea**										
	EC 4216	3.55	0.25	0.00	0.00	0.00	0.00	0.00	0.00	3.55	0.25
	Bundel Lobia 2	2.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.75
	Total	**5.55**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.55**	**1.00**
	Oat										
	Kent	63.35	75.00	0.00	0.00	0.00	0.00	0.00	0.00	63.35	75.00
	JHO 822	35.00	65.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	65.00

	JHO 2010-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	0.00	5.50
	JHO 2000-4	5.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	8.00
	JHO2009-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00	2.00
	JHO 99-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
	JHO 99-2	1.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	1.50	2.50
	JHO 851	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
	Total	**104.85**	**150.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**8.50**	**104.85**	**159.00**
	Berseem										
	Wardan	8.55	12.50	0.00	0.00	0.00	0.00	0.00	0.00	8.55	12.50
	BB 2	2.20	4.10	0.00	0.00	0.00	0.00	0.00	0.00	2.20	4.10
	BB 3	0.50	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.50
	JBSC 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
	Total	**11.25**	**18.10**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**11.25**	**19.10**
	Total Forage Crops	**121.65**	**169.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**9.50**	**121.65**	**179.10**
	Grand Total(Jhansi)	**121.65**	**169.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**9.50**	**121.65**	**179.10**
52. ICRISAT, Patencheru											
Cereal Crops	**Pearlmillet**										
	Dhanshakthi	2.24	2.50	0.00	0.00	0.00	0.00	0.00	0.00	2.24	2.50
	ICMA 98222 (A line AHB 1200)	0.14	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.40
	ICMB 98222 (B line AHB 1200)	0.07	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.10
	ICMA 04888 (A line HHB 299)	0.14	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.40
	ICMB 04888 (B line HHB 299)	0.07	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.10
	ICMA 94222 (A line HHB 256)	0.2	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.15
	ICMB 94222 (B	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00

	line HHB 256)										
	ICMA 04999 (A line GHB 905 & MPMH 17)	0.32	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.50
	ICMB 04999 (B line GHB 905 & MPMH 17)	0.14	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.20
	843-22A (A line HHB 67 Imp. , RHB 177 & HHB 226)	0.37	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.37	1.30
	843-22B (B line HHB 67 Imp., RHB 177 & HHB 226)	0.14	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.60
	ICMA 93333 (A line RHB 173)	0.1	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.30
	ICMB 93333 (B line RHB 173)	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10
	ICMA 96666 (A line RHB 223)	0.2	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.30
	ICMB 96666 (B line RHB 223)	0.1	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
	Total	**4.38**	**7.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.38**	**7.05**
	Total Cereal Crops	**4.38**	**7.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.38**	**7.05**
Pulse Crops	**Pigeonpea**										
	ICPH 2675	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	ICPH 2740 (A line)	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
	ICPH 2740 (B line)	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	ICPH 2740 (R	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00

	line)										
	Total	**0.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.20**	**0.00**
	Total Pulses	**0.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.20**	**0.00**
Oilseed Crops	**Groundnut**										
	ICGS 76	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
	Total Oilseeds	**0.50**	**0.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.50**
	Grand Total (ICRISAT)	**5.08**	**7.55**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.08**	**7.55**
53. SKNAU, Jobner											
Cereals Crops	**Pearlmillet**										
	RAJ 171	0.10	7.60	0.00	0.00	0.00	0.00	0.00	0.00	0.10	7.60
	RIB 192 S/99 (R line RHB 173)	0.05	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.13
	RIB 494 (R line RHB 177)	0.07	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.23
	RIB-3135-18 (R line RHB 223)	0.10	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.60
	Total	**0.32**	**8.56**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.32**	**8.56**
	Total Cereals	**0.32**	**8.56**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.32**	**8.56**
Pulse crops	**Cowpea**										
	RC 101	2.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	2.00	3.50
	RC 19	5.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	3.00
	Total	**7.00**	**6.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**7.00**	**6.50**
	Guar										
	RGC 1033	76.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	76.00	80.00
	RGC 1038	10.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	12.00
	RGC 1055	0.40	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	5.00
	RGC 1066	1.55	2.50	0.00	0.00	0.00	0.00	0.00	0.00	1.55	2.50
	RGC 1017	0.40	3.30	0.00	0.00	0.00	0.00	0.00	0.00	0.40	3.30
	RGC 1002	0.40	1.25	0.00	0.00	0.00	0.00	0.00	0.00	0.40	1.25

	RGC 986	0.80	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	4.00
	RGC 197	1.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.10
	Total	**90.55**	**108.15**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**90.55**	**108.15**
	Mung										
	RMG 975	10.00	28.80	0.00	0.00	0.00	0.00	0.00	0.00	10.00	28.80
	MH 421	35.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	20.00
	Ganga 1	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	Ganga 8	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	MSJ 118	10.00	27.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	27.00
	IPM 2-3	0.00	5.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10
	Total	**56.00**	**80.90**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**56.00**	**80.90**
	Total Pulse crops	**153.55**	**195.55**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**153.55**	**195.55**
Oilseed Crops	**Groundnut**										
	Raj Mungfali 3	38.00	27.20	0.00	0.00	0.00	0.00	0.00	0.00	38.00	27.20
	Raj Mungfali 2	20.00	17.40	0.00	0.00	0.00	0.00	0.00	0.00	20.00	17.40
	Raj Mungfali 1	50.00	43.80	0.00	0.00	0.00	0.00	0.00	0.00	50.00	43.80
	RG 425	10.00	8.40	0.00	0.00	0.00	0.00	0.00	0.00	10.00	8.40
	Total	**118.00**	**96.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**118.00**	**96.80**
	Total Oilseeds	**118.00**	**96.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**118.00**	**96.80**
	Grand Total (Jobner)	**271.87**	**300.91**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**271.87**	**300.91**
54. AU, Jodhpur											
Cereals Crops	**Pearlmillet**										
	MBC 2	0.12	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.12	1.22
	MIR 525-2(R line MPMH 17)	0.10	6.95	0.00	0.00	0.00	0.00	0.00	0.00	0.10	6.95
	Total	**0.22**	**8.17**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.22**	**8.17**
	Total Cereals	**0.22**	**8.17**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.22**	**8.17**
Oilseed Crops	**Sesame**										
	RT 351	9.42	4.82	0.00	0.00	0.00	0.00	0.00	0.00	9.42	4.82

	RT 346	2.25	2.73	0.00	0.00	0.00	0.00	0.00	0.00	2.25	2.73
	Total	**11.67**	**7.55**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.67**	**7.55**
	Total Oilseeds	**11.67**	**7.55**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.67**	**7.55**
	Grand Total (Jodhpur)	**11.89**	**15.72**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.89**	**15.72**
55. IIMR, Hyderabad											
Cereal Crops	**Sorghum**										
	296A	0.50	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.10
	296B	0.40	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	1.00
	CS 3541	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.30
	MS 27A	0.05	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	1.00
	MS 27 B	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10
	C 43	0.10	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	5.00
	CSV 15	21.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	21.00	30.00
	CSV 24SS	0.10	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.00
	CSV 27	11.00	30.00	0.00	0.00	0.00	0.00	5.00	10.00	16.00	40.00
	415 A	0.30	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.30
	415 B	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.15
	CB 33	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10
	CSV 26 (Solapur)	0.15	0.25	0.00	0.00	0.00	0.00	0.00	10.00	0.15	10.25
	CSV 31	0.00	0.00	0.00	0.00	0.00	0.00	8.00	15.00	8.00	15.00
	CSV 32F	0.00	0.00	0.00	0.00	0.00	0.00	5.00	10.00	5.00	10.00
	CSV 33MF	0.00	0.00	0.00	0.00	0.00	0.00	3.00	5.00	3.00	5.00
	PMS 28A	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00	3.00	3.00
	PMS 28B	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	467A	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	5.00	5.00
	467B	0.00	0.00	0.00	0.00	0.00	0.00	3.00	3.00	3.00	3.00
	CSV 29R	0.00	0.00	0.00	0.00	0.00	0.00	5.00	10.00	5.00	10.00
	Total (Sorghum)	**34.20**	**69.30**	**0.00**	**0.00**	**0.00**	**0.00**	**38.00**	**72.00**	**72.20**	**141.30**
	Total (IIMR,	**34.20**	**69.30**	**0.00**	**0.00**	**0.00**	**0.00**	**38.00**	**72.00**	**72.20**	**141.30**

	Hyderabad)										
56. IIMR, Ludhiana											
Cereal Crops	**Maize**										
	BML 6 (Female of DMRH 1301)	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.07
	IML 418-1 (Male of DMRH-1301)	0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05
	BML-6	0.00	0.00	0.00	0.00	0.00	0.00	20.00	25.00	20.00	25.00
	IML-418-1	0.00	0.00	0.00	0.00	0.00	0.00	5.00	3.50	5.00	3.50
	BML-7	0.00	0.00	0.00	0.00	0.00	0.00	5.00	3.50	5.00	3.50
	HKI-193-1	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	HKI-163	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	WOSC	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.25
	Total	**0.08**	**0.12**	**0.00**	**0.00**	**0.00**	**0.00**	**32.25**	**34.25**	**32.33**	**34.37**
	Total Cereal Crops	**0.08**	**0.12**	**0.00**	**0.00**	**0.00**	**0.00**	**32.25**	**34.25**	**32.33**	**34.37**
	Total (IIMR, Ludhiana)	**0.08**	**0.12**	**0.00**	**0.00**	**0.00**	**0.00**	**32.25**	**34.25**	**32.33**	**34.37**
57. NSC, New Delhi											
Pulse Crops	**Mung**										
	MH 421	16.30	40.00	0.00	0.00	0.00	0.00	0.00	0.00	16.30	40.00
	IPM 2-3	58.67	41.32	0.00	0.00	0.00	0.00	0.00	0.00	58.67	41.32
	IPM 2-14	37.40	19.00	0.00	0.00	0.00	0.00	0.00	0.00	37.40	19.00
	SML 668	70.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.19	0.00
	SML 832	13.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.52	0.00
	Basanthi	5.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00	5.00	3.60
	Virat	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
	Sikha	0.00	6.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.53
	Meha	0.00	2.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.36
	Total	**201.08**	**120.81**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**201.08**	**120.81**

	Urd										
	IPU 2-43	14.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.20	0.00
	Uttara	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
	PU 31	28.78	15.50	0.00	0.00	0.00	0.00	0.00	0.00	28.78	15.50
	Vallabh Urd 1	12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.50	0.00
	RV 3-14	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.00
	Total	**63.48**	**15.50**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**63.48**	**15.50**
	Grand Total (NSC)	**264.56**	**136.31**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**264.56**	**136.31**
58. HIL, Hyderabad											
Oilseed Crops	**Groundnut**										
	ICGV 91114	416.00	350.00	0.00	0.00	0.00	0.00	0.00	0.00	416.00	350.00
	ICGV 00350	590.00	590.00	0.00	0.00	0.00	0.00	0.00	0.00	590.00	590.00
	Total	**1006.00**	**940.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1006.00**	**940.00**
	Soybean										
	JS 95-60	300.00	240.80	0.00	0.00	0.00	0.00	0.00	0.00	300.00	240.80
	Total	**300.00**	**240.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**300.00**	**240.80**
	Total Oilseeds	**1306.00**	**1180.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1306.00**	**1180.80**
	Grand Total (HIL)	**1306.00**	**1180.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1306.00**	**1180.80**
59. BARC, Mumbai											
Oilseed Crops	**Groundnut**										
	TG 51	86.80	90.00	0.00	0.00	0.00	0.00	0.00	0.00	86.80	90.00
	TLG 45	20.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00
	TG 38	37.50	40.00	0.00	0.00	0.00	0.00	0.00	0.00	37.50	40.00
	TPG 41	1.50	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	2.00
	Total Oilseeds	**145.80**	**152.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**145.80**	**152.00**
	Grand Total (BARC)	**145.80**	**152.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**145.80**	**152.00**
60. ARI, Pune											

Oilseed Crops	**Soybean**										
	JS 335	200.00	138.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	138.00
	MACS 1188	125.40	297.00	0.00	0.00	0.00	0.00	0.00	0.00	125.40	297.00
	MACS 1281	10.00	39.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	39.00
	Total Oilseeds	**335.40**	**474.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**335.40**	**474.00**
	Grand Total (ARI, Pune)	**335.40**	**474.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**335.40**	**474.00**
61. Lokbharti											
Oilseed Crops	**Soybean**										
	JS 20-29	100.00	70.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	70.00
	Total Oilseeds	**100.00**	**70.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**100.00**	**70.00**
	Grand Total (Lokbharti)	**100.00**	**70.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**100.00**	**70.00**
62. ICAR-NRRI, Cuttack											
Cereals Crops	**Paddy**										
	Ankit (CR Dhan101) CR2702	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	0.00
	Annada	10.50	12.00	0.00	0.00	0.00	0.00	0.00	0.00	10.50	12.00
	Bhuvan(IET-7804)	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00
	Binadhan-12	70.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00	0.00
	Ciherung Sub-1	15.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	8.00
	CR Dhan 40	2.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.50
	CR Dhan 201(IET-21924)	81.70	20.00	0.00	0.00	0.00	0.00	0.00	0.00	81.70	20.00
	CR Dhan 209	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
	CR Dhan 300(CR2301-5)	3.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.80	0.00
	CR Dhan 303(CR2649-7)	10.30	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.30	10.00

	CR Dhan 304(IET 22117)	6.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	7.00
	CR Dhan 305 (IET 21287)	1.30	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	1.00
	CR Dhan 401(Reeta) (IET 19969)	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.00
	CR Dhan 500(IET 20220)	60.00	36.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	36.00
	CR DHAN-501 (IET 19189)	5.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00	5.00	3.60
	CR Dhan 505(IET 21719)	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
	CR Dhan 601 (IET 18558)	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00	0.00
	CR Dhan 10 (IET 18312)	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0.00
	CR Dhan 203(Sachala)	9.60	12.00	0.00	0.00	0.00	0.00	0.00	0.00	9.60	12.00
	CR Dhan 307	5.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	15.00
	CR Dhan 310	7.50	5.30	0.00	0.00	0.00	0.00	0.00	0.00	7.50	5.30
	CR Dhan 405	2.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	3.00
	CR Dhan 800	5.00	2.10	0.00	0.00	0.00	0.00	0.00	0.00	5.00	2.10
	CR Dhan 910	0.30	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.10
	CR sugandh Dhan-3 (IET 18395)	1.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50
	CR 1009-Sub-1	6.10	6.50	0.00	0.00	0.00	0.00	0.00	0.00	6.10	6.50
	CR-1014	0.30	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.30	1.20
	Dharitri (IET 6272)	4.20	7.00	0.00	0.00	0.00	0.00	0.00	0.00	4.20	7.00
	Gayatri (IET 8002)	2.00	16.80	0.00	0.00	0.00	0.00	0.00	0.00	2.00	16.80

	Geetanjali (CRM-2007-1) (IET-17276)	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
	IR64 Drt 1(IET 22836)(DRR-42)	45.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	0.00
	Khitish (IET-4094)	5.60	8.00	0.00	0.00	0.00	0.00	0.00	0.00	5.60	8.00
	Lunasampad (IET 19470)	1.60	1.80	0.00	0.00	0.00	0.00	0.00	0.00	1.60	1.80
	Lunasuwarna (IET 18697)	1.60	1.80	0.00	0.00	0.00	0.00	0.00	0.00	1.60	1.80
	Lunusree	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00
	Naveen (CR-749-20-2) (IET-14461)	35.00	25.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	25.00
	Phalguni (IET 18720)	0.50	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00
	Pooja(IET-12241)	44.10	76.20	0.00	0.00	0.00	0.00	0.00	0.00	44.10	76.20
	Poorna Bhog	0.30	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.10
	Samalei (IET-3350)	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	Sambha Sub - 1 (IET 21248)	23.50	7.80	0.00	0.00	0.00	0.00	0.00	0.00	23.50	7.80
	SARALA CR-260-77 (IET-10279)	5.60	21.00	0.00	0.00	0.00	0.00	0.00	0.00	5.60	21.00
	SATYABHAMA	12.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	3.00
	SAVITRI (IET - 5897)(CR 1009)	4.60	11.40	0.00	0.00	0.00	0.00	0.00	0.00	4.60	11.40
	SHATABDI (IET-4786)	36.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	36.00	30.00
	SWARANA-SUB 1	314.70	125.10	0.00	0.00	0.00	0.00	0.00	0.00	314.70	125.10
	Varshadhan (IET-15296)	15.30	16.20	0.00	0.00	0.00	0.00	0.00	0.00	15.30	16.20
	CRMS 31- A	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00

	CRMS 31- B	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
	CRMS 32- A	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00
	CRMS 32- B	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
	CR Dhan 407	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.90	0.50	0.90
	CR Dhan 907	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.90	0.50	0.90
	Ketakijoha	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.60	1.00	1.60
	Ranjit	0.00	0.00	0.00	0.00	0.00	0.00	6.00	7.50	6.00	7.50
	Nua Chinikamini	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.60	0.30	0.60
	Nua Kalajeera	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.20	1.00	1.20
	Padmini	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.60	0.30	0.60
	CR Borodhan 2	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.50	1.00
	CR Dhan 200	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.50	1.00
	CR Dhan 204	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.50	1.00
	CR Dhan 206	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.50	1.00
	CR Dhan 311	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.50	1.00
	CR Dhan 601	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.50	1.00
	Improved Lalat	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.00	0.50	1.00
	Ratna	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.60	0.30	0.60
	Sahabhagidhan	0.00	0.00	0.00	0.00	0.00	0.00	0.10	3.00	0.10	3.00
	CRURRS, Hazaribagh										
	Abhishek	47.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	47.00	30.00
	Anjali	2.70	2.70	0.00	0.00	0.00	0.00	0.00	0.00	2.70	2.70
	Hazaridhan	2.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.50
	Sahabhagi Dhan	383.70	231.00	0.00	0.00	0.00	0.00	0.00	0.00	383.70	231.00
	Vandana	2.04	2.10	0.00	0.00	0.00	0.00	0.00	0.00	2.04	2.10
	CRLRRS, Gerua										
	Chandrama	38.00	45.80	0.00	0.00	0.00	0.00	0.00	0.00	38.00	45.80
	Naveen	15.00	62.20	0.00	0.00	0.00	0.00	0.00	0.00	15.00	62.20
	Total	**1421.08**	**877.30**	**0.00**	**0.00**	**0.00**	**0.00**	**13.50**	**23.90**	**1434.58**	**901.20**

	Grand Total (Cuttack)	**1421.08**	**877.30**	**0.00**	**0.00**	**0.00**	**0.00**	**13.50**	**23.90**	**1434.58**	**901.20**
63. ICAR-IIRR, Hyderabad											
Cereals Crops	**Paddy**										
	Binadhan-10	0.30	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.10
	Binadhan-11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Binadhan-12	20.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	20.00	1.40
	Binadhan-8	0.40	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.60
	Ciherung Sub-1	13.50	0.18	0.00	0.00	0.00	0.00	0.00	0.00	13.50	0.18
	DRR Dhan 48 (IET 24555)	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00
	DRR Dhan 49 (IET 24557)	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.00
	DRR Dhan 50 (IET 25671)	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	0.00
	DRR Dhan 51 (IET 25484)	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.00
	DRR Dhan 45	4.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.30	0.00
	DRR Dhan 47 (IET 23356)	4.00	3.50	0.00	0.00	0.00	0.00	0.00	0.00	4.00	3.50
	DRR Dhan 39	6.30	7.00	0.00	0.00	0.00	0.00	0.00	0.00	6.30	7.00
	DRR Dhan 43	1.50	2.80	0.00	0.00	0.00	0.00	0.00	0.00	1.50	2.80
	DRR Dhan 46	6.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	7.00
	Imp. Samba Mahsuri (RP Bio-226)	27.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	27.00	30.00
	IR64 Drt 1(IET 22836)(DRR-42)	50.00	64.50	0.00	0.00	0.00	0.00	0.00	0.00	50.00	64.50
	Jagjeevan (IET-19487)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	JAYA	17.20	4.20	0.00	0.00	0.00	0.00	0.00	0.00	17.20	4.20
	KRISHNA HAMSA	0.50	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.30

	MASURI	2.00	2.80	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.80
	RASI (IET- 1444)	0.30	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.50
	Sampada (IET 19424)	43.00	47.80	0.00	0.00	0.00	0.00	0.00	0.00	43.00	47.80
	SUKHA DHAN-6	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
	Total	**215.90**	**172.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**215.90**	**172.68**
	Grand Total (IIPR)	**215.90**	**172.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**215.90**	**172.68**
64. IIWBR, Karnal											
Cereal Crops	**Wheat**										
	DBW 17	30.00	110.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	110.00
	DBW 71	20.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	45.00
	DBW 90	48.60	45.00	0.00	0.00	0.00	0.00	0.00	0.00	48.60	45.00
	DBW 93	50.00	45.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	45.00
	DBW 173	37.00	50.00	0.00	0.00	0.00	0.00	363.00	375.00	400.00	425.00
	DBW 187	340.00	350.00	0.00	0.00	0.00	0.00	0.00	0.00	340.00	350.00
	WB 2	137.40	100.00	0.00	0.00	0.00	0.00	0.00	0.00	137.40	100.00
	HD 3086	700.00	850.00	0.00	0.00	0.00	0.00	0.00	0.00	700.00	850.00
	HD 2967	1004.00	1000.00	0.00	0.00	0.00	0.00	0.00	0.00	1004.00	1000.00
	HD 3226	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	PBW 723	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**2367.00**	**2595.00**	**0.00**	**0.00**	**0.00**	**0.00**	**363.00**	**375.00**	**2730.00**	**2970.00**
	Barley										
	DWRUB 52	50.90	55.00	0.00	0.00	0.00	0.00	0.00	0.00	50.90	55.00
	DWRB 137	30.00	35.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	35.00
	Total	**80.90**	**90.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**80.90**	**90.00**
	Total Cereal Crops	**2447.90**	**2685.00**	**0.00**	**0.00**	**0.00**	**0.00**	**363.00**	**375.00**	**2810.90**	**3060.00**
	Grand Total (IIWBR)	**2447.90**	**2685.00**	**0.00**	**0.00**	**0.00**	**0.00**	**363.00**	**375.00**	**2810.90**	**3060.00**

65. IARI, RS, Indore											
Cereal Crops	**Wheat**										
	HI 1544	298.80	500.00	0.00	0.00	0.00	0.00	0.00	0.00	298.80	500.00
	HI 1531	43.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	43.00	40.00
	HD 2987	70.00	90.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00	90.00
	HD 2932	45.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	45.00	80.00
	HI 1605	0.00	0.00	0.00	0.00	0.00	0.00	120.00	120.00	120.00	120.00
	HI 1620	0.00	0.00	0.00	0.00	0.00	0.00	40.00	40.00	40.00	40.00
	HI 1612	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00
	HI 8663	75.00	170.00	0.00	0.00	0.00	0.00	0.00	0.00	75.00	170.00
	HI 8713	430.00	350.00	0.00	0.00	0.00	0.00	0.00	0.00	430.00	350.00
	HI 8737	300.00	300.00	0.00	0.00	0.00	0.00	0.00	0.00	300.00	300.00
	HI 8759	200.00	300.00	0.00	0.00	0.00	0.00	0.00	0.00	200.00	300.00
	Total	**1461.80**	**1830.00**	**0.00**	**0.00**	**0.00**	**0.00**	**170.00**	**170.00**	**1631.80**	**2000.00**
	Total Cereal Crops	**1461.80**	**1830.00**	**0.00**	**0.00**	**0.00**	**0.00**	**170.00**	**170.00**	**1631.80**	**2000.00**
	Grand Total (Indore)	**1461.80**	**1830.00**	**0.00**	**0.00**	**0.00**	**0.00**	**170.00**	**170.00**	**1631.80**	**2000.00**
66. IARI, Pusa Samastipur											
Cereal crops	**Wheat**										
	HD 2967	600.00	600.00	0.00	0.00	0.00	0.00	0.00	0.00	600.00	600.00
	HD 2733	390.00	390.00	0.00	0.00	0.00	0.00	0.00	0.00	390.00	390.00
	HD 2824	50.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	60.00
	HD 3118	70.00	90.00	0.00	0.00	0.00	0.00	0.00	0.00	70.00	90.00
	HD 2985	100.00	120.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	120.00
	HD 3171	40.00	40.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	40.00
	HD 2888	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
	HI 1563	100.00	110.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	110.00
	HI 1612	20.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00
	Total	**1375.00**	**1435.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1375.00**	**1435.00**

	Total Cereal Crops	**1375.00**	**1435.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1375.00**	**1435.00**
	Grand Total (Samastipur)	**1375.00**	**1435.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1375.00**	**1435.00**
67. IISS, Mau											
Cereal Crops	**Wheat**										
	CBW 38	50.40	35.00	0.00	0.00	0.00	0.00	0.00	0.00	50.40	35.00
	DBW 39	100.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	80.00
	HD 2967	50.00	2.62	0.00	0.00	0.00	0.00	0.00	0.00	50.00	2.62
	Total	**200.40**	**117.62**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**200.40**	**117.62**
	Total Cereal Crops	**200.40**	**117.62**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**200.40**	**117.62**
	Grand Total (MAU)	**200.40**	**117.62**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**200.40**	**117.62**
68. ICAR RC NEH, Manipur											
Cereal Crops	**Paddy**										
	RC Maniphou-4	0.00	0.00	0.00	0.00	0.00	0.00	2.50	3.00	2.50	3.00
	RC Maniphou-5	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.85	0.50	0.85
	RC Maniphou-6	0.00	0.00	0.00	0.00	0.00	0.00	3.50	5.80	3.50	5.80
	RC Maniphou-7	0.00	0.00	0.00	0.00	0.00	0.00	15.00	15.50	15.00	15.50
	RC Maniphou-10	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	10.00	10.00
	RC Maniphou-11	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.65	0.50	0.65
	RC Maniphou-12	0.00	0.00	0.00	0.00	0.00	0.00	30.00	35.00	30.00	35.00
	RC Maniphou-13	0.00	0.00	0.00	0.00	0.00	0.00	35.00	40.50	35.00	40.50
	Gomatidhan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	173.00	0.00	173.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**97.00**	**284.30**	**97.00**	**284.30**
	Maize										
	Pusa Composite 3	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.50	1.00	1.50
	MS 8-1	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**2.50**	**2.00**	**2.50**

	Total Cereal Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**99.00**	**286.80**	**99.00**	**286.80**
	Urd										
	SK PD-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.35
	SKR 57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.36
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.71**	**0.00**	**0.71**
Pulses Crops	**Rajamsh**										
	Tripura Rajmash Selection 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.00	0.62
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.62**	**0.00**	**0.62**
	Total Pulses Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.33**	**0.00**	**1.33**
Oilseed Crops	**Soybean**										
	JS-335	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.57	0.50	0.57
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.50**	**0.57**	**0.50**	**0.57**
	Groundnut										
	ICGS-76	0.00	0.00	0.00	0.00	0.00	0.00	1.50	2.65	1.50	2.65
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.50**	**2.65**	**1.50**	**2.65**
	Sesame										
	Tripura Siping	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	1.20
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.20**	**0.00**	**1.20**
	Toria										
	TRC Toria 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	0.00	1.30
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.30**	**0.00**	**1.30**
	Total Oilseed Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**5.72**	**2.00**	**5.72**
	Grand Total (Manipur)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**101.00**	**293.85**	**101.00**	**293.85**
69. ICAR RC NEH, Tripura											
Cereal Crops	**Paddy**										

	Tripura Khara 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.20	0.00	5.20
	Tripura Khara 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	0.00	1.40
	Tripura Jala 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.80
	Tripura Chikan Dhan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	62.00	0.00	62.00
	Tripura Sarat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.70	0.00	3.70
	Tripura Nirog	0.00	0.00	0.00	0.00	0.00	0.00	0.00	73.00	0.00	73.00
	Tripura Hakuchuk 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.10	0.00	4.10
	Tripura Hakuchuk 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.20	0.00	12.20
	Tripura Aush	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40	0.00	3.40
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**165.80**	**0.00**	**165.80**
	Total Oilseed Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**165.80**	**0.00**	**165.80**
	Grand Total (Tripura)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**165.80**	**0.00**	**165.80**
70. NEH Region, Meghalaya											
Cereal Crops	**Paddy**										
	Shahsarang	0.00	0.00	8.00	10.00	0.00	0.00	0.00	0.00	8.00	10.00
	NEH Megha Rice 1	0.00	0.00	2.00	3.00	0.00	0.00	0.00	0.00	2.00	3.00
	NEH Megha Rice 2	0.00	0.00	4.00	6.00	0.00	0.00	0.00	0.00	4.00	6.00
	Bhalum 3	0.00	0.00	3.00	5.00	0.00	0.00	0.00	0.00	3.00	5.00
	Bhalum 5	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	3.00
	Bhalum 1	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
	Bhalum 2	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25
	Lampnah	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
	Megha SA 2	0.00	0.00	0.00	1.50	0.00	0.00	0.00	0.00	0.00	1.50
	NEH Megha Rice	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50

	3										
	Total	**0.00**	**0.00**	**17.00**	**30.25**	**0.00**	**0.00**	**0.00**	**0.00**	**17.00**	**30.25**
	Total Oilseed Crops	**0.00**	**0.00**	**17.00**	**30.25**	**0.00**	**0.00**	**0.00**	**0.00**	**17.00**	**30.25**
	Grand Total (Meghayala)	**0.00**	**0.00**	**17.00**	**30.25**	**0.00**	**0.00**	**0.00**	**0.00**	**17.00**	**30.25**
71. CIARI, Port Blair											
Cereal Crops	**Paddy**										
	CARI Dhan 1	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.06	0.05	0.06
	CARI Dhan 2	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.07	0.05	0.07
	CARI Dhan 3	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.05
	CARI Dhan 4	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.17	0.20	0.17
	CARI Dhan 5	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.15	0.20	0.15
	CARI Dhan 6	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.20	0.20
	CARI Dhan 7	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.06	0.25	0.06
	CARI Dhan 8	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.30	0.30	0.30
	CARI Dhan 9	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.40	0.30	0.40
	CSR36	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.05	0.10	0.05
	Gayatri	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.08	0.20	0.08
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.90**	**1.57**	**1.90**	**1.57**
	Total CerealCrops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.90**	**1.57**	**1.90**	**1.57**
Pulses Crops	**Green Gram**										
	CARI Mung 2	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.03	0.05
	CARI Mung 4	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.04	0.05
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.07**	**0.10**	**0.07**	**0.10**
	Black Gram										
	CARI Urd 1	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.02	0.04
	CARI Urd 2	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.02	0.04
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**	**0.08**	**0.04**	**0.08**

	Total Pulses Crops	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.11**	**0.18**	**0.11**	**0.18**
	Grand Total (CIARI)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.01**	**1.75**	**2.01**	**1.75**
	Grand Total	**62215.57**	**80482.80**	**12623.51**	**15795.70**	**2386.03**	**2806.77**	**6475.83**	**16201.52**	**83690.14**	**115286.79**

Note: For *Rab i*2018-19, expected breeder seed production figures were used in compilation.

Table – 2: Centre-wise breeder seed production during 2018-19

(in quintals)

S. No.	Center	GOI		State		Pulses Seed Hub		Additional (ISP & others)		Grand Total	
		Indent	Production	Indent	Production	Target	Production	Indent	Production	Indent	Production
	State Agriculture Universities										
1	CSKHPKV, Palampur	163.99	205.22	117.35	148.80	-	-	654.85	757.42	936.19	1111.44
2	PJTSAU, Hyderabad	496.59	560.66	619.40	633.70	8.00	8.00	100.05	225.88	1224.04	1428.24
3	IGKV, Raipur	1762.80	2042.64	153.00	194.79	-	-	258.60	342.00	2174.40	2579.43
4	AAU, Anand	111.10	123.75	335.97	414.75	-	-	337.45	426.69	784.52	965.19
5	UAS. Raichur	330.14	460.27	0.00	0.00	-	-	0.00	58.70	330.14	518.97
6	OUAT, Bhubaneswar	800.40	779.35	0.00	0.00	150.00	100.00	33.15	45.25	983.55	924.60
7	TNAU, Coimbatore	120.88	106.13	536.15	649.36	3.53	3.53	701.52	845.16	1362.08	1604.18
8	DRPCAU, Pusa	627.66	645.17	293.10	293.10	530.00	540.00	2948.00	3035.30	4398.76	4513.57
9	AU, Kota	3406.50	4650.80	0.00	0.00	125.00	226.70	0.00	0.00	3531.50	4877.50
10	SVPUA&T, Meerut	2.00	2.25	2.00	0.00	-	-	0.00	185.00	4.00	187.25
11	BCKV, West Bengal	97.95	99.25	15.50	22.00	-	-	0.00	35.00	113.45	156.25
12	SKUAST (K), Srinagar	2.00	2.45	61.60	91.35	-	-	0.00	0.00	63.60	93.80
13	NDUA&T, Faizabad	120.05	1256.35	0.00	0.00	-	-	0.00	289.54	120.05	1545.89
14	SDAU, SK Nagar	359.45	353.08	1527.03	1591.93	-	-	0.00	117.27	1886.48	2062.28
15	VNMKV, Parbhani	1797.84	2526.66	0.00	0.00	68.00	81.09	8.00	9.23	1873.84	2616.98
16	GBPUAT, Pantnagar	719.07	1910.45	0.00	0.00	300.00	547.00	0.00	5005.26	1019.07	7462.71
17	RVSKVV, Gwalior	7088.10	11859.90	0.00	0.00	113.00	173.80	0.00	3.20	7201.10	12036.90
18	SKRAU, Bikaner	1014.67	1141.25	0.00	0.00	-	-	0.00	28.00	1014.67	1169.25
19	NAU, Navsari	0.00	0.00	51.10	0.00	-	-	141.00	253.50	192.10	253.50
20	UAHS, Shivamogga	0.00	0.00	216.50	190.00	-	-	0.00	0.00	216.50	190.00
21	UAS, Dharwad	2980.30	4798.94	721.00	843.60	140.00	134.00	0.00	0.00	3841.30	5776.54
22	CCSHAU, HISAR	1124.98	1202.43	348.95	431.52	-	-	1.50	3.25	1465.93	1637.20
23	KAU, Thrissur	26.00	52.60	0.40	0.00	-	-	44.00	49.24	70.40	101.84
24	BAU, Sabour	188.00	225.00	0.00	0.00	75.00	104.50	0.00	325.00	263.00	654.50
25	CSAUAT, Kanpur	352.54	1178.45	0.00	147.05	-	-	0.00	0.00	352.54	1325.50

26	JNKVV, Jabalpur	8207.56	13076.27	3950.59	5747.17	160.00	184.00	0.00	1135.61	12318.15	20143.05
27	UAS , Bangalore	991.58	652.05	45.30	73.25	43.50	66.00	86.65	145.20	1167.03	936.50
28	AAU, Jorhat	28.40	27.75	0.00	0.00	-	-	0.00	400.35	28.40	428.10
29	PAU, Ludhiana	3006.27	4177.02	28.32	50.60	-	-	32.00	44.00	3066.99	4271.62
30	JAU, Junagadh	504.53	557.30	1765.18	2370.84	-	-	0.00	0.00	2269.71	2928.14
31	BHU, Varanasi	205.88	283.35	169.30	143.15	-	-	0.00	0.00	375.18	426.50
32	MPKV, Rahuri	1390.15	2310.69	30.05	41.74	80.00	42.00	126.60	213.19	1626.80	2607.62
33	MPUAT, Udaipur	518.97	537.14	0.00	0.00	-	-	0.00	6.60	518.97	543.74
34	PDKV, Akola	1437.10	962.02	61.50	92.37	-	-	3.00	523.86	1501.60	1578.25
35	BAU, Ranchi	127.69	47.90	56.00	63.15	-	-	0.00	0.00	181.99	111.05
36	BSKVV, Dapoli	23.24	131.50	0.35	12.60	-	-	43.70	165.17	67.29	309.27
37	SKUAST, Jammu	105.30	133.70	61.75	67.70	-	-	0.00	0.00	167.05	201.40
38	ANGRAU, Guntur	7453.92	6401.90	1414.32	1387.28	580.00	580.00	0.00	114.90	9448.24	8484.08
39	PAJANCOA & RI, Karaikal	0.00	0.00	7.00	45.80	-	-	0.00	0.00	7.00	45.80
40	SKNAU, Jobner	271.87	300.91	0.00	0.00	-	-	0.00	0.00	271.87	300.91
41	AU, Jodhpur	11.89	15.72	0.00	0.00	-	-	0.00	0.00	11.89	15.72
	Total SAUs	**47977.36**	**65798.27**	**12588.71**	**15747.60**	**2376.03**	**2790.62**	**5520.07**	**14788.77**	**68451.37**	**99125.26**
	ICAR Institute										
42	CAZRI, Jodhpur	5.10	9.76	-	-	-	-	0.00	0.00	5.10	9.76
43	CRIJAF, Barrackpore	9.50	15.00	-	-	-	-	4.50	4.30	14.00	19.30
44	VPKAS, Almora	124.70	147.12	2.80	3.85	-	-	14.50	23.60	142.00	174.57
45	ICAR-DGR, Junagadh	121.68	132.00	-	-	-	-	0.00	0.00	121.68	132.00
46	IARI, New Delhi	1800.92	1993.00	-	-	-	-	217.00	237.00	2017.92	2230.00
47	IARI, RS, Karnal	1828.31	1888.75	-	-	-	-	0.00	0.00	1828.31	1888.75
48	IISR, Indore	480.50	501.00	-	-	-	-	0.00	0.00	480.50	501.00
49	IIOR, Hyderabad	0.25	1.65	-	-	-	-	0.00	0.00	0.25	1.65
50	IIPR, Kanpur	432.40	618.97	-	-	10.00	16.15	0.00	0.00	442.40	635.12
51	IGFRI, Jhansi	121.65	169.60	-	-	-	-	0.00	9.50	121.65	179.10
52	CCARI, Goa	0.00	0.00	15.00	14.00	-	-	0.00	0.00	15.00	14.00
53	CAU, Imphal	0.00	0.00	-	-	-	-	0.00	8.40	0.00	8.40

54	IIMR, Hyderabad	34.20	69.30	-	-	-	-	38.00	72.00	72.20	141.30
55	IIMR, Ludhiana	0.08	0.12	-	-	-	-	32.25	34.25	32.33	34.37
56	NRRI, Cuttack	1421.08	877.30	-	-	-	-	13.50	23.90	1434.58	901.20
57	IIRR, Hyderabad	215.90	172.68	-	-	-	-	0.00	0.00	215.90	172.68
58	IARI, RS, Pusa	1375.00	1435.00	-	-	-	-	0.00	0.00	1375.00	1435.00
59	IISS, Mau	200.40	117.62	-	-	-	-	0.00	0.00	200.40	117.62
60	IIWBR, Karnal	2447.90	2685.00	-	-	-	-	363.00	375.00	2810.90	3060.00
61	IARI, RS, Indore	1461.80	1830.00	-	-	-	-	170.00	170.00	1631.80	2000.00
62	ICAR RC NEH, Manipur	0.00	0.00	-	-	-	-	101.00	293.85	101.00	293.85
63	ICAR RC NEH, Tripura	0.00	0.00	-	-	-	-	0.00	165.80	0.00	165.80
64	CIARI, Port Blair	0.00	0.00	-	-	-	-	2.01	1.75	2.01	1.75
65	ICAR RC NEH, Meghalaya	0.00	0.00	17.00	30.25	-	-	0.00	0.00	17.00	30.25
	Total ICAR Institutes	**12081.37**	**12663.87**	**34.80**	**48.10**	**10.00**	**16.15**	**955.76**	**1419.35**	**13081.93**	**14147.47**
	Others										
66	Lokbharti, Sonasara	100.00	70.00	-	-	-	-	-	-	100.00	70.00
67	ARI, Pune	335.40	474.00	-	-	-	-	-	-	335.40	474.00
68	NSC, New Delhi	264.56	136.31	-	-	-	-	-	-	264.56	136.31
69	ICRISAT, Patencheru	5.08	7.55	-	-	-	-	-	-	5.08	7.55
70	HIL, Hyderabad	1306.00	1180.80	-	-	-	-	-	-	1306.00	1180.80
71	BARC, Mumbai	145.80	152.00	-	-	-	-	-	-	145.80	152.00
	Total others	**2156.84**	**2020.66**	**-**	**-**	**-**	**-**	**-**	**-**	**2156.84**	**2020.66**
	Grand Total	**62215.57**	**80482.80**	**12623.51**	**15795.70**	**2386.03**	**2806.77**	**6475.83**	**16208.12**	**83690.14**	**115293.39**

Note: For *Rab i*2018-19, expected breeder seed production figures were used in compilation.

Table 3: Crop- Wise (total) breeder seed production during 2018-19

(in quintals)

Crop	GOI		State		Pulses Seed Hub		Additional (ISP & others)		Grand Total	
	Indent	Production	Indent	Production	Target	Production	Indent	Production	Indent	Production
Cereal Crops										
Rice	4300.06	7569.76	3014.67	4736.54	-	-	996.51	4844.98	8309.54	17151.28
Wheat	19705.37	29965.06	2953.80	3231.30	-	-	4509.00	9298.00	27168.17	42494.36
Barley	437.95	637.10	280.50	303.00	-	-	12.00	13.60	720.95	953.70
Maize	82.63	199.83	23.64	45.84	-	-	68.52	108.20	174.79	353.87
Pearlmillet	9.04	55.14	2.45	2.72	-	-	0.30	6.56	11.79	64.42
Sorghum	61.87	244.11	9.10	12.20	-	-	93.02	159.37	163.99	415.68
Fingermillet	20.99	41.05	32.70	35.90	-	-	105.30	201.87	158.99	278.82
Foxtailmillet	4.52	9.50	40.80	171.80	-	-	0.00	0.00	45.32	181.30
Barnyard millet	1.00	6.00	2.00	2.00	-	-	2.00	2.00	5.00	10.00
Kodomillet	6.75	22.21	0.10	0.10	-	-	20.00	5.00	26.85	27.31
Prosomillet	1.00	2.50	0.50	0.50	-	-	0.00	0.04	1.50	3.04
Littlemillet	0.40	8.10	0.50	0.50	-	-	26.10	33.80	27.00	42.40
Buckwheat	0.00	0.00	0.10	0.10	-	-	0.00	0.00	0.10	0.10
Grain Amaranth	0.05	0.10	0.10	0.25	-	-	0.00	0.00	0.15	0.35
Total Cereal Crops	**24631.63**	**38760.46**	**6360.96**	**8542.75**	**-**	**-**	**5832.75**	**14673.42**	**36814.14**	**61976.63**
Pulse Crops										
Pigeon pea	276.71	461.62	79.60	78.90	290.60	336.10	14.43	65.66	661.34	942.28
Chickpea	9606.70	11947.40	2872.35	3047.10	980.00	989.00	136.90	617.00	13595.95	16600.50
Mungbean	748.52	833.47	114.99	182.32	292.10	344.49	225.14	312.50	1380.75	1672.78
Urdbean	399.47	626.44	181.10	208.02	154.33	437.18	37.25	90.73	772.15	1362.37
Lentil	387.90	641.70	163.50	183.04	545.00	550.00	7.10	8.00	1103.50	1382.74
Fieldpea	417.20	594.00	158.50	171.36	105.00	115.00	42.00	95.50	722.70	975.86
Rajmah	5.00	7.00	4.00	5.00	-	-	11.20	16.17	20.20	28.17
Horsegram	7.40	13.88	6.50	6.50	-	-	0.50	0.80	14.40	21.18

Lablab bean	0.00	0.00	6.00	9.00	3.00	5.00	1.00	1.50	10.00	15.50
Cowpea	22.75	27.00	19.20	25.70	16.00	30.00	10.83	15.09	68.78	97.79
Mothbean	29.80	30.51	0.90	0.82	-	-	0.00	8.00	30.70	39.33
Guar	164.33	205.27	1.25	1.30	-	-	0.00	4.30	165.58	210.87
Lathyrus	142.30	166.00	0.00	0.00	-	-	10.00	15.00	152.30	181.00
Total Pulse Crops	**12208.08**	**15554.29**	**3607.89**	**3919.06**	**2386.03**	**2806.77**	**496.35**	**1250.25**	**18698.35**	**23530.37**
Oilseed Crops										
Soybean	14510.20	15462.61	15.00	13.00	-	-	0.50	0.57	14525.70	15476.18
Sunflower	0.96	3.54	9.60	12.60	-	-	15.90	22.29	26.46	38.43
Groundnut	10065.01	9367.55	2098.40	2699.95	-	-	33.30	70.95	12196.71	12138.45
Sesame	41.48	68.00	30.76	44.20	-	-	19.33	20.73	91.57	132.93
Safflower	163.89	161.61	0.30	0.70	-	-	0.00	4.60	164.19	166.91
Niger	20.27	10.57	15.55	15.59	-	-	0.00	0.00	35.82	26.16
Castor	1.99	3.85	16.53	34.26	-	-	2.50	2.50	21.02	40.61
Linseed	77.50	129.03	277.90	296.57	-	-	20.50	30.00	375.90	455.60
Mustard	37.47	139.10	44.80	48.95	-	-	1.00	2.00	83.27	190.05
Rai	6.61	104.00	0.00	0.00	-	-	0.00	0.00	6.61	104.00
Toria	16.66	28.12	0.15	0.20	-	-	0.00	19.30	16.81	47.62
Raya	5.66	18.50	6.05	11.10	-	-	2.00	2.20	13.71	31.80
Gobhi Sarson	0.10	9.50	0.20	0.40	-	-	5.80	9.05	6.10	18.95
Brown Sarson	0.00	0.00	1.75	2.20	-	-	1.20	1.30	2.95	3.50
Karan Rai	0.00	0.00	0.05	0.10	-	-	0.30	0.40	0.35	0.50
Total Oilseed Crops	**24947.80**	**25505.98**	**2517.04**	**3179.82**	**-**	**-**	**102.33**	**185.89**	**27567.17**	**28871.69**
Fiber Crops										
Cotton	22.15	31.44	51.87	61.37	-	-	2.40	6.07	76.42	98.88
Jute	8.60	14.10	0.00	0.00	-	-	0.00	0.00	8.60	14.10
Sunhemp	0.90	0.90	0.00	0.00	-	-	0.50	0.50	1.40	1.40
Mesta	0.00	0.00	0.00	0.00	-	-	4.00	6.80	4.00	6.80
Total Fiber Crops	**31.65**	**46.44**	**51.87**	**61.37**	**-**	**-**	**6.90**	**13.37**	**90.42**	**121.18**

Forage Crops										
Fodder maize	63.14	184.10	0.00	0.00	-	-	1.00	1.00	64.14	185.10
Oats	242.05	326.00	82.50	88.05	-	-	33.00	42.50	357.55	456.55
Fodder sorghum	31.13	28.38	0.00	0.00	-	-	0.55	0.55	31.68	28.93
Fodder pearlmillet	0.00	0.00	0.20	1.00	-	-	0.50	30.50	0.70	31.50
Fodder cowpea	10.05	3.30	0.20	0.20	-	-	1.50	1.85	11.75	5.35
Guinea grass	0.00	0.00	0.30	0.30	-	-	0.00	0.00	0.30	0.30
Guar	0.00	0.00	0.10	0.30	-	-	0.00	0.00	0.50	0.30
Ricebean	0.25	1.25	0.00	0.00	-	-	0.10	0.10	0.35	1.35
Setaria grass	0.00	0.00	0.00	0.00	-	-	0.15	0.20	0.15	0.20
Stylo	0.00	0.00	0.00	0.00	-	-	0.00	0.04	0.00	0.04
Berseem	42.39	65.10	0.00	0.00	-	-	0.00	1.00	42.39	66.10
Metha	0.00	0.00	1.00	1.20	-	-	0.00	0.00	1.00	1.20
White clover	0.00	0.00	0.00	0.00	-	-	0.10	0.15	0.10	0.15
Lucerne	7.40	7.50	1.45	1.65	-	-	0.60	7.30	9.45	16.45
Total Forage Crops	**396.41**	**615.63**	**85.75**	**92.70**	**-**	**-**	**37.50**	**85.19**	**520.06**	**793.52**
Grand Total	**62215.57**	**80482.80**	**12623.51**	**15795.70**	**2386.03**	**2806.77**	**6475.83**	**16208.12**	**83690.14**	**115293.39**

Note: For *Rabi* 2018-19, expected breeder seed production figures were used in compilation.

Status of AICRP-NSP (Crops) - Revolving Fund during 2018-19

Indian Council of Agricultural Research (ICAR) took firm steps as early as 1979-80 by launching AICRP–National Seed Project (Crops) and created as many as 41 Breeder Seed Production (BSP) units in almost all State Agricultural Universities and crop based ICAR institutes to cater to the requirement of breeder seeds in different crops. To support and strengthen breeder seed production programme, ICAR during VIII Plan has made provision of revolving fund with a policy of single window system for stringent compliance to avoid operational problem of recurring fund in the BSP centres. To make the system more efficient, vibrant, accountable and sustainable, fund provided under various heads of revolving funds were clubbed together and the centres were directed to make single account. Centres were instructed to operate single account of the fund and the Nodal Officers were entrusted with the responsibility of fund operation. The centres are instructed to undertake breeder seed production of the field crops. It is mentionable that profits earned by the centres were ploughed back in the system for creation of infrastructure facilities to enhance the capability of BSP units.

Highlights

1. Revolving fund has made significant impact in enhancing breeder seed production in the country as a whole and subsequently strengthened the infrastructure facilities for breeder seed production.
2. JNKVV, Jabalpur; MPKV, Rahuri; GBPUAT, Pantnagar; IGKV, Raipur; VNMKV, Parbhani; UAS, Bengaluru and ICAR-NRRI, Cuttack were rated as very good performing centres.
3. All the centres have refunded the revolving fund amount. Centres have invested the profit obtained through the operation of revolving funds for infrastructure development in their respective centres.

Table: Utilization of revolving fund under AICRP-NSP (Crops) upto December 2018

(Rs. in lakhs)

S. No.	Centre	Amount sanctioned	Revenue generated in 2017-18 & 2018-19 (upto Dec. 2018)	Profit utilized during 2017-18 & 2018-19 (upto Dec. 2018)	Remarks (profit utilized for)
1	SKUAT, Srinagar	4.00	0.83 (12.71)	0.53	Seed production activity
2	CSKHPKV, Palampur	6.00	9.51 (128.44)	7.13	Repair of processing plant, seed store etc.
3	PAU, Ludhiana	15.00	7.65 (127.37)	7.65	Purchase of inputs
4	CCSHAU, Hisar	15.00	51.40	28.60	-
5	GBPUAT, Pantnagar	18.00	667.5	500.38	Seed production operations
6	NDUAT, Faizabad	10.00	50.33 (78.33)	10.50	Maintenance of farm equipments
7	BHU, Varanasi	10.00	25.13	12.13	Profit used for BSP

8	CSAUAT, Kanpur	17.00	0.41 (5.99)	0.29	Profits transferred to University RF
9	AAU, Jorhat	5.00	1.72 (23.01)	4.07	Strengthening of BSP
10	BAU, Ranchi	9.00	-	-	Seed purchase, labour payment
11	RPCAU, Dholi	10.00	68.06 (111.70)	35.36	Profit utilized for seed programme
12	OUAT, Bhubaneswar	13.00	14.26	Nil	-
13	SKRAU, Bikaner	40.00	85.76	40.77	-
14	SDAU, S K Nagar	20.00	74.49 (91.27)	48.35	Profit utilized for seed production & farm development
15	IGKV, Raipur	8.50	50.30 (321.36)	2.33	Utilized for farm development
16	PDKV, Akola	13.75	Nil	Nil	RF money credited to university RF account
17	JNKVV, Jabalpur	16.00	275.50	66.08	Remittance to University
18	MPKV, Rahuri	14.00	377.64	321.21	Strengthening of irrigation facilities.
19	VNMKV, Parbhani	55.00	312.27	196.71	Farm development and seed production activity
20	UAS, Bengaluru	13.00	4.65 (350.79)	10.25	Purchase of farm equipments
21	UAS, Dharwad	18.00	19.17 (433.13)	32.92	Farm development, electrification, borewell etc.
22	PJTSAU, Hyderabad	18.00	5.92 (113.91)	1.84	Farm development activity
23	TNAU, Coimbatore	15.00	73.58 (173.27)	59.08	Strengthening of seed production activity
24	KAU, Thrissur	4.00	48.89	44.40	Development of seed infrastructure
25	BSKKV, Dapoli	4.00	12.46 (15.00)	4.99	Seed production activity
26	VPKAS, Almora	4.50	5.41	4.16	Strengthening of seed production activity
27	IIPR, Kanpur	5.00	18.08 (37.54)	13.68	-
28	IGFRI, Jhansi	3.00	4.04 (3.93)	6.08	-
29	CRIJAF, Barrackpore	2.00	3.28	2.28	Labour payment & purchase of farm

					implements
30	CAZRI, Jodhpur	3.00	23.30	18.38	-
31	NRRI, Cuttack	15.00	115.00 (359.58)	98.02	-
32	IIRR, Hyderabad	4.82	15.15 (77.18)	59.89	-
33	IIMR, Hyderabad	10.5	12.70 (32.00)	5.00	Seed production activity, farm machinery purchase, monitoring etc.
	Total	**419.07**	**2434.39 (2496.51)**	**1642.91**	

Note:

1. The values given in parenthesis represent cumulative profit made over the years.
2. All centres have returned the sanctioned amount to council
3. All centres are using single window system

A. Seed Production and Certification

Experiment 1. Standardization of isolation distance for hybrid seed production of mustard

Year of start: 2017-18

Centers: IARI, New Delhi; PAU, Ludhiana; GBPUAT, Pantnagar; JNKVV, Jabalpur and NDUAT, Faizabad

Methodology

- Restorer line/pollen parent to be surrounded in all the four sides or one side (along the wind direction) by CMS line (female parent) at different distances viz. 100, 125,150, 200, 250,300, 350, 400,450, 500, 550 meters.
- Pollen parent: plot size of 1.5 m (width) X 24 m (length) with spacing of 45 X 15 cm to be grown in the center. (Minimum number of rows are 3)
- Pollen parent to be surrounded by the CMS line at different distances mentioned above. Two rows of female line (of 2 meters length).

Observations

- Seed setting percentage in CMS line to be recorded at all distances.
- Percent seed set in the CMS line should be recorded and submitted in the format.

Unified observation

Experiment on standardization of isolation distance for hybrid seed production of mustard reveals that seed setting in A line at all isolation distance from 100 m to 600 m was reported. The seed set was also observed in large isolation distance (500 m and 600 m) may be due to presence of fertile plant in respective CMS lines. The fertile plant in test plots may be due to either breaking of male sterility or mixture of CMS line with B line. Therefore it is suggested that centre (IARI, New Delhi) should supply stable and pure CMS line seeds to executing centers.

Table 1(A): Evaluation of pollen flow at seven distances

Direction (D)	% Seed Set (↓) / Isolation Distance (→)						
	100 m	150 m	200 m	300 m	400 m	500m	600m
Towards wind	98.5	97.5	96	96	95	95	95
Perpendicular to wind	97	97.5	97.5	97.5	98	97	98



Fig: The pollen parent plot in the wheat seed plot



Fig: The female parent plot in the wheat seed plot



Fig: Bagging in recipient parent cms line to confirm male sterility

Results

1. JNKVV, Jabalpur

The pollen viability of the male line was observed to be in the range of 95-97%, while that of female line was also in the range of 65-70%. The seed setting percentage ranged from 94-97% in the female line while the overall mean seed set percentage worked out to be 95.3%. The seed setting is there at larger distance 400m. Hence it can be concluded that there is a mixture of B line in the A line. Therefore, it is suggested to the supplying centers that it should be ensured that the female line i.e. supplied needs to be sterile, before being supplied to the various testing centers(Table 1).

Table 1: The seed setting percentage in the female parent

Direction (D)	% seed set							
	100 m	150m	200 m	300m	400m	500m	600m	Mean
Towards wind	97	95	93	92	90	95	95	93.85
Perpendicular to wind	96	97	98	97	98	97	98	97.28
Mean	**96.5**	**96**	**95.5**	**94.5**	**94**	**96**	**96.5**	95.57

Conclusion or Salient Finding(s):

Since the recipient (CMS) line was highly fertile, the overall purpose of the experiment was not concluded.

Suggestion(s), if any:

Before supplying the recipient line, it should be ensured that the female line, which is supplied, should be completely sterile.

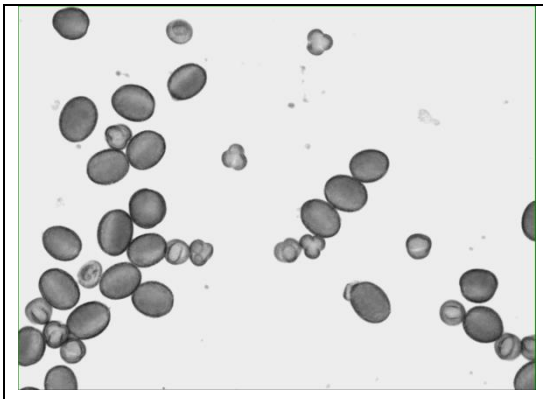
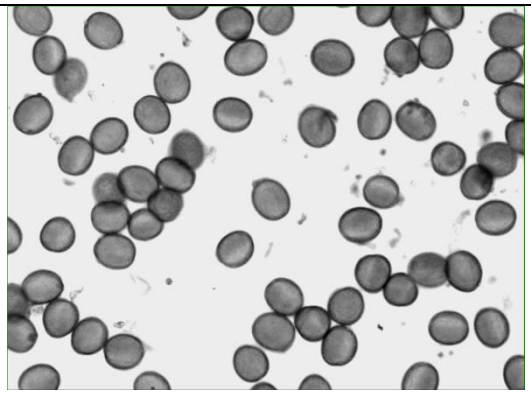
2. PAU, Ludhiana

The pollen viability of the male line was observed to be in the range of 95 – 98 % while that of the female (CMS) line was also in the range of 65 – 80 % (Plate 3). The seed setting percentage ranged from 97-100 % in the female line while the overall mean seed set percentage worked out to be 98.8% (Table 1.1).

Table 1.1: The seed setting percentage in the female parent

Direction (D)	% Seed Set (↓) / Isolation Distance (→)					
	100 m	150 m	200 m	300 m	400 m	Mean

Towards wind	100	100	99	100	100	99.8
Perpendicular to wind	98	98	97	98	98	97.8
Mean	99	99	98	99	99	98.8

	
Male line	**Female line**
The pollen fertility in the male and the female parents	

Conclusion or Salient Finding(s):

Since the female (CMS) line was highly fertile, the overall purpose of the experiment was defeated; the experiment was hence inconclusive.

	
Selfed seed on the female line	**Filled pods & near complete seed set on the female line**
The Selfed seed formed on bagged CMS line and the seed formed on a Female plot	

Suggestion(s), if any:

- It should be ensured that the female line that is supplied is in fact sterile before being supplied to the various testing centers.

3. IARI, New Delhi

There is lack of information on the safe isolation distance needed for taking up hybrid seed production in the Indian mustard hybrid seed production. A field experiment was conducted growing the Male parent of NRCHB-506 (Indian mustard hybrid) at one side and the female parent, (a CMS line) at 25m,50m,75m,100m,125m, 150m and 175m distances from the male parent. The flowering dates were recorded for both the parental lines. The pollen sterility was observed under a microscope taking the first flower opened in each CMS plant. The male fertile plant appeared in the CMS rows were removed the same day. The siliquae set and no. of seeds per siliquae was recorded in at least 20 plants in each female plot after harvesting of the plants. The per cent siliquae set ranged from 75 at 25m distance to 46 at 175m distance. The number of seeds per siliqua in the main stem ranged from 2-3 in different distances. The results indicated that the CMS plants are needed to be grown beyond this distance, may be at least 500 m to achieve a reasonably lower per cent outcrossing.

Experiment 2: Integrated approach for enhancing seed yield and quality in millets

Year of start: 2015-16

Crop	**Centers**
Finger millet	UAS, Bangalore; ANGRAU, Guntur; UAS, Dharwad; KKV, Dapoli; HPKV, Palampur and IGKV, Raipur
Foxtail millet	ANGRAU, Guntur; TNAU, Coimbatore and UAS Dharwad.
Kodo millet	JNKVV, Jabalpur; TNAU, Coimbatore and ANGRAU, Guntur
Proso millet	ANGRAU, Guntur; UAS, Bangalore and RPCAU, Pusa
Little millet	JNKVV, Jabalpur; TNAU, Coimbatore and IGKVV, Raipur

Objective: To standardize suitable seed quality enhancement techniques to enhance the production potential of millets

SMALL MILLETS TREATMENT DETAILS	
No of treatments	**Main plots** (Nutrient management): **04** **Sub-plots** (Seed Priming): **04**
Sowing method	
Finger millet: Transplanting with spacing of 30 X 10 cm (raising a nursery and transplanting at 21	

days in wet field)

Other four millets: Direct sowing – 30 x 10 cm – sown at 3-4 cm depth

Note

1. Only one method of planting should be followed for each crop as mentioned above.
2. Nursery management and Transplanting (Finger millet) for one ha. of main field:
   - Select 12.5 cents (500 m2) of nursery area near a water source, where water does not stagnate. Mix 37.5 kg of super phosphate with 500 kg of FYM or compost and spread the mixture evenly on the nursery area.
   - Plough two or three times with a mould board plough or five times with a country plough form raised beds by marking units of 6 plots each of size 3m x 1.5 m.
   - Provide 30 cm space between plots for irrigation.
   - Excavate the soil from the interspace and all around to a depth of 15 cm to form channels and spread the soil removed from the channels on the bed and level it. 4-5 days before removing plants, spray the nursery with the fungicide Mancozeb 75% W.P @ 2 gm /liter
   - Transplant the seedling from the nursery into the man field when they are only 15-25 days old.
   - Before transplanting, irrigate the nursery for approximately 2 hours in advance, to moisten and loosen the soil for removing the plants easily if the soil is dry in that time.
   - Carefully uproot the seedlings, keeping the soil intact around the roots; if possible lift them out with a trowel or spade as this gives support to the soil and helps to keep it intact with the roots.
   - Transfer the uprooted seedlings to the main plot within the next 30 minutes, before the roots and soil can dry out. The spacing will be 10 x 10 inches by using a rope or a marker.
   - Transplant the seedlings at shallow depth in the pits; do not press or inure the roots while placing the seedlings at the intersection of planting lines.
3. Micronutrients: magnesium (20 kg per acre) and calcium (6 kg per acre) or dolomite / limestone (40 kg per acre). Apply these micronutrients, 20-25 days before transplantation in the field.

Treatment details

I. Main-Plot treatments (Nutrient management)

N1 – No fertilizer

N2 – 125 kg Neem + 1250 kg Vermi compost per ha or 12.5 tons FYM/ha

N3 – 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha + Top dressing urea at 3-4 weeks after transplanting + 2% Borax spay at flowering

N4 - 125 kg Neem + 1250 kg Vermicompost (or) 12.5 tons FYM/ha + 50 kg Urea + 50 kg super phosphate and 50 kg Muriate of potash per ha + Top dressing urea at 3-4 weeks after transplanting + 2% Borax spay

II. Sub-plot treatments (Priming)

P1 – Control - No priming

P2 - Hydropriming for 6 h (Finger millet, Kodo millet), 8 h (Foxtail millet, Proso millet, and Little millet) by adopting seed to solution ratio of 1:1 and then mixing in 2.5-3 gm / kg of Carbendazim (Bavistin) with the seeds and leaving the mixture for 24 hours before sowing

P3 – Seed priming with 2 % KH2PO4 for 6 h (Finger millet and Kodo millet), 8 h (Foxtail millet, Proso millet and Little millet) by adopting seed to solution ratio of 1:1 and then mixing in 2.5-3

gm / kg of Carbendazim (Bavistin) with the seeds, and leaving the mixture for 24 hours before sowing		
P4 – Seed priming with 20 % liquid *Pseudomonas fluoresces*		
Design		Split Plot Design
No. of replications		3
Plot size	**Gross plot size**	2 m × 5.0 m (10.0 m^2)
Space between plots		60 cm
Recommended dose of fertilizer (NPK)		75 kg P2O5 and 25 kg K2O per ha or best recommended fertilizer dosage for your state, region or zone
Cultivar		Any recommended (bunch or spreading type) cultivar appropriate for seed production season
Source fertilizers		
1. Nitrogen		Urea (46 % N)
2. Phosphorus		Single super phosphate (SSP) (16 % P2O5)
3. Potassium		Muriate of potash (MOP) (60 % K2O)
OR		
1. Nitrogen and Phosphorus		Diammonium Phosphate (DAP) (18 % N and 46 % P2O5)
2. Potassium		Muriate of potash (MOP) (60 % K2O)
Pest / disease control • **Blast:** Seed treatment, mixing 2.5 gm/kg of Carbendazim (Bavistin) for at least 30 minutes. • **Seedling blight:** Spray Mancozeb 75 % WP @ 2 gm per liter in the nursery 15 days before sowing or 15 days after transplantation. • **Downy mildew:** Spray the crop with Mancozeb 75 % W.P. @ 2 gm per liter of water at the onset of the disease, or when symptoms are seen in 5-10% of the plants. • **Stem borer:** Use regent granules or its liquid form in the amount of 7 kgs / acre. 1 ml of the chemical should be mixed with 2 liters of water.		

Observations

- Field emergence
- Plant height at 30 days and at harvest
- Chlorophyll content
- Days to first flowering
- Days to 50% flowering
- No. of tillers $plant^{-1}$
- Seed yield plant-1
- Seed yield ha-1
- 100 seed weight

- Seed recovery percent

Resultant seed quality - seed germination and vigour index

Finger millet (*Eleusine coracana*)

Unified observation

Effect of nutrient management and seed priming on yield and seed quality attributing traits in finger Millet (Mean over locations)

During *kharif* 2018, this experiment was conducted at three locations namely IGKV, Raipur, UAS, Bangalore and HPKV, Palampur. The detailed mean data over locations are presented in Table 2.

The average over locations revealed that nutrient management treatments had significant effect on plant growth, seed yield and quality of finger millet. Among the nutrient management treatment, N4 (nutrient management with 125 kg Neem+1250 kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) showed superiority with respect to seed yield (30.30q/ha), chlorophyll content (42.49), plant height (118 cm) germination percentage (84%) and panicle weight (6.79 gm) as compared to control and other treatments. The seed priming treatment had significant effect on seed yield. Among the priming treatments, seed priming with 20% liquid *P. fluorescens* (P4) was superior as compared to control and other treatments in terms of seed yield (27.60 q/ha), no. of tillers (5.6) and other seed quality attributes.

Among interactions of priming with nutrient management treatments, N4P4 (Seed Priming with 20% liquid *pseudomonas fluorescence* in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) recorded highest seed yield (32.38 q/ha), no. of tillers (6.72), panicle length (7.74 gm), 100 seed weight (1.33 gm) and seed quality attributes closely followed by N4P3 (Seed Priming 2% KH_2PO_4 in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray).

Significant Observation:

Mean data over locations revealed that treatment combination N4P4 (Seed Priming with 20% liquid *Pseudomonas fluorescence* in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray)

leads to 74% increase of seed yield/ha over control. Due to treatment N4P4 74% and 16% increase over control were observed for germination % and vigour index-II respectively.

Table 2: Effect of nutrient management and seed priming on yield and seed quality attributing traits in Finger Millet (Mean over locations)

Treatments	Field emergence (%)	Days to 50% flowering	Chlorophyll content (SPAD)	Plant height (cm)	No. of tillers	Seed yield (q/ha)	100 Seed Weight (g)	Germination %	Vigour Index I	Vigour Index II
Nutrient Management										
N1:No fertilizer	78.00	74.41	39.44	100.49	3.85	21.41	0.29	81.32	947.15	10.87
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	81.25	73.73	36.16	106.91	4.87	23.51	0.32	82.07	966.35	13.77
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	83.17	73.95	41.34	112.33	5.54	27.15	0.32	82.80	1042.10	12.32
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	90.75	73.63	42.49	117.97	6.04	30.30	0.32	83.78	1065.80	14.11
Mean	**83.29**	**73.93**	**39.86**	**109.43**	**5.07**	**25.59**	**0.31**	**82.49**	**1005.35**	**12.77**
Priming										
P1:Control (No priming)	78.67	74.08	38.27	105.37	4.22	22.87	0.31	81.26	992.45	11.08
P2 :Hydro priming	82.96	73.99	39.62	107.98	4.89	25.37	0.32	82.83	992.45	12.75
P3:Seed priming with 2%	83.67	73.91	41.63	111.87	5.62	26.53	0.33	82.97	1033.20	12.90

KH2PO4										
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	87.88	73.74	39.91	112.38	5.62	27.60	0.32	82.91	1006.85	14.34
Mean	**83.29**	**73.93**	**39.86**	**109.40**	**5.08**	**25.59**	**0.32**	**82.49**	**1006.24**	**12.77**
Interaction										
N_1P_1	74.00	74.78	40.05	95.46	3.47	18.60	0.31	78.33	942.10	10.54
N_1P_2	76.34	73.89	37.74	99.99	3.75	21.53	0.32	82.43	891.70	10.55
N_1P_3	79.67	74.68	39.83	103.74	4.22	22.57	0.33	83.01	1007.40	10.18
N_1P_4	82.00	74.21	40.16	102.67	6.02	22.94	0.32	81.46	948.40	12.21
N_2P_1	76.67	73.55	33.72	101.37	3.94	20.66	0.31	82.79	977.85	11.23
N_2P_2	81.50	74.54	36.81	105.62	4.85	23.42	0.31	82.33	969.75	14.35
N_2P_3	81.67	73.21	38.29	109.54	5.45	24.92	0.32	82.13	963.40	14.69
N_2P_4	85.17	73.56	35.82	111.22	5.24	25.19	0.31	81.11	955.00	14.80
N_3P_1	77.50	74.57	39.56	110.07	4.62	24.50	0.32	82.78	1045.15	9.43
N_3P_2	83.67	73.90	43.19	110.12	5.22	26.19	0.32	82.00	1012.85	17.67
N_3P_3	81.84	73.66	42.60	114.61	5.97	28.04	0.32	83.13	1080.65	12.60
N_3P_4	89.17	73.66	40.02	114.40	6.39	29.88	0.32	83.31	1029.85	14.60
N_4P_1	86.00	73.43	39.75	114.67	4.75	26.60	0.31	81.10	990.70	13.11
N_4P_2	90.33	73.68	40.76	116.27	5.72	30.33	0.33	84.53	1094.95	13.44
N_4P_3	91.50	74.00	45.80	119.50	6.34	30.76	0.33	83.68	1081.80	14.12
N4P4	95.17	73.45	43.66	121.32	6.72	32.38	0.33	85.79	1095.70	15.77

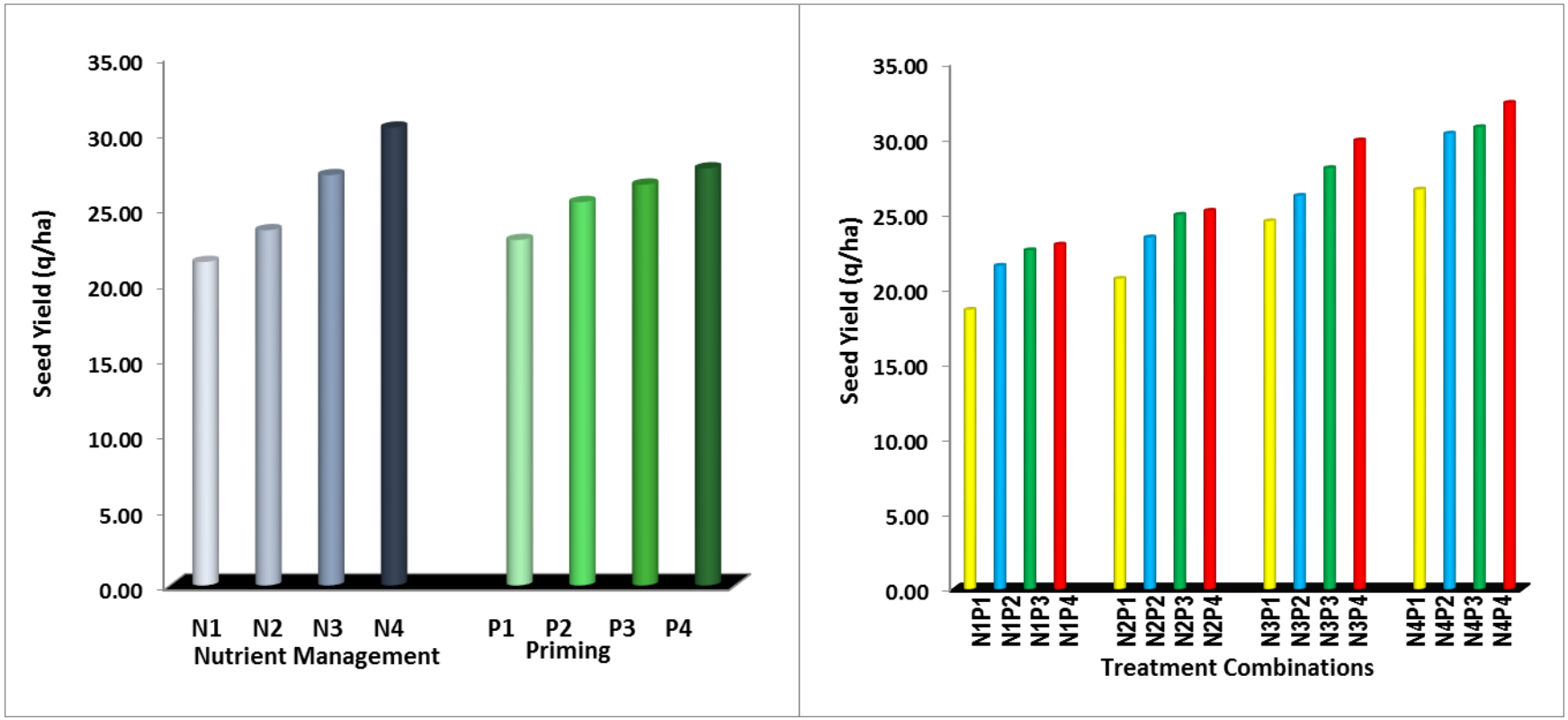


Fig: Effect of nutrient management and seed priming on Seed yield (q/ha) of Finger Millet (Mean over locations)

Centre wise report is given as follows;

1. IGKV, Raipur

Effect of nutrients management on plant growth, seed yield and quality attributes.

Among the four nutrients managements treatments N_4 (125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray) showed superiority with respect to growth and seed yield parameters *viz*., Field Emergence (93.50%), Seed Yield per hectare (33.00 q), 100 seed weight (0.35), Seed Recovery Percent (95.57%), Germination Percent (90.33%) and Vigour Index (14.11) whereas, N_4 was at Par with N_3 (50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray at flowering) for Days to 50% Flowering, Plant Height at 30 Days, Plant Height at harvest Stage, Tillers per Plant, Seed Recovery Percent and Vigour Index; for 100 Seed Weight with N_1 (No fertilizers).

Effect of seed priming on plant growth, seed yield and quality attributes

Among the Four Seed Priming Treatments, Treatment P4 (Seed Priming with 20% liquid Pseudomonas fluoresces) showed superiority for Yield and its components viz., Field Emergence (88.08 %), Tillers per plant (5.45), Seed Yield per Plant (18.17 gm), Seed Yield per hectare (32.58 q), Vigour Index (14.34) and Seed Recovery Percent (94.69 %) whereas it was at par with P2 (P2: Hydro priming for 6 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing) for Chlorophyll Content, 100 Seed Weight, Seed Recovery Percent, Germination Percent; P3 (P3: Seed Priming with 2% KH2PO4 for 6 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing) for 100 Seed Weight.

Interaction effect of seed priming on plant growth, seed yield and quality attributes

Among the two way interactions Nutrients management and Seed Priming were found to be significant for Field Emergence, Chlorophyll Content, Seed Yield per hectare, 100 Seed Weight, Germination percent and Vigour Index.

Interactions N4P4 (N4: 125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P4: Seed Priming with 20% liquid Pseudomonas fluoresces) exhibited superiority in Seed Yield per Plant (20.0 gm), Seed Yield Per hectare (38.74 q), 100 Seed Weight (0.36 gm), Vigour Index (15.77), Field Emergence (97.33 %) and tillers per plant (6.50). Whereas, other interactions superior were N4P2 (N4: 125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P2: Hydro priming for 6 h by adopting

seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing) for Seed Yield per hectare (35.27 q), Seed Recovery Percent (96.83 %), Germination Percent (95.30%), Field Emergence (95.33 %), Days to 50% Flowering (80.33), Chlorophyll Content (1.32 mg/gm), 100 Seed Weight (0.348 gm); N3P4 (N3: 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P4: Seed Priming with 20% liquid Pseudomonas fluoresces) for Days to 50% Flowering (80.33), tillers per plant (5.90), Seed Yield per plant (18.67 gm), Seed Yield per hectare (35.17 q) Seed Recovery Percent (94.68%), Germination Percent (91.30 %) and Vigour Index (14.60).

The Cost: Benefit ratio was calculated to determine the effects of treatments on economic returns. The highest C:B ratio was recorded by interactions N3P4 (1:3.42) (N3: 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P4: Seed Priming with 20% liquid Pseudomonas fluoresces) followed by N1P4 (1:3.00) (N1: No fertilizer; P4: Seed Priming with 20% liquid Pseudomonas fluoresces); N1P2 (1:2.93) (N1: No fertilizer; P2: Hydro priming for 6 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing).

Among the nutrients managements the C:B ratio was found to be higher in N3 (1:2.85) (N3: 50 kg Urea+50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray). Among the Seed priming the returns was found to be higher in P4 (1:2.73) (P4: Seed Priming with 20% liquid Pseudomonas fluoresces).

Conclusion:

It can be concluded that main effect N4 (125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray) exhibited higher Seed Yield but economic returns was higher in N3 (N3: 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray) due to low input cost. Likewise, Seed Priming P4 (P4: Seed Priming with 20% liquid Pseudomonas fluoresces) was found highest in Seed yield and Economic returns. Among the interactions N3P4 (N3: 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P4: Seed Priming with 20% liquid Pseudomonas fluoresces) was found to be highest in C:B ratio (1:3.43) due to moderate input cost despite of third rank (35.17 q per hectare) after N4P4 (125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P4: Seed Priming with 20% liquid Pseudomonas fluoresces)and N4P2 (125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50

kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P2: Hydro priming for 6 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing).

Table: 2.1 Effect of nutrient management and priming on seed yield and quality of finger millet at IGKV, Raipur during *Kharif 2018*

Treatments	Field emergence (%)	Plant height at 30 days (cm)	Plant height at harvest (cm)	Chlorophyll content (mg/gm)	Days to first flowering (Days)	Days of 50% flowering	No. of tillers/plant -1	Seed yield/plant -1 (gm)	Seed yield q/ ha -1	100 seed weight (gm)	Seed Recovery %	Germination %	VI
Nutrient Management													
N1:No fertilizer	76.67	68.23	95.17	0.74	60.25	81.25	3.70	13.33	23.50	0.351	89.88	85.92	10.87
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	80.83	75.83	110.92	1.11	61.25	80.92	4.63	14.00	26.63	0.341	91.69	85.92	13.77
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	82.42	75.07	103.80	1.11	59.25	80.83	4.87	15.50	29.11	0.343	93.20	88.33	12.32
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	93.50	78.77	115.52	1.02	60.92	80.58	5.18	16.50	33.00	0.345	95.57	90.33	14.11
Mean	83.36	74.48	106.35	1.00	60.42	80.90	4.60	14.83	28.06	0.345	92.58	87.63	12.77

SEm+	0.70	2.71	2.94	0.013	0.55	0.51	0.23	0.45	0.51	0.002	1.10	0.50	0.36
C.D. (0.05 P)	2.43	9.38	10.17	0.05	1.91	1.75	0.80	1.56	1.74	0.01	3.81	1.72	1.26
Priming													
P1:Control (No priming)	78.08	73.28	100.72	1.02	61.42	81.50	3.93	3.33	22.75	0.338	88.15	85.58	11.08
P2 :Hydro priming	84.33	74.10	104.15	1.07	60.50	80.75	4.17	3.50	29.01	0.347	95.14	90.08	12.75
P3:Seed priming with 2% KH2PO4	82.92	74.58	107.70	0.87	59.33	80.92	4.83	3.88	27.89	0.346	92.36	85.50	12.90
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	88.08	75.93	112.83	1.03	60.42	80.42	5.45	4.13	32.59	0.35	94.69	89.33	14.34
Mean	83.35	74.47	106.35	1.00	60.42	80.90	4.60	3.71	28.06	0.345	92.58	87.62	12.77
SEm+	0.57	1.09	3.25	0.015	1.17	0.51	0.13	0.58	0.46	0.003	0.86	0.78	0.30
C.D. (0.05 P)	1.67	3.17	9.48	0.04	3.43	1.49	0.38	1.69	1.33	0.01	2.51	2.27	0.89

Table: 2.2 Effect of nutrient management and priming on seed yield and quality of finger millet at IGKV, Raipur during *Kharif 2018*

Treatments	Field emergence (%)	Plant height at 30 days (cm)	Plant height at harvest (cm)	Chlorophyll content (mg/gm)	Days to first flowering (Days)	Days of 50% flowering (Days)	No. of tillers/plant -1	Seed yield/plant -1 (gm)	Seed yield / ha -1 (Q)	100 seed weight (gm)	Seed Recovery %	Germination %	VI
Interaction													
N1P1	71.67	67.13	91.67	0.71	62.00	82.00	3.53	10.67	18.068	0.349	83.500	77.70	10.54
N1P2	75.00	67.80	94.67	0.80	59.33	80.33	3.60	14.00	25.314	0.346	93.508	91.30	10.55
N1P3	79.33	67.93	95.33	0.72	62.67	82.00	3.73	12.67	24.396	0.361	89.295	86.00	10.18
N1P4	80.67	70.07	99.00	0.73	57.00	80.67	3.93	16.00	26.232	0.349	93.213	88.70	12.21
N2P1	76.33	74.13	100.00	1.28	61.33	80.33	3.87	11.33	21.932	0.340	87.316	88.00	11.23
N2P2	82.00	74.93	106.67	0.89	63.67	82.67	4.20	14.67	26.860	0.346	94.493	87.70	14.35
N2P3	80.00	76.60	113.93	0.93	56.00	80.00	5.00	12.00	27.536	0.330	90.500	84.70	14.69
N2P4	85.00	77.67	123.07	1.36	64.00	80.67	5.47	18.00	30.193	0.347	94.458	83.30	14.80
N3P1	76.67	74.53	99.80	1.34	61.00	83.00	4.13	13.33	24.493	0.340	88.551	89.30	9.43
N3P2	85.00	74.67	101.27	1.28	59.67	79.67	4.33	16.00	28.599	0.348	95.726	86.00	12.67
N3P3	78.67	74.73	105.73	0.95	56.00	80.33	5.13	14.00	28.164	0.342	93.841	86.70	12.60
N3P4	89.33	76.33	108.40	0.88	60.33	80.33	5.87	18.67	35.169	0.342	94.679	91.30	14.60
N4P1	87.67	77.33	111.40	0.75	61.33	80.67	4.20	14.00	26.522	0.321	93.213	87.30	13.11
N4P2	95.33	79.00	114.00	1.32	59.33	80.33	4.53	17.33	35.266	0.348	96.832	95.30	13.44
N4P3	93.67	79.07	115.80	0.88	62.67	81.33	5.47	14.67	31.449	0.348	95.788	84.70	14.12
N4P4	97.33	79.67	120.87	1.15	60.33	80.00	6.53	20.00	38.744	0.364	96.427	94.00	15.77
Mean	83.35	74.47	106.35	1.00	60.42	80.90	4.60	14.83	28.06	0.345	92.58	87.63	12.77
SEm+	1.14	2.17	6.5	0.03	2.35	1.02	0.26	1.16	0.91	0.01	1.72	1.56	0.61
C.D. (0.05 P)	3.33	6.34	18.97	0.08	6.85	2.98	0.76	3.38	2.66	0.02	5.02	4.54	1.77

Table: 2.3 Cost: Benefit Ratio as influenced by integrated approaches for increasing seed yield of Finger Millet (Ragi) *cv.* Indira Ragi 1(Cost of Cultivation per hectare)

Treatments	Total Cost (Rs.)	Yield (Q/ha)	Rate (Rs./Q)	Total Return (Rs./ha)	Net return (Rs.)	Cost: Benefit Ratio
N1P1	22460.00	18.07	2600	46975.85	24515.85	1:2.09
N1P2	22465.75	25.31	2600	65816.43	43350.68	1:2.93
N1P3	22565.75	24.40	2600	63429.95	40864.20	1:2.81
N1P4	22740.00	26.23	2600	68203.20	45463.20	1:3.00
N2P1	37460.00	21.93	2600	57024.15	19564.15	1:1.52
N2P2	37465.75	26.86	2600	69835.75	32370.00	1:1.86
N2P3	37565.75	27.54	2600	71594.20	34028.45	1:1.91
N2P4	37740.00	30.19	2600	78502.42	40762.42	1:2.08
N3P1	26422.60	24.49	2600	63681.16	37258.56	1:2.41
N3P2	26428.35	28.60	2600	74357.49	47929.14	1:2.81
N3P3	26528.35	28.16	2600	73227.05	46698.70	1:2.76
N3P4	26702.60	35.17	2600	91439.61	64737.01	1:3.42
N4P1	41422.60	26.52	2600	68956.52	27533.92	1:1.66
N4P2	41428.35	35.27	2600	91690.82	50262.47	1:2.21
N4P3	41528.35	31.45	2600	81768.12	40239.77	1:1.97
N4P4	41702.60	38.74	2600	100734.30	59031.70	1:2.42

2. CSKHPKV, Palampur

Effect of nutrient management

Results of the experiment (Table 2.4) revealed that all the characters except seed germination were affected significantly with different nutrient management treatments. Treatment N_4 (125 kg Neem+1250 kg Vermicompost per ha or 12.5 tons FYM per ha+50 kg Urea+50 kg SSP and 50 kg MOP per ha + Top dressing urea at 3-4 weeks after transplanting+2% Borax spay) showed superiority over other nutrient management treatments. However, it was at par with N_3 (50 kg Urea+50 kg SSP and 50 kg MOP per ha + Top dressing urea at 3-4 weeks after transplanting+2% Borax spay) treatment in respect of days to flowering, 100 seed weight, seed recovery (%), seed vigour and C:B ratio. Results further revealed that all characters were significantly lower with N_1 (Control). There was no significant difference between N_1 and N_2 (125 kg Neem+1250 kg Vermicompost per ha or 12.5 tons FYM/ha) with respect to days to flowering, 100 seed weight and seed vigour.

Effect of priming

Different priming treatment did not affect any of the characters except plant height which was significantly more with P_3 (Seed priming with 2 % KH_2PO_4)

and P_4 (Seed priming with 20 % liquid *Pseudomonas fluoresces*) over other priming treatments. Both P_3 and P_4 were at par with each other.

Interaction effect

No significant interaction of nutrient management with priming was observed on any of the characters except plant height at 30 DAT and 100 seed weight.

Conclusion:

Application of N_4 treatment (125 kg Neem+1250 kg Vermicompost per ha or 12.5 tons FYM per ha+50 kg Urea+50 kg SSP and 50 kg MOP per ha + Top dressing urea at 3-4 weeks after transplanting+2% Borax spay) exhibited better performance with respect to almost all the characters except seed germination (%). Different priming treatments did not show any significant affect on the performance of the crop with respect to any of the characters. Hence it can be concluded that N_4 treatment (125 kg Neem+1250 kg Vermicompost per ha or 12.5 tons FYM per ha+50 kg Urea+50 kg SSP and 50 kg MOP per ha + Top dressing urea at 3-4 weeks after transplanting+2% Borax spay) can be recommended for the higher yield and better quality of seed in finger millet.

Table: 2.4. Effect of nutrient management and priming on seed yield and quality of finger millet at Palampur (HP) during 2018

Treatments	Plant height at 30 DAT (cm)	Plant height at harvest (cm)	Days to first flowering	Days to 50% flowering	Branches/ plant at harvest	Seed yield/ plant (g)	Seed yield (q/ha)	100-seed weight (g)	Seed recovery (%)	Seed germination (%)	Vigour Index	Cost Benefit Ratio
	1	2	3	4	5	6	7	8	9	10	11	12
Nutrient Management												
N_1: No fertilizer	16.5	101.8	68.3	73.3	3.0	4.997	16.66	0.282	84.58	80.3	908.3	1.653
N_2: 125 kg Neem+1250 kg Vermicompost per ha or 12.5 tons FYM/ha	18.1	104.7	68.2	73.2	3.2	5.510	18.37	0.283	85.38	80.8	955.7	1.577
N_3: 50 kg Urea+50 kg SSP and 50 kg MOP per ha+Top dressing urea at 3-4 weeks after transplanting+2% Borax spay	22.0	119.5	70.5	74.1	4.1	7.059	23.53	0.292	89.45	80.4	1050.2	2.255
N_4:125 kg Neem+1250 kg Vermicompost per ha or 12.5 tons FYM per ha+50 kg Urea+50 kg SSP and 50 kg MOP per ha+Top dressing urea at 3-4 weeks after transplanting+2% Borax spay	23.2	122.0	70.7	74.4	4.3	8.079	26.93	0.293	89.65	81.0	1083.6	2.275
Mean	19.9	112.0	69.4	73.7	3.7	6.411	21.37	0.288	87.27	80.6	999.5	1.940
SEm±	0.15	0.34	0.12	0.14	0.08	0.041	0.138	-	0.173	0.294	13.999	0.013
CD(0.05)	0.53	1.20	0.42	0.50	0.15	0.14	0.49	0.001	0.61	NS	49.39	0.045
CV (%)	2.6	1.8	2.6	2.7	7.1	2.2	2.2	0.2	2.7	1.3	4.9	2.3
Priming												
P_1: Control - No priming	18.2	109.8	69.3	73.5	3.6	6.316	21.05	0.287	87.00	80.7	985.9	1.930

P_2 : Hydropriming	18.3	109.7	69.6	73.9	3.7	6.410	21.37	0.287	87.42	80.9	1029.9	1.955
P_3 : Seed priming with 2 % KH_2PO_4	21.7	114.7	69.4	73.8	3.6	6.442	21.47	0.288	87.23	81.0	1006.4	1.933
P4 : Seed priming with 20 % liquid *Pseudomonas fluoresces*	21.5	113.6	69.3	73.8	3.7	6.476	21.59	0.288	87.42	79.9	975.7	1.942
Mean	19.9	112.0	69.4	73.7	3.7	6.411	21.37	0.288	87.27	80.6	999.5	1.940
SEm±	0.10	0.27	0.13	0.14	0.07	0.040	0.132	-	0.15	0.289	18.05	0.012
CD(0.05)	0.31	0.80	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	1.8	0.8	2.6	2.6	6.6	2.1	2.1	0.4	0.6	1.2	6.3	2.2

Table: 2.5. Effect of nutrient management and priming on seed yield and quality of finger millet at Palampur (HP) during 2018

Treatments	Plant height at 30 DAT (cm)	Plant height at harvest (cm)	Days to first flowering	Days to 50% flowering	Branches/ plant at harvest	Seed yield/plant (g)	Seed yield (q/ha)	100-seed weight (g)	Seed recovery (%)	Seed germination (%)	Vigour Index	Cost Benefit Ratio
Interaction												
N_1P_1	15.2	99.5	68.0	73.0	3.0	4.893	16.31	0.281	84.18	80.3	911.2	1.631
N_1P_2	15.4	99.5	68.7	73.0	3.1	4.983	16.61	0.282	84.93	81.0	912.4	1.658
N_1P_3	17.7	104.7	68.3	73.7	2.9	5.015	16.72	0.281	84.79	80.7	924.8	1.639
N_1P_4	17.7	103.3	68.0	73.3	3.0	5.097	16.99	0.283	84.43	79.0	884.8	1.685
N_2P_1	16.7	102.3	68.3	73.0	3.2	5.373	17.91	0.284	84.98	80.7	927.7	1.571
N_2P_2	16.4	102.0	68.3	73.3	3.2	5.613	18.71	0.283	85.67	80.3	996.5	1.638
N_2P_3	19.6	108.2	68.0	73.3	3.0	5.486	18.29	0.284	85.22	81.7	944.8	1.576
N_2P_4	19.6	106.4	68.0	73.0	3.3	5.568	18.56	0.282	85.67	80.7	954.0	1.521
N_3P_1	20.0	118.0	70.3	73.7	4.1	6.992	23.31	0.291	89.34	80.7	1030.3	2.249

N_3P_2	20.2	118.1	70.7	74.7	4.3	6.973	23.24	0.291	89.44	81.0	1055.7	2.239
N_3P_3	23.8	120.9	70.7	74.0	4.1	7.136	23.79	0.294	89.47	80.7	1086.3	2.252
N_3P_4	24.0	120.9	70.3	74.0	4.1	7.134	23.78	0.291	89.53	79.3	1028.7	2.278
N_4P_1	21.0	119.5	70.7	74.3	4.2	8.007	26.69	0.294	89.51	81.0	1074.4	2.270
N_4P_2	21.4	119.3	70.7	74.7	4.2	8.072	26.91	0.292	89.63	81.3	1154.9	2.284
N_4P_3	25.6	125.0	70.7	74.0	4.3	8.130	27.10	0.292	89.42	81.0	1069.6	2.266
N4P4	24.9	124.0	70.7	74.7	4.4	8.105	27.02	0.295	90.05	80.7	1035.4	2.282
Mean	19.9	112.0	69.4	73.7	3.7	6.411	21.37	0.288	87.27	80.6	999.5	1.940
SEm± Nurient(N) Priming (P)	0.24 0.30	0.58 0.68	0.25 0.24	0.28 0.29	0.14 0.15	0.080 0.083	0.267 0.276	0.001 0.001	0.315 0.346	0.580 0.587	34.254 27.998	0.025 0.025
CD(0.05) Nutrient (N) at same level of Priming (P) Priming (P) at same level of Nutrient (N)	0.75 0.67	NS NS	NS NS	NS NS	NS NS	NS NS	NS NS	0.002 0.002	NS NS	NS NS	NS NS	NS NS

3. GKVK, Bengaluru

Effect of nutrient management on plant growth, seed yield and quality attributes of finger millet *cv.* ML-365

The nutrient management treatments had significant effect on plant growth, seed yield and quality of finger millet*cv.*ML-365. The field emergence (88%), chlorophyll content (42.49), plant height (116.4 cm), tillers/plant (6.9), panicle weight (6.792 kg per plot), seed yield (40.862 g per plant; 3.097kg per plot ; 30.97q per ha) and seed recovery (98.23 %) were recorded maximum in N_4(125 kg neem + 1250 kg vermicompost per ha + 50 kg urea + 50 kg SSP and 50 kg MOP per ha + top dressing urea at 3 to 4 weeks after transplanting + 2 % Borax). This was statistically on par N_3(50 kg Urea + 50 kg SSP and 50 kg MOP per ha + top dressing urea at 3-4 weeks after transplanting + 2 % Borax)with seed yield of 35.627 g/plant; 2.882kg/plot; 28.82q/ha and seed recovery (97.65 %). The minimum was recorded in N_1(control)(27.068 g/ plant, 2.407kg/plot, 24.07q/ha and 91.61 %, respectively).

The priming treatments had significant effect on plant growth**,** seed yield and quality attributes of finger millet *cv.* ML-365 (Table 2.6). The chlorophyll content (41.63SPAD units), plant height (113.2 cm), no. of tillers/plant (6.4), panicle weight (6.383 kg/plot), seed yield (39.339 g/plant: 3.022 kg/plot; 30.22q/ha) and seed recovery (96.53 %) were significantly the highest in P_3 treatment *(*priming of seeds with 2% KH_2PO_4 for 6h). This was followed by P_4 (priming of seeds with 20 % liquid *pseudomonas florescence* for 6h) recorded field emergence (87.67%), chlorophyll content (39.91), no. of tillers/plant (5.8), panicle weight (5.677 kg per plot), seed yield (36.167 g/plant; 2.862kg/plot and 28.62q/ha) with seed recovery (95.99%) and the lowest yield parameters were recorded inP_1 (Control)(27.345g/plant; 2.480 kg/plot and 24.80 q/ha, respectively).

The interaction of priming (P) with nutrient management (N) showed significant effect on plant growth, seed yield and quality attributes of finger millet*cv.*ML-365 (Table-2.6). The chlorophyll content (45.80 SPAD units), plant height (117.7cm), no. of tillers (7.2/plant), panicle weight (7.741 kg/plot), seed yield (44.783 g/plant; 3.372 kg/plot and 33.72q/ha) was found significantly highest among the interaction N_4P_3 (priming of seeds with 2% KH_2PO_4 followed by supply of inorganic and organic fertilizers along with borax spray at flowering). This was on par with the interaction N4P4treatment (priming of seeds with 20% liquid *Pseudomonas fluorescence* for 6h followed by supply of organic fertilizers along with borax spray at flowering). While, lowest was recorded in the interaction $N_1P_1$with growth parameters *viz.*, field emergence (76.33%), plant height (95.2cm), no. of tillers (3.4) and seed yields (22.017 g/plant; 2.143 kg/plot & 21.43 q/ha).The same trend was followed in the seed quality parameters also (Table 2.7).

Conclusion:

Application of 125 kg neem + 1250 kg vermicompost per ha + 50 kg urea + 50 kg SSP and 50 kg MOP per ha + top dressing urea at 3-4 weeks after transplanting + 2 % Borax showed superiority with respect to all the growth, yield and yield contributing characters over the rest of the nutrient management treatments. Among different priming treatments, seed priming with 2% KH_2PO_4 for 6h alone showed superiority in growth and seed yield followed by seed priming with 20% liquid *pseudomonas fluorescence*. Hence, these treatments could be advocated and practically used to enhance the seed yield and quality in finger millet.

Table: 2.6. Effect of seed priming, nutrient management on plant growth and seed yield of finger millet *cv.* ML-365 at Bengaluru during 2018

Treatment	Field emergence (%)	Days to 50% flowering	Chlorophyll content (SPAD)	Plant height (cm)	No. of tillers	Panicle weight (kg/plot)	Seed yield (g/ plant)	Seed yield (kg /plot)	Seed yield (q/ha)	Seed recovery (%)
Nutrient Management (N)										
N_1	79.33	68.67	39.44	104.5	4.0	4.009	27.068	2.407	24.07	91.61
N_2	81.67	67.08	36.16	105.1	5.1	4.747	32.948	2.553	25.53	95.22
N_3	83.91	66.92	41.34	113.7	6.2	6.033	35.627	2.882	28.82	97.65
N_4	88.00	65.92	42.49	116.4	6.9	6.792	40.862	3.097	30.97	98.23
Mean	**83.23**	**67.15**	**39.85**	**109.9**	**5.5**	**5.395**	**34.126**	**2.735**	**27.35**	**95.67**
SEm±	**0.834**	**0.315**	**0.513**	**0.923**	**0.217**	**0.198**	**0.570**	**0.09**	**0.98**	**0.286**
CD(P 0.05)	**2.47**	**0.93**	**1.52**	**2.74**	**0.64**	**0.58**	**1.69**	**0.27**	**2.91**	**0.85**
Priming treatments (P)										
P_1	79.25	67.25	38.27	105.6	4.5	4.377	27.345	2.480	24.80	94.36
P_2	81.58	67.33	39.62	110.1	5.6	5.145	33.654	2.573	25.73	95.82
P_3	84.42	67.00	41.63	113.2	6.4	6.383	39.339	3.022	30.22	96.53
P_4	87.67	67.00	39.91	110.7	5.8	5.677	36.167	2.862	28.62	95.99
Mean	**83.23**	**67.14**	**39.85**	**109.9**	**5.6**	**5.395**	**34.126**	**2.734**	**27.34**	**95.67**
SEm±	**0.921**	**0.393**	**0.398**	**0.726**	**0.454**	**0.108**	**0.508**	**0.083**	**0.83**	**0.274**
CD(P=0.05)	**2.74**	**NS**	**1.18**	**2.16**	**1.35**	**0.32**	**1.51**	**0.25**	**2.47**	**0.81**
NxP (Nutrient management x seed priming)										
N_1P_1	76.33	69.33	40.05	95.2	3.4	2.892	22.017	2.143	21.43	90.98
N_1P_2	77.67	68.33	37.74	105.8	3.9	3.818	28.167	2.267	22.67	90.87
N_1P_3	80.00	68.33	39.83	111.2	4.7	5.079	30.390	2.658	26.58	92.83
N_1P_4	83.33	68.66	40.16	105.7	4.1	4.248	27.700	2.560	25.60	91.77

N_2P_1	77.00	67.33	33.72	101.8	4.0	3.774	25.800	2.215	22.15	90.98
N_2P_2	81.00	67.66	36.81	108.2	5.5	4.421	28.510	2.470	24.70	96.46
N_2P_3	83.33	66.33	38.29	106.5	5.9	5.960	40.283	2.844	28.44	96.96
N_2P_4	85.33	67.00	35.82	104.2	5.0	4.833	37.200	2.682	26.82	96.47
N_3P_1	79.33	67.00	39.56	112.4	5.1	5.145	29.573	2.569	25.69	97.33
N_3P_2	82.33	67.33	43.19	111.0	6.1	5.586	34.900	2.673	26.73	97.86
N_3P_3	85.00	66.66	42.60	117.2	6.8	6.752	41.900	3.216	32.16	97.85
N_3P_4	89.00	66.66	40.02	113.9	6.9	6.651	36.133	3.069	30.69	97.56
N_4P_1	84.33	65.33	39.75	113.1	5.5	5.696	31.990	2.660	26.60	98.14
N_4P_2	85.33	66.00	40.76	115.5	6.9	6.756	43.040	2.882	28.82	98.09
N_4P_3	89.33	66.66	45.80	117.7	7.2	7.741	44.783	3.372	33.72	98.50
N4P4	93.00	65.66	43.66	119.1	6.9	6.975	43.633	3.138	31.38	98.18
Mean	**83.23**	**67.14**	**39.86**	**109.9**	**5.5**	**5.395**	**34.126**	**2.714**	**27.14**	**95.67**
SEm±	**1.391**	**0.607**	**1.599**	**1.331**	**0.342**	**0.293**	**1.213**	**0.162**	**1.620**	**0.364**
CD(0.05P)	**4.13**	**1.80**	**4.75**	**3.95**	**1.02**	**0.87**	**3.60**	**0.48**	**4.81**	**1.08**
CV (%)	**1.4**	**2.56**	**6.9**	**2.1**	**10.6**	**9.4**	**6.2**	**10.24**	**10.24**	**8.0**

Table 2.7 Effect of seed priming & nutrient management on seed quality of finger millet *cv.* ML-365 at Bengaluru during 2018

Treatment	1000 seed weight(g)	Seed germination (%)	Seed vigour index-I
Nutrient Management (N)			
N_1	2.274	77.75	986
N_2	3.240	79.50	977
N_3	3.257	79.67	1034
N_4	3.306	80.00	1048
Mean	**3.019**	**79.23**	**1011**
SEm±	**0.06**	**0.83**	**21.86**
CD(P 0.05)	**0.17**	**2.48**	**64.9**
Priming treatments (P)			
P_1	3.074	77.50	999
P_2	3.263	77.50	955
P_3	3.467	82.42	1060
P_4	3.272	79.50	1038
Mean	**3.269**	**79.23**	**1013**
SEm±	**0.03**	**0.92**	**30.47**
CD(P=0.05)	**0.09**	**2.74**	**90.5**
Interaction (Nutrient management x seed priming)			
N_1P_1	2.920	77.00	973
N_1P_2	3.313	75.00	871
N_1P_3	3.503	82.33	1090
N_1P_4	3.360	76.67	1012
N_2P_1	3.163	79.67	1028
N_2P_2	3.100	79.00	943
N_2P_3	3.593	80.00	982
N_2P_4	3.103	79.33	956
N_3P_1	3.163	78.33	1060
N_3P_2	3.260	79.00	970
N_3P_3	3.303	82.00	1075
N_3P_4	3.303	79.33	1031
N_4P_1	3.050	75.00	907
N_4P_2	3.380	77.00	1035
N_4P_3	3.470	85.33	1094
N4P4	3.323	82.67	1156
Mean	**3.269**	**79.23**	**1011**
SEm±	**0.075**	**1.39**	**44.1**
CD(0.05P)	**0.223**	**4.13**	**131**

CV (%)	**4.0**	**3.0**	**7.5**

Nutrient management

N_1: No fertilizer; **N2:** 125 kg neem + 1250 kg vermicompost per ha ; **N_3:** 50 kg urea + 50 kg SSP and 50 kg MOP per ha + top dressing urea at 3-4 weeks after transplanting + 2 % Borax; **N_4:** 125 kg neem + 1250 kg vermicompost per ha + 50 kg Urea + 50 kg SSP and 50 kg MOP per ha + top dressing urea at 3-4 weeks after transplanting + 2 % Borax

Priming treatments: P1: Control; **P_2:** Hydro-priming for 6 hrs; **P_3:** Seed priming with 2% $KH_2PO_4$for 6 hr; **P_4:** Seed priming with 20 % liquid *Pseudomonas fluoresces*



Nursery bed raised for finger millet



Experimental plot Finger Millet

3. KKV, Dapoli

Replicated data of the observations taken for the investigation conducted during Kharif-2018 is given in Table 2.8. The results so obtained by split-plot analysis of the data are presented in Table 2.9. Main plots i.e. Nutrient management (N) revealed significant variation for all the characters under study. Subplots i.e. Priming methods (P) revealed significant variation for all the characters under study except seed recovery percentage. However, nutrient management x priming interaction (N x P) was found to be significant for all the characters under study.

Nutrient management

In case of main plots, N4 was significantly superior for all the traits under study viz., plant height at 30 DAS (33.83 cm), plant height at harvest (99.82 cm), total chlorophyll content (10.43 mg/g), days to first flowering (84.08 days), days to 50 % flowering (90.75 days), number of tillers/plant (4.07), seed yield/plant (12.00 g), seed yield/ha (2104.73 kg), 100 seed weight (0.24 g), seed recovery (62.36 %), germination (80.33 %), vigour index (710.55) and B:C ratio (1.32). However, N3was at par with N4for seed recovery, germination, vigour index and B:C ratio.

Effect of priming

In case of sub-plots, P4 was significantly superior for plant height at harvest (93.13 cm), days to first flowering (85.67 days), days to 50 % flowering (92.08 days),

number of tillers/plant (3.72), seed yield/plant (9.77 g), seed yield/ha (1722.88 kg), 100 seed weight (0.24 g), seed recovery (61.65 %), germination (80.58 %),vigour index (691.71)and B:C ratio (1.24). P3revealed highest significant plant height at 30 DAS (30.97 cm), plant height at harvest (93.13 cm) and total chlorophyll content (9.59 mg/g).However, P3was at par with P4for plant height at 30 DAS, plant height at harvest, total chlorophyll content, days to 50 % flowering, number of tillers/plant, seed yield/plant, seed yield/ha, vigour index and B:C ratio.

Nutrient management x priming interaction

Interaction N_4P_4 was significantly superior for days to first flowering (79.67), days to 50% flowering (87.67), number of tillers/plant (4.53), seed yield/plant (14.14 g), seed yield/ha (2473.25 kg),100 seed weight (0.26 g), seed recovery (66.18 %), germination (84.00 %), vigour index (794.53) and B:C ratio (1.44) while N_4P_3 recorded highest significant plant height at 30 DAS (38.93cm), plant height at harvest (110.20cm) and total chlorophyll content (11.87mg/g).However, both the treatments were at par with each other for plant height at harvest, total chlorophyll content, days to 50 % flowering, number of tillers/plant, seed yield/ha, 100 seed weight, seed recovery, germination, vigour index and B:C ratio. Treatment N_4P_4 recorded highest total returns of Rs. 127812 and net returns of Rs. 38960with lowest seed production Cost/kg of Rs.32.50 (Table 2.10).N_4P_4 recorded 149.5%, 11.5% and 25.6% increase in seed yield/ha, germination, and vigour index, respectively over control.

Conclusion:

Higher seed yields and resultant seed quality might have been possible due to increase in overall seedling and plant vigour expressed through plant height at harvest and total chlorophyll content and in yield contributing characters *viz*., number of tillers/plant and 100 seed weight. Hence it is concluded that for achieving higher seed yields and resultant seed quality viz., germination (%) and seedling vigour through seed production programme of finger millet, primed seeds with 20 % liquid *Pseudomonas fluorescens* or 2% KH_2PO_4 be sown and transplanted at 21 DAS along with per hectare nutrient dose of 125 kg Neem+ 1250 kg vermicompost mixed with 50 kg/ha each of Urea, SSP, MoP followed by top dressing of urea at 3-4 weeks after transplanting and 2 % Borax spray at flowering.

Table 2.8: Effect of nutrient management, priming and their interactions on growth, seed yield and seed quality parameters in Finger Millet *cv.* Dapoli Nagli-1 during *Kharif* 2018.

Treatments	Plant Height at 30 DAS (cm)	Plant Height at Harvest (cm)	Total Chlorophyll Content (mg/g)	Days to First Flowering (Days)	Days to 50 % Flowering (Days)
N1:No fertilizer	23.27	82.70	8.28	88.17	94.58
N2:125 kg Neem+1250kg Vermi compost per ha	27.07	84.55	8.70	88.75	95.33
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	30.52	90.58	8.79	87.50	94.08
N4: 125 kg Neem+1250kg Vermi compost per ha + 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	33.83	99.82	10.43	84.08	90.75
Mean	**28.67**	**89.41**	**9.05**	**87.13**	**93.69**
SEm±	**0.34**	**0.70**	**0.12**	**0.39**	**0.36**
CD(0.05P)	**1.20**	**2.47**	**0.43**	**1.37**	**1.26**
P1:Control (No priming)	25.80	84.48	8.40	88.50	95.00
P2: Hydro priming	27.95	86.90	8.96	87.92	94.67
P3:Seed priming with 2% $KH_2PO_4$and mixing with carbendazim	30.97	93.13	9.59	86.42	93.00
P4: Seed priming with 20% Liquid *Pseudomonas fluorescens*	29.97	93.13	9.25	85.67	92.08
Mean	**28.67**	**89.41**	**9.05**	**87.13**	**93.69**
SEm±	**0.47**	**0.86**	**0.16**	**0.35**	**0.42**

CD(0.05P)	**1.37**	**2.54**	**0.46**	**1.04**	**1.22**
N_1P_1	20.20	80.40	8.41	88.33	95.00
N_1P_2	23.20	82.13	8.58	89.33	96.00
	Cont.				
N_1P_3	24.87	83.33	8.13	86.67	93.00
N_1P_4	24.80	84.93	8.00	88.33	94.33
N_2P_1	24.20	82.40	8.56	87.67	95.00
N_2P_2	27.33	84.60	8.23	89.00	96.67
N_2P_3	29.27	87.87	8.88	89.00	94.33
N_2P_4	27.47	83.33	9.12	89.33	95.33
N_3P_1	28.80	85.80	8.26	88.00	94.67
N_3P_2	29.47	88.53	9.12	88.33	95.00
N_3P_3	30.80	91.13	9.46	88.33	95.67
N_3P_4	33.00	96.87	8.32	85.33	91.00
N_4P_1	30.00	89.33	8.37	90.00	95.33
N_4P_2	31.80	92.33	9.91	85.00	91.00
N_4P_3	38.93	110.20	11.87	81.67	89.00
N_4P_4	34.60	107.40	11.56	79.67	87.67
Mean	**28.67**	**89.41**	**9.05**	**87.13**	**93.69**
SEm± (P) at same level of N	**0.68**	**1.40**	**0.25**	**0.78**	**0.71**
SEm± (N) at same level of P	**0.88**	**1.65**	**0.30**	**0.73**	**0.80**
CD(0.05P) (P) at same level of N	**2.82**	**5.26**	**0.96**	**2.20**	**2.54**
CD(0.05P) (N) at same level of P	**2.65**	**5.03**	**0.91**	**2.25**	**2.45**

CV (%) P	**5.63**	**3.35**	**6.03**	**1.41**	**1.54**
CV (%) N	**4.10**	**2.71**	**4.70**	**1.54**	**1.32**

Table 2.9: Effect of nutrient management, priming and their interactions on growth, seed yield and seed quality parameters in Finger Millet cv. Dapoli Nagli-1 during Kharif 2018.

Treatments	**No. of Tillers plant^{-1} (No.)**	**Seed Yield plant^{-1} (g)**	**Seed Yield ha^{-1} (kg)**	**100 Seed Weight (g)**
N1:No fertilizer	2.50	5.78	1041.71	0.22
N2:125 kg Neem+1250kg Vermi compost per ha	3.52	7.81	1354.41	0.23
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	3.80	10.00	1761.44	0.22
N4: 125 kg Neem+1250kg Vermi compost per ha + 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	4.07	12.00	2104.73	0.24
Mean	**3.47**	**8.90**	**1565.57**	**0.23**
SEm±	**0.05**	**0.12**	**20.44**	**0.002**
CD(0.05P)	**0.17**	**0.42**	**72.10**	**0.007**
P1:Control (No priming)	3.17	7.89	1383.17	0.23
P2: Hydro priming	3.35	8.45	1490.30	0.22
P3:Seed priming with 2% $KH_2PO_4$and mixing with carbendazim	3.65	9.49	1665.94	0.23
P4: Seed priming with 20% Liquid	3.72	9.77	1722.88	0.24

Pseudomonas fluorescens				
Mean	**3.47**	**8.90**	**1565.57**	**0.23**
SEm±	**0.07**	**0.10**	**31.50**	**0.002**
CD(0.05P)	**0.20**	**0.30**	**92.50**	**0.007**
N_1P_1	2.27	5.64	991.43	0.21
N_1P_2	2.40	5.74	1035.11	0.23
N_1P_3	2.67	5.93	1074.78	0.22
N_1P_4	2.67	5.83	1065.52	0.23
N_2P_1	3.40	7.72	1334.76	0.23
N_2P_2	3.47	7.64	1352.62	0.22
N_2P_3	3.53	7.99	1378.84	0.23
N_2P_4	3.67	7.90	1351.43	0.22
N_3P_1	3.53	8.58	1485.41	0.23
N_3P_2	3.73	9.35	1636.03	0.21
N_3P_3	3.93	10.86	1922.97	0.22
N_3P_4	4.00	11.20	2001.34	0.23
N_4P_1	3.47	9.62	1721.07	0.23
N_4P_2	3.80	11.06	1937.42	0.23
N_4P_3	4.47	13.17	2287.18	0.25
N_4P_4	4.53	14.14	2473.25	0.26
Mean	**3.47**	**8.90**	**1565.57**	**0.23**

SEm± (P) at same level of N	**0.06**	**0.24**	**40.88**	**0.004**
SEm± (N) at same level of P	**0.11**	**0.21**	**58.27**	**0.004**
CD(0.05P) (P) at same level of N	**0.35**	**0.63**	**189.58**	**0.014**
CD(0.05P) (N) at same level of P	**0.31**	**0.66**	**175.32**	**0.014**
CV (%) P	**5.76**	**3.94**	**6.97**	**3.44**
CV (%) N	**2.88**	**4.65**	**4.52**	**3.16**

Cont….

Table 2.9: Effect of nutrient management, priming and their interactions on growth, seed yield and seed quality parameters in Finger Millet cv. Dapoli Nagli-1 during Kharif 2018.

Treatments	**Seed Recovery (%)**	**Germination (%)**	**Vigour Index**	**B:C Ratio**
N1:No fertilizer	57.67(7.59)	77.00(61.36)	667.42	1.02
N2:125 kg Neem+1250kg Vermi compost per ha	58.18(7.62)	77.67(61.83)	601.64	1.06
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	60.28(7.76)	80.29(63.69)	657.04	1.32
N4: 125 kg Neem+1250kg Vermi compost per ha + 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	62.36(7.90)	80.33(63.73)	710.55	1.32
Mean	**59.62(7.72)**	**78.82(62.66)**	**659.16**	**1.18**
SEm±	**0.05**	**0.40**	**18.48**	**0.02**
CD(0.05P)	**0.16**	**1.40**	**65.19**	**0.04**

P1:Control (No priming)	58.08(7.62)	78.58(62.48)	645.44	1.11
P2: Hydro priming	59.29(7.70)	77.42(61.64)	634.01	1.15
P3:Seed priming with 2% $KH_2PO_4$and mixing with carbendazim	59.46(7.71)	78.71(62.55)	665.49	1.22
P4: Seed priming with 20% Liquid *Pseudomonas fluorescens*	61.65(7.85)	80.58(63.95)	691.71	1.24
Mean	**59.62 (7.72)**	**78.82 (62.66)**	**659.16**	**1.18**
SEm±	**0.06**	**0.35**	**13.84**	**0.02**
CD(0.05P)	**NS**	**1.02**	**40.65**	**0.04**
N_1P_1	61.64 (7.81)	75.33(60.23)	632.65	0.99
N_1P_2	59.39 (7.51)	77.50 (61.70)	672.01	1.02
N_1P_3	58.41 (7.64)	79.00 (62.74)	681.96	1.04
N_1P_4	54.81 (7.40)	76.17 (60.79)	683.07	1.04
N_2P_1	52.73 (7.26)	78.83 (62.64)	660.55	1.05
N_2P_2	56.22 (7.50)	76.00 (60.67)	572.49	1.06
N_2P_3	58.74 (7.66)	76.83 (61.24)	594.36	1.07
N_2P_4	65.01 (8.06)	79.00 (62.77)	579.15	1.05
N_3P_1	58.98 (7.67)	82.00 (64.92)	642.17	1.21
N_3P_2	63.21 (7.95)	78.83 (62.61)	616.90	1.27
N_3P_3	58.30 (7.63)	77.17 (61.46)	659.00	1.40
N_3P_4	60.61 (7.78)	83.17 (65.78)	710.10	1.42
N_4P_1	59.57 (7.72)	78.17 (62.15)	646.40	1.19
N_4P_2	61.32 (7.83)	77.33 (61.57)	674.66	1.27

N_4P_3	62.38 (7.90)	81.83 (64.78)	726.63	1.39
N_4P_4	66.18 (8.13)	84.00 (66.44)	794.53	1.44
Mean	**59.62 (7.72)**	**78.82 (62.66)**	**659.16**	**1.18**
SEm± (P) at same level of N	**0.09**	**0.79**	**36.96**	**0.04**
SEm± (N) at same level of P	**0.11**	**0.72**	**30.27**	**0.04**
CD(0.05P) (P) at same level of N	**0.35**	**2.17**	**87.40**	**0.09**
CD(0.05P) (N) at same level of P	**0.33**	**2.25**	**95.56**	**0.09**
CV (%) P	**2.56**	**1.92**	**7.28**	**4.38**
CV (%) N	**2.05**	**2.19**	**9.71**	**3.18**

(Figures in parentheses are square root and arc sine transformed values for seed recovery (%) and germination (%), respectively.)

Table 2.10: Economics of seed production in finger millet *cv.* Dapoli Nagli-1 as influenced by different treatment combinations during *Kharif*- 2018.

Treatment	Good Seed (kg)	Rejected Seed (kg)	Straw Yield (kg)	Good Seed Returns (Rs.)	Rejected Seed Returns (Rs.)	Straw Returns (Rs.)	Total Returns (Rs.)	Input Cost (Rs.)	Total Cost (Rs.)	Net Return (Rs.)	B:C @ Input Cost	B:C @ Total Cost	Cost/Kg (Rs.)
N_1P_1	892.29	99.14	1608.42	44614	2875	4021	51511	29881	52132	-622	1.72	0.99	50.70
N_1P_2	931.60	103.51	1742.90	46580	3002	4357	53939	29881	52933	1006	1.81	1.02	48.92
N_1P_3	967.30	107.48	1840.06	48365	3117	4600	56082	29903	53673	2409	1.88	1.04	47.51
N_1P_4	958.97	106.55	1944.02	47948	3090	4860	55898	30000	53672	2226	1.86	1.04	47.68
N_2P_1	1201.28	133.48	2531.31	60064	3871	6328	70263	37151	66579	3684	1.89	1.06	46.93
N_2P_2	1217.36	135.26	2405.94	60868	3923	6015	70805	37151	66826	3979	1.91	1.06	46.73
N_2P_3	1240.96	137.88	2347.36	62048	3999	5868	71915	37173	67270	4645	1.93	1.07	46.26
N_2P_4	1216.29	135.14	2078.80	60814	3919	5197	69931	37270	66797	3134	1.88	1.05	47.42
N_3P_1	1336.87	148.54	2518.50	66843	4308	6296	77447	32631	64021	13426	2.37	1.21	39.96
N_3P_2	1472.43	163.60	2588.25	73621	4744	6471	84836	32631	66607	18230	2.60	1.27	37.62
N_3P_3	1730.67	192.30	3298.40	86534	5577	8246	100356	32653	71812	28544	3.07	1.40	33.51
N_3P_4	1801.21	200.13	3302.00	90060	5804	8255	104119	32750	73253	30866	3.18	1.42	32.86
N_4P_1	1548.96	172.11	2889.16	77448	4991	7223	89662	39181	75583	14079	2.29	1.19	40.91
N_4P_2	1743.68	193.74	3159.52	87184	5619	7899	100701	39181	79373	21329	2.57	1.27	37.77
N_4P_3	2058.46	228.72	3666.53	102923	6633	9166	118722	39203	85554	33168	3.03	1.39	33.89
N_4P_4	2225.93	247.33	3737.16	111296	7172	9343	127812	39300	88852	38960	3.25	1.44	32.50

Foxtail millet *(Sataria italica)*

Unified observation

Effect of nutrient management and seed priming on yield and seed quality attributing traits in foxtail Millet (Mean over two locations)

During kharif 2018, this experiment was conducted at two locations namely UAS, Dharwad and TNAU, Coimbatore. The detailed mean data over locations are presented in Table 2.11.

The average over locations revealed that nutrient management treatments had significant effect on plant growth, seed yield and quality of little millet. Among the nutrient management treatments N_4 (nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) showed superiority with respect to seed yield (21 q/ha), plant height (115 cm), chlorophyll (43.22 cm), Germination (90 %) and vigour index-I (1148) as compared to control and other treatments. The seed priming treatment had significant effect on seed yield. Among the priming treatments, seed priming with 20 % liquid *P. fluorescens* was superior as compared to control and other treatments in terms of seed yield (20.5 q/ha), plant height (114), germination (90%), vigour index (1121) and seed quality attributes.

Among interactions of priming with nutrient management treatments, N_4P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescence*) in combination with nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) recorded highest seed yield (23.7 q/ha), plant height (120 cm), chlorophyll (45), vigour index-I (1162), field emergence (93.0%) and seed quality attributes closely followed by N_4P_3 (Seed Priming with 2% KH_2PO_4 in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray).

Significant Observation:

Mean data over locations revealed that treatment combination N_4P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescence* in combination with nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha + Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) leads to 48.1% increase of seed yield/ha over control.

Table 2.11: Effect of nutrient management and seed priming on yield and seed quality attributing traits in Foxtail Millet (Mean over locations)

Treatments	Germination %	Days to 50% Flowering	Plant Population(m2)	Plant Height (cm)	Chlorophyll Content	Number of Tillers/ plant	1000 seed weight (g)	Vigour Index	Field emergence (%)	Seed Yield (q./ha.)	B:C Ratio
Nutrient Management											
N1:No fertilizer	88	56.6	71.92	100.00	32.70	11.70	2.56	1088	85.29	16.8	0.81
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	89	55.3	74.83	106.00	37.68	13.00	2.62	1090	87.42	17.7	1.10
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 week after transplanting+ 2% Borax spray	90	55	76.67	111.00	40.42	14.30	2.66	1119	89.00	19.4	1.42
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	90	53.3	78.75	115.00	43.22	17.30	2.77	1148	91.63	21.0	1.83
Mean	**89.25**	**55.05**	**75.54**	**108.00**	**38.50**	**14.07**	**2.65**	**1111**	**88.33**	**18.72**	**1.29**
Priming											
P1:Control (No priming)	88	56.3	70.5	105.00	35.83	11.70	2.56	1099	84.34	17.2	0.76
P2 :Hydro priming	90	56.1	76.67	107.00	38.48	13.00	2.60	1107	89.00	17.5	1.28
P3:Seed priming with 2% KH2PO4	90	54.6	78.92	108.00	39.86	15.30	2.74	1117	91.29	19.3	1.68
P4: Seed priming with 20% Liquid *P. fluorescence*	90	53	76.08	114.00	39.81	16.70	2.70	1121	90.71	20.5	1.87
Mean	**89.50**	**55.00**	**75.54**	**108.50**	**38.49**	**14.18**	**2.65**	**1111**	**88.83**	**18.6**	**1.40**
Interaction											
N_1P_1	88	58.6	62.00	95.00	28.71	9.70	2.50	1081	82.50	16.0	0.78

N_1P_2	89	57.3	73.33	98.00	33.24	10.30	2.57	1085	85.17	16.7	1.25
N_1P_3	88	56.2	80.00	100.00	35.42	12.70	2.59	1089	89.00	16.9	1.47
N_1P_4	88	54.4	72.33	107.00	33.50	13.30	2.60	1096	86.00	17.8	1.82
N_2P_1	89	54.4	68.67	107.00	34.06	10.30	2.57	1090	82.84	16.7	0.83
N_2P_2	90	57.5	75.67	107.00	36.93	11.30	2.57	1091	85.84	17.1	1.17
N_2P_3	89	55.7	83.33	106.00	41.14	14.30	2.64	1104	92.67	18.2	1.60
N_2P_4	90	53.6	71.67	112.00	38.69	15.30	2.69	1103	86.84	19.0	1.83
N_3P_1	89	56.9	75.33	108.00	39.13	11.70	2.59	1112	86.00	17.6	0.92
N_3P_2	89	55.5	77.00	110.00	40.17	12.30	2.64	1126	87.67	19.0	1.20
N_3P_3	90	54.9	74.33	110.00	40.03	15.30	2.70	1126	87.84	20.3	1.40
N_3P_4	90	52.6	80.00	114.00	42.31	17.00	2.72	1124	92.00	20.6	1.90
N_4P_1	88	55.2	76.00	111.00	41.51	14.70	2.61	1113	87.00	18.8	0.82
N_4P_2	90	54.3	80.67	113.00	43.67	16.00	2.65	1127	88.84	20.0	1.23
N_4P_3	89	52.0	78.00	114.00	42.99	18.00	3.04	1149	90.17	21.3	1.55
N_4P_4	90	51.6	80.33	120.00	44.81	20.30	2.78	1162	93.00	23.7	1.92

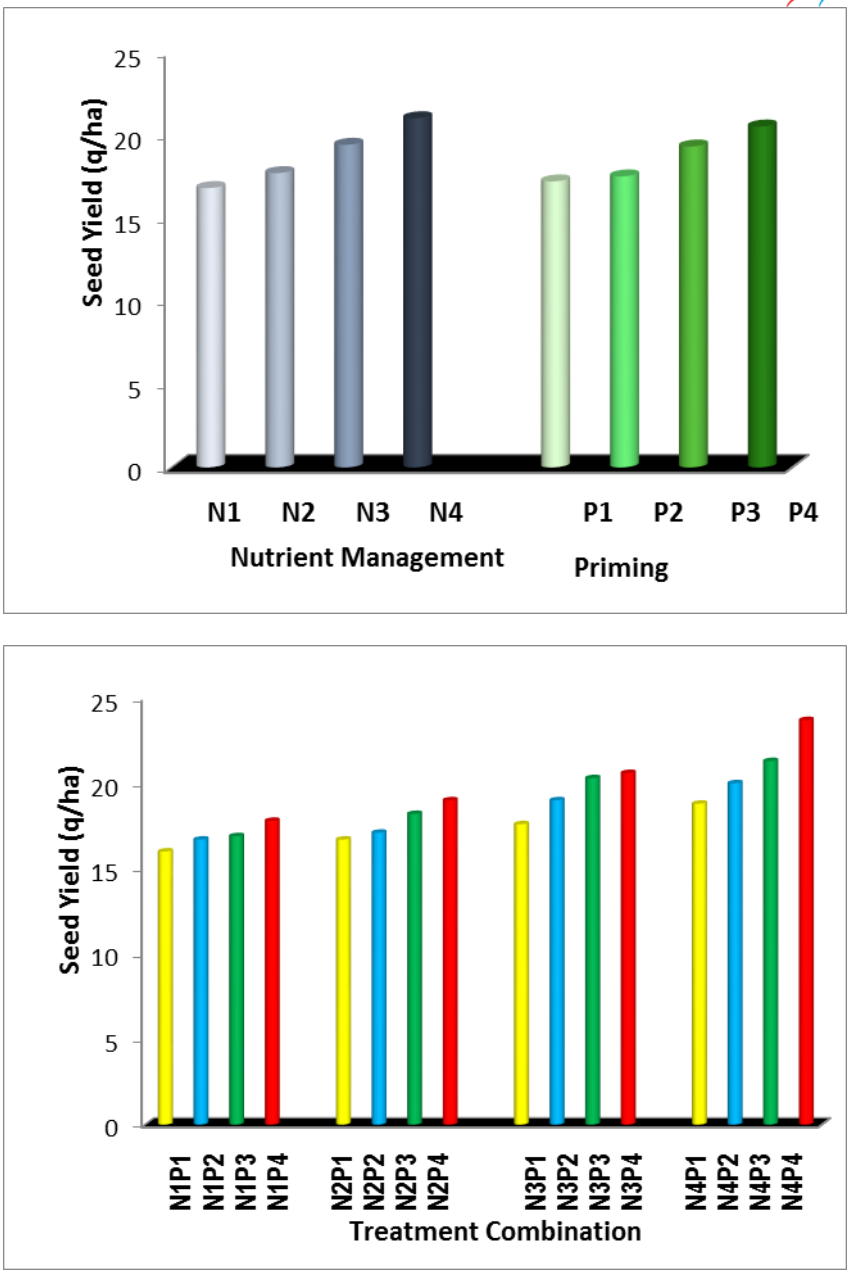


Fig: Effect of nutrient management and seed priming on Seed yield (q/ha) of Foxtail Millet (Mean over locations)

Centre wise report is given as follows;

1. UAS, Dharwad

Table 2.12. Effect of nutrient management and seed priming on plant growth parameters of foxtail millet (Variety: DHFT-109-3) at Dharwad during 2018

Treatments	Field Emergence (%)	Plant Population (m^2)	Plant height (cm) at 30 DAS	Chlorophyll content (µmol/m^2)
Nutrient management				
N1:No fertilizer	82.58	71.92	22.41	41.30
N2:125 kg Neem+1250kg Vermi compost per ha	83.83	74.83	26.93	49.65
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	86.00	76.67	27.63	50.94
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	88.25	78.75	29.64	54.64
Mean	85.17	75.54	26.65	49.13
SE.m ±	1.22	1.44	0.44	0.81
CD (P=0.05)	NS	NS	1.52	2.81
Seed Priming				
P1:Control (No priming)	80.67	70.50	24.76	45.65
P2 :Hydro priming	86.00	76.67	27.10	49.95
P3:Seed priming with 2% KH2PO4	88.58	78.92	27.83	51.31
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	85.42	76.08	26.92	49.62
Mean	76.77	68.13	21.99	40.53
SE.m ±	1.86	1.61	0.68	1.25
CD (P=0.05)	5.42	4.70	1.98	3.65
Interaction effect				
N_1P_1	77.00	62.00	18.88	34.81
N_1P_2	82.33	73.33	22.99	42.38
N_1P_3	90.00	80.00	25.13	46.33

N_1P_4	81.00	72.33	22.62	41.69
N_2P_1	76.67	68.67	24.63	45.41
N_2P_2	84.67	75.67	27.20	50.15
N_2P_3	93.33	83.33	29.99	55.28
N_2P_4	80.67	71.67	25.92	47.78
N_3P_1	84.00	75.33	26.99	49.75
N_3P_2	86.33	77.00	27.74	51.14
N_3P_3	83.67	74.33	26.88	49.55
N_3P_4	90.00	80.00	28.92	53.31
N_4P_1	85.00	76.00	28.55	52.62
N_4P_2	90.67	80.67	30.46	56.14
N_4P_3	87.33	78.00	29.33	54.07
N4P4	90.00	80.33	30.23	55.72
Mean	85.17	75.54	26.65	49.13
SEm±	3.71	3.22	1.35	2.50
CD (0.05P) NXP=?	NS	NS	NS	NS
CV (%)	7.55	7.39	8.81	9.18

Note: Crop is in vegetative stage, final data will be reported after harvest.

Conclusion:

Among the fertilizer combination N_4:125 kg Neem + 1250 kg Vermicompost (or) 12.5 tons FYM/ha + 50 kg Urea + 50 kg super phosphate and 50 kg Muriate of potash per ha + Top dressing urea at 3-4 weeks after transplanting + 2 % Borax spay reduced significantly superior over other treatment combinations and control. The treatment recorded increased plant height (29.64 cm) and chlorophyll content (54.64 µmol/m^2) at 30 days after sowing. Seed priming with (P_3) KH_2PO_4 @ 2 % solution was recorded significantly higher field emergence (88.58 %), Plant population (78.92 m^{-2}), plant height (27.83 cm) and chlorophyll content (51.31 µmol/m^2) on other priming treatments .

Among the treatment combinations N_4P_3 recorded numerically superior over rest of combinations.

2. TNAU, Coimbatore

The results revealed that, the basal nutrient application of 125 kg neem + 1250 kg vermi per ha + 50 kg urea +50 kg Super phosphate + 50 kg Muriate of potash + Top dressing urea + 2 % Borax spray recorded significantly higher values for field emergence (95 %) plant height (115 cm) and number of tillers (17.3) and chlorophyll content (31.8 (µmol/m^2)) over control (88%, 100 cm, 11.7 & 24.1 (µmol/m^2), respectively). It also induces the early flowering (48.5 days) which is three days earlier than control (51.3 days). Same trend was noticed in days to 50%

flowering which took 53.3 days for 50% flowering but control required 56.6 days. The same fertilizer treatment also recorded significantly higher values for seed yield (17.2 g/plant & 21.0 q/ha) with maximum 1000 seed weight (2.77 g) and seed recovery (90 %) compared to control (13.4 g, 16.8 q/ha, 2.56 g, and 88 %, respectively). Seeds harvested from the same fertilizer treatment also recorded significantly higher germination percentage (90 %) and vigour index (1148) over control (88% and 1088) respectively.

Priming with 20 % liquid *Pseudomonas fluorescens* recorded significantly higher values for plant height (114 cm) and number of tillers (16.7) and chlorophyll content (30.0 µmol/m^2) over control (105 cm, 11.7 & 26.0 (µmol/m^2), respectively. It also induces the early flowering (48.2 days) and 50% flowering (53 days) over control (51.9 days & 56.3 days). The same fertilizer treatment also recorded significantly higher values for seed yield (16.3 g/plant & 20.5 q/ha) with maximum 1000 seed weight (2.70 g) and seed recovery (89 %) compared to control (14.7 g, 17.2 q/ha, 2.56 g and 88 %, respectively). Seeds harvested from the same priming treatment also recorded higher germination percentage (90 %) and vigour index (1121) over control (88% and 1099, respectively).

Fertilizer application of 125 kg neem + 1250 kg vermi per ha + 50 kg urea +50 kg Super phosphate + 50 kg Muriate of potash + Top dressing urea + 2 % Borax spray in combination of priming with 20 % liquid *Pseudomonas fluorescens* recorded highest plant height (120 cm), Number of tillers (20.3), single plant seed yield (18.0 gm), yield per hectare (23.7 q/ha) compare to 95 cm, 9.7, 12.9 g and 16.0 q/ha respectively in control (Table 2.13, 2.14, 2.15 & 2.16).

Monitoring team review- Foxtail millet



Effect of Fertilizer (organic+inorganic) and priming in plant height –Foxtail millet





Table 2.13. Effect of fertilizer and priming treatment on plant physiological parameters in foxtail millet at Coimbatore during 2018

Treatments	Field emergence (%)	Plant height at 30 DAS (cm)	Plant height at maturity(cm)	Chlorophyll content (µmol/ m^2)
N1:No fertilizer	88	44	100	24.1
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	91	46	106	25.7
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	92	49	111	29.9
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	95	49	115	31.8
Mean	**92**	**47**	**109**	**27.8**
SEd	0.81	0.63	0.82	1.52
CD (p=0.05)	1.62	1.26	1.64	3.05
P1:Control (No priming)	88	45	105	26.0
P2 :Hydro priming	92	46	107	27.0
P3:Seed priming with 2% KH2PO4	94	47	108	28.4
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	96	51	114	30.0
Mean	**92**	**47**	**109**	**27.8**
SEd	1.24	0.64	1.21	0.46
CD (p=0.05)	2.48	1.28	2.43	0.93
N_1P_1	88	43	95	22.6
N_1P_2	88	49	98	24.1

N_1P_3	88	50	100	24.5
N_1P_4	91	52	107	25.3
N_2P_1	89	46	107	22.7
N_2P_2	87	47	107	23.7
N_2P_3	92	48	106	27.0
N_2P_4	93	53	112	29.6
N_3P_1	88	43	108	28.5
N_3P_2	89	49	110	29.2
N_3P_3	92	50	110	30.5
N_3P_4	94	52	114	31.3
N_4P_1	89	46	111	30.4
N_4P_2	87	47	113	31.2
N_4P_3	93	48	114	31.9
N4P4	96	53	120	33.9
Mean	**92**	**47**	**109**	**27.8**
SEd	1.62	0.94	1.70	2.43
CD (p=0.05)	3.24	1.88	3.41	4.86
CV (%)	2.16	3.12	5.67	9.96

Table 2.14 Effect of fertilizer and priming treatment on yield parameters in foxtail millet at Coimbatore during 2018

Treatments	Days to first flowering	Days to 50 % flowering	No.of tillers plant^{-1}	Seed yield plant^{-1}
N1:No fertilizer	51.3	56.6	11.7	13.4
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	50.0	55.3	13.0	14.6
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	49.8	55.0	14.3	16.5
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	48.5	53.3	17.3	17.2
Mean	**49.9**	**55.0**	**14.0**	**15.4**
SEd	0.37	0.41	0.14	0.61
CD (p=0.05)	0.74	0.83	0.28	1.22
P1:Control (No priming)	51.9	56.3	11.7	14.7
P2 :Hydro priming	50.2	56.1	13.0	14.9
P3:Seed priming with 2% KH2PO4	49.3	54.6	15.3	15.7
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	48.2	53.0	16.7	16.3
Mean	**49.9**	**55.0**	**14.0**	**15.4**
SEd	0.46	0.62	0.36	0.71

CD (p=0.05)	0.92	1.24	0.72	1.43
N_1P_1	52.3	58.6	9.7	12.9
N_1P_2	51.4	57.3	10.3	13.2
N_1P_3	51.4	56.2	12.7	13.6
N_1P_4	50.2	54.4	13.3	13.9
N_2P_1	50.6	54.4	10.3	14.1
N_2P_2	50.8	57.5	11.3	13.0
N_2P_3	49.8	55.7	14.3	15.0
N_2P_4	48.9	53.6	15.3	15.9
N_3P_1	53.8	56.9	11.7	15.5
N_3P_2	49.6	55.5	12.3	16.2
N_3P_3	48.1	54.9	15.3	16.7
N_3P_4	47.5	52.6	17.0	17.5
N_4P_1	50.0	55.2	14.7	16.4
N_4P_2	49.3	54.3	16.0	16.8
N_4P_3	48.0	52.0	18.0	17.6
N4P4	46.5	51.6	20.3	18.0
Mean	**49.9**	**55.0**	**14.0**	**15.4**
SEd	1.23	0.91	0.82	0.91
CD (p=0.05)	2.46	1.82	1.64	1.81
CV (%)	3.15	2.62	8.62	11.21

Table 2.15. Effect of fertilizer and priming treatment on yield parameters in foxtail millet Coimbatore during 2018

Treatments	Seed yield (q/ha)	1000 seed weight (g)	Seed recovery (%)
N1:No fertilizer	16.8	2.56	88
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	17.7	2.62	89
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	19.4	2.66	89
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	21.0	2.77	90
Mean	**18.7**	**2.65**	**89**
SEd	7.5	0.05	0.82
CD (p=0.05)	15.0	0.11	NS
P1:Control (No priming)	17.2	2.56	88
P2 :Hydro priming	17.5	2.60	89

P3:Seed priming with 2% KH2PO4	19.3	2.74	89
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	20.5	2.70	89
Mean	**18.7**	**2.65**	**89**
SEd	6.3	0.07	0.78
CD (p=0.05)	12.6	0.14	NS
N_1P_1	16.0	2.50	87
N_1P_2	16.7	2.57	87
N_1P_3	16.9	2.59	89
N_1P_4	17.8	2.60	88
N_2P_1	16.7	2.57	88
N_2P_2	17.1	2.57	89
N_2P_3	18.2	2.64	89
N_2P_4	19.0	2.69	89
N_3P_1	17.6	2.59	87
N_3P_2	19.0	2.64	88
N_3P_3	20.3	2.70	90
N_3P_4	20.6	2.72	90
N_4P_1	18.8	2.61	89
N_4P_2	20.0	2.65	90
N_4P_3	21.3	3.04	89
N4P4	23.7	2.78	90
Mean	**18.7**	**2.65**	**89**
SEd	8.9	0.09	1.13
CD (p=0.05)	17.8	0.18	NS
CV (%)	14.71	7.42	2.4

Table 2.16 Effect of fertilizer and priming treatment on yield parameters and cost benefit ratio in foxtail millet Coimbatore during 2018

Treatments	Seed germination (%)	Vigour index	B:C Ratio*
N1:No fertilizer	88	1088	0.81
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	89	1090	1.10
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	90	1119	1.42
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+	90	1148	1.83

Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray			
Mean	**89**	**1111**	
SEd	1.13	14.6	
CD (p=0.05)	NS	28.5	
P1:Control (No priming)	88	1099	0.76
P2 :Hydro priming	90	1107	1.28
P3:Seed priming with 2% KH2PO4	90	1117	1.68
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	90	1121	1.87
Mean	**90**	**1111**	
SEd	1.02	11.3	
CD (p=0.05)	NS	22.7	
N_1P_1	88	1081	0.78
N_1P_2	89	1085	1.25
N_1P_3	88	1089	1.47
N_1P_4	88	1096	1.82
N_2P_1	89	1090	0.83
N_2P_2	90	1091	1.17
N_2P_3	89	1104	1.60
N_2P_4	90	1103	1.83
N_3P_1	89	1112	0.92
N_3P_2	89	1126	1.20
N_3P_3	90	1126	1.40
N_3P_4	90	1124	1.90
N_4P_1	88	1113	0.82
N_4P_2	90	1127	1.23
N_4P_3	89	1149	1.55
N4P4	90	1162	1.92
Mean	**89**	**1111**	
SEd	1.32	12.8	
CD (p=0.05)	NS	25.6	
CV (%)	5.42	6.24	

*** Net return per rupee of expenditure**

Kodo millet (*Paspalum scrobiculatum*)

Unified observation

Effect of nutrient management and seed priming on yield and seed quality attributing traits in kodo Millet (Mean over two locations)

During *kharif* 2018, this experiment was conducted at two locations namely TNAU, Coimbatore and JNKVV, Jabalpur. The detailed mean data over locations are presented in Table 2.17.

The average over locations revealed that nutrient management treatments had significant effect on plant growth, seed yield and quality of kodo millet. Among the nutrient management treatments N_4(Seed Priming with 125 kg Neem+1250kg vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) showed superiority with respect to seed yield (15.44 q/ha), vigour index-I (1304.15), chlorophyll content (34), 100 seed weight (5.56), percent germination (88%) and other seed quality attributes as compared to control.

The seed priming treatment had significant effect on seed yield. Among the priming treatments the seed priming with 2% KH_2PO_4 (P_3) was superior for germination (88%) and seed yield (15.27 q/ha). This was closely followed by seed priming with 20% liquid *P. Fluroscence* with seed yield of 14.67 q /ha as compared to control and other treatment over the control and other treatments.

Among interactions of priming with nutrient management treatments, N_4P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescence* in combination with nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) recorded highest seed yield (16.58 q/ha), germination (93.3%), and vigour index-I (1932) closely followed by N_4P_3 (Seed Priming with 2% KH_2PO_4 in combination with nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray).

Significant Observation:

Mean data over locations revealed that treatment combination N_4P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescence* in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) leads to 48.16% increase of seed yield/ha over control. Due to treatment 28% and 42% increase over control were observed in case of germination and vigour index-I respectively.

Table 2.17: Effect of nutrient management and seed priming on yield and seed quality attributing traits in Kodo Millet (Mean over locations)

Treatments	Germination %	VI-I	Days to 50% Flowering	Number of tillers per plant	1000 seed weight (g)	Seed Yield (q./ha.)	B:C RATIO
Nutrient Management							
N1:No fertilizer	79.02	1139.65	72.50	7.50	5.34	12.08	**0.62**
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	82.56	1194.77	72.26	7.43	5.39	13.96	**0.83**
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	83.27	1246.10	70.89	7.30	5.38	14.90	**1.10**
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	88.35	1304.15	73.65	6.92	5.56	15.44	**1.35**
Mean	**83.30**	**1221.17**	**66.21**	**29.57**	**85.08**	**7.29**	**84.80**
Priming							
P1:Control (No priming)	84.52	610.52	79.17	6.07	5.25	14.97	**0.58**
P2 :Hydro priming	80.94	1170.27	72.89	7.24	5.43	13.86	**0.76**
P3:Seed priming with 2% KH2PO4	87.77	1292.69	70.91	7.45	5.49	15.27	**0.90**
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	87.15	1339.44	70.61	7.78	5.52	14.67	**1.25**
Mean	**85.09**	**1103.23**	**67.90**	**35.12**	**83.59**	**7.13**	**85.21**
Interaction							
N_1P_1	72.81	1010.15	74.81	6.11	5.24	11.19	0.60

N_1P_2	75.65	1115.48	72.71	6.55	5.42	11.35	0.73
N_1P_3	86.31	1223.15	70.96	6.80	5.43	14.16	0.92
N_1P_4	80.48	1209.98	71.71	6.90	5.44	11.88	1.15
N_2P_1	78.31	1015.15	73.66	6.53	5.25	11.75	0.58
N_2P_2	79.98	1136.65	72.91	7.26	5.35	14.16	0.69
N_2P_3	86.65	1268.31	70.81	7.48	5.50	15.11	0.95
N_2P_4	85.81	1358.48	71.86	7.60	5.45	14.80	1.05
N_3P_1	77.15	1123.15	73.56	7.11	5.13	13.75	0.66
N_3P_2	81.15	1170.65	71.16	7.45	5.44	14.81	0.80
N_3P_3	86.81	1334.15	69.36	7.68	5.52	15.62	0.96
N_3P_4	87.98	1356.48	69.51	8.08	5.44	15.42	1.20
N_4P_1	83.81	1180.31	77.75	7.31	5.40	13.99	0.68
N_4P_2	86.48	1257.31	74.91	7.80	5.52	15.09	0.83
N_4P_3	90.31	1345.15	72.56	7.83	5.55	16.14	1.20
N_4P_4	93.31	1432.81	69.36	8.65	5.77	16.58	1.36
Mean	**83.31**	**1221.08**	**66.23**	**29.58**	**85.80**	**7.32**	**84.81**

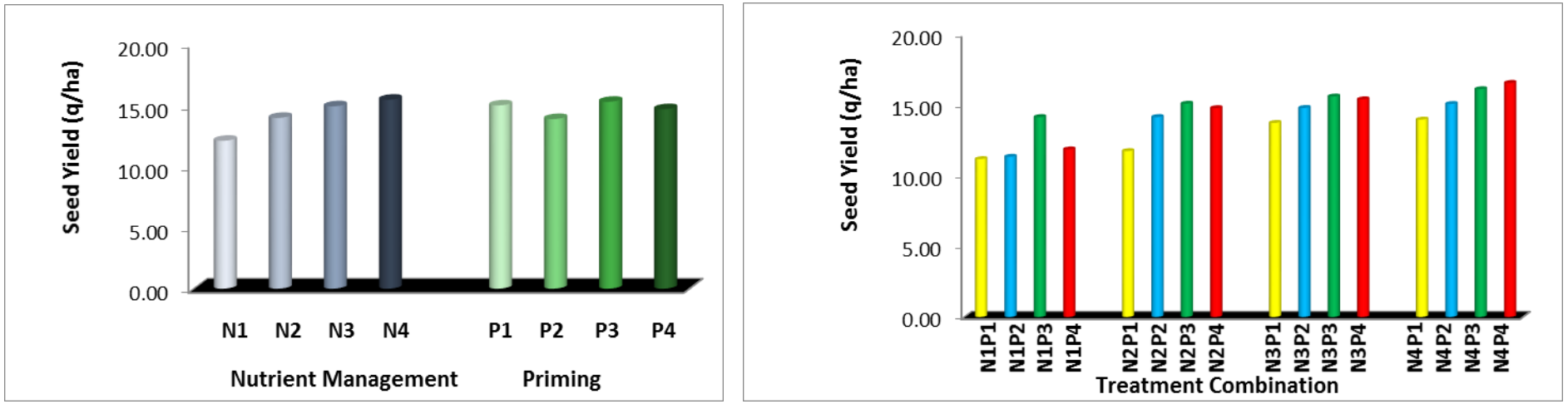


Fig: Effect of nutrient management and seed priming on Seed yield (q/ha) of Kodo Millet (Mean over locations)

Centre wise report is given as follows;

1. JNKVV, Jabalpur

The experiment was conducted with Kodo millet variety JK 439 as per technical programme during *Kharif* 2018. Sowing was done on 10.07.2018 in a spacing 30 x 10 cm. The seeds were treated with carbandazim @ 2.5g kg^{-1} seeds before sowing. All the four proposed priming treatments were given on 06.07.2018. Recommended dose of fertilizers were applied as per technical programme.

Effect of nutrient management on plant growth, seed yield and quality attributes

The nutrient management treatments had significant effect on plant growth, seed yield and quality of kodo millet. Highest seed yield (q/ha) and other yield attributing traits were recorded by N_4 (125 kg Neem + 1250 kg Vermi compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha).This was closely followed by N_3 (50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha).

Effect of priming on plant growth, seed yield and quality attributes

The priming treatment had significant effect on plant growth, seed yield and quality attributes. Highest seed yield per plant and seed yield (q/ha) was noticed in P_3 (Seed priming with 2% KH_2PO_4 for 6 hour) followed by P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescens*). (Table 2.18)

Interaction effect of nutrient management and priming on plant growth, seed yield and quality attributes

Considering different treatments, seed priming with P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescens*) with N_4 (125 kg Neem + 1250 kg Vermi compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha) recorded higher seed yield. It was closely followed by the seed priming with P_3 (Seed priming with 2% KH_2PO_4 for 6 hour) in combination with N_4 (125 kg Neem + 1250 kg Vermi compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha) under direct sown condition.

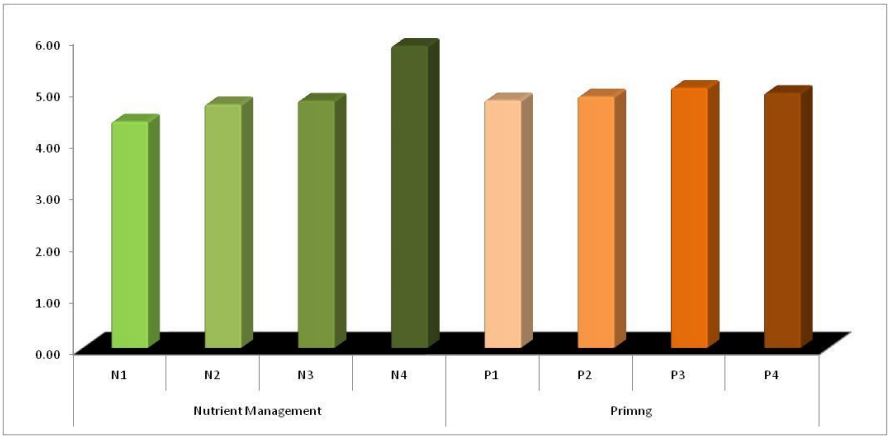
Conclusion

Therefore, it is concluded that direct sowing with fertilizer dose 125 kg Neem + 1250 kg Vermi compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha and seed Priming with 20 % liquid *Pseudomonas fluorescens* were found better for yield and its attributing traits.

Table 2.18: Yield and yield attributing characters of Kodo millet as influenced by nutrient management and priming at JNKVV, Jabalpur during *Kharif* 2018

Main plot (Nutrient Management)	Sub Plot (Priming)	Field Emergence %	Plant Height at 30 days	Plant Height at harvest	Chloro phyll content	Days to first flowering	Days to 50% flowering	No. of tillers / plant	Seed yield/ plant (g)	100 seed weight (g)	Seed Yield q/ha	Germination %	Vigour Index I	B:C ratio
N1	P1	67.29	31.45	88.55	27.05	66.82	73.62	4.82	5.9	6.13	10.37	67.62	1026.29	0.81
	P2	71.62	36.67	95.82	27.33	62.32	69.62	5.09	6.09	6.26	10.5	72.29	1175.95	0.94
	P3	73.62	37.11	97.22	31.36	59.22	66.62	5.29	5.9	6.34	15.32	89.62	1266.29	1.13
	P4	71.62	36.82	97.42	31.32	59.52	69.62	5.09	6.09	6.26	10.35	78.95	1176.95	1.36
N2	P1	74.95	33.98	97.15	29.64	64.72	71.62	5.35	6.05	6.08	11.25	76.62	943.29	0.79
	P2	76.95	35.66	98.49	29.64	62.12	70.62	5.42	6.56	6.21	15.12	76.95	1123.29	0.90
	P3	81.29	36.72	100.02	32.46	62.92	67.62	5.55	6.5	6.34	16.22	87.29	1222.62	1.16
	P4	78.95	35.10	99.69	31.82	63.22	68.62	5.49	6.21	6.17	15.29	83.62	1200.29	1.26
N3	P1	77.62	37.65	97.62	29.66	69.42	71.62	5.62	6.35	5.75	14.3	73.29	999.29	0.87
	P2	79.62	39.65	98.22	31.41	65.62	69.62	5.69	6.21	6.2	15.22	78.29	1077.29	1.01
	P3	80.95	41.06	100.62	34.02	61.82	66.62	5.75	6.67	6.27	16.34	85.62	1248.29	1.17
	P4	77.62	39.73	99.75	30.14	65.22	66.82	5.75	6.37	5.99	15.34	84.95	1179.95	1.41
N4	P1	79.62	36.11	95.35	26.61	73.02	81.29	5.62	7.33	6.23	14.07	85.62	1161.62	0.89
	P2	84.95	37.67	101.49	32.27	68.92	77.62	5.69	7.46	6.32	15.18	87.95	1161.62	1.04
	P3	85.62	38.14	102.22	32.78	66.62	73.62	5.75	7.51	6.34	16.28	91.62	1168.29	1.41
	P4	87.62	39.71	98.49	35.88	65.12	70.62	5.89	7.53	6.43	16.36	93.62	1301.62	1.57
Nutrient Management (Main plot)	No fertilizer	70.96	35.43	94.67	29.18	61.89	69.79	4.99	5.92	6.17	11.56	77.04	1161.29	0.83
	12.5 tons FYM/ha	78.04	35.36	98.84	30.89	63.25	69.92	5.45	6.33	6.21	14.41	81.12	1122.54	1.04
	50 kg Urea +50 kg Super	78.95	39.52	99.05	31.31	65.52	68.67	5.7	6.42	6.05	15.31	80.54	1126.2	1.31

	phosphate and 50 kg MOP +													
	12.5 tons FYM/ha+ 50 kg Urea +50 kg Super phosphate and 50 kg MOP	84.45	37.91	99.39	31.89	68.42	75.79	5.74	7.46	6.33	15.47	89.7	1198.29	1.56
Priming (Sub plot)	No priming	78.04	39.04	89.04	31.04	62.04	63.04	4.90	5.90	6.04	14.26	88.04	1189.04	0.79
	Hydro priming for 6 hours	78.29	37.41	98.51	30.16	64.75	71.87	5.47	6.48	6.25	14.01	78.87	1134.54	0.97
	Seed priming with 2% KH2PO4 for 6 hours	80.37	38.26	100.02	32.65	62.65	68.62	5.59	6.65	6.32	16.04	88.54	1226.37	1.11
	Seed priming with 20% liquid P. fluorescens	78.95	37.84	98.84	32.29	63.27	68.92	5.56	6.55	6.21	14.33	85.29	1214.87	1.46
Nutrient Management	CD at 5%	3.33	4.77	47.73	2.92	28.09	33.02	7.27	7.41	3.58	6.91	35.81	488.66	
Priming	CD at 5%	21.6	22.2	45.26	3.12	27.15	31.45	8.26	7.26	3.13	6.84	34.21	456.25	
Interactions	CD at 5%	5.05	7.92	93.84	4.23	52.56	64.43	12.92	13.2	5.55	12.2	70.01	975.71	



Effect of nutrient management and priming treatments on seed yield of kodo millet

2. TNAU, Coimbatore

The results revealed that, the basal nutrient application of 125 kg neem + 1250 kg vermi per ha + 50 kg urea +50 kg Super phosphate + 50 kg Muriate of potash + Top dressing urea + 2 % Borax spray recorded significantly higher values for field emergence (93 %), plant height (73.3 cm), number of tillers (8.1) and chlorophyll content (37.1 (µmol/m^2)) over control (89 %, 69.6 cm, 10.0 & 35.6 (µmol/m^2) respectively. It also induces the early flowering (66.5 days) than control (69.0 days). Same trend was noticed in days to 50 % flowering which took 71.5 days for 50% flowering but control required 75.2 days. The same fertilizer treatment also recorded significantly higher values for seed yield (6.5 g/plant & 15.4 q/ha) with maximum 1000 seed weight (4.79 g) and seed recovery (90 %) compared to control (4.5 g, 12.6 q/ha, 4.51 g and 89 %) respectively. Seeds harvested from the same fertilizer treatment also recorded significantly higher germination percentage (87 %) and vigour index (1410) over control (81% and 1118) respectively.

Priming with 20 % liquid *Pseudomonas fluorescens* recorded significantly higher values for plant height (75.3 cm) and number of tillers (10.0) and chlorophyll content (40.9 µmol/m^2) over control (69.7cm, 8.1 & 36.2 µmol/m^2) respectively. It also induces the early flowering (66.6 days) and 50% flowering (72.3 days) over control (68.6 days & 75.3 days). The same fertilizer treatment also recorded significantly higher values for seed yield (6.4 g/plant & 15.0 q/ha) with maximum 1000 seed weight (4.82 g) and seed recovery (91 %) compared to control (4.6 g, 12.9 q/ha, 4.45 g, and 89 %) respectively. Seeds harvested from the same priming treatment also recorded higher germination percentage (89 %) and vigour index (1464) over control (81% and 1132) respectively.

Fertilizer application of 125 kg neem + 1250 kg vermi per ha + 50 kg urea +50 kg Super phosphate + 50 kg Muriate of potash + Top dressing urea + 2 % Borax spray in combination of priming with 20 % liquid *Pseudomonas fluorescens* recorded highest plant height (81 cm), Number of tillers (11.4), seed yield (7.3 g/plant ; 16.8 q/ha) compare to 67 cm, 7.4, 3.8 g and 12.0 q/ha respectively in control (Table 2.19, 2.20, 2.21 & 2.22).



Effect of Fertilizer (organic+ inorganic) and priming on plant height – Kodo millet



Experimental plot of kodo millet

Table 2.19. Effect of fertilizer and priming treatment on plant physiological parameters in kodo millet at Coimbatore during 2018

Treatments	Field emergence (%)	Plant height at 30 DAS (cm)	Plant height at maturity (cm)	Chlorophyll content (µmol/m^2)
N1:No fertilizer	89	19.8	69.6	35.6
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	91	21.8	71.9	34.9
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	93	22.1	73.9	36.1
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	93	24.6	73.3	37.1
Mean	**91.5**	**22.1**	**72.8**	**38.6**
SEd	0.26	1.23	1.43	0.54
CD (p=0.05)	0.52	2.45	2.87	1.08
P1:Control (No priming)	90	19.7	69.7	36.2
P2 :Hydro priming	91	21.7	72.0	37.9
P3:Seed priming with 2% KH2PO4	92	23.0	74.3	39.1
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	93	24.0	75.3	40.9
Mean	**91.5**	**22.08**	72.8	**38.6**
SEd	0.43	0.92	1.17	0.72
CD (p=0.05)	0.86	1.85	2.35	1.44
N_1P_1	87	18.1	67.6	34.6
N_1P_2	89	18.4	68.6	35.2
N_1P_3	90	21.0	70.8	36.0
N_1P_4	90	21.8	71.5	36.8
N_2P_1	90	18.8	71.9	34.9
N_2P_2	90	23.3	73.9	36.1
N_2P_3	91	22.5	73.3	37.1
N_2P_4	92	22.6	74.8	39.1
N_3P_1	92	19.9	71.6	37.2
N_3P_2	93	21.5	73.8	39.0
N_3P_3	93	21.9	75.9	41.4

N_3P_4	94	25.1	77.0	42.8
N_4P_1	91	22.1	72.6	38.1
N_4P_2	93	23.6	75.4	41.2
N_4P_3	94	26.3	77.8	43.7
N4P4	95	26.5	81.0	34.6
Mean	**91.5**	**22.1**	**72.8**	**38.6**
SEd	0.62	1.44	1.54	1.02
CD (p=0.05)	1.24	2.88	3.08	2.06
CV (%)	3.14	3.74	6.23	11.25

Table 2.20. Effect of fertilizer and priming treatment on plant physiological and yield parameters in kodo millet at Coimbatore during 2018

Treatments	Days to first flowering	Days to 50 % flowering	No.of tillers plant-1	Seed yield plant-1
N1:No fertilizer	69.0	75.2	10.0	4.5
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	67.8	74.9	9.4	5.5
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	67.3	73.1	8.9	5.8
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	66.5	71.5	8.1	6.5
Mean	**67.6**	**73.7**	**9.1**	**5.6**
SEd	0.37	0.43	0.22	0.11
CD (p=0.05)	0.74	0.86	0.45	0.20
P1:Control (No priming)	68.6	75.3	8.1	4.6
P2 :Hydro priming	68.0	73.9	9.0	5.2
P3:Seed priming with 2% KH2PO4	67.3	73.2	9.3	5.9
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	66.6	72.3	10.0	6.4
Mean	**67.6**	**73.6**	**9.1**	**5.6**
SEd	0.52	0.33	0.21	0.14
CD (p=0.05)	1.04	0.67	0.42	0.28
N1P1	70.4	76.0	7.4	3.8
N1P2	68.9	75.8	8.0	5.3
N1P3	68.9	75.3	8.3	4.4
N1P4	67.9	73.8	8.7	5.2
N2P1	67.6	75.7	7.7	4.3

N2P2	68.7	75.2	9.1	5.0
N2P3	67.5	74.0	9.4	6.0
N2P4	67.6	75.1	9.7	6.5
N3P1	68.7	75.5	8.6	4.7
N3P2	67.4	72.7	9.2	5.5
N3P3	66.8	72.1	9.6	6.2
N3P4	66.3	72.2	10.4	6.7
N4P1	67.9	74.2	9.0	5.7
N4P2	67.3	72.2	9.9	6.0
N4P3	66.1	71.5	9.9	6.9
N4P4	64.7	68.1	11.4	7.3
Mean	**67.6**	**73.7**	**9.1**	**5.6**
SEd	0.76	1.02	0.62	0.34
CD (p=0.05)	1.52	2.05	1.24	0.67
CV (%)	2.78	3.44	7.40	12.61

Table 2.21. Effect of fertilizer and priming treatment on seed yield parameters in kodomillet at Coimbatore during 2018

Treatments	Seed yield (q/ha)	1000 seed weight (g)	Seed recovery (%)
N1:No fertilizer	12.6	4.51	89
N2:125 kg Neem+1250 kg Vermi compost per ha or 12.5 tons FYM per ha.	13.5	4.57	89
N3: 50 kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	14.5	4.71	90
N4: 125 kg Neem+1250 kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	15.4	4.79	90
Mean	**14.0**	**4.64**	**90**
SEd	13.5	0.06	NS
CD (p=0.05)	27.1	0.12	NS
P1:Control (No priming)	12.9	4.45	89
P2 :Hydro priming	13.7	4.60	88
P3:Seed priming with 2% KH2PO4	14.5	4.65	90
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	15.0	4.82	91
Mean	**14.0**	**4.63**	**90**
SEd	11.2	0.08	NS
CD (p=0.05)	22.5	0.17	NS
N1P1	12.0	4.35	88

N1P2	12.2	4.57	89
N1P3	13.0	4.51	90
N1P4	13.4	4.61	90
N2P1	12.5	4.41	91
N2P2	13.2	4.49	90
N2P3	14.0	4.65	89
N2P4	14.3	4.72	90
N3P1	13.2	4.51	90
N3P2	14.4	4.67	91
N3P3	14.9	4.77	89
N3P4	15.5	4.89	89
N4P1	13.9	4.57	89
N4P2	15.0	4.71	90
N4P3	16.0	4.76	90
N4P4	16.8	5.11	91
Mean	**14.0**	**4.64**	**90**
SEd	17.3	NS	NS
CD (p=0.05)	34.6	NS	NS
CV (%)	13.82	6.15	3.12

Table 2.22. Effect of fertilizer and priming treatment on resultant seed quality parameters in kodomillet at Coimbatore during 2018

Treatments	Seed germination (%)	Vigour index	B:C Ration*
N1:No fertilizer	81	1118	0.62
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	84	1267	0.83
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	86	1366	1.10
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	87	1410	1.35
Mean	85	1290	
SEd	0.62	7.2	
CD (p=0.05)	1.24	14.5	
P1:Control (No priming)	81	1132	0.58
P2 :Hydro priming	83	1206	0.76
P3:Seed priming with 2% KH2PO4	87	1359	0.90
P4: Seed priming with 20% Liquid Pseudomonas fluorescence	89	1464	1.25
Mean	85	1290	

SEd	0.46	9.3	
CD (p=0.05)	0.92	18.7	
N1P1	78	994	0.60
N1P2	79	1055	0.73
N1P3	83	1180	0.92
N1P4	82	1243	1.15
N2P1	80	1087	0.58
N2P2	83	1150	0.69
N2P3	86	1314	0.95
N2P4	88	1516	1.05
N3P1	81	1247	0.66
N3P2	84	1264	0.80
N3P3	88	1420	0.96
N3P4	91	1533	1.20
N4P1	82	1199	0.68
N4P2	85	1353	0.83
N4P3	89	1522	1.20
N4P4	93	1564	1.36
Mean	85	1290	
SEd	0.86	11.8	
CD (p=0.05)	1.73	23.6	
CV (%)	4.26	8.23	

*** Profit gained for Rs 1 /- expenditure**

Proso millet (*Panicum miliaceum*)

Unified observation

Effect of nutrient management and seed priming on yield and seed quality attributing traits in Proso Millet (Mean over locations)

During *kharif* 2018, this experiment was conducted at two locations *viz*., UAS, Bangalore and RPCAU, Pusa. Details of mean data over locations are presented in Table 2.23.

The average over locations revealed that nutrient management treatments had significant effect on plant growth, seed yield and quality of proso millet. Among the nutrient management treatment N_4 (nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) showed superiority with respect to seed yield (13.4q/ha), panicle weight (2.09g.), plant height (132.6 cm), 1000 seed weight (5.49g) and no. of tillers/plant (13.60) as compared to control and other treatments. The seed priming treatment had significant effect on seed yield. Among the priming treatments, seed priming with 20% liquid *P. fluorescens* was superior as compared to control and other

treatments in terms of seed yield (16.39 q/ha), panicle weight (1.77 g), no. of tillers per plant (11.6), seed germination (83.17%), seed vigour index- I (1466) and seed quality attributes.

Among interactions of priming with nutrient management treatments, N_4P_4(Seed Priming with 20% liquid *Pseudomonas fluorescence* in combination with nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray) recorded highest seed yield (13.45 q/ha), panicle weight (2.09 gm), no. of tillers per plant (13.60 gm), 1000 seed weight (5.49gm) and seed quality attributes seed vigour index I (1822), field emergence (84.3%) closely followed by N4P3 (Seed Priming with 2% KH_2PO_4 in combination of nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray).

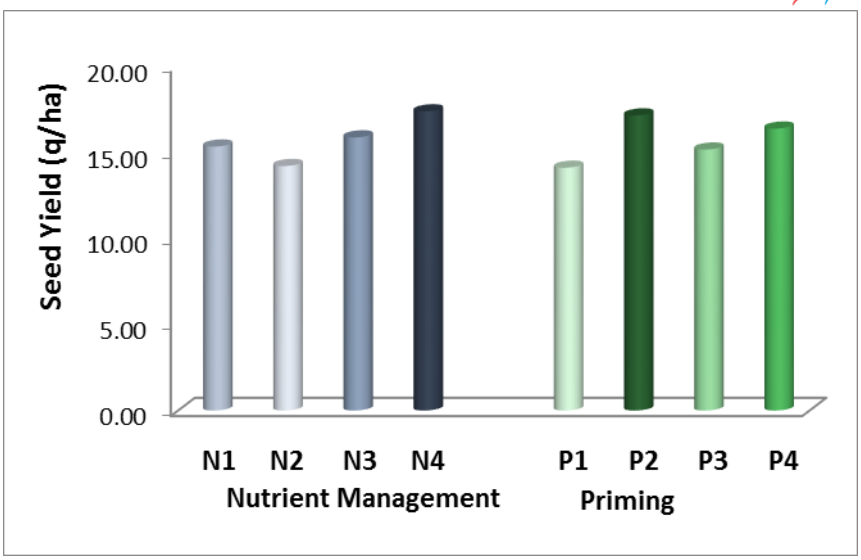
Significant Observation:

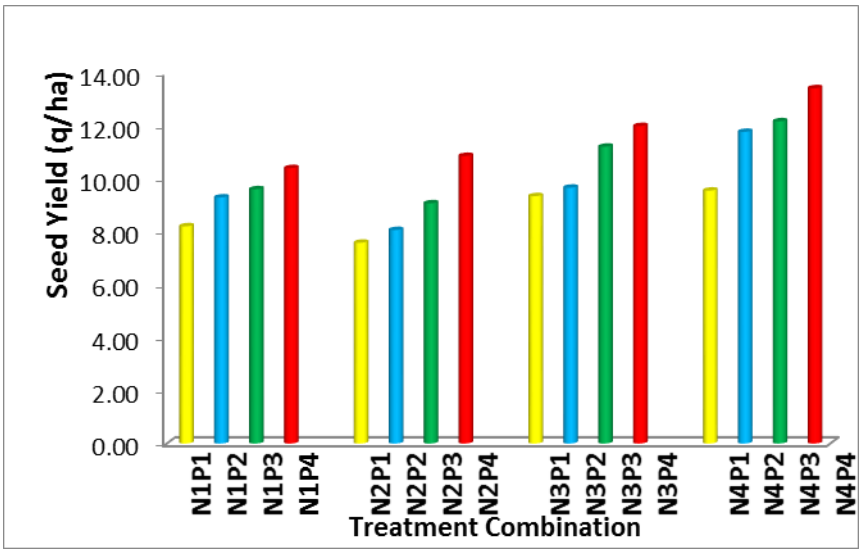
Mean data over locations revealed that treatment N_4P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescence* in combination with nutrient management with 125 kg Neem+1250 kg Vermi compost per ha or 12.5 tons FYM per ha+50 kg Urea+ 50 kg SSP and 50 kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2 % Borax spray) leads to 64 % increase of seed yield/ha over control. Due to treatment 22% and 11% increase over control were observed in case of vigour index-I and germination percentage respectively.

Table 2.23: Effect of nutrient management and seed priming on yield and seed quality attributing traits in Proso Millet (Mean over locations)

Treatments	Field emergence	Days to 50% flowering	Chlorophyll Content	Plant Height (cm)	Number of Tillers/plant	Seed yield (q/ha)	1000 seed weight (g)	Seed germination (%)	Seed vigour index-I
Nutrient Management									
N1:No fertilizer	68.83	49.17	33.63	88.31	9.25	15.35	4.87	80.71	1341.53
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	72.17	48.54	35.31	91.49	10.91	14.22	4.89	80.54	1375.06
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	74.92	48.38	36.92	96.82	10.78	15.88	5.02	82.80	1437.40
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	79.17	47.46	36.66	99.13	11.70	17.39	5.02	80.42	1363.61
Mean	**73.77**	**48.38**	**35.63**	**93.94**	**10.66**	**15.71**	**4.95**	**81.12**	**1379.40**
Priming									
P1:Control (No priming)	69.91	49.04	35.00	90.38	10.25	14.11	4.83	79.13	1309.95
P2 :Hydro priming	72.08	48.63	35.27	93.80	10.12	17.15	5.04	81.42	1320.28
P3:Seed priming with 2% KH2PO4	75.17	47.59	35.76	95.03	11.11	15.17	4.92	81.00	1421.62
P4: Seed priming with 20% Liquid *P.fluorescence*	77.92	48.09	36.30	96.53	11.16	16.39	5.02	83.17	1465.76

Mean	**73.77**	**48.34**	**35.58**	**93.93**	**10.66**	**15.71**	**4.95**	**81.18**	**1379.40**
Interaction									
N_1P_1	65.67	48.67	35.81	112.80	8.50	8.21	5.27	79.33	1493.00
N_1P_2	67.33	48.33	36.14	111.20	9.00	9.30	5.28	82.33	1685.00
N_1P_3	69.67	46.33	35.40	115.10	10.30	9.61	5.43	84.00	1733.00
N_1P_4	72.67	47.67	37.16	122.20	9.60	10.41	5.37	87.33	1718.00
N_2P_1	68.00	47.67	37.02	106.20	8.70	7.59	5.35	80.67	1506.00
N_2P_2	71.67	47.00	36.25	111.00	8.80	8.07	5.36	81.67	1523.00
N_2P_3	73.67	47.00	36.74	111.90	10.70	9.08	5.40	84.67	1716.00
N_2P_4	75.33	46.67	38.09	119.50	10.20	10.87	5.41	85.33	1810.00
N_3P_1	70.67	46.00	39.29	118.80	9.10	9.35	5.39	86.00	1618.00
N_3P_2	73.00	45.67	38.34	123.80	9.80	9.67	5.42	86.00	1606.00
N_3P_3	76.67	45.67	41.82	126.20	10.40	11.22	5.42	80.00	1755.00
N_3P_4	79.33	45.33	40.91	123.50	10.40	12.00	5.48	90.67	1966.00
N_4P_1	75.33	45.00	38.85	123.30	11.00	9.56	5.37	80.33	1545.00
N_4P_2	76.33	44.33	37.79	125.20	11.70	11.78	5.41	83.00	1548.00
N_4P_3	80.67	44.00	41.02	128.30	12.60	12.18	5.46	92.00	1810.00
N_4P_4	84.33	44.00	42.49	132.60	13.60	13.43	5.49	88.00	1822.00





Effect of nutrient management and seed priming on Seed yield (q/ha) of Proso Millet

Centre wise report is as follows;

1. GKVK, Bengaluru

The nutrient management treatments had significant effect on growth, seed yield and quality parameters of proso millet. The nutrient dosage of 125 kg Neem + 1250 kg vermi-compost per ha + 50 kg Urea + 50 kg SSP and 50 kg MOP per ha + Top dressing urea at 3-4 weeks after transplanting + 2 % Borax (N_4) recorded the highest field emergence (79.17%), plant height (127.3cm), no.of tillers (12.2), panicle weight (1.798 kg/plot), seed yield (23.38g/plant; 1.174kg/plot and11.74q/ha), seed recovery (94.71%) and resultant seed quality. This was followed by N_3 (pure chemical fertilizers) recorded the seed yields (20.02 g/plant; 1.056 kg/plot and 10.56 q/ha) with seed recovery (95.02%). The lowest of all the parameters were recorded in control N_1 (no fertilizer).

Priming treatments improved the seed yield and yield attributing characters as compared to control. The priming treatment P_4 **(**Seed priming with 20 % liquid *Pseudomonas fluoresces* by adopting seed to solution ratio of 1:1 and then mixing in 2.5 g/kg carbendazim) was found to enhance the seed yield (22.07 g/plant; 1.168 kg/plot & 11.68 q/ha). Further, seed quality *viz.,* seed germination (87.83%) and vigour index (1829) were significantly higher over control P_1 (seed yield 8.68q/ha). This was closely followed by P_3 (seed priming with 2% KH_2PO_4 for 6h) with seed yield (10.53q/ha) (Table 2.24).

Among the interactions, seed priming P_4 (20 % liquid *Pseudomonas fluoresces* for 6h) with N_4 **(**125 kg Neem + 1250 kg vermi-compost per ha + 50 kg Urea + 50 kg SSP and 50 kg MOP per ha + Top dressing urea at 3-4 weeks after transplanting + 2 % Borax) recorded the highest seed yield (13.43 q/ha) with resultant seed quality and lowest seed yield (8.21 q/ha) was recorded among the interaction N_1xP_1 (No priming and no fertilizer application).

Conclusion:

Integrated approach of direct (line) method of sowing in the nutrient dosage of 125 kg Neem + 1250 kg vermi-compost per ha + 50 kg Urea + 50 kg SSP and 50 kg MOP per ha + Top dressing urea at 3-4 weeks after transplanting + 2 % Borax in combination with bio-priming (20 % liquid *Pseudomonas fluoresces* for 6h resulted in increased plant growth, seed yield and quality parameters in proso millet variety *TNAU-145* due to synergistic effect of integrated approach.

Prosomillet *cv. TNAU-145* at the grain filling stage



Table 2.24. Effect of seed priming, nutrient management on plant growth and seed yield of proso millet *cv. TNAU-145* at Bengaluru during 2018

Treatment	Field emergence (%)	Days to 50% flowering	Chlorophyll content (SPAD -502)	Plant height (cm)	No. of tillers	Panicle weight (kg/plot)	Seed yield (g/ plant)	Seed yield (kg/plot)	Seed yield (q/ha)	Seed recovery (%)
Nutrient Management (N)										
N_1	68.83	47.75	36.13	115.3	9.3	1.488	15.45	0.939	9.39	93.13
N_2	72.17	47.08	37.02	112.2	9.6	1.440	15.63	0.891	8.91	93.21
N_3	74.92	45.67	40.08	123.1	9.9	1.606	20.02	1.056	10.56	95.02
N_4	79.17	44.33	40.04	127.3	12.2	1.798	23.38	1.174	11.74	94.71
Mean	**73.77**	**46.20**	**38.31**	**119.5**	**10.27**	**1.583**	**18.62**	**1.015**	**10.15**	**94.01**
SEm±	**0.591**	**0.525**	**0.396**	**2.576**	**0.223**	**0.044**	**0.282**	**0.03**	**0.30**	**0.310**
CD(P 0.05)	**1.755**	**1.559**	**1.176**	**7.652**	**0.662**	**0.130**	**0.837**	**0.09**	**0.89**	**0.920**
Priming treatments (P)										
P_1	69.91	46.83	37.74	115.3	9.3	1.417	15.31	0.868	8.68	93.15
P_2	72.08	46.33	37.13	117.8	9.8	1.520	18.06	0.971	9.71	94.30
P_3	75.17	45.75	38.74	120.4	11.0	1.627	19.05	1.053	10.53	94.31
P_4	77.92	45.92	39.66	124.4	10.9	1.767	22.07	1.168	11.68	94.32
Mean	**73.77**	**46.207**	**38.31**	**119.4**	**10.27**	**1.582**	**18.62**	**1.015**	**10.15**	**94.02**
SEm±	**0.253**	**0.308**	**0.296**	**1.423**	**0.123**	**0.031**	**0.253**	**0.02**	**0.20**	**0.192**
CD(P=0.05)	**0.751**	**0.915**	**0.879**	**4.227**	**0.365**	**0.092**	**0.751**	**0.06**	**0.59**	**0.570**
NxP (Nutrient management x seed priming)										
N_1P_1	65.67	48.67	35.81	112.8	8.5	1.371	12.43	0.821	8.21	92.41
N_1P_2	67.33	48.33	36.14	111.2	9.0	1.480	15.83	0.930	9.30	93.25
N_1P_3	69.67	46.33	35.40	115.1	10.3	1.511	16.40	0.961	9.61	93.49

N_1P_4	72.67	47.67	37.16	122.2	9.6	1.590	17.13	1.041	10.41	93.38
N_2P_1	68.00	47.67	37.02	106.2	8.7	1.309	12.67	0.759	7.59	92.78
N_2P_2	71.67	47.00	36.25	111.0	8.8	1.357	14.83	0.807	8.07	93.53
N_2P_3	73.67	47.00	36.74	111.9	10.7	1.458	16.53	0.908	9.08	93.49
N_2P_4	75.33	46.67	38.09	119.5	10.2	1.637	18.50	1.087	10.87	93.06
N_3P_1	70.67	46.00	39.29	118.8	9.1	1.485	16.90	0.935	9.35	94.53
N_3P_2	73.00	45.67	38.34	123.8	9.8	1.517	18.70	0.967	9.67	95.06
N_3P_3	76.67	45.67	41.82	126.2	10.4	1.672	19.17	1.122	11.22	95.23
N_3P_4	79.33	45.33	40.91	123.5	10.4	1.750	25.30	1.200	12.00	95.25
N_4P_1	75.33	45.00	38.85	123.3	11.0	1.505	19.23	0.956	9.56	92.87
N_4P_2	76.33	44.33	37.79	125.2	11.7	1.727	22.87	1.178	11.78	95.36
N_4P_3	80.67	44.00	41.02	128.3	12.6	1.868	24.10	1.218	12.18	95.02
N4P4	84.33	44.00	42.49	132.6	13.6	2.092	27.33	1.343	13.43	95.60
Mean	**73.77**	**46.20**	**38.32**	**119.4**	**10.27**	**1.583**	**18.62**	**1.015**	**10.14**	**94.01**
SEm±	**0.482**	**0.497**	**0.591**	**1.470**	**0.375**	**0.077**	**0.907**	**0.06**	**0.66**	**0.620**
CD(0.05P)	**1.431**	**1.476**	**1.755**	**4.367**	**1.114**	**0.228**	**2.694**	**0.18**	**1.96**	**1.841**
CV (%)	**1.13**	**1.86**	**2.67**	**2.13**	**6.33**	**8.47**	**8.43**	**11.31**	**11.31**	**8.14**

Table 2.25. Effect of seed priming, nutrient management on seed quality of proso millet cv. TNAU-145 at Bengaluru during 2018

Treatment	1000 seed weight(g)	Seed germination(%)	Seed vigour index-I
Nutrient management (N)			
N_1	5.34	83.25	1657
N_2	5.38	83.08	1639
N_3	5.43	85.67	1736
N_4	5.43	85.83	1681
Mean	**5.39**	**84.45**	**1678**
SEm±	**0.023**	**1.87**	**54**
CD(P 0.05)	**0.068**	**NS**	**NS**
Priming (P)			
P_1	5.35	81.58	1540
P_2	5.37	83.25	1591
P_3	5.43	85.17	1753
P_4	5.44	87.83	1829
Mean	**5.39**	**84.45**	**1678**
SEm±	**0.019**	**0.65**	**17.0**
CD(P=0.05)	**0.056**	**1.931**	**50.0**
NxP (Nutrient management x seed priming)			
N_1P_1	5.27	79.33	1493
N_1P_2	5.28	82.33	1685
N_1P_3	5.43	84.00	1733
N_1P_4	5.37	87.33	1718
N_2P_1	5.35	80.67	1506
N_2P_2	5.36	81.67	1523
N_2P_3	5.40	84.67	1716
N_2P_4	5.41	85.33	1810
N_3P_1	5.39	86.00	1618
N_3P_2	5.42	86.00	1606
N_3P_3	5.42	80.00	1755
N_3P_4	5.48	90.67	1966
N_4P_1	5.37	80.33	1545
N_4P_2	5.41	83.00	1548
N_4P_3	5.46	92.00	1810
N4P4	5.49	88.00	1822
Mean	**5.39**	**84.45**	**1678**
SEm±	**0.044**	**3.54**	**104**
CD(0.05P)	**0.130**	**10.51**	**309**
CV (%)	**1.41**	**7.26**	**11.0**

2. RPCAU, Pusa

All parameters were not significantly influenced by nutrient management in proso millets. However, seed yield/plant, seed yield/plot and seed yield/ha were significantly affected by priming. Seeds primed with (P2)hydro priming for 8 hours by adopting seed to solution ratio of 1:1 and then mixing with carbendazim (Bavistin) @2.5g/Kg of seed and leaving the mixture for 24 hours before sowing recorded significantly higher seed yield/plot (44.28g) and seed yield/ha (245.99kg) than other priming treatments. However, priming the seed with (P4) seed priming with 20% liquid *pseudomonas fluroesence* recorded significantly higher seed yield/plant than other priming treatments (Table 2.21a).

Interaction between nutrient management and priming was turned out to be significant on grain yield. Seed priming with (P2) hydro priming for 8 hours by adopting seed to solution ratio of 1:1 and then mixing with carbendazim (Bavistin) @2.5g/Kg of seed and leaving the mixture for 24 hours before sowing together with N_4 (125 g neem +250 g vermicompost +50 g urea +50 g super phosphate +50 g MOP + 2 % Borex spray at flowering)/ha recorded significantly higher seed yield than other methods of priming at different nutrient management practices. (Table 2.21 b) The next best treatment was N_1P_4 followed by N_3P_2.

Table 2.21a: Integrated approach for enhancing seed yield and quality in proso millets at DRPCAU, Dholi centre during 2018

Sl.	Treatment	P.H. cm	Chlorophyll content (%)	Days to first flowering	Days to 50% flowering	No. of tillers /plant	Seed yield /plant (g)	Seed yield/plot (g)	Seed yield/h (Kg)	100 seed weight (g)	Seed recovery (%)	Seed germination (%)	Seedling vigor
A.	**Nutrient (Main plot treatment)**												
	N_1(control)	61.32	31.13	41.58	50.58	9.19	1.95	38.34	213.01	0.44	89.57	78.17	1026.05
	N_2	70.77	33.59	41.67	50.00	12.22	2.10	35.14	195.21	0.44	90.51	78.00	1111.12
	N_3	70.54	33.75	42.08	51.08	11.66	1.97	38.15	211.95	0.46	87.69	79.92	1138.79
	N_4	70.95	33.28	41.50	50.58	11.19	1.73	41.48	230.46	0.46	89.91	75.00	1046.22
	SE(m)±	2.35	0.90	0.22	0.46	1.52	0.19	1.64	9.12	0.01	0.98	0.84	42.34
	C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
B.	**Priming (Sub plot treatment)**												
	P_1(control)	65.46	32.65	42.25	51.25	11.19	1.82	35.19	195.49	0.43	90.07	76.67	1079.89
	P_2	69.79	33.40	41.75	50.92	10.44	1.96	44.28*	245.99*	0.47	89.63	79.58	1049.55
	P_3	69.66	32.78	41.25	49.83	11.22	1.88	35.67	198.15	0.44	90.16	76.83	1090.23
	P_4	68.66	32.93	41.58	50.25	11.41	2.09*	37.98	210.99	0.46	87.83	78.50	1102.52
	SE(m)±	1.63	0.58	0.35	0.47	1.09	0.06	1.39	7.76	0.01	0.94	0.85	46.54
	C.D. at 5%	NS	NS	NS	NS	NS	0.17	4.09	22.77	NS	NS	NS	NS

Table 2.21(b). Interaction effect of nutrient management and seed priming on seed yield (kg) in proso millets at DRPCAU, Dholi centre during 2018

Interaction effect of nutrient management and seed priming on Seed yield/h (kg)					
Factor A\B	**P1**	**P2**	**P3**	**P4**	**MEAN**
N_1	150.55	201.63	201.06	298.81	213.01
N_2	205.94	171.69	205.91	197.30	195.21
N_3	183.17	288.91	192.59	183.13	211.95
N_4	242.33	321.74	193.06	164.72	230.46
MEAN	195.49	245.99	198.15	210.99	

Factor (B) at same level of A- SEm ±18.23 CD : 48.44

Factor (A) at same level of B- SEm ±16.24 CD : 50.69

Little millet *(Panicum sumatrense)*

Unified observation

Effect of nutrient management and seed priming on yield and seed quality attributing traits in Little Millet (Mean over locations)

During *kharif* 2018, this experiment was conducted at three locations namely TNAU Coimbatore, IGKV, Raipur and JNKVV Jabalpur. The detailed mean data over locations are presented in Table 2.22.

The average over locations revealed that nutrient management treatments had significant effect on plant growth, seed yield and quality of little millet. Among the nutrient management treatments, N_4 (125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after sowing+ 2% Borax spray) showed superiority with respect to seed yield (10.32 q/ha), no of tillers/plant (8.17), plant height (110.49 cm), germination percentage (88 %) and vigour index (1172) as compared to control and other treatments. The seed priming treatment had significant effect on seed yield. Among the priming treatments, seed priming with 20% liquid *P. fluorescens* (P_4) was superior as compared to control and other treatments in terms of seed yield (9.49 q/ha), no. of tillers/plant (7.4), chlorophyll content (26) and seed quality attributes.

Among interactions of priming with nutrient management treatments, N_4P_4 (seed priming of 20% liquid *P fluorescence* in combination of nutrient with 125 kg Neem+1250 kg Vermi compost per ha or 12.5 tons FYM per ha+50 kg Urea+ 50 kg SSP and 50 kg MOP per ha+ Top dressing urea at 3-4 weeks after sowing+ 2 % Borax

spray) recorded highest seed yield (11.56 q/ha), no of tillers/ plant (9.54), 100 seed weight (2.27 gm), chlorophyll content (19.48) and seed quality attributes *viz*., vigour index II (18.17), field emergence (89%) closely followed by N_4P_3 (125 kg Neem+1250 kg Vermi compost per ha or 12.5 tons FYM per ha+50 kg Urea+ 50 kg SSP and 50 kg MOP per ha+ Top dressing urea at 3-4 weeks after sowing+ 2 % Borax spray with seed priming of 2 % KH_2PO_4).

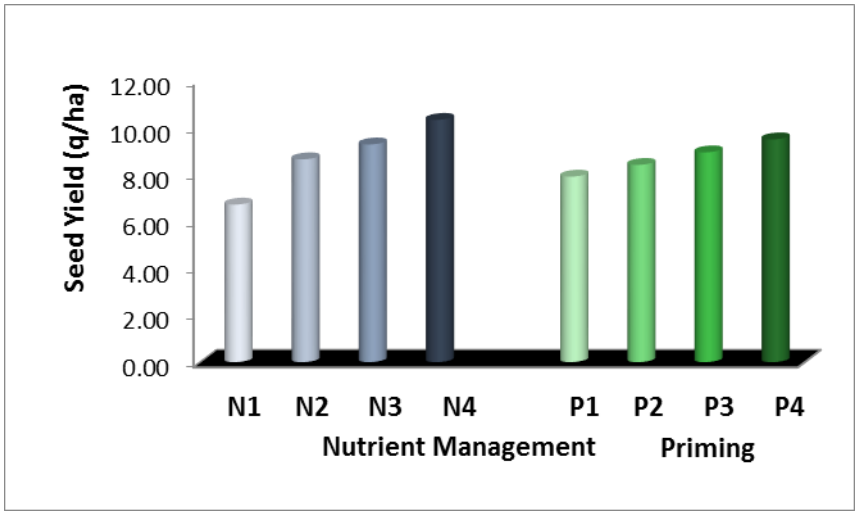
Significant Observation:

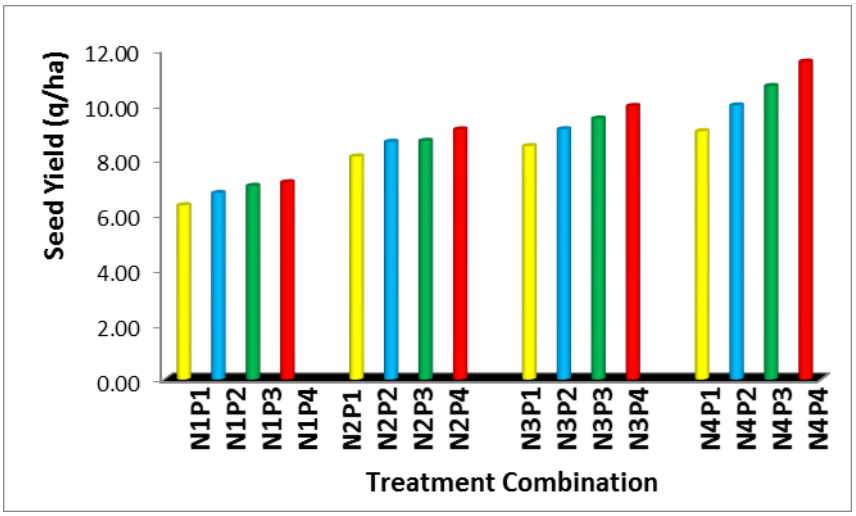
Mean data over locations revealed that seed priming with 20% *P. fluorescence* in combination with nutrient management with 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after sowing+ 2% Borax spray leads to 83% increase of seed yield/ha over control. Due to treatment N_4P_4, 11.52% and 45.94% increase over control were observed in case of germination percentage and vigour index II respectively.

Table 2.22: Effect of nutrient management and seed priming on yield and seed quality attributing traits in little Millet (Mean over locations)

Treatments	Germination %	Days to 50 % flowering	Plant height (cm)	Chlorophyll Content	Number of tillers per plant	1000 seed weight (g)	Seed yield (q/ha)	Field emergence (%)	VI-I	VI-II
Nutrient Management										
N1:No fertilizer	82.65	52.05	104.28	22.80	6.31	1.85	6.71	77.99	1043.15	12.46
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	83.82	54.00	105.84	24.85	7.03	2.07	8.64	82.25	1077.17	14.32
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	86.19	53.40	106.69	26.73	7.38	2.12	9.27	83.86	1105.96	13.34
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	88.36	51.86	110.49	27.69	8.17	2.14	10.32	86.05	1172.17	14.85
Mean	**85.26**	**52.83**	**106.83**	**25.52**	**7.22**	**2.05**	**8.73**	**82.54**	**1099.61**	**13.74**
Priming										
P1:Control (No priming)	81.27	53.87	104.87	23.97	6.45	1.92	7.90	80.46	1007.58	13.01
P2 :Hydro priming	85.29	53.15	105.90	24.94	6.99	1.86	8.40	83.26	1071.25	13.79
P3:Seed priming with 2% KH2PO4	86.10	51.84	107.25	26.33	7.33	2.08	8.93	84.28	1148.75	13.43
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	87.83	52.20	108.99	26.45	7.93	2.16	9.49	84.95	1170.59	14.73
Mean	**85.12**	**52.76**	**106.75**	**25.42**	**7.17**	**2.01**	**8.68**	**83.24**	**1099.54**	**13.74**

Interaction										
N_1P_1	79.08	53.83	103.63	22.31	5.85	1.93	6.34	74.86	958.63	12.45
N_1P_2	82.38	53.24	104.28	23.40	6.70	1.98	6.78	79.42	1005.29	13.54
N_1P_3	84.97	49.42	104.48	23.76	6.56	2.00	7.04	79.31	1137.96	12.41
N_1P_4	84.64	52.23	105.16	22.19	6.62	2.04	7.17	78.86	1071.96	11.44
N_2P_1	80.53	54.12	103.55	22.77	6.37	2.01	8.11	78.75	1063.13	12.07
N_2P_2	82.08	54.39	104.66	24.11	7.06	2.08	8.65	83.08	1014.63	13.68
N_2P_3	84.58	53.59	106.74	26.41	7.08	2.07	8.68	83.08	1066.96	15.43
N_2P_4	85.74	53.97	108.46	26.07	7.59	2.11	9.10	85.75	1106.46	16.09
N_3P_1	83.42	54.96	104.29	25.18	6.80	2.04	8.49	82.97	1120.79	13.63
N_3P_2	87.75	53.58	106.55	26.12	7.36	2.11	9.10	85.08	1062.79	14.15
N_3P_3	84.86	52.93	107.18	27.39	7.37	2.13	9.49	85.97	1034.29	12.36
N_3P_4	86.75	52.15	108.73	28.07	8.06	2.15	9.95	85.75	1090.46	13.20
N_4P_1	87.08	53.01	108.39	25.99	7.09	2.07	9.03	84.97	1141.29	13.90
N_4P_2	89.85	52.29	109.09	27.51	7.74	2.12	9.97	86.36	1197.63	13.79
N_4P_3	87.31	51.54	110.74	27.82	8.33	2.14	10.68	87.75	1171.79	13.53
N_4P_4	88.19	50.55	113.75	29.48	9.54	2.27	11.56	88.76	1120.96	18.17





Effect of nutrient management and seed priming on Seed yield (q/ha) of Little Millet (Mean over locations)

Centre wise report is given as follows;

1. JNKVV, Jabalpur

The experiment was conducted with little millet variety JK 8 as per technical programme during *Kharif* 2018. Sowing was done on 10.07.2018 in a spacing 30 x 10 cm. The seeds were treated with carbandazim @ 2.5g kg^{-1} seeds before sowing. All the four proposed priming treatments were given on 06.07.2018. Recommended dose of fertilizers were applied as per technical programme.

Effect of nutrient management on plant growth, seed yield and quality attributes

The nutrient management treatments had significant effect on seed yield and attributing traits of little millet. Highest field emergence %, plant height, chlorophyll content, number of tillers/ plant, seed yield per plant and seed yield (q/ha) were recorded in N_4 (125 kg Neem + 1250 kg Vermi compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha followed by N_3 (50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha).

Effect of priming on plant growth, seed yield and quality attributes

The priming treatment had significant effect on plant growth, seed yield and quality attributes. Highest field emergence %, chlorophyll content, no. of tillers/ plant, seed yield per plant and seed yield (q/ha) were noticed in P_3 (Seed priming with 2% KH_2PO_4 for 6 hour) followed by P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescens)*.

Interaction effect of sowing method, nutrient management and priming on plant growth, seed yield and quality attributes

Considering different treatments, seed priming with P_4 (Seed Priming with 20% liquid *Pseudomonas fluorescens*) with N_4 (125 kg Neem + 1250 kg Vermi compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha) recorded higher seed yield under direct sown condition. It was closely followed by seed priming with P_3 (Seed priming with 2% KH_2PO_4 for 6 hour) in combination with N_4 (125 kg Neem + 1250 kg Vermi compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha) under direct sown condition.

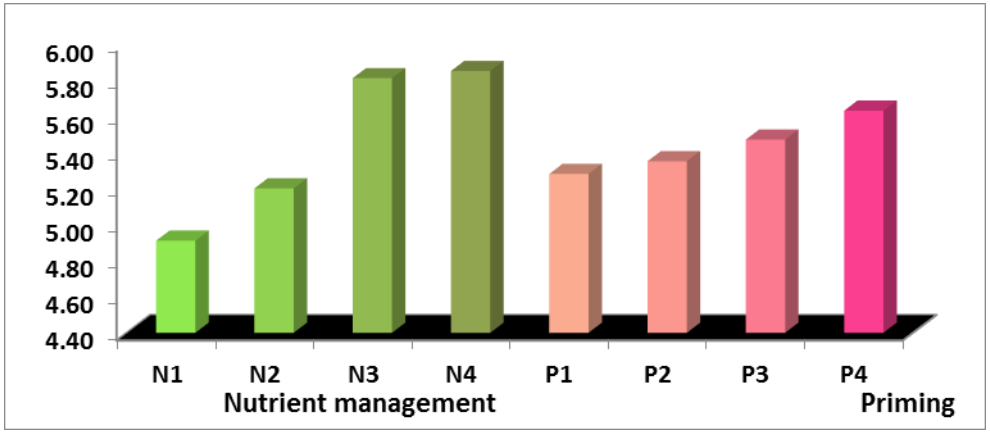
Conclusion:

It is concluded that direct sowing with fertilizer dose 125 kg Neem + 1250 kg vermin compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Muriate of potash per ha and seed priming with 20 % liquid *Pseudomonas fluorescens* were found better for yield and its attributing traits.

Table 2.23: Yield and yield attributing characters of little millet as influenced by nutrient management and priming at JNKVV, Jabalpur during *Kharif* 2018

Main plot (Nutrient Management)	Sub Plot (Priming)	Field Emergence %	Plant Height at 30 days	Plant Height at harvest	Chlorophyll content	Days to first flowering	Days to 50% flowering	No. of tillers/ plant	Seed yield/ plant (g)	100 seed weight (g)	Seed Yield q/ha	Germination %	Vigour Index I	B:C ratio
N1	P1	65.58	34.25	56.43	26.58	36.25	42.75	3.92	3.3	1.4	5.97	81.25	873.25	0.76
	P2	67.92	34.56	58.32	27	36.25	42.45	4.58	3.41	1.4	6.09	82.45	892.58	0.92
	P3	69.92	36.58	59.33	29.18	34.25	31.17	4.58	3.44	1.44	6.41	85.92	968.92	1.17
	P4	67.58	35.58	59.17	22.64	35.25	41.75	3.92	3.32	1.42	6.16	82.92	911.92	1.30
N2	P1	71.25	39.92	59.84	27	40.25	46.59	4.58	3.45	1.4	6.4	74.58	951.25	0.87
	P2	72.58	40.25	60.35	27.82	39.25	46.25	4.92	3.45	1.4	6.43	79.25	957.25	0.96
	P3	76.58	41.25	60.64	34.19	38.25	44.95	4.92	3.65	1.45	6.51	83.75	976.92	1.10
	P4	75.58	37.25	61.05	30.96	39.25	45.98	4.58	3.55	1.4	6.47	82.92	975.92	1.31
N3	P1	76.25	40.25	56.48	33.02	41.25	47.75	4.58	3.68	1.4	6.88	77.25	921.58	0.87
	P2	74.58	44.92	61.47	33.58	39.25	45.95	5.25	3.71	1.46	6.98	84.25	936.58	1.06
	P3	77.25	44.92	63.12	34.92	36.25	43.85	5.25	3.76	1.47	7.28	86.58	957.58	1.32
	P4	75.58	42.92	61.59	33.92	36.56	45.95	5.25	3.64	1.42	6.97	84.25	939.92	1.49
N4	P1	77.25	42.92	62.06	32.83	41.25	45.57	4.58	3.83	1.41	6.86	85.25	947.58	0.89
	P2	77.92	45.58	62.10	34.67	38.25	45.25	5.25	3.83	1.43	6.9	86.25	962.25	1.12
	P3	78.58	46.58	62.59	33.09	37.25	44.55	5.25	3.9	1.42	7.16	88.92	1070.58	1.44
	P4	78.28	46.92	65.63	35.42	36.25	41.51	5.58	4.08	1.44	7.42	92.58	1100.92	1.61
Nutrient Management (Main plot)	No fertilizer	67.37	34.86	57.93	25.97	35.12	39.15	3.87	2.99	1.03	5.78	82.76	911.29	0.77
	12.5 tons FYM/ha	74.41	39.67	60.46	29.99	39.25	45.94	4.75	3.52	1.41	6.45	80.13	965.34	1.02
	50 kg Urea +50 kg Super phosphate and 50 kg MOP +	75.92	43.25	60.66	33.86	38.33	45.88	5.08	3.7	1.44	7.06	83.08	938.92	1.16

	12.5 tons FYM/ha+ 50 kg Urea +50 kg Super phosphate and 50 kg MOP	78.01	45.5	63.08	34	38.25	44.22	5.17	3.91	1.43	7.1	88.25	1020.33	1.30
Priming (Sub plot)	No priming	72.31	39.07	58.42	29.59	39.48	45.4	4.15	3.3	1.13	6.26	79.31	923.15	0.82
	Hydro priming for 6 hours	72.58	40.66	59.88	30.1	37.58	44.31	4.33	2.93	0.75	5.93	82.38	936.50	0.96
	Seed priming with 2% KH2PO4 for 6 hours	75.58	42.33	61.42	32.85	36.50	41.13	5.02	3.69	1.45	6.72	86.29	993.50	1.19
	Seed priming with 20% liquid P. fluorescens	74.26	40.67	61.86	30.74	36.83	43.8	4.83	3.65	1.42	6.88	85.67	982.17	1.36
Nutrient Management	CD at 5%	1.94	3.46	46.55	1.56	26.78	31.65	5.90	6.08	2.22	5.55	34.49	487.30	
Priming	CD at 5%	1.24	2.47	39.36	1.24	20.14	24.17	3.58	5.47	1.5	4.78	30.58	421.92	
Interactions	CD at 5%	3.68	6.56	92.47	2.86	51.19	63.06	11.51	11.84	4.18	10.83	68.64	974.39	



Effect of nutrient management and priming on seed yield of little millet

2. IGKV, Raipur

Effect of nutrients management on plant growth, seed yield and quality attributes

Among the four nutrients managements Treatment N_4 (125 kg Neem+1250 kg vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting +2% Borax spray) showed superiority with respect to growth and seed yield parameters *viz.,* Field Emergence (90.18 %), Number of tillers per plant (8.63), Seed yield per hectare (13.27 q), 100 Seed Weight (0.214 gm) and Vigour Index (14.85) whereas, N_4 was at par with N_3 (50 kg Urea+50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting +2% Borax spray at flowering) for Plant Height at harvest stage, Grain yield per plant, Germination percent and Seed recovery percent.

Effect of seed priming on plant growth, seed yield and quality attributes

Among the seed priming treatments, treatment P_4 (Seed Priming with 20% liquid *Pseudomonas fluoresces*) showed superiority for yield and its components *viz.*, Tillers per plant (8.45), Seed yield per plant (12.17 g), Seed yield per hectare (11.52 q), 100 Seed weight (0.215 gm), Chlorophyll content (1.12 mg/gm), Field emergence, Vigour index (14.73). Non primed seed performed poor for most of the characters *viz.,* Plant height, Tillers per plant, 100 Seed weight, Seed Yield per Plant, Seed yield per hectare, Seed Recovery Percent, Germination percent and Vigour Index.

Interaction effect of seed priming on plant growth, seed yield and quality attributes

Among the two way interactions nutrients management and seed priming was found significant for more number of tillers per plant, Seed Yield per hectare, Seed Recovery Percent, Germination Percent, Vigour Index, Field emergence and Chlorophyll content.

Interaction N_4P_4 (N_4: 125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P_4: Seed Priming with 20% liquid *Pseudomonas fluoresces)* showed superiority in terms of Tillers per plant (10.13), Seed Yield per hectare (14.83 q), 100 Seed weight (0.230 gm), Vigour Index (18.17) whereas, other interactions found superior were N_4P_2 (N_4: 125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting +2% Borax spray; P_2: Hydro priming for 8 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing) for Field Emergence (95.16); N_3P_2 (N_3: 50 kg Urea+50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting +2% Borax spray; P_2: Hydro priming for 8 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing) for Germination percent

(92%); N_2P_2 (125 kg Neem+1250 kg Vermicompost P_2: Hydro priming for 8 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing) for Seed Recovery Percent (96.62%).

The Cost: Benefit ratio was calculated to determine the effects of treatments on the economic returns. The highest C: B ratio was recorded by interactions N_3P_4 (1:2.35) (N_3: 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting +2% Borax spray; P_4: Seed Priming with 20% liquid *Pseudomonas fluoresces*) followed by N_3P_3 (1:2.18) (N_3: 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P_3: Seed Priming with 2% KH_2PO_4 for 8 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing) and N_3P_2(1:2.09) (N_3: 50 kg Urea+50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P_2: Hydro priming for 8 h by adopting seed to solution ratio of 1:1 and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/kg seeds, and leaving the mixture for 24 hours before sowing).

Among the nutrient management the C:B ratio was found to be higher in N_3 (1:2.09) (50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray). Among the Seed Priming the return was found to be higher in P_4 (1:1.66) (Seed Priming with 20% liquid *Pseudomonas fluoresces*).

It was observed that by organic way the seed yield was towards higher side but C:B ratio was at the lower side due to higher expenses on procurements of organic inputs and low price of produce.

Conclusion:

It can be concluded that main effect N_4 (125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray) exhibited higher Seed Yield but economic returns was recorded higher in N_3 (50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2 % Borax spray) due to low inputs cost. Likewise, Seed Priming P_4 (Seed Priming with 20% liquid *Pseudomonas fluoresces*) was found highest in Seed yield and Economic returns. Among the interactions, N_4P_4 (N_4: 125 kg Neem + 1250 kg Vermicompost + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray; P_4: Seed Priming with 20 % liquid *Pseudomonas fluoresces*) was found highest for seed yield and its components but N_3P_4 (N_3: 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing

Urea at 3-4 weeks after transplanting + 2% Borax spray; P_4: Seed Priming with 20% liquid *Pseudomonas fluoresces*) gave highest economic returns due to low input cost.

Table 2.24: Effect of Nutrients Management on Plant growth, Seed yield and Quality attributes in Little millet at IGKV, Raipur during 2018.

Treatments	Field emergence (%)	Plant height at 30 days (cm)	Plant height at harvest (cm)	Chlorophyll content (mg/gm)	Days to first flowering (Days)	Days of 50% flowering (Days)	No. of tillers/ plant -1	Seed yield/plant -1 (gm)	Seed yield / ha -1 (Q)	100 seed weight (gm)	Seed Recovery %	Germination %	VI
Nutrient Management													
N1:No fertilizer	84.58	86.48	153.40	0.92	42.67	61.08	6.95	7.58	6.48	0.19	91.80	80.17	12.46
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	89.75	87.97	153.87	0.95	43.75	61.67	7.33	9.00	10.85	0.21	92.35	84.33	14.32
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	90.67	86.75	154.00	0.92	43.33	61.42	7.57	10.83	11.41	0.21	94.94	86.50	13.34
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg	94.13	90.18	159.90	0.87	43.08	60.25	8.63	12.00	13.27	0.21	95.20	86.83	14.85

MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray													
Mean	89.78	87.85	155.29	0.92	43.21	61.11	7.62	9.85	10.50	0.205	93.57	84.46	13.74
SEm+	0.57	2.32	1.72	0.014	0.31	0.37	0.11	0.38	0.24	0.002	0.75	1.56	0.27
C.D. (0.05 P)	1.98	8.02	5.93	0.050	0.90	1.29	0.39	1.33	0.59	0.006	2.60	5.4	0.92
Priming													
P1:Control (No priming)	87.08	86.15	153.88	0.72	42.83	61.00	6.70	7.92	9.25	0.20	89.93	81.50	13.01
P2 :Hydro priming	92.21	88.17	154.23	0.92	43.25	61.33	7.75	9.33	10.52	0.21	94.26	87.50	13.79
P3:Seed priming with 2% KH2PO4	89.25	88.50	155.73	0.84	43.33	61.08	7.58	10.00	10.72	0.20	94.23	83.00	13.43
P4: Seed priming with 20% Liquid Pseudomonas fluorescence	90.58	88.57	157.32	1.12	43.42	61.00	8.45	12.17	11.52	0.22	95.87	85.83	14.73
Mean	89.78	87.85	155.29	0.90	43.21	61.10	7.62	9.86	10.50	0.21	93.57	84.46	13.74
SEm+	0.65	1.43	1.17	0.015	0.31	0.69	0.14	0.43	0.22	0.002	0.79	0.83	0.27
C.D. (0.05 P)	1.89	4.18	3.41	0.040	0.91	2.01	0.40	1.25	0.46	0.006	2.32	2.42	0.80

Table 2.25: Effect of Nutrients Management on Plant growth, Seed yield and Quality attributes in Little millet at IGKV, Raipur during 2018.

Treatments	Field emergence (%)	Plant height at 30	Plant height at	Chlorophyll content (mg/gm)	Days to first flowering	Days of 50% flowering	No. of tillers/plant -1	Seed yield/plant -1 (gm)	Seed yield / ha -1	100 seed weight	Seed Recovery %	Germination %	VI

		days (cm)	harvest (cm)		(Days)	(Days)			(Q)	(gm)			
Interaction													
N1P1	82.00	83.53	152.67	0.84	42.67	61.33	5.73	6.33	5.86	0.185	89.16	76.0	12.45
N1P2	88.33	89.40	153.13	1.11	43.00	60.67	7.53	7.33	6.56	0.196	90.49	80.7	13.54
N1P3	85.00	86.73	153.60	0.79	42.33	62.00	7.00	7.33	6.68	0.193	91.96	82.0	12.41
N1P4	83.00	86.27	154.20	0.93	42.67	60.33	7.53	9.33	6.81	0.202	95.57	82.0	11.44
N2P1	85.00	87.27	151.20	0.50	43.00	60.67	6.53	6.67	9.86	0.201	84.24	82.0	12.07
N2P2	92.67	87.93	151.67	1.10	43.33	62.33	7.67	8.00	11.11	0.210	96.62	86.0	13.68
N2P3	86.67	88.47	154.87	1.03	44.33	60.33	7.13	10.00	10.72	0.208	92.01	84.0	15.43
N2P4	94.67	88.20	157.73	1.15	44.33	63.33	8.00	11.33	11.69	0.214	96.54	85.3	16.09
N3P1	88.67	84.80	153.20	0.51	43.00	62.33	6.93	9.33	10.10	0.203	92.89	82.0	13.63
N3P2	92.67	85.87	153.47	0.58	43.67	62.00	7.73	11.33	11.11	0.207	94.51	92.0	14.15
N3P3	91.67	87.47	154.13	0.75	43.67	62.33	7.47	9.33	11.69	0.204	96.61	82.0	12.36
N3P4	89.67	88.87	155.20	1.30	43.00	59.00	8.13	13.33	12.75	0.213	95.74	90.0	13.20
N4P1	92.67	89.00	158.47	1.05	42.67	59.67	7.60	9.33	11.21	0.207	93.43	86.0	13.90
N4P2	95.17	89.47	158.67	0.87	43.00	60.33	8.07	10.67	13.29	0.211	95.42	91.3	13.79
N4P3	93.67	91.33	160.33	0.78	43.00	59.67	8.73	13.33	13.77	0.207	96.34	84.0	13.53
N4P4	95.00	90.93	162.13	1.11	43.67	61.33	10.13	14.67	14.83	0.230	95.61	86.0	18.17
Mean	89.78	87.85	155.29	0.90	43.21	61.10	7.62	9.85	10.50	0.21	93.57	84.46	13.74
SEm+	1.29	2.87	2.34	0.03	0.62	1.38	0.27	0.86	0.32	0.004	1.59	1.66	0.55
C.D. (0.05 P)	3.77	8.37	6.82	0.09	1.81	4.77	0.8	2.5	0.93	0.011	4.64	4.85	1.59

Table2.26: **Cost: Benefit Ratio as influenced by integrated approaches for increasing seed yield of Little Millet (Kutki) *cv* CG Kutki 2 (Cost of Cultivation per hectare)**

Treatments	Total Cost (Rs.)	Yield (Q/ha)	Rate (Rs./Q)	Total Return (Rs./ha)	Net return (Rs.)	Cost: Benefit Ratio
N1P1	9880.00	5.86	2600	15229.47	5349.47	1:1.54
N1P2	9885.75	6.56	2600	17050.72	7164.97	1:1.72
N1P3	9985.75	6.68	2600	17364.73	7378.98	1:1.74
N1P4	10160.00	6.81	2600	17710.14	7550.14	1:1.74
N2P1	24880.00	9.86	2600	25623.19	743.19	1:1.03
N2P2	24885.75	11.11	2600	28888.89	4003.14	1:1.16
N2P3	24985.75	10.72	2600	27884.06	2898.31	1:1.12
N2P4	25160.00	11.69	2600	30396.14	5236.14	1:1.21
N3P1	13842.60	10.10	2600	26251.21	12408.61	1:1.90
N3P2	13848.35	11.11	2600	28888.89	15040.54	1:2.09
N3P3	13948.35	11.69	2600	30396.14	16447.79	1:2.18
N3P4	14122.60	12.75	2600	33159.42	19036.82	1:2.35
N4P1	28842.60	11.21	2600	29140.10	297.50	1:1.01
N4P2	28848.35	13.29	2600	34541.06	5692.71	1:1.20
N4P3	28948.35	13.77	2600	35797.10	6848.75	1:1.24
N4P4	29122.60	14.83	2600	38560.39	9437.79	1:1.32

3. TNAU, Coimbatore

The results revealed that, the basal nutrient application of 125 kg neem + 1250 kg vermi per ha + 50 kg urea +50 kg Super phosphate + 50 kg Muriate of potash + Top dressing urea + 2 % Borax spray recorded significantly higher values for plant height (108.5 cm) and number of tillers (10.7) and chlorophyll content (48.2 µmol/m^2) over control (101.5cm, 8.1 & 41.5 µmol/m^2) respectively. It also induces the early flowering (47.3 days) than control (51.9 days). Same trend was noticed in days to 50% flowering which took 51.1 days for 50% flowering but control required 55.9 days. The same fertilizer treatment also recorded significantly higher values for seed yield (5.9 g/plant & 10.58 q/ha) with maximum 1000 seed weight (2.90 g) and seed recovery (94 %) compared to control (5.0 g/plant, 7.9 q/ha, 2.61 g, and 93 %, respectively). Seeds harvested from the same fertilizer treatment also recorded significantly higher germination percentage (90 %) and vigour index (1324) over control (85 %, 1175) respectively.

Priming with 20 % liquid *Pseudomonas fluorescens* recorded significantly higher values for plant height (107.8 cm) and number of tillers (10.5) and chlorophyll content (47.5 µmol/m^2) over control (102.3 cm, 8.5 & 41.6 µmol/m^2) respectively. It also induces the early flowering (47.3 days) than control (50.2 days). Same trend was noticed in days to 50% flowering which

took 51.8 days for 50% flowering but control required 55.2 days. The same fertilizer treatment also recorded significantly higher values for seed yield (5.98 g/plant & 10.06 q/ha) with maximum 1000 seed weight (2.86 g) compared to control (4.9 g, 8.19 q/ha, and 2.63 g) respectively. Seeds harvested from the same priming treatment also recorded higher germination percentage (92 %) and vigour index (1359) over control (83%, 1092) respectively.

Fertilizer application of 125 kg neem + 1250 kg vermi per ha + 50 kg urea +50 kg Super phosphate + 50 kg Muriate of potash + Top dressing urea + 2 % Borax spray in combination of priming with 20 % liquid *Pseudomonas fluorescens* recorded highest plant height (113.5 cm), Number of tillers (12.9), single plant seed yield (6.47 g), yield per hectare (12.44 q/ha) compare to 101.8 cm, 7.9, 4.3 g and 7.18 q/ha respectively in control (Table 2.27, 2.28, 2.29 & 2.30).

Conclusion:

Priming with 20 % liquid *Pseudomonas fluorescens* combined with the treatment of 125 kg neem + 1250 kg vermi per ha + 50 kg urea +50 kg Super phosphate + 50 kg Muriate of potash + Top dressing urea + 2 % Borax spray under direct sowing recorded the highest seed yield and resultant seed quality characteristics in all the three foxtail millet, little millet and kodo millet.



Effect of Fertilizer (organic+inorganic) and priming in plant height –Little millet



Resultant seed germination (%) in Little millet

Table 2.27: Effect of fertilizer and priming treatment on plant physiological parameters in little millet at Coimbatore during 2018

Treatments	Field emergence (%)	Plant height at 30 DAS (cm)	Plant height at maturity (cm)	Chlorophyll content (µmol/m^2)
N1:No fertilizer	82	47.8	101.5	41.5
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	83	50.5	103.2	43.6
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	85	56.3	105.4	45.4
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	86	57.7	108.5	48.2
Mean	**86**	**53.2**	**104.6**	**44.6**
SEd	0.47	1.20	0.54	1.12
CD (p=0.05)	0.94	2.41	1.08	2.24
P1:Control (No priming)	82	49.7	102.3	41.6
P2 :Hydro priming	85	51.2	103.6	43.8
P3:Seed priming with 2% KH2PO4	88	55.8	104.6	45.3
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	90	56.1	107.8	47.5
Mean	**86**	**53.2**	**104.6**	**44.6**
SEd	0.87	1.31	0.46	0.98
CD (p=0.05)	1.74	2.63	0.92	1.96
N_1P_1	77	47.2	101.8	39.5
N_1P_2	82	47.5	101.4	42.1
N_1P_3	83	49.3	100.5	41.3
N_1P_4	86	47.3	102.1	43.0
N_2P_1	80	47.2	99.6	40.8
N_2P_2	84	48.8	102.0	43.4
N_2P_3	86	51.4	104.7	44.0

N_2P_4	87	54.7	106.6	46.1
N_3P_1	84	51.8	103.2	42.0
N_3P_2	88	54.0	104.7	44.2
N_3P_3	89	59.8	104.3	46.5
N_3P_4	92	59.7	109.4	49.0
N_4P_1	85	53.0	104.7	44.1
N_4P_2	86	55.0	106.5	47.0
N_4P_3	91	59.8	109.3	49.6
N4P4	93	63.2	113.5	51.9
Mean	**86**	**53.2**	**104.6**	**44.6**
SEd	1.23	1.73	0.92	1.36
CD (p=0.05)	2.46	2.47	1.84	2.72
CV (%)	3.86	3.91	4.71	10.62

Table 2.28: Effect of fertilizer and priming treatment on plant physiological and yield parameters in little millet at Coimbatore during 2018

Treatments	Days to first flowering	Days to 50 % flowering	No. of tillers plant^{-1}	Seed yield plant^{-1}
N1:No fertilizer	51.9	55.9	8.1	5.01
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	48.8	54.4	9.0	5.37
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	48.0	52.9	9.5	5.61
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	47.3	51.1	10.7	5.91
Mean	**49.0**	**53.5**	**9.3**	**5.47**
SEd	0.43	0.12	0.35	0.06
CD (p=0.05)	0.86	0.24	0.71	0.12
P1:Control (No priming)	50.2	55.2	8.5	4.93
P2 :Hydro priming	49.6	53.8	8.9	5.30
P3:Seed priming with 2% KH2PO4	48.8	53.3	9.4	5.66
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	47.3	51.8	10.5	5.98

Mean	**49.0**	**53.5**	**9.3**	**5.46**
SEd	0.50	0.23	0.24	0.08
CD (p=0.05)	1.01	0.46	0.50	0.17
N_1P_1	52.3	57.4	7.9	4.33
N_1P_2	53.5	56.6	8.0	4.95
N_1P_3	52.4	55.1	8.1	5.18
N_1P_4	49.4	54.6	8.4	5.60
N_2P_1	50.6	55.1	8.0	4.89
N_2P_2	48.9	54.6	8.6	5.12
N_2P_3	48.5	55.5	9.2	5.65
N_2P_4	47.3	52.6	10.2	5.83
N_3P_1	49.7	54.8	8.9	5.12
N_3P_2	48.3	52.8	9.1	5.54
N_3P_3	47.4	52.6	9.4	5.73
N_3P_4	46.7	51.5	10.8	6.05
N_4P_1	48.3	53.8	9.1	5.40
N_4P_2	47.3	51.3	9.9	5.63
N_4P_3	47.3	50.4	11.0	6.13
N4P4	46.3	48.8	12.9	6.47
Mean	**49.0**	**53.5**	**9.3**	**5.47**
SEd	0.88	0.62	0.43	0.21
CD (p=0.05)	1.76	1.24	0.87	0.42
CV (%)	2.14	2.76	6.92	13.71

Table 2.29: Effect of fertilizer and priming treatment on seed yield parameters in little millet at Coimbatore during 2018

Treatments	Seed yield (q/ha)	1000 seed weight (g)	Seed recovery (%)
N1:No fertilizer	7.86	2.61	93
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	8.61	2.71	94
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	9.34	2.82	94
N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	10.58	2.90	94
Mean	**9.09**	**2.75**	**94**

SEd	8.4	0.04	NS
CD (p=0.05)	16.8	0.08	NS
P1:Control (No priming)	8.19	2.63	93
P2 :Hydro priming	8.75	2.73	93
P3:Seed priming with 2% KH2PO4	9.36	2.79	95
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	10.06	2.86	94
Mean	**9.09**	**2.75**	**94**
SEd	7.4	0.03	NS
CD (p=0.05)	14.8	0.06	NS
N_1P_1	7.18	2.53	93
N_1P_2	7.69	2.59	93
N_1P_3	8.04	2.64	93
N_1P_4	8.55	2.67	94
N_2P_1	8.08	2.61	94
N_2P_2	8.40	2.74	93
N_2P_3	8.82	2.69	94
N_2P_4	9.13	2.80	93
N_3P_1	8.50	2.70	92
N_3P_2	9.22	2.80	94
N_3P_3	9.51	2.88	93
N_3P_4	10.13	2.90	93
N_4P_1	9.03	2.73	94
N_4P_2	9.73	2.83	94
N_4P_3	11.10	2.94	94
N4P4	12.44	3.08	94
Mean	**9.09**	**2.75**	**94**
SEd	10.5	0.07	NS
CD (p=0.05)	21.0	0.14	NS
CV (%)	15.62	5.21	3.62

Table 2.30: Effect of fertilizer and priming treatment on resultant seed quality parameters in little millet at Coimbatore during 2018

Treatments	Seed germination (%)	Vigour index	B:C Ratio*
N1:No fertilizer	85	1175	0.43
N2:125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha.	87	1189	0.68
N3: 50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	89	1273	0.82

N4: 125 kg Neem+1250kg Vermi compost per ha or 12.5 tons FYM per ha+50kg Urea+ 50 kg SSP and 50kg MOP per ha+ Top dressing urea at 3-4 weeks after transplanting+ 2% Borax spray	90	1324	0.96
Mean	**88**	**1240**	
SEd	0.72	9.5	
CD (p=0.05)	1.45	19.2	
P1:Control (No priming)	83	1092	0.48
P2 :Hydro priming	86	1206	0.62
P3:Seed priming with 2% KH2PO4	89	1304	0.85
P4: Seed priming with 20% Liquid *Pseudomonas fluorescence*	92	1359	1.02
Mean	**88**	**1240**	
SEd	0.61	8.4	
CD (p=0.05)	1.22	16.8	
N_1P_1	80	1044	0.42
N_1P_2	84	1118	0.58
N_1P_3	87	1307	0.83
N_1P_4	89	1232	0.96
N_2P_1	85	1175	0.53
N_2P_2	81	1072	0.62
N_2P_3	86	1157	0.76
N_2P_4	89	1237	0.97
N_3P_1	91	1320	0.53
N_3P_2	87	1189	0.72
N_3P_3	86	1111	0.98
N_3P_4	86	1241	1.15
N_4P_1	90	1335	0.55
N_4P_2	92	1433	0.78
N_4P_3	89	1273	1.10
N4P4	86	1141	1.27
Mean	**88**	**1240**	
SEd	1.12	12.3	
CD (p=0.05)	2.22	24.5	

*** Profit gained for Rs 1 /- expenditure**

Experiment 3: Planting windows for quality seed production of soybean in offseason

Year of start: 2015-16

Centers	Varieties
UAS- Dharwad (Dharwad and Haveri)	DSb 21 (Oct. to January end)
UAS, Bangalore	JS 335 (Mandya) (in paddy fallows Nov. to Jan.)
MAU, Parbhani	MAUS 162 (Oct. to January end)
PJTSAU, Hyderabad	JS 335 (Andhra and Telangana) (Oct. to January end)
JNKVV, Jabalpur	JS 20-34 and JS 20-69 (Nov. to Jan. end)
MPKV, Rahuri	JS 335 and MAUS 162 (Sept. to January)

Objective: To standardize best planting date off season soybean seed production and to assess seed quality.

Experimental details

Design	:	FRBD	Replication	:	Three
Plot size	:	3.6 m ×5.0 m	Sowing	:	Ridges and furrow
Spacing	:	45 × 5 cm			

Fertilizer & Micro nutrients

50% higher dose than RDF 20:80:40 kg/ha (415kgDAP /ha), Ridge sowing + soil application of ZnSo4 @ 30 kg/ha along with foliar spray @ 0.5% at 48 and 56 days after sowing

Season: Best date of sowing for off season crop- centers will decide based on their data

Observations to be recorded

A. Growth and yield parameters

1. Field emergence (%)
2. Plant height (cm)
3. Number of primary branches per plant
4. Days to 50% flowering
5. Days to maturity
6. Number of pods per plant
7. Number of seeds per pod
8. Seed yield per ha.
9. Harvest index (%)

B. Flowering and Pod characteristics

1. Days to flower initiation
2. Days to 50% flowering
3. Days to pod maturity

4. Length of pod (cm)
5. Diameter of pod (cm)
6. Shattering (%)

C. Seed Morphometry (Image Analysis)

1. Length of seed (mm)
2. Width of seed (mm)
3. Area of seed (mm2)
4. Seed Diameter (mm)
5. Seed perimeter (mm)
6. Seed roundness

D. Biochemical parameters

1. Protein content (%)
2. Oil content (%)

Storage study

The seeds from offseason production will be evaluated for seed quality parameters at monthly interval.

1. Germination (%)
2. Moisture content
3. Seed vigour
4. Dry matter production
5. Seed mycoflora
6. Electrical conductivity

Unified observation

Table 3: Centre wise best planting window for soybean seed production during off season

Centre	Best window period	Percentage increase over normal date of sowing		
		Seed yield (q/ha)	Germination %	SV-I
UAS Dharwad	November 1-4	(-) 24.0	(-) 3.0	(-) 12.0
UAS Bangalore	December 1st	(-) 13.0	(+) 4.0	(-) 1.3
MAU Parbhani	November 1 -4	(+) 69.0	(-) 4.0	(-) 2.0
PJTSAU, Hyderabad	September 3 -4	(-) 20.0	(-) 4.0	(-) 2.0
JNKVV Jabalpur	December 3-4	(-) 26.0	(-)1.5	(-) 6.1

MPKV, Rahuri	January 3rd	(-) 31.0	(-) 2.0	(-) 4.0

In UAS, Dharwad, sowing during 30th October to 30th November recorded to be the best window period for off season sowing as compared to other off season sowing period, because 24%, 3% and 12% decrease were observed in seed yield (q/ha), germination percentage and seed vigour index (SV I), respectively as compared to normal sowing.

In UAS, Bangalore, sowing during December 1st week recorded to be the best window period for off season sowing as compared to other off season sowing period, because 13% and 1.3% decrease were observed in seed yield (q/ha) and seed vigour index (SV I), respectively and there was 4% increase in germination percentage were observed as compared to normal sowing.

In MAU, Parbhani location sowing during November 1st -30th recorded to be the best window period for off season sowing as compared to other off season period, because 69% increase in seed yield (q/ha) whereas, 4% and 2% decrease were observed in germination percentage and seed vigour index (SV I), respectively as compared to normal sowing.

At JNKVV, Jabalpur, December 15th -30th sowing recorded to be the best window period for off season sowing as compared to other sowing period, because 26%, 1.5% and 6% decrease were observed in seed yield (q/ha), germination percentage and seed vigour index (SV I), respectively as compared to normal sowing.

At MPKV, Rahuri sowing during January 3rd week recorded to be the best window for off season sowing as compared to other sowing period, because 32%, 2% and 4% decrease were observed w.r.t. seed yield (q/ha), germination percentage and seed vigour index (SV I), respectively as compared to normal sowing.

In PJTSAU, Hyderabad, sowing during September 3rd to 4th week was recorded to be the best window period for off season sowing as compared to other off season sowing period, because 20%, 4% and 2% decrease were observed in seed yield, germination percentage and seed vigour index respectively as compared to normal sowing.

Significant observation:

The best planting window for soybean off season seed production at UAS, Dharwad, UAS Bangalore, MAU Parbhani, PJTSAU, Hyderabad, JNKVV Jabalpur and MPKV, Rahuri were November 1st to 4th week, December 1st week, November 1st to 4th week, September 3rd to 4th

week, December 3rd to 4th week and January 3rd week, respectively w.r.t least decrease in seed yield (q/ha), germination (%) and vigour (SV I) as compared to normal date of sowing.

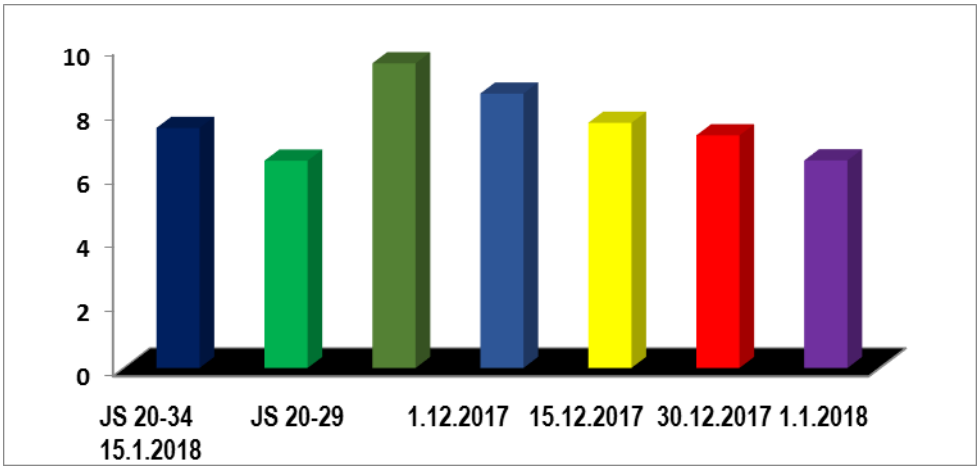
Results

JNKVV, Jabalpur

The experiment was laid out using two soybean varieties with five sowing dates. The first date of sowing was 1.12.2017 and subsequently five sowing were done in 15 days interval. With respect to varieties, no significant difference was observed for seed yield. The seed yield of early variety over the sowing date was 7.47 q/ha, which was on par with medium duration variety (6.45 q/ha).

With respect to sowing date, highest seed yield is observed for normal sowing (11.99 q/ha) and least reduction was observed in sowing at December, 1st week (9.48 q/ha), with reduction of 25% over the normal date of sowing.

With respect to interaction, highest seed yield (12.27q/ha) was observed for early duration variety under normal sowing which was at par with medium duration varieties with normal sowing, which was followed by early duration varieties sown at 1st week of December (9.2q/ha) and 7.88 q/ha in medium duration variety with sowing at December, 1st week.



Effect of planting windows on seed yield for quality seed production of soybean in off season (2017-18)

Table. 3.1: Effect of planting windows on yield and attributing traits for quality seed production of soybean in off-season at JNKVV, Jabalpur during *Rabi* 2017-18

Main treatment	Sub treatment	Field Emergence (%)	Days to 50% flowering	Plant height (cm)	No. of branches/plant	No. of pods/ plant	Length of pods (cm)	Width of pods (cm)	No. of seeds /pod	100 seed weight (g)	Days to flowering	Days to maturity	Seed yield q/ha	HI %	Days to 1st flower bud initiation	Days to first flower	Days to pod maturity
JS 20-34	**10.07.2018**	86.62	49.23	38.07	9.34	36.62	4.81	0.97	2.57	11.98	68.31	96.31	12.27	38.77	35.06	63.65	91.31
	1.12.2017	80.98	54.98	35.75	8.31	33.65	4.75	0.94	3.48	10.94	65.98	84.65	9.2	36.34	55.98	58.65	87.31
	15.12.2017	82.65	53.65	36.35	7.75	30.25	4.52	0.90	3.22	9.44	62.98	88.31	8.65	32.61	47.31	53.31	88.98
	30.12.2017	65.98	49.98	32.65	7.55	24.65	4.25	0.92	3.18	8.92	61.98	91.65	7.4	31.46	45.98	49.98	93.65
	1.01.2018	57.65	46.31	25.65	7.01	23.31	3.75	0.89	3.05	8.32	64.31	87.98	6.72	30.41	47.65	52.98	95.65
	15.01.2018	64.31	44.31	25.65	6.45	19.31	3.62	0.91	2.95	8.32	57.31	87.31	5.4	30.41	43.98	53.31	85.65
JS 20-29	**10.07.2018**	85.09	64.13	81.56	7.3	67.34	4.52	0.95	2.74	10.92	90.65	106.98	11.72	31.74	55.32	84.31	96.31
	1.12.2017	91.98	79.31	68.65	6.91	54.98	4.08	0.94	5.72	9.88	88.31	138.31	7.88	30.41	38.65	42.65	103.98
	15.12.2017	87.65	76.65	63.31	7.18	49.98	3.92	0.88	5.48	9.42	85.65	136.31	6.5	29.31	35.65	41.65	95.31
	30.12.2017	72.65	75.65	61.65	6.88	43.98	3.75	0.94	5.32	8.65	85.98	129.31	5.84	29.08	34.65	41.65	88.98
	1.01.2018	47.65	72.31	59.65	6.38	40.98	3.45	0.94	5.08	8.22	77.98	124.98	5.56	27.3	32.31	37.65	82.98
	15.01.2018	60.98	70.65	56.98	6.18	37.65	3.45	1.03	4.88	7.42	71.98	120.65	5.26	26.21	30.65	36.98	80.98
Varieties	JS 20-34	70.31	49.85	31.21	7.41	26.23	4.18	0.91	3.18	9.19	62.51	87.98	7.47	32.25	48.18	53.65	90.25
	JS 20-29	74.98	75.98	63.31	6.84	47.48	3.8	0.93	5.4	9.04	84.48	132.23	6.45	29.02	35.31	40.9	92.81
	SEd	2.71	1.32	1.66	1.52	1.66	0.2	0.02	0.18	0.18	1.3	1.47	1	1.25	1.02	1.52	1.55
	CD	5.99	1.98	2.95	2.56	2.95	0.29	0.05	0.24	0.26	1.93	2.4	1.05	1.77	2.17	2.54	2.63
Sowing Dates	**10.07.2018**	84.95	54.42	65.33	8.21	56.65	4.63	0.95	2.62	11.45	63.42	102.31	11.99	34.65	41.87	58.2	93.42
	1.12.2017	84.76	65.54	47.26	8.61	54.42	4.67	0.94	4.36	10.83	63.87	104.65	9.48	33	42.76	47.76	95.76
	15.12.2017	85.09	62.65	45.08	8.06	45.62	4.44	0.91	4.09	9.68	62.2	103.09	8.54	31.29	38.54	43.87	92.76
	30.12.2017	70.76	59.87	40.28	7.56	34.91	4.16	0.95	3.91	9.25	60.31	100.65	7.63	29.99	36.76	42.65	91.25
	1.01.2018	65.42	56.98	37.42	6.98	31.65	4.03	0.94	3.86	8.99	60.42	97.76	7.24	29.68	36.42	42.76	91.24
	15.01.2018	55.98	54.31	35.98	6.6	27.09	3.78	0.94	3.73	8.46	54.87	94.42	6.46	28.76	33.87	42.31	83.87
	SEd	3.21	1.42	1.86	1.68	1.86	0.21	0.02	0.55	0.19	1.4	1.61	1.01	1.33	1.51	1.67	1.71
	CD	7.55	2.27	3.52	3.02	3.53	0.34	0.06	0.26	0.29	2.21	2.81	1.08	2	2.51	2.99	3.11
Varieties x Sowing Dates	**SEd**	4.85	1.75	2.5	2.2	2.5	0.26	0.04	0.22	0.23	1.71	2.07	1.04	1.59	1.89	2.18	2.25
	CD	12.19	3.22	5.39	4.51	5.4	0.47	0.10	0.35	0.39	3.11	4.16	1.15	2.75	3.64	4.46	4.67

Table. 3.2: Effect of planting windows on yield and attributing traits for quality seed production of soybean in off-season at JNKVV, Jabalpur during *Rabi* 2017-18

Treatments	Germination (%)					Seedling Length (cm)				
	Initial	60 DAS	120 DAS	180 DAS	240 DAS	Initial	60 DAS	120 DAS	180 DAS	240 DAS
JS 20-34										
10.07.2018	96.27	94.88	92.38	89.35	83.75	37.81	36.25	34.7	33.73	29.23
1.12.2017	94.35	93.1	91.85	87.05	86.15	35.49	34.01	33.07	32.74	28
15.12.2017	92.45	89.95	88.05	85.85	82.55	33.4	33.03	32.11	31.2	27.4
30.12.2017	90.05	88.35	86.05	83.95	80.35	32.51	31.1	29.97	29.41	27
1.01.2018	81.85	80.15	78.4	77.05	75.68	30.07	29.09	28.17	27.98	26.29
15.01.2018	80.95	79.85	75.95	74.85	71.85	28	27.67	27.07	26.56	26.9
JS 20-29										
10.07.2018	92.21	90.19	87.01	83.84	80.01	32.06	30.41	29.21	29.19	27.03
1.12.2017	90.1	88.1	87.09	84.97	83.41	31.37	31.29	29.97	28.4	26.09
15.12.2017	89.01	87.02	86.13	83.39	82.12	29.96	30.39	29.03	27.37	26.54
30.12.2017	87.17	86.49	84.03	82.06	80.06	28.41	27.04	27.53	26.1	25.39
1.01.2018	85.02	82.9	81.38	80.1	78.4	26.18	26.72	25.57	25.1	23.93
15.01.2018	82.63	80.19	75.1	73.32	70.06	25.06	24	24.3	23.49	22.38
SEd	2.732	2.292	2.253	2.494	2.642	2.557	1.888	1.88	1.972	2.941
CD	4.402	3.12	3.009	3.702	4.126	3.883	1.959	1.938	2.099	4.068

Table. 3.3: Effect of planting windows on yield and attributing traits for quality seed production of soybean in off-season at JNKVV, Jabalpur during *Rabi* 2017-18

Treatments	Seedling dry weight					SVI					SVII				
	Initial	60 DAS	120 DAS	180 DAS	240 DAS	Initial	60 DAS	120 DAS	180 DAS	240 DAS	Initial	60 DAS	120 DAS	180 DAS	240 DAS
JS 20-34															
10.07.2018	1.98	1.84	1.73	1.69	1.68	3397.29	3202.18	2975.97	2791.45	2244.37	133.76	119.45	105.7	98.73	92.12
1.12.2017	1.86	1.83	1.72	1.68	2.27	3054.45	2936.55	2811.75	2557.95	2202.18	120.44	116.47	104.55	96.01	144.42
15.12.2017	1.85	1.83	1.71	1.69	1.65	2855.85	2741.86	2610.36	2467.35	2063.84	117.01	112.08	99.96	94.35	88.46
30.12.2017	1.84	1.82	1.71	1.67	1.64	2647.95	2532.08	2369.65	2259.7	1976.23	113.26	109.38	97.18	91.77	85.24
1.01.2018	1.82	1.81	1.8	1.65	1.62	2259.55	2116.05	2016.75	1966.93	1773.95	101.71	98.65	95.95	83.02	78.74
15.01.2018	1.81	1.8	1.79	1.65	1.6	2066.46	2015.91	1854.45	1805.78	1755.68	99.48	96.95	91.91	80.21	73.21
JS 20-29															
10.07.2018	1.72	1.64	1.62	1.48	1.38	2731.73	2524.94	2331.93	2243.56	1970.02	105.23	95.86	90.77	75.74	64.56
1.12.2017	1.77	1.64	1.61	1.44	1.34	2607.09	2536.23	2390.45	2208.26	1977.51	101.58	93.32	89.93	73.42	64.54
15.12.2017	1.7	1.62	1.61	1.42	1.32	2447.52	2384.75	2292.68	2080.2	1921.95	99.39	90.62	88.76	70.49	61.87
30.12.2017	1.69	1.61	1.6	1.4	1.31	2219.75	2117.91	2056.45	1941.95	1800.55	96.8	89.06	85.94	67.71	59.11
1.01.2018	1.65	1.6	1.59	1.38	1.28	2023.77	1947.15	1888.48	1821.26	1691.07	91.37	84.7	82.36	64.55	55.65
15.01.2018	1.67	1.66	1.58	1.52	1.24	1841.95	1736.3	1612.35	1535.55	1402.32	89.23	86.36	75.2	68.83	47.1
SEd	0.848	2.897	2.885	2.859	2.836	24.988	14.743	15.919	14.08	44.255	4.483	5.169	3.272	2.731	3.49

MPKV, Rahuri

The data on effect of different sowing dates on phenology, morphometry, seed yield and quality in storage of soybean are presented in Table 3.4 to 3.7.

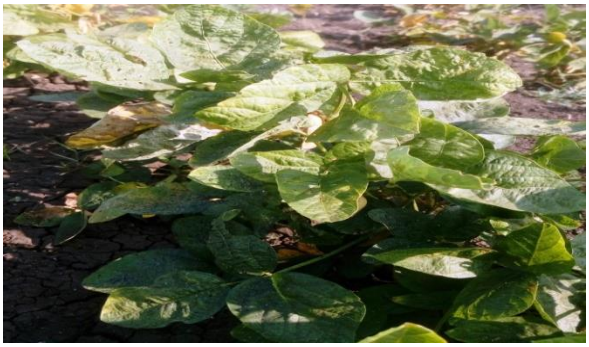
Seed sown at 15th June (S_1) recorded the highest field emergence (86.80%), days to 1st flower bud (36. 67), days to 1st flower open (39.00), days to 50% flowering (45.67), plant height (80.60 cm), number of primary branches (7.67/plant), number of pods (94/plant), pod length (4.23 cm), 100 seed weight (12.18 g), seed yield (3.91 kg/plot), seed yield (2173.31 kg/ha). seed length (6.49 mm), seed width (4.77 mm), surface area (80.34 mm) roundness (91.15 mm).

The best alternative window for soybean seed production was found to be 15th January during summer season. Seed sown at 15th January (S_8) recorded the field emergence (78.36 %), plant height (59.59 cm), number of primary branches (6.87/plant), 100 seed weight (11.83 g), seed yield (2.47 kg/plot), seed yield (1369.99 kg/ha).

The data presented in table 3.6 and 3.7 revealed that the seed harvested from 15th June to 30th January sowing recorded more than 79 % seed germination up to 8 month.



Experimental plot view



Heavy aphid infestation in October sowing

Table 3.4: Effect of sowing dates on seed yield attributes of soybean at MPKV, Rahuri during 2018.

Treatments Sowing at	Field Emergence (%)	Days to 1st flower bud	Days to 1st flower open	Days to 50% flowering	Plant height (cm)	No. of primary branches/ plant	No. of pods/ plant	No. of seeds/pod	Length of pod (cm)	Days to maturity
15th June (S1)	86.80 (68.83)	36.67	39.00	45.67	80.60	7.67	94.00	2.67	4.23	105.00
30th June(S2)	86.54 (68.69)	36.33	38.67	45.00	77.67	7.60	86.07	2.87	4.13	105.67
15th July (S3)	83.28 (66.17)	37.67	39.67	44.33	79.01	7.20	81.33	2.53	4.00	105.00
30th July (S4)	82.26 (65.21)	34.00	40.33	46.67	77.83	6.67	67.80	2.33	3.60	103.00
1st October (S5)	67.21 (55.09)	37.33	42.67	47.00	73.91	6.13	48.13	2.27	3.41	108.33
15th October (S6)	65.90 (54.31)	37.67	42.33	47.67	65.13	5.33	45.60	2.27	3.27	107.33
30st October(S7)	67.16 (55.09)	38.00	42.67	48.33	62.40	5.07	48.93	2.27	3.25	109.00
15th January (S8)	78.36 (62.41)	33.33	37.00	42.67	59.59	6.87	62.73	2.53	3.64	100.33
30th January(S9)	75.37 (60.30)	33.33	36.67	42.00	55.49	6.53	67.00	2.67	3.77	97.67
15th February(S10)	75.03 (60.20)	32.33	35.00	41.00	53.56	5.00	57.27	2.27	3.55	97.67
SE ±	2.314	1.233	0.449	0.623	0.691	0.192	1.466	0.094	0.048	0.554
CD at 5%	6.877	3.663	1.333	1.850	2.053	0.570	4.357	0.278	0.143	1.647

***Figures in parenthesis are Arc sin transformed values**

Table 3.5: Yield, seed morphometry and biochemical parameters as influenced by different sowing dates in soybean at MPKV, Rahuri during 2018.

Treatments Sowing at	100 seed weight (g)	Seed yield/plot (kg)	Seed yield/ha (kg)	Seed length (mm)	Seed width (mm)	Surface area (mm^2)	Roundness (mm)	Protein content (%)	Oil content (%)
15th June (S1)	12.18	3.91	2173.31	6.49	4.77	80.34	91.15	35.34	19.40
30th June (S2)	12.69	3.85	2138.31	6.46	4.55	75.77	89.96	35.36	18.47
15th July (S3)	12.47	3.33	1848.50	6.34	4.46	71.74	87.60	35.49	17.67
30th July (S4)	12.15	2.88	1600.17	6.20	3.95	68.78	83.04	34.80	17.33
1st October (S5)	11.17	2.11	1171.28	5.81	3.77	60.53	76.30	34.43	17.25
15th October (S6)	11.27	1.98	1101.84	5.69	3.75	63.47	73.63	34.22	17.54
30st October (S7)	11.04	1.59	882.21	5.20	4.70	58.35	73.59	34.22	17.26

15th January (S8)	11.83	2.47	1369.99	5.81	4.11	70.40	80.46	33.57	18.58
30th January (S9)	11.81	2.06	1144.43	5.67	3.87	64.05	79.70	34.82	17.43
15th February (S10)	10.12	1.02	566.11	4.68	3.56	56.34	70.12	33.81	15.80
SE ±	0.266	0.122	67.634	0.131	0.296	1.604	1.676	0.523	0.696
CD at 5%	0.791	0.362	200.959	0.388	NS	4.767	4.979	NS	NS

Table 3.6: Effect of sowing dates on seed quality of soybean during storage at MPKV, Rahuri during 2018.

Treatments	Germination (%)					Root shoot length (cm)				
	Initial	60 DAS	120 DAS	180 DAS	240 DAS	Initial	60 DAS	120 DAS	180 DAS	240 DAS
15th June (S1)	93.33 (75.07)	91.67 (73.26)	89.33 (70.95)	86.00 (68.04)	83.33 (65.92)	32.10	29.90	27.65	24.67	23.10
30th June (S2)	92.67 (74.32)	91.00 (72.56)	88.67 (70.35)	86.67 (68.60)	82.67 (65.42)	31.77	29.00	26.93	25.20	23.13
15th July (S3)	91.33 (72.90)	90.33 (71.89)	88.33 (70.07)	87.00 (68.89)	82.67 (65.40)	30.70	28.83	26.28	24.20	22.07
30th July (S4)	90.00 (71.62)	88.67 (70.34)	86.33 (68.32)	83.67 (66.18)	81.33 (64.41)	29.67	27.47	25.48	22.73	20.83
1st October (S5)	88.33 (70.05)	87.33 (69.15)	86.33 (68.31)	84.00 (66.43)	81.00 (64.16)	28.80	26.53	25.27	23.67	21.10
15th October (S6)	88.00 (69.77)	87.00 (68.88)	84.33 (66.69)	81.00 (64.16)	79.00 (62.73)	27.35	25.86	24.07	22.03	19.00
30st October (S7)	88.33 (70.05)	88.00 (69.77)	85.33 (67.53)	81.67 (64.65)	79.00 (62.73)	29.27	27.34	25.02	22.47	19.33
15th January (S8)	89.67 (71.25)	88.33 (70.03)	84.00 (66.43)	81.00 (64.16)	79.33 (62.97)	29.67	27.50	24.77	22.13	20.43
30th January (S9)	90.00 (71.62)	88.67 (70.38)	84.00 (66.45)	82.33 (65.17)	80.33 (63.68)	29.43	27.80	24.83	22.10	21.20
15th February(S10)	87.00 (68.88)	86.67 (68.60)	84.33 (66.69)	81.67 (64.66)	78.67 (62.50)	26.07	24.99	23.07	21.37	19.10
SE ±	0.813	0.710	0.716	0.614	0.526	0.870	0.709	0.622	0.511	0.422
CD at 5%	2.417	2.110	2.127	1.825	1.563	2.585	2.108	1.847	1.518	1.254

***Figures in parenthesis are Arc sin transformed values DAS = Days after storage**

Table 3.7: Effect of sowing dates on seed quality of soybean during storage at MPKV, Rahuri during 2018.

Treatments	Dry matter content (g)					Vigour Index I					Vigour Index II				
	Initial	60 DAS	120 DAS	180 DAS	240 DAS	Initial	60 DAS	120 DAS	180 DAS	240 DAS	Initial	60 DAS	120 DAS	180 DAS	240 DAS
15th June (S1)	1.33	1.28	1.25	1.22	1.17	2996	2741	2470	2121	1925	123.82	117.64	111.67	104.63	97.76
30th June (S2)	1.27	1.25	1.21	1.18	1.16	2944	2639	2388	2184	1913	118.00	113.45	107.29	102.56	96.19
15th July (S3)	1.27	1.25	1.22	1.20	1.17	2804	2605	2322	2105	1824	116.30	112.92	107.77	104.11	96.73
30th July (S4)	1.18	1.16	1.13	1.10	1.06	2670	2436	2200	1902	1695	106.20	102.85	97.84	92.31	86.49
1st October (S5)	1.08	1.07	1.02	0.99	0.96	2544	2317	2181	1988	1709	95.40	93.16	88.06	82.88	77.47
15th October (S6)	1.07	1.03	0.99	0.97	0.92	2407	2250	2030	1785	1502	93.87	89.61	83.77	78.30	72.96
30st October (S7)	1.13	1.08	1.02	0.97	0.91	2585	2406	2135	1835	1528	100.11	94.75	87.32	79.49	71.90
15th January (S8)	1.22	1.17	1.09	1.07	1.01	2661	2429	2080	1793	1621	109.09	103.64	91.84	86.67	80.40
30th January (S9)	1.16	1.12	1.06	1.03	0.98	2649	2465	2086	1820	1704	104.70	99.31	89.32	84.53	78.72
15th February(S10)	1.12	1.06	0.98	0.96	0.91	2268	2166	1945	1745	1503	97.15	91.87	82.93	78.40	71.85
SE ±	0.013	0.013	0.013	0.017	0.016	91.03	68.45	58.28	50.31	43.01	1.484	1.395	1.089	1.674	1.632
CD at 5%	0.040	0.037	0.038	0.049	0.048	270.47	203.38	173.17	149.49	127.80	4.410	4.145	3.234	4.973	4.849

UAS, Bengaluru

Sowing time had significant effect on phenology, morphometry, seed yield and quality of soybean *cv.* JS-335. Seed sown in the normal season *viz.,* during *kharif* (25-07-2017) recorded the highest field emergence (81.87%), plant height (35.37cm), branches number (5.4 per plant), pods per plant (49.5), seed yield (3.417 kg/plot & 19.53 q/ha), along with seed quality parameters like seed germination (95%), seedling length (43.26cm) and seed vigour index-I (4112). While, the alternate window for soybean seed production, sowing at January 1st week (2-01-2018) was best suited for off-season sowing. Most of the plant growth, seed morphometry and quality parameters *viz*., branches/plant (5.60), pods/plant (28.9), seed yield (2.834 kg/plot & 16.19 q/ha), seed length (0.740 cm), seed width (0.614 cm), seed area (0.502 cm^2), seed diameter (0.646 cm), seed germination (96%) and seed vigour (3486) were found to be significantly maximum in the 2nd January sowing. The seed yield (16.19 q/ha) was on par with the *kharif* sowing (19.53 q/ha) (Table 3.8-3.10). The lowest seed yield was recorded in November 2nd (6.53 q/ha) and November 16th (7.83 q/ha) sowing. Hence, January 1st week could be a best alternative planting window for soybean seed production during off-season.

Table 3.8. Influence of sowing dates on growth and yield parameters of soybean *cv.* JS-335 at Bengaluru during 2017-18

Treatments	Field emergence (%)	Plant height (cm)	No. of branches /plant	No. of pods/ plant	No. of seeds/ pod	Seed yield/ plant (g)	Seed yield/ Plot (kg)	Seed yield/ha (q)
T_0: Normal season sowing	81.87	35.37	5.4	49.5	3.1	8.9	3.417	19.53
T_1: November 1st week	43.93	36.95	4.3	22.3	2.3	5.9	1.143	6.53
T_2: November 3rd week	53.12	32.58	3.1	24.3	2.4	8.6	1.371	7.83
T_3 : December 1st week	83.15	26.07	5.0	26.3	2.8	4.4	2.174	12.42
T_4: December 3rd week	72.08	25.17	5.3	33.5	2.6	5.5	1.918	10.96
T_5 :January 1st week	78.31	26.27	5.6	28.9	2.9	8.6	2.834	16.19
T_6 : January 3rd week	73.28	47.13	3.8	28.7	2.8	7.8	2.072	11.84
Mean	**69.39**	**32.79**	**4.6**	**30.5**	**2.7**	**7.1**	**2.133**	12.19
SEm±	**2.17**	**1.87**	**0.33**	**1.83**	**0.26**	**0.74**	**0.23**	**1.29**
CD (P=0.05)	**6.58**	**5.68**	**1.00**	**5.54**	**NS**	**2.25**	**0.68**	**3.91**
CV (%)	**5.4**	**9.9**	**12.4**	**10.3**	**17.0**	**18.0**	**18.0**	**18.0**

Table 3.9. Influence of sowing dates on flowering and pod characteristics of soybean *cv.* JS-335 at Bengaluru during 2018.

Treatments	Days to 1st flowering	Days to 50% flowering	Days to pod maturity	Pod length (cm)	Pod diameter (cm)
T_0 : Normal season sowing	35.0	40.7	82.67	3.8	2.9

T_1 : November 1st week	41.3	45.3	86.67	2.5	2.2
T_2 : November 3rd week	40.0	45.0	86.00	2.0	1.5
T_3 : December 1st week	39.0	42.0	85.00	2.8	2.8
T_4 : December 3rd week	38.0	42.7	85.67	2.6	1.9
T_5 : January 1st week	37.0	41.7	84.00	3.3	3.3
T_6 : January 3rd week	40.0	43.0	85.00	2.6	2.9
Mean	**38.6**	**42.9**	**85.00**	**2.8**	**2.5**
SEm±	**1.31**	**1.09**	**0.98**	**0.27**	**0.20**
CD (P=0.05)	**NS**	**NS**	**NS**	**0.81**	**0.61**
CV(%)	**5.9**	**4.4**	**2.0**	**16.3**	**13.8**

Table 3.10. Influence of sowing dates on seed morphometry (Image Analysis) and seed quality of soybean *cv.* JS-335 at Bengaluru during 2018.

Treatments	Seed length (cm)	Seed width (cm)	Seed area (cm^2)	Seed diameter (cm)	Seed germination (%)	Seedling length (cm)	SVI-I
T_0: Normal season sowing	0.684	0.442	0.358	0.619	95.00	43.26	4112
T_1: November 1st week	0.527	0.411	0.216	0.419	91.33	31.11	2842
T_2: November 3rd week	0.434	0.324	0.247	0.349	94.33	28.32	2672
T_3 : December 1st week	0.615	0.499	0.330	0.498	94.67	35.77	3388
T_4: December 3rd week	0.683	0.568	0.341	0.592	95.33	38.29	3650
T_5 : January 1st week	0.740	0.614	0.502	0.646	96.00	36.30	3486
T_6 : January 3rd week	0.700	0.556	0.400	0.591	91.33	31.70	2896
Mean	**0.626**	**0.488**	**0.342**	**0.531**	**94.00**	**34.96**	3292
SEm±	**0.02**	**0.04**	**0.04**	**0.10**	**1.11**	**1.05**	**126**
CD (P=0.05)	**0.07**	**0.11**	**0.13**	**0.20**	**3.35**	**3.19**	**381**
CV(%)	**6.4**	**10.0**	**11.0**	**6.2**	**2.0**	**5.2**	**7.0**

VNMKV, Parbhani

The experiment was conducted with two soybean varieties viz. MAUS-162 and MAUS-158 and seven sowing dates in FRBD during 2017-18. The analyzed data on growth and yield parameters, pod and seed characteristics and storage presented in Table 3.11 to 3.13. The normal sowing date recorded significantly highest field emergence, plant height and number of branches thereafter decreases with advancement of offseason sowing dates. The normal sowing date was recorded lowest days to flowering and 50% flowering thereafter it was increased with advancement of offseason sowing dates up to December sowing however again it was decreased due to increase in temperature during development stage in January sowing. The variety MAUS-158 was found early maturing as compared to MAUS-162 in all dates of sowing. Days to maturity decreased with advancement of off season sowing dates.

In off season soybean seed production sowing in the month of December was found superior for yield, which ranged from 425 kg/ha to 448 kg/ha and number of pods/plant (17.1 to 19.5) than other offseason sowing dates. The variety MAUS-158 was found better than MAUS-162 for yield and yield attributing traits, pod and seed characteristics for off season soybean seed production. Whereas the variety MAUS-162 was found superior for seed quality parameters and both varieties maintained minimum seed certification standard up to 180 days after harvesting.

Table 3.11: Effect of planting windows seed yield and yield parameters offseason soybean production.

Treatments	Field emergence %	Plant height (cm)	No. branches	Days to flowering	Days to 50 % flowering	Days to maturity	Pods/ Plant	Seeds/Pod	100 Seed Weight (g)	Seed yield (kg/ha)	HI (%)
D_0 Normal Sowing											
Dt. 26/06/2017	90.0	116.3	2.3	34.7	39.0	100.3	48.9	3.0	10.2	1338	45.4
V1 -MAUS- 162	88.7	63.3	5.0	34.0	38.0	97.0	56.5	3.0	11.7	1580	47.7
V2-MAUS-158											
D_1Offseason Sowing	88.3	25.1	2.1	49.7	54.0	104.0	13.3	2.0	8.3	327	39.1
Dt. 01/10/2017	88.0	18.2	2.4	50.6	54.3	99.0	13.2	2.5	8.8	337	39.6
V1 -MAUS- 162											
V2-MAUS-158											
D_2 Offseason Sowing	85.7	43.4	2.5	53.0	57.3	104.0	14.8	2.1	6.5	316	33.9
Dt. 20/10/2017	82.7	26.8	1.9	53.7	57.7	100.7	15.4	2.6	7.5	347	36.7
V1 -MAUS- 162											
V2-MAUS-158											
D_3 Offseason Sowing	80.3	19.5	2.3	54.0	58.0	103.7	14.8	2.3	8.4	359	33.2
Dt. 10/11/2017	81.3	14.7	2.7	55.0	58.6	100.0	14.9	2.6	8.7	385	34.4
V1 -MAUS- 162											
V2-MAUS-158											
D_4 Offseason Sowing	83.0	16.1	2.6	55.0	59.0	98.0	15.2	2.5	8.3	392	34.7
Dt. 01/12/2017	84.7	15.1	2.7	54.3	58.3	96.3	17.1	2.6	9.4	425	35.7
V1 -MAUS- 162											
V2-MAUS-158											
D_5 Offseason Sowing	81.67	12.8	2.7	55.3	59.0	98.3	16.2	2.3	8.8	410	33.4
Dt. 20/12/2017	79.0	18.5	2.7	54.7	58.0	95.7	19.5	2.6	9.2	448	35.8
V1 -MAUS- 162											
V2-MAUS-158											

D_6 Offseason Sowing Dt. 10/01/2018 V1 -MAUS- 162 V2-MAUS-158	77.3 73.0	17.0 17.0	2.4 2.4	51.6 52.0	55.3 55.3	96.0 94.3	13.5 15.0	2.2 2.4	7.5 8.2	303 380	29.4 30.2
Mean	83.11	30.28	2.68	50.5	54.4	99.0	20.61	2.5	8.7	525	36.4
Variety **SE±** **CD**	0.65 1.90	0.78 2.27	0.10 NS	0.23 0.69	0.21 0.63	0.32 0.95	1.33 3.87	0.03 NS	0.08 0.25	10.2 29.6	4.42 1.28
Sowing Date **SE±** **CD**	1.22 3.55	1.46 4.25	0.19 0.56	0.44 1.29	0.41 1.18	0.61 1.78	0.94 2.74	0.05 0.16	0.16 0.47	19.06 55.3	0.82 2.40
Interaction **SE±** **(VxD) CD**	1.73 NS	2.07 6.02	0.27 0.80	0.63 1.83	0.57 1.67	0.87 2.58	1.33 3.87	0.08 0.23	0.23 0.66	26.9 78.2	1.17 3.39
CV%	3.61	11.85	17.9	5.16	18.3	15.2	11.2	5.60	4.60	8.9	5.6

Table 3.12: Effect of planting windows on seed morphometry characters and germination of offseason soybean seed production at VNMKV, Parbhani

Treatments	Length of pod (cm)	Girth of pod (cm)	Length of seed (mm)	Width of seed (mm)	Germination %					
					Initial	60 DAH	120 DAH	180 DAH	240 DAH	300DAH
D_0 Normal Sowing Dt. 26/06/2017										
V1 -MAUS- 162	3.7	2.3	6.5	4.2	89.6	85.3	73.6	70.0	58.0	42.0
V2-MAUS-158	4.0	2.3	7.4	4.3	87.0	80.0	77.3	62.3	48.0	35.7
D_1Offseason Sowing Dt. 01/10/2017										
V1 -MAUS- 162	2.0	1.3	6.0	4.1	78.0	79.7	77.3	71.6	63.3	49.0
V2-MAUS-158	2.2	1.7	6.4	4.3	78.3	81.7	77.3	66.6	61.0	39.7
D_2 Offseason Sowing Dt. 20/10/2017										
V1 -MAUS- 162	2.1	1.9	5.9	4.0	87.0	81.3	76.3	77.6	64.3	48.3

V2-MAUS-158	2.4	2.1	5.8	4.1	84.3	83.2	79.7	74.0	62.0	38.3
D_3 Offseason Sowing Dt. 10/11/2017										
V1 -MAUS- 162	2.6	1.6	5.8	3.9	84.6	78.0	74.3	72.3	62.0	43.6
V2-MAUS-158	2.8	1.8	5.7	4.0	83.3	87.7	75.0	70.0	64.3	36.0
D_4 Offseason Sowing Dt. 01/12/2017										
V1 -MAUS- 162	2.3	1.5	5.7	3.8	85.0	80.0	82.7	76.3	60.6	38.0
V2-MAUS-158	2.6	1.7	5.6	3.9	85.6	85.6	77.0	70.7	63.3	44.0
D_5 Offseason Sowing Dt. 20/12/2017										
V1 -MAUS- 162	2.4	1.8	5.4	3.6	82.6	88.0	81.0	75.3	65.3	45.6
V2-MAUS-158	2.6	2.1	5.5	3.7	77.6	89.6	75.6	73.0	58.0	43.7
D_6 Offseason Sowing Dt. 10/01/2018										
V1 -MAUS- 162	2.5	1.8	5.2	3.4	82.0	82.6	80.0	76.0	63.3	40.0
V2-MAUS-158	2.7	1.9	5.4	3.6	79.6	84.3	76.3	69.0	55.6	37.3
Mean	2.1	1.8	5.9	3.9	83.2	83.3	77.4	71.8	60.7	41.5
Variety SE±	0.05	0.04	0.05	4.04	0.62	0.91	0.65	0.72	0.89	0.89
CD	0.05	0.13	0.16	0.13	1.81	2.64	1.89	2.10	NS	NS
Sowing Date	0.09	0.08	0.10	0.09	1.16	1.70	1.21	1.35	1.66	1.66
SE±	0.27	0.25	0.30	0.25	3.39	4.94	3.54	3.93	4.84	4.82
CD										
Interaction	0.13	0.12	0.14	0.12	1.65	2.40	1.72	1.91	2.36	2.35
SE±	3.9	0.35	0.42	0.35	4.79	6.99	5.0	5.56	6.85	NS
(VxD) CD										
CV%	8.8	11.5	4.3	5.4	3.5	5.0	3.9	4.6	6.7	9.8

Table 3.13: Effect of planting windows on seed quality parameters of offseason soybean seed production at VNMKV, Parbhani

Treatments	**Seedling Length (cm)**						**Vigour Index**					
	Initial	**60 DAH**	**120 DAH**	**180 DAH**	**240 DAH**	**300 DAH**	**Initial**	**60 DAH**	**120 DAH**	**180DAH**	**240 DAH**	**300 DAH**

D_0 Normal Sowing												
Dt. 26/06/2017	30.3	30.4	25.5	26.5	22.1	19.6	2716	2605	1877	1855	1279	821
V1 -MAUS- 162	29.9	30.7	25.6	26.3	20.3	17.9	2599	2457	1986	1637	989	640
V2-MAUS-158												
D_1Offseason Sowing												
Dt. 01/10/2017	28.2	28.8	26.5	25.9	23.9	21.4	2452	2293	2056	1850	1515	1051
V1 -MAUS- 162	24.7	28.4	25.5	24.9	21.9	22.9	1929	2320	1968	1657	945	905
V2-MAUS-158												
D_2 Offseason Sowing												
Dt. 20/10/2017	30.0	29.3	26.6	27.5	22.7	23.1	2467	2386	2028	2134	1458	1122
V1 -MAUS- 162	28.9	29.4	28.1	27.1	24.7	23.2	2444	2450	2237	2007	1530	891
V2-MAUS-158												
D_3 Offseason Sowing												
Dt. 10/11/2017	31.5	29.7	27.4	26.4	23.4	21.4	2676	2313	2034	1913	1451	948
V1 -MAUS- 162	29.5	29.3	26.0	26.4	24.5	20.3	2463	2567	1954	1848	1584	733
V2-MAUS-158												
D_4 Offseason Sowing												
Dt. 01/12/2017	30.6	29.8	27.6	26.6	24.8	23.2	2590	2388	2283	2029	1504	881
V1 -MAUS- 162	30.0	30.3	26.3	25.5	24.2	19.4	2594	2591	2030	1803	1530	851
V2-MAUS-158												
D_5 Offseason Sowing												
Dt. 20/12/2017	31.2	29.2	27.1	26.7	23.1	21.1	2583	2570	2195	2006	1504	962
V1 -MAUS- 162	30.0	29.3	26.2	25.8	23.5	18.8	2328	2653	1984	1882	1362	818
V2-MAUS-158												
D_6 Offseason Sowing												
Dt. 10/01/2018	30.0	27.5	26.3	25.3	23.7	22.4	2502	2269	2137	1922	1499	893
V1 -MAUS- 162	30.6	27.5	27.1	26.4	22.0	19.7	2441	2323	2073	1825	1227	733
V2-MAUS-158												
Mean	29.8	29.3	26.6	26.2	23.2	21.0	2485	2442	2060	1883	1384	875

Variety	**SE±**	0.41	0.32	0.37	0.21	0.39	0.29	38.1	43.1	32.4	23.6	50.6	25.1
	CD	1.19	NS	NS	NS	1.06	0.84	NS	NS	NS	NS	147	73.1
Sowing Date	**SE±**	7.7	0.07	0.68	0.40	0.75	0.54	71.4	80.6	60.7	43.3	94.8	47.1
	CD	NS	NS	NS	NS	NS	1.57	207	NS	NS	128	NS	136
Interaction	**SE±**	1.08	0.85	0.97	0.57	1.06	0.76	101	114	85.9	62.6	134	66.6
(VxD)	**CD**	3.15	NS	NS	NS	NS	2.23	293	331	NS	182	389	193
	CV%	6.3	5.1	6.3	3.8	7.9	6.3	7.1	8.1	7.2	5.8	16.7	13.2

UAS, Dharwad

The experiment was conducted at two different locations L1: Dharwad and L2: Haveri. Among the locations Dharwad location recorded significantly higher plant growth and yield and seed quality parameters. Among dates of sowing June 15th followed by Nov-15th sowing recorded significantly higher plant growth, seed yield and quality parameters over other dates of sowing. Among the treatment combination seeds obtained from Dharwad location produced from June 15th sowing recorded significantly higher seed quality parameters up to 8 months of storage (Table 3.14 to 3.18).

Table 3.14: Effect of sowing dates on plant growth parameters of soybean (Dsb 21) at two location under UAS, Dharwad

Treatment combination	Field Emergence (%)	Plant height (cm)	No. of Primary branches	Days to 50 % flowering	Days to maturity
L_1 : Dharwad	77.74	50.53	5.16	49.32	89.72
L_2 : Haveri	73.41	48.28	4.93	46.91	86.11
SEm±	**0.19**	**1.00**	**0.10**	**0.05**	**1.76**
CD at 5%	**0.57**	**2.94**	**NS**	**0.17**	**NS**
S_1: October 30	77.55	55.70	5.69	54.82	98.18
S_2: November 15	76.61	52.00	5.31	50.52	92.73
S_3: November 30	72.31	51.03	5.21	49.57	90.99
S_4: December 15	77.55	49.46	5.05	48.05	88.20
S_5: December 30	75.66	46.24	4.72	44.93	82.47
S_6: January 15	73.77	42.01	4.29	40.82	74.92
S_7: June-15	88.12	64.12	6.51	53.14	98.01
SEm±	**5.55**	**1.74**	**0.18**	**1.69**	**3.04**
CD at 5%	**NS**	**5.10**	**0.52**	**4.95**	**8.92**
$L_1 S_1$	79.54	57.13	5.84	56.90	99.57
$L_1 S_2$	78.57	53.33	5.45	51.82	95.11
$L_1 S_3$	75.50	52.33	5.35	50.84	93.33
$L_1 S_4$	79.54	50.73	5.18	49.29	90.46
$L_1 S_5$	77.60	47.43	4.84	46.08	84.58
$L_1 S_6$	75.66	42.22	4.31	41.02	75.29
$L_1 S_7$	83.17	64.50	5.95	55.50	96.10
$L_2 S_1$	75.56	54.27	5.54	52.73	96.79
$L_2 S_2$	74.64	50.67	5.18	49.23	90.35
$L_2 S_3$	69.11	49.72	5.08	48.30	88.66
$L_2 S_4$	75.56	48.19	4.92	46.82	85.94
$L_2 S_5$	73.72	45.06	4.60	43.78	80.35
$L_2 S_6$	71.88	41.80	4.27	40.61	74.54
$L_2 S_7$	84.21	59.95	5.50	53.45	96.50
SEm±	**0.48**	**2.46**	**0.25**	**2.39**	**4.30**
CD at 5%	**NS**	**NS**	**NS**	**7.00**	**NS**
CV	**8.5**	**10.25**	**7.25**	**9.12**	**10.12**

Table 3.15: Effect of sowing dates on seed yield parameters of soybean (Dsb 21) at two location under UAS, Dharwad

Treatment	No. of	No. of	Seed yield	Pod length	Pod

combination	pods/plant	seeds/pod	q/ha	(cm)	Diameter (cm)
L_{1} : Dharwad	27.81	2.8	16.67	3.74	1.72
L_{2} : Haveri	26.41	3.0	15.84	3.62	1.67
SEm±	**0.55**	**0.07**	**0.33**	**0.07**	**0.30**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**
S_1: October 30	30.44	3.0	18.66	4.17	1.92
S_2: November 15	28.75	3.0	17.63	3.94	1.81
S_3: November 30	28.21	3.0	17.30	3.86	1.78
S_4: December 15	27.34	2.8	16.77	3.75	1.72
S_5: December 30	25.56	2.8	15.68	3.64	1.67
S_6: January 15	22.37	2.7	11.48	2.73	1.25
S_7: June-15	45.25	3.1	24.45	4.50	1.95
SEm±	**0.96**	**0.12**	**0.57**	**0.13**	**0.60**
CD at 5%	**2.82**	**NS**	**1.68**	**0.38**	**NS**
L_1 S_1	30.87	3.00	18.93	4.23	1.94
L_1 S_2	29.48	3.00	18.08	4.04	1.86
L_1 S_3	28.93	3.00	17.74	3.96	1.82
L_1 S_4	28.04	2.67	17.20	3.84	1.77
L_1 S_5	26.22	2.67	16.08	3.59	1.65
L_1 S_6	23.34	2.33	11.98	3.77	1.27
L_1 S_7	48.12	3.20	25.24	4.52	1.89
L_2 S_1	30.00	3.00	18.40	4.11	1.89
L_2 S_2	28.01	3.00	17.18	3.84	1.76
L_2 S_3	27.48	3.00	16.85	3.76	1.73
L_2 S_4	26.64	3.00	16.34	3.65	1.68
L_2 S_5	24.91	3.00	15.28	3.68	1.69
L_2 S_6	21.39	3.00	10.98	3.08	1.23
L_2 S_7	43.27	3.15	23.15	4.25	1.88
SEm±	**1.36**	**0.16**	**0.81**	**0.18**	**0.90**
CD at 5%	**3.99**	**NS**	**2.38**	**NS**	**NS**
CV	**8.95**	**10.25**	**7.50**	**9.50**	**6.25**

Table 3.16: Effect of sowing dates on seed yield parameters of soybean (Dsb 21) at two location under UAS, Dharwad

Treatment combination	Seed moisture (%)	Seed germination (%)	Seedling length (cm)	Seedling vigour index	Seedling dry weight (mg)
L_{1} : Dharwad	11.09	80.14	21.64	1760	1.76
L_{2} : Haveri	11.12	78.40	21.17	1691	1.69
SEm±	**0.25**	**1.77**	**0.48**	**107**	**0.07**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**

S_1: October 30	11.98	83.69	22.60	1893	1.89
S_2: November 15	11.31	84.59	22.84	1934	1.93
S_3: November 30	11.10	84.62	22.85	1939	1.94
S_4: December 15	10.76	79.59	21.49	1748	1.75
S_5: December 30	10.45	75.49	20.38	1576	1.58
S_6: January 15	11.01	67.63	18.26	1264	1.26
S_7: June-15	10.50	86.24	27.25	2154	1.95
SEm±	**0.95**	**3.07**	**0.83**	**123**	**0.12**
CD at 5%	**NS**	**8.99**	**2.43**	**362**	**0.36**
L_1 S_1	12.15	83.33	22.50	1876	1.88
L_1 S_2	11.60	85.16	22.99	1959	1.96
L_1 S_3	11.39	86.79	23.43	2039	2.04
L_1 S_4	11.04	79.26	21.40	1724	1.72
L_1 S_5	10.32	76.26	20.59	1602	1.60
L_1 S_6	10.03	70.02	18.91	1360	1.36
L_1 S_7	10.25	88.25	26.50	2560	1.96
L_2 S_1	11.81	84.04	22.69	1909	1.91
L_2 S_2	11.02	84.03	22.69	1909	1.91
L_2 S_3	10.82	82.45	22.26	1840	1.84
L_2 S_4	10.48	79.92	21.58	1772	1.77
L_2 S_5	10.59	74.73	20.18	1549	1.55
L_2 S_6	12.00	65.24	17.62	1168	1.17
L_2 S_7	10.25	85.25	25.51	2450	1.98
SEm±	**0.87**	**4.33**	**1.17**	**174**	**0.17**
CD at 5%	**NS**	**NS**	**3.43**	**511**	**0.51**
CV	**6.50**	**9.50**	**7.50**	**10.25**	**7.35**

Table 3.17: Effect of sowing dates on seed morphological parameters of soybean (Dsb 21) at two location under UAS, Dharwad

Treatment combination	1000 seed weight (g)	Seed recovery (%)	Electrical conductivity (dsm^{-1})	Number of Diseased seed
L_1 : Dharwad	139.05	90.51	0.41	19
L_2 : Haveri	138.43	88.45	0.40	18
SEm±	**0.63**	**1.78**	**0.01**	**0.54**
CD at 5%	**1.83**	**NS**	**0.04**	**1.57**
S_1: October 30	143.31	95.70	0.36	17
S_2: November 15	136.94	95.80	0.33	19
S_3: November 30	138.89	94.10	0.41	19
S_4: December 15	139.20	87.88	0.43	18
S_5: December 30	138.00	85.49	0.46	17

S_6: January 15	136.10	77.91	0.43	19
S_7: June-15	145.12	**95.50**	0.35	13
SEm±	**1.08**	**3.09**	**0.02**	**0.93**
CD at 5%	**3.18**	**9.05**	**0.06**	**2.73**
L_1 S_1	144.19	96.00	0.34	17
L_1 S_2	138.43	97.02	0.33	20
L_1 S_3	140.70	93.21	0.40	20
L_1 S_4	140.72	88.32	0.43	19
L_1 S_5	139.84	87.86	0.47	17
L_1 S_6	130.42	80.67	0.45	20
L_1 S_7	149.50	98.25	0.31	16
L_2 S_1	142.42	95.39	0.37	18
L_2 S_2	135.45	94.59	0.32	18
L_2 S_3	137.07	94.99	0.42	18
L_2 S_4	137.69	87.44	0.42	17
L_2 S_5	136.16	83.12	0.45	17
L_2 S_6	141.78	75.16	0.41	18
L_2 S_7	148.25	97.50	0.34	15
SEm±	**1.53**	**4.36**	**0.03**	**1.31**
CD at 5%	**NS**	**12.80**	**0.09**	**3.86**
CV	**1.91**	**8.45**	**13.10**	**12.54**

Treatment combination	**Length of seed (mm)**	**Width of the seed (mm)**	**Area of seed (mm^2)**	**Protein content (%)**	**Oil content (%)**
L_{1} : Dharwad	8.02	7.30	58.56	15.92	32.99
L_{2} : Haveri	7.91	7.23	57.30	15.57	32.35
SEm±	**0.02**	**0.02**	**0.26**	**0.07**	**0.15**
CD at 5%	**0.06**	**0.05**	**0.77**	**0.21**	**NS**
S_1: October 30	8.28	7.50	62.11	16.60	33.73
S_2: November 15	8.06	7.37	59.35	15.87	32.23
S_3: November 30	8.12	7.42	60.19	16.09	32.69
S_4: December 15	7.98	7.30	58.28	16.13	32.76
S_5: December 30	7.82	7.12	55.64	15.40	31.28
S_6: January 15	7.54	6.90	52.00	14.39	33.35
S_7: June-15	8.28	7.65	63.34	16.55	33.55
SEm±	**0.04**	**0.03**	**0.46**	**0.12**	**0.26**
CD at 5%	**0.11**	**0.09**	**1.34**	**0.36**	**NS**
L_1 S_1	8.33	7.50	62.49	16.71	33.94
L_1 S_2	8.11	7.40	60.00	16.04	32.58

L_1 S_3	8.17	7.47	60.98	16.30	33.12
L_1 S_4	8.03	7.33	58.91	16.30	33.12
L_1 S_5	7.87	7.17	56.38	15.60	31.70
L_1 S_6	7.58	6.93	52.58	14.55	33.51
L_1 S_7	8.35	7.73	63.15	16.50	33.12
L_2 S_1	8.23	7.50	61.73	16.50	33.52
L_2 S_2	8.00	7.33	58.71	15.69	31.88
L_2 S_3	8.06	7.37	59.41	15.88	32.26
L_2 S_4	7.93	7.27	57.64	15.95	32.41
L_2 S_5	7.77	7.07	54.90	15.19	30.86
L_2 S_6	7.49	6.87	51.42	14.23	33.18
L_2 S_7	8.21	7.13	62.15	15.59	33.72
SEm±	**0.05**	**0.04**	**0.65**	0.17	0.36
CD at 5%	**0.15**	**0.12**	**1.89**	**NS**	**NS**
CV	**6.25**	**5.75**	**8.50**	6.92	5.89

Table 3.18: Effect of sowing dates on seed germination of soybean (Dsb 21) at two location under UAS, Dharwad

Treatment combination	Months of storage							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
L_1 : Dharwad	78.99	77.85	76.41	70.19	71.47	63.93	54.72	36.01
L_2 : Haveri	76.72	75.62	74.60	68.52	69.78	62.50	53.50	35.20
SEm±	**1.72**	**1.70**	**1.71**	**1.57**	**1.60**	**1.37**	**1.17**	**0.77**
CD at 5%	**5.05**	**4.97**	**5.02**	**4.62**	**4.70**	**4.01**	**3.43**	**2.26**
S_1: October 30	82.48	81.29	79.02	72.59	73.92	66.21	56.67	37.29
S_2: November 15	83.38	82.18	81.07	74.47	75.83	67.92	58.14	38.26
S_3: November 30	83.40	82.21	81.10	74.49	75.86	67.94	58.16	38.27
S_4: December 15	78.45	77.32	76.28	70.06	71.35	63.90	54.70	35.99
S_5: December 30	74.41	73.34	72.35	66.46	67.68	60.61	51.88	34.14
S_6: January 15	65.01	64.07	63.21	58.06	59.13	52.70	45.11	29.69
S_7: June-15	88.50	88.00	85.00	84.20	78.50	73.10	71.50	69.30
SEm±	**2.98**	**2.94**	**2.97**	**2.73**	**2.78**	**2.37**	**2.02**	**1.33**
CD at 5%	**8.74**	**8.61**	**8.70**	**7.99**	**8.14**	**6.94**	**5.94**	**3.91**
L_1 S_1	82.13	80.95	77.51	71.20	72.51	64.94	55.59	36.58
L_1 S_2	83.93	82.73	81.61	74.96	76.34	68.37	58.53	38.51
L_1 S_3	85.54	84.31	83.17	76.40	77.80	69.68	59.65	39.25
L_1 S_4	78.12	77.00	75.96	69.77	71.05	63.64	54.48	35.84
L_1 S_5	75.17	74.08	73.08	67.13	68.36	61.23	52.41	34.49
L_1 S_6	69.02	68.02	67.10	61.64	62.77	55.72	47.69	31.38
L_1 S_7	90.57	90.06	86.99	86.17	80.34	74.81	73.17	70.92
L_2 S_1	82.83	81.64	80.53	73.98	75.33	67.47	57.76	38.00

L_2 S_2	82.82	81.63	80.53	73.97	75.33	67.46	57.75	38.00
L_2 S_3	81.27	80.10	79.02	72.58	73.91	66.20	56.67	37.29
L_2 S_4	78.77	77.64	76.59	70.36	71.65	64.17	54.93	36.14
L_2 S_5	73.65	72.59	71.61	65.78	66.99	60.00	51.36	33.79
L_2 S_6	61.00	60.12	59.31	54.48	55.48	49.69	42.54	27.99
L_2 S_7	89.49	88.99	85.95	85.15	79.38	73.92	72.30	70.08
SEm±	**4.21**	**4.15**	**4.20**	**3.85**	**3.93**	**3.34**	**2.86**	**1.88**
CD at 5%	**12.36**	**12.18**	**12.31**	**11.31**	**11.51**	**9.81**	**8.40**	**5.53**
CV	**9.40**	**8.97**	**9.70**	**8.10**	**7.63**	**9.16**	**10.06**	**7.06**

PJTSAU, Hyderabad

Sowing of soybean variety, JS 335 on 01.07.2015 has resulted in a seed yield of 5.319 q/ha. As the sowings were delayed by 15 days and 45 days, the reduction in yield was 18.52% and 50.87%, respectively. The per cent reduction in pod number and test weight was 57.64% and 9.25%, respectively. However, the seed from later sowings i.e., August sowing exhibited maximum seedling vigour of 2401 with a germination of 89% in contrast to sowing on 01.07.2015. The per cent reduction in oil was 21.64% when the sowing was delayed by 45 days. Similar decrease in length, width, thickness, area and perimeter of the seed was also noticed by delayed sowings.

Rabi, 2017-18:

SRTC, Rajendranagar: JS 335 variety of soybean sown on 20.10.2018 has recorded seed yield of 13.83 q/ha as against Basara (8.85 q/ha) (Tables 3.13 and Table 3.14). However, the seed recovery percentage is very low in JS 335 variety (79.31) as compared to Basara variety (99.16) (Table 3.15 and 3.16).

Table 3.19: Influence of sowing dates on yield and yield components in soybean varieties, JS 335 and Basara during *rabi*, 2017-18

Dates of sowing	Days to first flowering			Plant height (cm)			Branches/ plant (no.)			Pods/plant (no.)			Pod length (cm)		
	JS 335	Basara	Mean	JS 335	Basara	Mean	JS 335	Basara	Mean	JS 335	Basara	Mean	JS 335	Basara	Mean
20.10.2017	34	35	34.5	26.6	31.5	**29.1**	4.3	4.0	**4.2**	60	38.5	**49.3**	4.2	3.8	**4.0**
01.11.2017	38	39	38.5	22.7	26.3	**24.5**	2.7	2.2	**2.5**	43.8	24.4	**34.1**	4.4	4.0	**4.2**
15.11.2017	34	34	34.0	28.8	42.8	**35.8**	3.1	3.3	**3.2**	36.9	30.4	**33.7**	4.4	4.0	**4.2**
30.11.2017	42	42	42.0	27.0	27.4	**27.2**	3.7	3.0	**3.4**	49.7	27.9	**38.8**	4.3	3.9	**4.1**
15.12.2017	45	45	45.0	30.3	37.6	**34.0**	3.1	4.4	**3.8**	43.3	44.9	**44.1**	4.2	3.8	**4.0**
02.01.2018	44	44	44.0	26.1	48.7	**37.4**	2.3	5.0	**3.7**	27	83.6	**55.3**	3.7	3.8	**3.8**
16.01.2018	39	39	39.0	30.3	48.0	**39.2**	2.9	5.9	**4.4**	32.9	83.3	**58.1**	3.9	3.8	**3.9**
Mean	39.4	39.7	**39.6**	**27.40**	**37.47**	**32.44**	**3.16**	**3.97**	**3.56**	**41.94**	**47.57**	**44.76**	**4.16**	**3.87**	**4.01**
				SEM	SED	CD	SEM	SED	CD	SEM	SED	CD	SEM	SED	CD
Ai.-Aj. (V)				0.72	1.02	2.06	0.15	0.21	0.43	1.64	2.31	4.68	0.04	0.06	0.12
Bi.-Bj. (D/S)				0.39	0.54	1.10	0.08	0.11	0.23	0.87	1.24	2.50	0.02	0.03	0.07
AiBi-AiBj				1.02	1.44	2.91	0.21	0.30	0.61	2.31	3.27	6.62	0.06	0.09	0.17
C.V (%)				6.28			12.31			10.34			3.05		

Table.3.20: Influence of sowing dates on yield and yield components in soybean varieties, JS 335 and Basara during *rabi*, 2017-18

Dates of sowing	Seeds/pod (no.)			100 seed weight (g)			Single plant yield (g)			Seed yield/plot (kg)			Seed yield/ha (q)		
	JS 335	Basara	Mean	JS 335	Basara	Mean	JS 335	Basara	Mean	JS 335	Basara	Mean	JS 335	Basara	Mean
20.10.2017	2.9	2.5	**2.7**	10.81	12.41	**11.61**	10.67	7.95	**9.31**	2.08	1.33	**1.71**	13.83	8.85	**11.34**
01.11.2017	3.0	3.2	**3.1**	10.62	12.6	**11.61**	6.83	5.42	**6.13**	1.35	1.37	**1.36**	9.04	9.39	**9.22**
15.11.2017	3.0	2.7	**2.9**	11.24	12.51	**11.88**	6.59	6.06	**6.33**	1.47	0.97	**1.22**	9.8	6.48	**8.14**
30.11.2017	3.0	2.7	**2.9**	10.3	12.68	**11.49**	6.36	6.14	**6.25**	0.71	0.35	**0.53**	4.75	2.57	**3.66**

15.12.2017	3.0	2.5	**2.8**	10.24	12.55	**11.40**	5.69	6.19	**5.94**	0.52	0.32	**0.42**	3.74	2.9	**3.32**
02.01.2018	2.9	2.6	**2.8**	7.06	9.89	**8.48**	3.19	13.25	**8.22**	0.41	0.9	**0.66**	2.98	5.98	**4.48**
16.01.2018	3.1	2.8	**3.0**	8.16	9.25	**8.71**	5.31	11.61	**8.46**	0.56	0.65	**0.61**	3.74	5.36	**4.55**
Mean	**2.99**	**2.71**	**2.85**	**9.78**	**11.70**	**10.74**	**6.38**	**8.09**	**7.23**	**1.01**	**0.84**	**0.93**	**6.84**	**5.93**	**6.39**
	SEM	SED	CD	SEM	SED	CD	SEM	SED	CD	SEM	SED	CD	SEM	SED	CD
Ai.-Aj. (V)	0.11	0.16	0.32	0.14	0.20	0.41	0.34	0.49	0.98	0.05	0.06	0.13	0.75	0.90	1.95
Bi.-Bj. (D/S)	0.06	0.08	0.17	0.08	0.11	0.22	0.18	0.26	0.52	0.02	0.03	0.07	0.30	0.45	0.98
AiBi-AiBj	0.16	0.22	0.45	0.20	0.29	0.58	0.49	0.69	1.39	0.06	0.09	0.18	0.90	1.35	
C.V (%)	11.11			3.79			13.35			13.77			13.77		

Table 3.21: Influence of sowing dates on seed recovery percentage in soybean varieties, JS 335 and Basara during *rabi*, 2017-18

Sieve size	Dates of Sowing							
	20.10.2017		01.11.2017		15.11.2017		31.11.2017	
	JS 335	Basara	JS 335	Basara	JS 335	Basara	JS 335	Basara
8 mm R	0.02	0	0	0	0	0	0	0
7 mm R	0.05	0.204	0.123	1.109	0	0.411	0	1.787
5.5 mm R	56.22	93.793	49.352	74.219	44.648	76.711	25.66	67.436
4.75 mm R	85.52	99.774	84.682	94.735	74.402	95.673	62.098	91.66
3.5 mm R	97.16	100	99.683	99.687	98.085	99.658	96.385	99.312
4 x 20 mm S	**79.31**	**99.159**	**81.108**	**92.428**	**71.442**	**94.73**	**62.084**	**88.462**

Table 3.22: Influence of sowing dates on seed recovery percentage in soybean varieties, JS 335 and Basara during *rabi*, 2017-18

Sieve size	Dates of Sowing					
	15.12.2017		02.01.2018		16.01.2018	
	JS 335	Basara	JS 335	Basara	JS 335	Basara
8 mm R	0	0	0	0	0	0
7 mm R	0	0.562	0	0	0	0
5.5 mm R	29.829	48.664	11.106	36.656	10.150	24.826
4.75 mm R	78.169	86.565	62.341	90.942	72.912	7.746
3.5 mm R	98.826	99.078	98.039	99.814	99.214	99.155
4 x 20 mm S	**73.366**	**82.280**	**56.736**	**87.597**	**56.261**	**68.769**

Table 3.23: Influence of sowing dates on seedling characters of soybean varieties (JS335 and Basara) during *rabi*, 2017-18

Dates of sowing	Germination (%)			Root length (cm)		
	JS 335	Basara	Mean	JS 335	Basara	Mean
20.10.20 17	97	96.3	96.7	13.2	12.6	12.9
01.11.2017	96.3	96.3	96.3	12.8	13.5	13.2
15.11.2017	97.5	99.5	98.5	14.1	13.2	13.7
30.11.2017	100	100	100	13.6	13.7	13.7
15.12.2017	95.3	93	94.2	5	4.8	4.9
02.01.2018	88.8	100	94.4	4.6	5.9	5.2
16.01.2018	97.3	97.8	97.6	4.9	5.9	5.4
Mean	**96**	**97.6**	**96.8**	**9.7**	**9.9**	**9.8**
	SEM	SED	CD	SEM	SED	CD
Ai.-Aj. (V)	1.39	1.96	3.97	0.27	0.38	0.76
Bi.-Bj. (D/S)	0.74	1.05	2.12	0.14	0.2	0.41
AiBi-AiBj	1.96	2.77	5.61	0.38	0.53	1.08

C.V (%)	4.05			7.66		

Table 3.24: Influence of sowing dates on seedling characters of soybean varieties (JS335 and Basara) during *rabi*, 2017-18

Dates of sowing	Shoot length (cm)			Seedling length (cm)			Seedling vigour index I		
	JS 335	Basara	Mean	JS 335	Basara	Mean	JS 335	Basara	Mean
20.10.20 17	14.3	14.3	**14.3**	27.5	26.9	**27.2**	2670	2595	**2632.5**
01.11.2017	14.3	13	**13.7**	27.1	26.5	**26.8**	2608	2550	**2579**
15.11.2017	13.3	12.7	**13**	27.3	25.9	**26.6**	2657	2581	**2619**
30.11.2017	13.3	13.4	**13.4**	27	27.2	**27.1**	2697	2718	**2707.5**
15.12.2017	7.7	6.5	**7.1**	12.7	11.3	**12**	1212	1051	**1131.5**
02.01.2018	7	8.3	**7.7**	11.5	14.1	**12.8**	1021	1413	**1217**
16.01.2018	7.9	8.2	**8.1**	12.8	14.1	**13.5**	1243	1383	**1313**
Mean	**11.11**	**10.91**	**11.01**	**20.84**	**20.86**	**20.85**	**2015.4**	**2041.6**	**2028.5**
	SEM	SED	CD	SEM	SED	CD	SEM	SED	CD
Ai.-Aj. (V)	0.22	0.31	0.64	0.51	0.72	1.46	53.85	76.15	154.05
Bi.-Bj. (D/S)	0.12	0.17	0.34	0.27	0.38	0.78	28.78	40.71	82.34
AiBi-AiBj	0.31	0.44	0.9	0.72	1.02	2.06	76.15	107.7	217.84
C.V (%)	5.71			6.9			7.51		

Experiment 4: Optimization of seed rate in Soybean (*Glycin max* L.)

Year of start: 2017-18

Centers:

Centers:	Variety	
	Medium maturity	**Early Maturity**
JNKVV, Jabalpur	JS 20-29	JS 20-34
RVSKVV, Gwalior	JS 20-29	JS 20-34
VNMKV, Parbhani	MAUS 162	JS 20-34
UAS, Dharwad	Dsb 21	JS 93-05
MPKV, Rahuri	KDS 344	JS 93-05
AU, Kota	RKS 45	JS 20-34
IISR, Indore	NRC 86	JS 20-34
PDKV, Akola	NRC 86	JS 20-34
PJTSAU, Hyderabad	Any suitable variety	Any suitable variety
UAS, Bengaluru	Any suitable variety	Any suitable variety

Objectives:

Soybean crop is highly sensitive to climatic factors and supply of quality seeds is becoming a critical problem due to climatic uncertainties. Study need to be conducted on reduction of seed requirement with following objectives

- To increase the productivity with reduced seed rate

- To study the effect of less plant population on control of insect and disease infestation
- To enhance the Interaction of early and medium maturing varieties to reduced seed rate
- To find out economic viability of low seed rate and production

Treatment details

I. Main-Plot treatments

- T_0 - Recommended seed rate @ 70 kg/ha
- T_1 - Reduced seed rate @ 60kg/ha
- T_2 - Reduced seed rate @ 50kg/ha

II. Sub-plot treatments (Sowing method)

- S_1-Hand dibbling with ridge & furrow
- S_2-Flat bed

Technical Details

- Plot size: 6 rows of 6 m for each treatment
- Uniform seed treatment: 2gXelora + 1.5 g Vitavax power + 2 g Thiomethoxam + 5 ml water per kg seed.
- Weed management: Due to less plant population weed may be more. Pre (*Diclosulam* @ 26g/ha) and post emergence (*Imazythopyr* @ 1 l/ha) herbicides may be followed.
- Sowing by dibbling of single seed per spot as per spacing at uniform depth of 3-5 cm.
- No. of replications: 4
- Experimental design: Split Plot design

Observations to be recorded

1. Plant population per sq. meter
2. Plant height at maturity
3. Plant canopy diameter
4. Number of branches per plant
5. Number of pods per plant
6. Yield per plant
7. Yield per ha.
8. 100 seed weight
9. Seed quality parameters (Germination % and SVI-I & II)

10. Storability of seeds at monthly interval (Germination %; seedling length; Seed Vigor; Dry matter production; Seed health)
11. Information on pests & diseases during crop growth.
12. Cost benefit ratio

Unified observation

The experiment to identify the best reduced seed rate and sowing method for seed production of soybean was conducted at nine locations (JNKVV, Jabalpur; RVSKVV, Gwalior; VNMKV, Parbhani; UAS, Dharwad; MPKV, Rahuri; AU, Kota; IISR, Indore; PDKV, Akola; PJTSAU, Hyderabad and UAS, Bengaluru)

The study conducted reveals that among the varieties, the highest seed yield is observed for medium duration variety (19.99 q/ha) which was closely followed by early maturing variety (19.09 q/ha). With respect to seed sowing method, highest seed yield is observed for ridges and furrows (20.50 q/ha) as compared to flat bed method (18.98 q/ha). With respect to seed rate highest seed yield is observed for 70 kg/ha (21.27 q/ha) which was at par with reduced seed rate 60 kg/ha (20.4 q/ha) and 19.25 q/ha seed yield has been recorded for 50 kg/ha.

With respect to interaction, $V_1S_1T_0$ (medium duration variety with flat bed sowing and seed rate at 70 kg/ha) recorded highest seed yield (22.30 q/ha) which was at par with $V_1S_2T_0$ (medium duration with ridge and furrow sowing and seed rate at 70 kg/ha) has been recorded. The reduced seed rate of 50 and 60 kg/ha has been recommended under flat bed and ridge and furrow sowing method in both medium and early duration variety as reduction in seed yield of 4 % and 9.5 % respectively, was recorded as compared to recommended seed rate (70 kg/ha).

In case of medium duration variety by the application of seed rate at 60 kg/ha, pods/plant, vigour index-I increased by 16% and 1.5% respectively and decrease in yield up to 7 % as compared to recommended seed rate 70 kg/ha. Even though there is decrease in plant population it can be compensated by increase in no. of pods/plant, no of branches/plant, vigour index-I and II by the application of reduced seed rate. In case of early maturing variety irrespective of sowing method the pods/plant and no. of branches/plant increased by 7% and 11% respectively and decrease in yield up to 10 % by the application of seed rate of 50 kg/ha as compared to recommended seed rate 70 kg/ha was recorded.

Significant observation:

The reduced seed rate of 60 kg/ha has been recommended under flat bed and ridge and furrow sowing method in both medium and early duration variety as reduction in seed yield of 4 % was recorded as compared to recommended seed rate (70 kg/ha).

Table 4.1: Effect of varieties, sowing method and seed rate on the seed yield of soybean over the locations

Varieties	Sowing Method	Seed Rate			Mean(Sowing method)	Mean (Varieties)
		70 Kg/ha	60 kg/ha	50 kg/ha		
Medium	**Flat Bed**	22.32	20.41	20.51	**18.98(Flat Bed)**	**19.98(Medium)**
Maturity varieties	**Ridge & Furrow**	21.4	20.23	18.51		
Early	**Flat Bed**	20.19	19.19	18.31	**20.50 (Ridge and Furrow)**	**19.08(Early)**
Maturity varieties	**Ridge & Furrow**	20.65	18.61	18.44		
Mean (Seed Rate)		**21.27**	**20.44**	**19.25**		

Table 4.2: Average performance of medium maturing soybean varieties over locations for yield and quality attributing traits as influenced by reduced seed rate and sowing methods. (Mean over locations)

Treatments	Plant population/m2	Plant height (cm)	No. of branches per plant	No of pods/plant	Seed yield qt/ha	100 Seed weight	Germination %	Root shoot length	Vigour Index I	Vigour index II	B:C Ratio
Variety											
V_1:	46.77	45.33	8.09	63.43	19.98	12.65	89.53	24.28	2628.58	88.45	2.59
V_2:	51.32	40.59	8.20	56.68	19.08	13.27	89.65	23.66	2403.64	86.09	2.72
Mean	**49.04**	**42.96**	**8.14**	**60.05**	**19.53**	**12.96**	**89.59**	**23.97**	**2516.11**	**87.27**	**2.65**
Sowing method											
S_1-Flat bed	47.72	42.38	7.48	57.73	18.98	12.58	90.45	21.24	2311.72	88.23	2.74
S_2-Ridges & furrow	50.67	44.69	7.95	61.84	20.50	12.96	90.69	21.68	2331.12	85.11	2.75
Mean	**49.19**	**43.53**	**7.71**	**59.78**	**19.74**	**12.77**	**90.57**	**21.46**	**2321.42**	**86.67**	**2.74**
Seed rate											
T_0 -	56.97	446.50	7.13	56.23	21.27	12.98	91.62	21.92	2398.86	85.07	2.70
T_1 -	49.90	43.22	7.90	57.28	20.44	12.72	90.09	21.53	2336.12	87.72	2.68
T_2 -	42.88	41.43	8.07	64.53	19.25	12.57	90.12	21.29	2277.34	89.22	2.50
Mean	**49.92**	**177.05**	**7.70**	**59.35**	**20.32**	**12.76**	**90.61**	**21.58**	**2337.44**	**87.34**	**2.63**
V1S1T0	51.77	53.55	8.51	47.65	22.32	13.24	91.08	21.57	2364.18	83.59	2.38
V1S1T1	49.36	51.06	8.24	50.08	20.41	12.23	90.99	21.96	2399.21	87.97	2.35
V1S1T2	42.93	49.38	9.26	55.56	20.51	12.83	90.14	21.05	2251.54	87.32	2.38
V1S2T0	49.70	52.00	8.64	48.86	21.40	13.48	89.76	22.32	2309.86	90.97	2.10
V1S2T1	42.78	48.70	9.33	51.99	20.23	12.78	89.19	22.19	2316.08	86.67	2.14
V1S2T2	39.46	50.36	9.83	54.03	18.51	11.83	88.65	21.91	2274.83	89.44	2.20
V2S1T0	56.10	43.38	8.50	54.22	20.19	12.87	91.64	23.75	2515.88	84.05	2.24
V2S1T1	53.12	41.04	8.33	51.30	19.19	12.59	89.66	23.71	2441.91	81.60	2.18
V2S1T2	47.00	42.33	9.79	62.45	18.31	11.91	91.23	22.51	2391.02	85.71	2.23
V2S2T0	52.82	41.63	8.87	54.44	20.65	13.68	91.42	23.84	2428.55	88.07	2.17
V2S2T1	49.51	38.84	9.40	52.31	18.61	12.33	90.64	23.66	2359.81	85.69	1.75
V2S2T2	41.95	38.30	9.54	53.84	18.44	13.32	90.46	22.89	2334.83	87.27	2.13

Results

1. JNKVV, Jabalpur

The experiment to identify the best reduced seed rate and sowing method for seed production of soybean was conducted at JNKVV, Jabalpur. The study conducted reveals that among the varieties the highest seed yield is observed for medium duration variety (25.11 q/ha) which was closely followed by early varieties (20.94 q/ha). With respect to seed sowing method highest seed yield is observed for Ridges and Furrows (23.37 q/ha) as compared to flat bed method (22.68 q/ha). With respect to seed rate highest seed yield is observed for 70 kg/ha (24.56 q/ha) which was at par with reduced seed rate 60 kg/ha (23.61 q/ha) and 20.91 q/ha seed yield has been recorded for 50kg/ha.

With respect to interaction, $V_1S_1T_0$ (early duration variety with ridge and furrow sowing and seed rate at 70 kg/ha) recorded highest seed yield (24.63 q/ha) which was at par with $V_1S_2T_0$ (early duration with flat bed sowing and seed rate at 70 kg/ha) (23.67 q/ha) has been recorded. In case of medium duration variety by the application of seed rate at 60 kg/ha no. of pods/plant and no of branches per plant increased by 9.53 % and 1.67 % respectively and decrease in yield up to 1.95 % as compared to recommended seed rate 70 kg/ha. Even though there is decrease in plant population, it can be compensated by increase in no. of pods/plant, no of branches/plant and vigour index-II by the application of reduced seed rate. In case of early maturing variety irrespective of sowing method the no. of pods/plant and no. of branches/plant and 100 seed weight increased by 15.45 % and 2.11 % and 1.51%respectively and decrease in yield upto 3.09 % by the application of seed rate of 60 kg/ha as compared to recommended seed rate 70 kg/ha was recorded. The reduced seed rate of 60 has been recommended under flat bed and ridge and furrow sowing method in both medium and early duration variety as reduction in seed yield of 4 % was recorded whereas due to reduced seed rate of 50 kg/ha, 15 % reduction in seed yield was recorded as compared to recommended seed rate (70 kg/ha).

Table 4.3: Effect of varieties, sowing method and seed rate on the seed yield of soybean at JNKVV, Jabalpur during 2018

Varieties	Sowing Methods	Seed Rate			Varietal Mean	Mean Sowing Method
		70 kg/ha	60 kg/ha	50 kg/ha		
Early Maturing Varieties	Ridge and furrow	24.63	20.74	19.76	V1(20.94)	S1 (23.37)
	Flat bed	23.67	20.24	16.67		
Medium Maturing Varieties	Ridge and furrow	25.32	27.67	22.18	V2(25.11)	S2 (22.68)
	Flat bed	24.66	25.81	25.06		
Mean (Seed Rate)		24.56	23.61	20.91		

Table 4.4: Performance of soybean varieties as influenced by reduced seed rate and sowing method for yield and quality attributing traits at JNKVV, Jabalpur during 2018

Treatment	Plant population (m^2)		Plant height at maturity (cm)		Number of branches per plant		Plant canopy diameter		Number of pods per plant	
Varieties	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69
Sowing methods										
S1: Hand dibbling with ridge and furrow	31.33	36.27	55.80	56.48	7.00	7.66	74.77	87.66	61.66	67.66
S2: Flat bed	29.00	29.36	58.03	60.23	6.33	8.33	73.41	81.66	54.66	64.66
mean	**30.16**	**32.81**	**56.91**	**58.35**	**6.66**	**7.99**	**74.09**	**84.66**	**58.16**	**66.16**
SEm±	2.04	1.75	0.61	0.74	0.10	0.09	0.38	0.34	0.84	0.74
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Seed rates										
T0 : 70 kg/ha	36.50	36.16	59.45	62.75	6.41	7.45	73.83	80.26	50.06	62.04
T1: 60 kg/ha	30.00	26.42	54.95	55.20	8.52	9.12	75.29	84.15	65.51	71.57
T2: 50 kg/ha	24.00	25.87	38.23	56.10	6.54	7.62	73.16	90.47	59.04	65.06
mean	**30.17**	**29.48**	**50.88**	**58.02**	**7.16**	**8.06**	**74.09**	**84.96**	**58.20**	**66.22**
SEm±	1.36	1.16	0.41	0.49	0.07	0.06	0.25	0.22	0.56	0.49
CD(0.05P)	5.30	4.53	1.59	1.91	0.25	0.22	NS	NS	NS	NS
Interaction										
S1T0	38.14	38.83	58.47	60.31	6.75	7.95	75.50	85.35	56.47	65.15
S1T1	35.27	33.50	60.55	65.22	6.65	8.26	72.16	75.15	44.54	62.17
S1T2	31.65	28.50	53.62	53.61	10.95	12.17	77.25	88.41	66.65	69.31

S2T0	29.87	24.34	56.89	56.31	7.75	8.65	73.33	80.78	65.14	68.65
S2T1	25.36	28.50	55.47	55.50	7.15	7.84	71.58	90.26	63.98	67.98
S2T2	23.28	25.25	56.83	59.21	6.23	9.39	74.75	90.31	55.15	65.45
mean	**30.60**	**29.82**	**56.97**	**58.36**	**7.58**	**9.04**	**74.10**	**85.04**	**58.66**	**66.45**
SEm±	4.09	3.49	1.23	1.47	0.20	0.17	0.76	0.67	1.67	1.47
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 4.5: Performance of soybean varieties as influenced by reduced seed rate and sowing method for yield and quality attributing traits at JNKVV, Jabalpur during 2018

Treatment	**Yield per plant (g)**		**Yield per hector (q)**		**100 seed weight (g)**		**Germination (%)**		**Seedling length (cm)**	
Varieties	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69
Sowing methods										
S1: Hand dibbling with ridge and furrow	12.55	13.50	21.89	23.54	12.58	10.56	90.71	94.37	20.52	22.34
S2: Flat bed	11.39	12.40	19.36	20.35	11.57	10.35	92.34	96.56	20.44	21.47
Mean	**11.97**	**12.95**	**20.625**	**21.945**	**12.075**	**10.455**	**91.525**	**95.465**	**20.48**	**21.905**
SEm±	0.31	0.27	0.38	0.31	1.40	1.27	0.33	0.39	0.08	0.09
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Seed rates										
T0 : 70 kg/ha	10.92	13.25	25.25	25.97	11.35	11.30	93.33	97.67	20.75	22.37
T1: 60 kg/ha	13.20	14.15	22.17	27.92	12.86	10.66	87.82	95.30	21.34	22.04
T2: 50 kg/ha	11.61	13.80	19.46	22.43	12.02	9.41	90.34	97.22	21.66	21.82
mean	**11.91**	**13.73**	**22.29**	**25.44**	**12.08**	**10.46**	**90.50**	**96.73**	**21.25**	**22.08**
SEm±	0.21	0.18	0.25	0.21	0.93	0.84	0.22	0.26	0.05	0.06
CD(0.05P)	NS	NS	0.98	0.81	NS	NS	NS	NS	NS	NS
Interaction										
S1T0	13.21	13.94	24.63	25.32	12.34	11.25	92.47	97.25	21.37	22.48
S1T1	13.65	14.86	20.74	27.68	10.36	11.36	94.20	95.82	20.45	22.78

S1T2	13.19	14.52	19.76	22.18	13.25	10.85	93.31	95.13	20.83	22.19
S2T0	12.52	13.74	23.67	24.66	12.47	10.47	92.85	98.20	20.39	21.65
S2T1	12.61	12.89	20.24	25.81	12.15	9.58	89.25	99.23	20.99	21.39
S2T2	12.11	12.72	16.68	25.06	11.89	9.24	90.72	97.42	21.57	22.56
mean	**12.88**	**13.78**	**20.95**	**25.12**	**12.08**	**10.46**	**92.13**	**97.18**	**20.93**	**22.18**
SEm±	0.62	0.54	0.76	0.63	2.79	2.53	0.66	0.79	0.15	0.18
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	3.07	NS	0.71

Table 4.6: Performance of soybean varieties as influenced by reduced seed rate and sowing method for yield and quality attributing traits at JNKVV, Jabalpur during 2018

Treatment	**Seedling vigour index-I**		**Seedling dry weight (mg)**		**Seedling vigour index-II**		**B: C ratio**	
Varieties	V1 : JS-20-34	V2 : JS-20-69	V1 : J S-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69
Sowing methods								
S1: Hand dibbling with ridge and furrow	1861.37	2155.41	0.15	0.19	13.61	17.93	4.01	4.19
S2: Flat bed	1887.43	2073.14	0.17	0.18	15.70	17.38	4.08	4.1
mean	**1874.4**	**2114.275**	**0.16**	**0.185**	**14.655**	**17.655**	**4.045**	**4.145**
SEm±								
CD(0.05P)								
Seed rates								
T0 : 70 kg/ha	1936.60	2184.88	0.19	0.20	17.73	17.58	4	4.09
T1: 60 kg/ha	1874.08	2100.41	0.16	0.19	14.05	18.11	3.89	4.17
T2: 50 kg/ha	1956.76	2121.34	0.17	0.18	15.36	17.50	3.77	3.92
mean	**1922.48**	**2135.54**	**0.17**	**0.19**	**15.71**	**17.73**	**3.89**	**4.06**
SEm±								
CD(0.05P)								
Interaction								

S1T0	1976.08	2186.18	0.18	0.19	16.64	18.48	4.12	4.31
S1T1	1926.39	2182.78	0.17	0.18	16.01	17.25	4.03	4.22
S1T2	1943.65	2110.93	0.17	0.18	15.86	17.12	3.99	4.2
S2T0	1893.21	2126.03	0.17	0.18	15.78	17.68	3.24	4.07
S2T1	1873.36	2122.53	0.14	0.19	12.50	18.85	3.91	3.26
S2T2	1956.83	2197.80	0.15	0.17	13.61	16.56	4.03	4.2
mean	**1928.25**	**2154.38**	**0.16**	**0.18**	**15.07**	**17.66**	**3.89**	**4.04**
SEm±	0.62	0.54	0.76	0.63	2.79	2.53	0.66	0.79
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	3.07

Table 4.7: Effect of reduced seed rate and sowing methods on seed germination (%) during storage at JNKVV, Jabalpur during 2018

	Storage studies at monthly interval							
	Oct		**Nov**		**Dec**		**Jan**	
Varieties	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69
Sowing methods								
S1: HDR&F	88.23	94.37	85.13	90.48	82.35	85.06	79.68	83.52
S2: Flat bed	86.03	93.45	84.07	91.22	80.16	83.85	75.15	80.82
mean	**87.13**	**93.91**	**84.6**	**90.85**	**81.255**	**84.455**	**77.415**	**82.17**
SEm±								
CD(0.05P)								
Seed rates								
T0 : 70 kg/ha	87.08	94.27	85.34	93.34	84.04	86.91	80.24	82.43
T1: 60 kg/ha	85.55	93.94	83.42	92.20	80.52	84.44	79.27	80.82
T2: 50 kg/ha	86.42	90.21	82.35	90.15	81.03	82.24	79.32	81.51
mean	**86.35**	**92.81**	**83.70**	**91.90**	**81.86**	**84.53**	**79.61**	**81.59**
SEm±								
CD(0.05P)								
Interaction								
S1T0	89.17	97.04	85.30	95.49	83.73	90.30	78.46	80.03
S1T1	88.09	95.32	84.45	90.22	82.52	87.16	75.82	77.00
S1T2	86.13	93.00	84.26	90.09	80.67	87.12	74.57	76.52
S2T0	87.28	96.42	83.11	92.83	80.34	88.40	72.31	79.46
S2T1	84.34	94.81	82.62	91.31	79.51	85.61	76.17	78.24
S2T2	88.44	89.91	83.53	91.43	81.08	84.54	75.10	78.50
mean	**87.24**	**94.42**	**83.88**	**91.90**	**81.31**	**87.19**	**75.41**	**78.29**
SEm±	0.64	0.77	0.53	0.62	0.47	0.49	0.36	0.33
CD(0.05P)	NS	3.00	NS	2.41	NS	1.92	1.42	1.27

Table 4.8: Effect of reduced seed rate and sowing methods on Seedling length (cm) during storage

	Storage studies at monthly interval							
	Oct		Nov		Dec		Jan	
Varieties	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1 : JS-20-34	V2 : JS-20-69
Sowing methods								
S1: HDR&F	21.14	23.37	20.63	21.26	19.34	20.45	18.30	19.42
S2: Flat bed	20.04	22.39	18.57	19.23	18.36	18.60	17.24	19.15
mean	**20.59**	**22.88**	**19.6**	**20.245**	**18.85**	**19.525**	**17.77**	**19.285**
SEm±	0.07	0.09	0.06	0.07	0.06	0.06	0.05	0.04
CD(0.05P)	NS	NS	0.24	NS	0.24	NS	0.21	0.15
Seed rates								
T0 : 70 kg/ha	21.80	22.23	18.09	20.76	19.82	19.90	18.25	19.32
T1: 60 kg/ha	16.55	19.78	15.10	18.38	14.62	15.15	14.40	17.19
T2: 50 kg/ha	15.95	17.84	12.28	18.47	12.50	13.20	13.16	14.66
mean	**18.10**	**19.95**	**15.16**	**19.20**	**15.65**	**16.08**	**15.27**	**17.06**
SEm±	NS	NS	0.04	0.05	0.04	0.04	0.04	0.03
CD(0.05P)	0.19	0.23	0.16	0.19	0.16	0.15	0.14	0.10
Interaction								
S1T0	22.07	22.28	19.61	20.66	19.32	19.38	18.53	19.78
S1T1	19.27	21.73	17.05	19.54	17.40	18.47	17.71	18.29
S1T2	20.36	20.64	17.42	19.40	18.26	18.34	17.13	18.38
S2T0	20.19	20.47	18.36	18.47	17.19	17.28	15.27	17.26
S2T1	18.60	20.13	18.74	18.63	15.22	16.21	15.20	17.10
S2T2	21.37	21.24	15.46	17.32	15.15	16.24	15.38	16.12
mean	**20.31**	**21.08**	**17.77**	**19.00**	**17.09**	**17.65**	**16.54**	**17.82**
SEm±	0.15	0.18	0.12	0.14	0.12	0.11	0.11	0.08
CD(0.05P)	NS	0.69	NS	0.56	NS	0.44	NS	0.29

Table 4.9: Effect of reduced seed rate and sowing methods on Seedling vigour-I index during storage

Varieties	Storage studies at monthly interval							
	Oct		Nov		Dec		Jan	
	V1 : JS-20-34	V2 :JS-20-69	V1 : JS-20-34	V2 :JS-20-69	V1 : JS-20-34	V2 : JS-20-69	V1:JS-20-34	V2:JS-20-69
Sowing methods								
S1: HDR&F	1865.18	2205.43	1756.23	1923.60	1592.65	1739.48	1458.14	1621.96
S2: Flat bed	1724.04	2092.35	1561.18	1754.16	1490.98	1623.34	1295.59	1547.70
mean	**1794.61**	**2148.89**	**1658.705**	**1838.88**	**1541.815**	**1681.41**	**1376.865**	**1584.83**
SEm±	0.07	0.09	0.06	0.07	0.06	0.06	0.05	0.04
CD(0.05P)	NS	NS	0.24	NS	0.24	NS	0.21	0.15
Seed rates								
T0 : 70 kg/ha	1898.34	2095.62	1543.80	1937.74	1665.67	1729.51	1464.38	1592.55
T1: 60 kg/ha	1415.85	1858.13	1259.64	1694.64	1177.20	1279.27	1141.49	1389.30
T2: 50 kg/ha	1378.40	1609.35	1011.26	1665.07	1012.88	1085.57	1043.85	1194.94
mean	**1564.20**	**1854.37**	**1271.57**	**1765.82**	**1285.25**	**1364.78**	**1216.57**	**1392.26**
SEm±	NS	NS	0.04	0.05	0.04	0.04	0.04	0.03
CD(0.05P)	0.19	0.23	0.16	0.19	0.16	0.15	0.14	0.10
Interaction								
S1T0	1967.98	2162.05	1672.73	1972.82	1622.69	1744.60	1453.86	1582.99
S1T1	1697.49	2071.30	1439.87	1762.90	1524.14	1516.58	1342.77	1408.33
S1T2	1753.61	1919.52	1467.81	1747.75	1479.49	1590.81	1277.38	1406.44
S2T0	1762.18	1973.72	1525.90	1714.57	1388.28	1519.60	1104.17	1371.48
S2T1	1568.72	1908.53	1548.30	1701.11	1288.86	1302.98	1157.78	1337.90
S2T2	1889.96	1909.69	1291.37	1583.57	1316.74	1280.78	1155.04	1265.42
mean	**1773.32**	**1990.80**	**1491.00**	**1747.12**	**1436.70**	**1492.56**	**1248.50**	**1395.43**
SEm±	0.17	0.21	0.47	0.45	0.23	0.72	0.114	0.49
CD(0.05P)	NS	0.69	NS	0.56	NS	0.44	NS	0.24

2. MPKV, Rahuri

The data on influence of varieties, sowing types and seed rates on seed yield, yield contributing traits and quality are presented in Table4.1 to 4.6. From the data it is revealed that the seed yield and seed quality of soybean influenced significantly due to varieties, sowing types and seed rates.

Effect of varieties

From the data (Table 4.1) it was observed that the yield contributing parameters *viz.,* plant population (49.93/m^2), plant height (68.08 cm), plant canopy diameter (47.76 cm), number of branches (8.20), number of pods (88.77 plant^{-1}), seed yield (20.09 g plant^{-1}), seed yield (4.58 kg plot^{-1}), seed yield (23.64 q ha^{-1}) as well as the seed quality parameters *viz.,* initial germination (93.42 %), root shoot length (29.61 cm), dry matter content (1.184 g), vigour index I (2768) and vigour index II (110.63) were significantly higher in soybean variety Phule Agrani. However, 100 seed weight was higher in JS 9305 (14.14 g).

Effect of sowing method

The sowing method also affected the seed yield and quality attributes. From the data (Table 4.2) it was revealed that yield contributing parameters *viz*., plant population (45.55/m2), plant height (61.93 cm), plant canopy diameter (47.30 cm), number of branches (8.49), number of pods (80.38 plant-1), seed yield (19.40 g plant-1), seed yield (4.60 kg plot-1), seed yield (23.71 qt ha-1) as well as the seed quality parameters *viz*., initial germination (93.13 %), root shoot length (29.30 cm), dry matter content (1.171 g), vigour index I (2730) and vigour index II (109.10) were significantly higher in the sowing method of ridges and furrows over the flat bed sowing.

Effect of seed rates

It was observed that, plant population (50.55/m^2) , plant height (64.40 cm), seed yield per plot (4.61 kg), seed yield per hector (23.79 qt) as well as seed quality parameters viz., initial germination (94.00 %), root shoot length (30.26 cm), dry matter content (1.180 g), seed vigour index I (2845) and vigour index II (110.93) were significantly higher at seed rate 70 kg ha^{-1} followed by the seed rate 60 kg ha^{-1}. The plant canopy diameter (46.65 cm) number of branches (8.71/ plant^{-1}), number of pods (81.94 plant^{-1}) and seed yield (20.04 g plant^{-1}) were significantly higher at seed rate 50 kg ha^{-1}.

Interaction effect

The interaction effect of varieties, sowing type and seed rates showed significant effect on the seed yield and quality attributes. The seed yield (5.08 kg plot^{-1}) and seed yield (26.22 qt ha^{-1}) as well as seed quality parameters *viz.*, initial germination (95.25 %), root shoot length (31.47 cm), dry matter content (1.20 g), seed vigour index I (2997) and vigour index II (114.30)

were significantly higher in the ridges and furrow sowing method of soybean variety Phule Agrani with the seed rate 70 kg ha^{-1}($V_1S_2T_0$). The plant population (57.25/m^2), plant height (72.40 cm) was highest in the same treatment combination ($V_1S_2T_0$). The same variety sown with ridges method and with the seed rate 60 kg ha^{-1} showed at par values for most of the yield and quality parameters. (Table 4.3)

Information on pests & diseases during crop growth

The aphids, white flies and tobacco caterpillar (*Spodepteralitura* (Fab.) and soybean mosaic virus attack was higher in both the varieties with seed rate @70 kg/ha which was found minimum in the plots of both the varieties with seed rate of 60 and 50 kg/ha.

Cost benefit ratio

The highest cost benefit ratio (1.52) was observed in ridges and furrow sowing method of the soybean variety Phule Agrani @ 70 and 60 kg/ha and was found lowest (1.20) in the flat bed sowing of the soybean variety JS 9305 @ 60 kg/ha sowing. (Table 4.4)

Seed Storability study

The germination (92.25 and 92.00) as well as vigour index I (2497 and 2384), vigour index II (107.01 and 104.42) were significantly highest in the variety Phule Agrani seeds sown in ridges and furrow method with the seed rate @50kg/ha ($V_1S_2T_2$) stored at 30 and 60 days respectively. (Table 4.5)



Experimental plot view

Table 4.1: Effect of variety, sowing method and seed rate on seed yield and quality parameters of soybean at MPKV, Rahuri during 2018

Treatments	Plant population /m²	Plant height (cm)	Plant canopy diameter (cm)	No. of branches/ plant	No. of pods /plant	Seed yield/ plant (g)
Variety						
V_1: Phule Agrani	49.93	68.08	47.76	8.20	88.77	20.09
V_2: JS 9305	39.23	53.93	40.59	8.19	69.52	17.23
SE ±	0.289	0.198	0.155	0.067	0.453	0.130
CD at 5%	0.832	0.571	0.447	NS	1.303	0.374
Sowing method						
S_1-Flat bed	43.62	60.08	41.05	7.90	77.91	17.92
S_2-Ridges & furrow	45.55	61.93	47.30	8.49	80.38	19.40
SE ±	0.289	0.198	0.155	0.067	0.453	0.130
CD at 5%	0.832	0.571	0.447	0.193	1.303	0.374
Seed rate						
T_0 - Recommended seed rate @ 70 kg/ha	50.55	64.40	41.81	7.56	76.39	17.44
T_1- Reduced seed rate @ 60kg/ha	45.76	60.16	44.06	8.31	79.10	18.50
T_2 - Reduced seed rate @ 50kg/ha	37.44	58.45	46.65	8.71	81.94	20.04
SE ±	0.354	0.243	0.190	0.082	0.554	0.159
CD at 5%	1.020	0.699	0.547	0.237	1.595	0.458

Table 4.2: Effect of variety, sowing method and seed rate on seed yield and quality parameters of soybean at MPKV, Rahuri during 2018

Treatments	Seed yield Kg/plot	Seed yield qt/ha	100 seed weight (g)	Germination (%)	Root shoot length (cm)	Dry matter content (g)	Vigour index I	Vigour index II
Variety								
V_1: Phule Agrani	4.58	23.64	11.65	93.42 (75.22)	29.61	1.184	2,768	110.63
V_2: JS 9305	4.20	21.65	14.14	91.46 (73.13)	27.93	1.149	2,556	105.12
SE ±	0.044	0.226	0.049	0.332	0.160	0.003	16.126	0.430
CD at 5%	0.126	0.651	0.141	0.953	0.460	0.008	46.263	1.234

Sowing method								
S_1-Flat bed	4.18	21.58	12.84	91.75 (73.43)	28.24	1.162	2593	106.66
S_2-Ridges & furrow	4.60	23.71	12.95	93.13 (74.92)	29.30	1.171	2730	109.10
SE ±	0.044	0.226	0.049	0.332	0.160	0.003	16.126	0.430
CD at 5%	0.126	0.651	NS	0.953	0.460	0.008	46.263	1.234
Seed rate								
T_0- Recommended seed rate @ 70 kg/ha	4.61	23.79	12.98	94.00 (75.85)	30.26	1.180	2845	110.93
T_1 - Reduced seed rate @ 60kg/ha	4.45	22.97	12.89	91.81 (73.57)	28.87	1.165	2653	107.00
T_2 - Reduced seed rate @ 50kg/ha	4.11	21.18	12.82	91.50 (73.11)	27.17	1.155	2487	105.70
SE ±	0.054	0.277	0.060	0.407	0.196	0.004	19.750	0.527
CD at 5%	0.154	1.594	NS	1.167	0.563	0.010	56.661	1.511

***Figures in parenthesis are Arc sin transformed values**

Table 4.3: Interaction effects of variety, sowing type and seed rate on seed yield and quality parameters of soybean at MPKV, Rahuri during 2018

Treatments	Plant population/m^2	Plant height (cm)	Plant canopy diameter (cm^2)	No. of branches/plant	No. of pods /plant	Seed yield/ plant (g)
$V_1S_1T_0$	53.60	70.15	41.45	7.30	85.30	18.54
$V_1S_1T_1$	50.20	65.90	44.55	8.05	87.85	19.35
$V_1S_1T_2$	41.75	65.25	47.50	8.45	90.75	20.83
$V_1S_2T_0$	57.25	72.40	49.00	7.75	86.35	19.36
$V_1S_2T_1$	52.80	68.15	50.70	8.50	89.25	20.73
$V_1S_2T_2$	44.00	66.60	53.35	9.15	93.10	21.76
$V_2S_1T_0$	45.35	56.65	34.75	7.15	65.15	14.62
$V_2S_1T_1$	39.40	52.45	37.50	8.10	67.95	15.97
$V_2S_1T_2$	31.40	50.10	40.55	8.35	70.45	18.25
$V_2S_2T_0$	46.00	58.40	42.05	8.05	68.75	17.23
$V_2S_2T_1$	40.65	54.15	43.50	8.60	71.35	17.98
$V_2S_2T_2$	32.60	51.85	45.20	8.90	73.45	19.33
SE ±	0.708	0.486	0.380	0.164	1.109	0.318
CD at 5%	NS	NS	NS	NS	NS	NS

Table 4.4: Interaction effects of variety, sowing type and seed rate on seed yield and quality parameters of soybean at MPKV, Rahuri during 2018

Treatment	Seed yield /plot (kg)	Seed yield /ha (kg)	B:C ratio	100 seed weight(g)	Germination (%)	Root shoot length (cm)	Dry matter content (g)	Vigour index I	Vigour index II
$V_1S_1T_0$	4.55	23.49	1.43	11.77	93.75 (75.50)	30.62	1.188	2,871	111.33
$V_1S_1T_1$	4.54	23.43	1.44	11.51	93.50 (75.25)	29.28	1.183	2,737	110.57
$V_1S_1T_2$	4.25	21.91	1.36	11.43	91.75 (73.35)	27.47	1.173	2,521	107.59
$V_1S_2T_0$	5.08	26.22	1.52	11.80	95.25 (77.43)	31.47	1.200	2,997	114.30
$V_1S_2T_1$	4.95	25.55	1.52	11.75	93.50 (75.33)	29.90	1.185	2,794	110.80
$V_1S_2T_2$	4.12	21.24	1.27	11.66	92.75 (74.48)	28.95	1.178	2,685	109.21
$V_2S_1T_0$	4.18	21.57	1.31	14.15	93.00 (74.67)	29.09	1.160	2,705	107.87
$V_2S_1T_1$	3.84	19.79	1.22	14.10	87.75 (69.50)	27.67	1.138	2,428	99.82
$V_2S_1T_2$	3.75	19.32	1.20	14.08	90.75 (72.33)	25.33	1.133	2,297	102.77
$V_2S_2T_0$	4.63	23.87	1.38	14.21	94.00 (75.81)	29.89	1.173	2,809	110.22
$V_2S_2T_1$	4.48	23.12	1.37	14.19	92.50 (74.19)	28.65	1.155	2,651	106.82
$V_2S_2T_2$	4.31	22.24	1.33	14.11	90.75 (72.28)	26.93	1.138	2,443	103.23
SE ±	0.107	0.554	1.43	0.120	0.814	0.391	0.007	39.500	1.054
CD at 5%	0.309	1.594	1.44	NS	2.334	NS	NS	NS	3.023

Figures in parenthesis are Arc sin transformed values

Table 4.5: Effect of variety, sowing method and seed rate on seed quality parameters of soybean during storage at MPKV, Rahuri during 2018

Treatments	Germination (%)		Root shoot length (cm)		Dry matter content (g)		Vigour index I		Vigour index II	
Storage Period (Days)	30	60	30	60	30	60	30	60	30	60
Variety										
V_1: Phule Agrani	90.88 (72.43)	90.71 (72.27)	25.61	24.33	1.148	1.126	2328	2208	104.29	102.13
V_2: JS 9305	89.29 (70.92)	88.83 (70.50)	24.59	23.56	1.124	1.105	2196	2093	100.35	98.19
SE ±	0.216	0.227	0.163	0.119	0.002	0.002	16.965	11.607	0.260	0.314
CD at 5%	0.621	0.652	0.467	0.340	0.005	0.007	48.670	33.299	0.745	0.902
Sowing method										
S_1-Flat bed	89.33 (70.97)	89.13 (70.79)	24.59	23.43	1.129	1.109	2198	2088	100.85	98.85
S_2-Ridge & furrow	90.83 (72.39)	90.42 (71.98)	25.60	24.46	1.143	1.122	2327	2213	103.79	101.47
SE ±	0.216	0.227	0.163	0.119	0.002	0.002	16.965	11.607	0.260	0.314
CD at 5%	0.621	0.652	0.467	0.340	0.005	0.007	48.670	33.299	0.745	0.902
Seed rate										
T_0- Recommended seed rate @ 70 kg/ha	89.31 (70.95)	88.81 (70.48)	24.40	23.59	1.124	1.099	2180	2095	100.43	97.61
T_1 - Reduced seed rate @ 60kg/ha	90.06 (71.67)	89.94 (71.56)	25.36	23.92	1.138	1.116	2286	2152	102.52	100.37
T_2 - Reduced seed rate @ 50kg/ha	90.88 (72.42)	90.56 (72.12)	25.53	24.33	1.144	1.132	2321	2204	104.00	102.51
SE ±	0.265	0.278	0.200	0.145	0.002	0.003	20.777	14.215	0.318	0.385
CD at 5%	0.760	0.799	0.573	0.416	0.006	0.008	59.608	40.782	0.912	1.104

***Figures in parenthesis are Arc sin transformed values**

Table 4.6: Interaction effect of variety, sowing method and seed rate on seed quality parameters of soybean during storage at MPKV, Rahuri during 2018

Treatments	Germination (%)		Root shoot length (cm)		Dry matter content (g)		Vigour index I		Vigour index II	
Storage Period (Days)	30	60	30	60	30	60	30	60	30	60
$V_1S_1T_0$	90.25 (71.81)	90.25 (71.81)	24.95	23.67	1.128	1.113	2252	2136	101.75	100.41
$V_1S_1T_1$	90.25 (71.81)	90.25 (71.81)	25.17	23.80	1.145	1.128	2272	2148	103.34	101.75
$V_1S_1T_2$	90.50 (72.05)	90.25 (71.81)	25.11	23.40	1.150	1.135	2273	2112	104.07	102.43
$V_1S_2T_0$	90.00 (71.57)	89.75 (71.33)	24.34	23.61	1.138	1.113	2190	2119	102.38	99.85
$V_1S_2T_1$	92.00 (73.57)	91.75 (73.31)	27.02	25.60	1.165	1.133	2486	2349	107.18	103.91
$V_1S_2T_2$	92.25 (73.84)	92.00 (73.57)	27.06	25.91	1.160	1.135	2497	2384	107.01	104.42
$V_2S_1T_0$	87.25 (69.08)	86.75 (68.65)	23.68	23.38	1.103	1.068	2066	2028	96.19	92.60
$V_2S_1T_1$	87.50 (69.30)	87.25 (69.08)	24.06	22.62	1.120	1.080	2106	1974	97.99	94.23
$V_2S_1T_2$	90.25 (71.81)	90.00 (71.57)	24.59	23.69	1.128	1.130	2220	2132	101.75	101.70
$V_2S_2T_0$	89.75 (71.33)	88.50 (70.18)	24.64	23.70	1.130	1.103	2211	2098	101.41	97.57
$V_2S_2T_1$	90.50 (72.05)	90.50 (72.05)	25.20	23.64	1.123	1.123	2281	2139	101.59	101.59
$V_2S_2T_2$	90.50 (72.05)	90.00 (71.57)	25.36	24.31	1.140	1.128	2295	2188	103.18	101.48
SE ±	0.530	0.557	0.399	0.290	0.004	0.006	41.554	28.430	0.636	0.770
CD at 5%	1.520	1.598	1.145	0.833	0.013	0.017	119.217	81.565	1.824	2.208

*Figures in parenthesis are Arc sin transformed values

3. GKVK, Bengaluru

The sowing method had significant influence on the yield and quality of soybean varieties (JS-335 and JS-9560). It was evident from the data that seed yield (11.76g/plant; 1.157 kg/plot and 19.28q/ha) and yield attributing characters *viz*., plant population (27.4/m2), plant canopy diameter (32.05cm, no.of branches (10 per plant) and no. of pods (39.67 per plant) were the highest in the raised bed method (S1) as compared to flatbed method (S2) (16.26q/ha) (Table 4.7- 4.8).

The varietyJS-9560 is early maturing variety compared to JS 335, which is a medium maturing variety. Among the two varieties, the medium maturing variety (JS-335) performed better with respect to seed yield (11.757 g per plant; 1.159 kg per plot and 19.31 q per ha) as against the early maturing variety V2 (10.912 g per plant; 0.974 kg per plot and 16.22 q /ha) respectively.

Among the seed rate treatments, the plant growth parameters *viz*., plant canopy diameter (32.63cm), no. of branches (10.5 per plant), no. of pods (44.91 per plant), seeds per plant (72.3) were found to be significantly the highest in seed rate @ 30kg/ha(T5). Whereas, the seed yield was recorded maximum (22.67q/ha) in seed rate @ 50kg/ha (T3) as against the recommended seed rate @ 70kg/ ha(19.84q/ha).

The interactions also varied significantly among the treatments (Table-4.9). The interaction S_1V_1(Raised bed method x medium maturing variety JS-335) recorded the highest yield (20.24q/ha) as compared with S_2V_2(flatbed sowing x early maturing variety JS-9560) which yielded lowest seed yield (16.12 q/ha). Overall, the interaction of $V_1S_1T_3$ recorded significantly maximum seed yield (25.13 q/ha) while minimum seed yield recorded in $V_2S_2T_5$ (11.54 q/ha).

Hence, soybean variety JS-335 could be positively enhance the seed yield and quality by adopting the raised bed sowing method with reduced seed rate @ 50kg per ha.

Table 4.7.Influence of sowing methods and seed rates in medium maturing variety JS-335 and early maturing variety JS95-60 for seed yield and quality in soybean at GKVK, Bengaluru during 2018

Treatments	Plant population /m^2	Plant height (cm)	Plant canopy diameter (cm^2)	No. of branches/plant	No. of pods/ plant	No. of seeds/ plant	Seed yield/plant (g)	Seed yield/ plot (kg)	Seed yield / ha (q)	100 seed weight (g)	Seed germination (%)	SVI-I
Sowing methods (2)												
S_1	27.4	22.75	32.05	10.0	39.67	76.6	11.760	1.157	19.28	14.14	89.45	3573
S_2	26.5	20.92	29.43	9.5	33.86	68.2	10.909	0.976	16.26	13.55	89.77	3551
Mean	**26.95**	**21.83**	**30.74**	**9.7**	**36.76**	**72.4**	**11.334**	**1.096**	**18.27**	**13.84**	**89.61**	**3562**
SEm±	**0.03**	**0.38**	**0.19**	**0.23**	**0.73**	**4.02**	**0.07**	**0.03**	**0.55**	**0.12**	**0.32**	**55.0**
CD(P=0.05)	**0.08**	**1.08**	**0.54**	**0.66**	**2.09**	**11.43**	**0.19**	**0.08**	**1.56**	**0.54**	**0.93**	**156.3**
Varieties(2)												
V_1 (JS-335)	28.2	24.66	32.25	8.2	42.25	87.2	11.757	1.159	19.31	12.37	96.65	3902
V_2 (JS-9560)	25.8	19.01	29.23	11.3	31.27	57.7	10.912	0.974	16.22	15.31	82.57	3223
Mean	**27.0**	**21.83**	**30.74**	**9.7**	**36.76**	**72.45**	**11.334**	**1.096**	**18.27**	**13.84**	**89.61**	**3562**
SEm±	**0.24**	**0.46**	**0.41**	**0.03**	**0.31**	**2.86**	**0.19**	**0.05**	**0.84**	**0.21**	**1.06**	**69.0**
CD(P=0.05)	**0.69**	**1.32**	**1.17**	**0.09**	**0.88**	**8.13**	**0.54**	**0.14**	**2.28**	**0.59**	**3.02**	**196.2**
Seed rate												
T_1	40.1	23.52	28.87	8.6	29.09	64.2	8.484	1.190	19.84	13.64	90.75	3660
T_2	33.4	22.54	29.87	9.3	31.50	71.0	10.439	1.149	19.15	13.33	89.50	3650
T_3	27.4	21.28	31.15	9.8	38.51	82.2	12.161	1.360	22.67	14.16	89.00	3526
T_4	19.6	21.35	31.18	10.3	39.82	72.4	12.461	0.983	16.37	13.89	90.68	3495
T_5	14.4	20.51	32.63	10.5	44.91	72.3	13.128	0.799	13.32	14.19	88.12	3479
Mean	**26.98**	**21.84**	**30.74**	**9.7**	**36.76**	**72.42**	**11.334**	**1.096**	**18.27**	**13.84**	**89.61**	**3562**
SEm±	**0.30**	**0.33**	**0.57**	**0.16**	**1.03**	**3.54**	**0.19**	**0.05**	**0.78**	**0.27**	**0.82**	**78.0**
CD(P=0.05)	**0.86**	**0.94**	**1.64**	**0.47**	**2.93**	**10.0**	**0.56**	**0.14**	**2.22**	**0.77**	**2.34**	**12.7**

Table 4.8.Interaction effect of sowing method, variety and seed rate on growth, yield and quality of medium maturing soybean variety (V1) JS-335 and early maturing variety (V2) JS-9560 at GKVK, Bengaluru during 2018

Treatments	Plant population /m^2	Plant height (cm)	Plant canopy diameter (cm)	No. of branches/plant	No. of pods/ plant	No. of seeds/ plant	Seed yield/plant (g)	Seed yield/plot (kg)	Seed yield per ha (q)	100 seed weight (g)	Seed germination (%)	SVI-I
Interaction (V x S)												
S_1 V_1	28.6	25.13	33.60	8.4	46.09	96.0	12.153	1.215	20.24	12.46	96.60	3923
S_2 V_1	27.7	24.19	30.90	8.0	38.41	78.4	11.361	1.103	18.39	12.27	96.70	3881
S_1 V_2	26.2	20.38	30.51	11.6	33.24	57.2	11.367	1.099	18.32	15.82	82.30	3224
S_2 V_2	25.3	17.65	27.95	10.9	29.31	58.1	10.458	0.967	16.12	14.81	82.85	3222
Mean	**26.95**	**21.84**	**30.74**	**9.7**	**36.76**	**72.42**	**11.334**	**1.096**	**18.27**	**13.84**	**89.61**	**3562**
SEm±	**0.07**	**0.18**	**0.83**	**0.15**	**0.76**	**3.78**	**0.12**	**0.03**	**0.464**	**0.29**	**0.37**	**81.0**
CD(P=0.05)	**0.19**	**0.51**	**2.37**	**0.43**	**2.18**	**10.76**	**0.35**	**0.08**	**1.32**	**0.82**	**1.06**	**230.3**
Interaction (S x T)												
S_1 T_1	40.7	24.78	29.15	9.0	31.34	75.6	8.861	1.280	21.32	14.13	90.87	3651
S_1 T_2	33.6	23.64	31.69	9.5	33.90	75.3	10.655	1.190	19.83	13.21	89.50	3709
S_1 T_3	28.0	22.07	32.51	10.2	41.31	78.6	12.595	1.444	24.06	14.40	89.37	3434
S_1 T_4	20.1	22.10	32.90	10.5	43.10	73.7	12.970	1.041	17.35	14.37	90.25	3570
S_1 T_5	14.7	21.17	34.02	10.9	48.68	79.9	13.719	0.831	13.85	14.59	87.25	3501
S_2 T_1	39.4	22.25	28.60	8.3	26.85	52.8	8.107	1.101	18.35	13.15	90.62	3668
S_2 T_2	33.1	21.43	28.05	9.2	29.10	66.8	10.224	1.108	18.46	13.46	89.50	3591
S_2 T_3	26.8	20.48	29.79	9.4	35.70	85.7	11.728	1.277	21.29	13.92	88.62	3619
S_2 T_4	19.2	20.59	29.46	10.2	36.54	71.2	11.951	0.924	15.40	13.41	91.12	3421
S_2 T_5	14.1	19.85	31.24	10.2	41.12	64.7	12.536	0.767	12.78	13.78	89.00	3457
Mean	**26.95**	**21.84**	**30.74**	**9.7**	**36.76**	**72.42**	**11.334**	**1.096**	**18.27**	**13.84**	**89.61**	**3562**

SEm±	**0.42**	**0.47**	**0.81**	**0.23**	**1.45**	**5.00**	**0.28**	**0.07**	**1.11**	**0.38**	**1.16**	**112.0**
CD(P=0.05)	**1.21**	**1.33**	**2.32**	**0.67**	**4.14**	**14.23**	**0.79**	**0.19**	**3.16**	**1.08**	**3.32**	**318.47**

Table 4.9: Interaction effect of sowing method, variety and seed rate on growth, yield and quality of medium maturing soybean variety (V1) JS-335 and early maturing variety (V2) JS-9560GKVK, Bengaluru during 2018

Treatments	Plant population /m^2	Plant height (cm)	Plant canopy diameter (cm)	No. of branches/plant	No. of pods/ plant	No. of seeds/ plant	Seed yield/plant (g)	Seed yield/plot (kg)	Seed yield per ha (q)	100 seed weight (g)	Seed germination (%)	SVI-I
Interaction (V x T)												
V_1T_1	41.2	26.71	30.52	6.9	31.66	66.0	8.636	1.234	20.57	11.68	96.87	4052
V_1T_2	35.0	26.06	31.56	8.0	35.00	84.9	10.759	1.224	20.41	12.10	96.62	3981
V_1T_3	28.7	23.78	32.09	8.6	44.66	101	12.482	1.457	24.28	12.94	96.37	3806
V_1T_4	20.6	23.90	32.34	8.8	46.64	90.1	13.231	0.991	16.51	12.33	96.87	3811
V_1T_5	15.4	22.85	34.74	8.7	53.31	94.1	13.676	0.889	14.81	12.81	96.50	3856
V_2T_1	38.9	20.32	27.22	10.4	26.52	62.3	8.332	1.146	19.10	15.60	84.62	3268
V_2T_2	31.7	19.02	28.17	10.7	28.00	57.2	10.120	1.073	17.89	14.59	82.37	3320
V_2T_3	26.1	18.77	30.21	11.0	32.35	63.5	11.840	1.264	21.06	15.39	81.62	3247
V_2T_4	18.7	18.79	30.02	11.9	33.00	54.7	11.690	0.975	16.24	15.46	84.50	3180
V_2T_5	13.5	18.16	30.52	12.4	36.50	50.5	12.579	0.709	11.82	15.56	79.75	3098
Mean	**26.95**	**21.84**	**30.74**	**9.7**	**36.76**	**72.42**	**11.334**	**1.096**	**18.27**	**13.84**	**89.61**	**3562**
SEm±	**0.42**	**0.47**	**0.81**	**0.23**	**1.45**	**5.00**	**0.28**	**0.07**	**1.11**	**0.38**	**1.16**	**112.0**
CD(P=0.05)	**1.19**	**1.33**	**2.30**	**0.65**	**4.12**	**14.21**	**0.79**	**0.19**	**3.16**	**1.08**	**3.29**	**318.4**
Interaction (S x V x T)												
$V_1 S_1T_1$	42.2	27.96	30.35	7.0	33.32	82.1	8.972	1.329	22.15	11.46	97.25	4100
$V_1 S_1T_2$	35.0	27.21	32.17	8.3	38.10	86.7	10.635	1.249	20.81	11.48	96.50	4041
$V_1 S_1T_3$	29.5	24.06	33.80	8.6	47.27	108.5	13.060	1.508	25.13	13.20	95.75	3640

$V_1 S_1T_4$	21.0	23.76	34.52	8.9	51.50	92.1	13.755	1.051	17.52	12.80	97.00	3897
$V_1 S_1T_5$	15.5	22.63	37.15	9.1	60.27	110.8	14.343	0.936	15.60	13.35	96.50	3936
$V_2 S_1T_1$	40.2	25.46	30.70	6.9	30.00	49.9	8.300	1.140	19.00	11.89	96.50	4003
$V_2 S_1T_2$	35.0	24.89	30.95	7.7	31.90	83.0	10.882	1.200	20.00	12.67	96.75	3921
$V_2 S_1T_3$	28.0	23.49	30.37	8.5	42.05	93.1	11.905	1.406	23.44	12.67	97.00	3972
$V_2 S_1T_4$	20.2	24.04	30.15	8.6	41.77	88.2	12.707	0.930	15.50	11.86	96.75	3725
$V_2 S_1T_5$	15.2	23.08	32.32	8.3	46.35	77.5	13.010	0.841	14.02	12.27	96.50	3783
$V_1 S_2T_1$	39.2	21.60	27.95	11.1	29.35	69.0	8.750	1.230	20.50	16.80	84.50	3203
$V_1 S_2T_2$	32.2	20.06	31.20	10.7	29.70	63.8	10.675	1.131	18.85	14.92	82.50	3378
$V_1 S_2T_3$	26.5	20.08	31.22	11.8	35.35	48.7	12.130	1.379	22.98	15.60	83.00	3228
$V_1 S_2T_4$	19.2	20.45	31.27	12.0	34.70	55.3	12.185	1.031	17.18	15.95	83.50	3243
$V_1 S_2T_5$	14.0	19.71	30.90	12.7	37.10	49.2	13.095	0.726	12.10	15.82	78.00	3065
$V_2 S_2T_1$	38.5	19.04	26.50	9.7	23.70	55.7	7.915	1.062	17.70	14.40	84.75	3333
$V_2 S_2T_2$	31.2	17.97	25.15	10.7	26.30	50.6	9.565	1.016	16.93	14.25	82.25	3262
$V_2 S_2T_3$	25.7	17.46	29.20	10.3	29.35	78.2	11.550	1.148	19.14	15.17	80.25	3265
$V_2 S_2T_4$	18.2	17.14	28.77	11.8	31.30	54.2	11.195	0.919	15.31	14.96	85.50	3116
$V_2 S_2T_5$	13.0	16.61	30.15	12.1	35.90	51.8	12.063	0.693	11.54	15.30	81.50	3131
Mean	**26.95**	**21.84**	**30.74**	**9.7**	**36.76**	**72.42**	**11.334**	**1.096**	**18.27**	**13.84**	**89.61**	**3562**
SEm±	**0.60**	**0.66**	**1.15**	**0.33**	**2.06**	**7.08**	**0.39**	**0.09**	**1.56**	**0.54**	**1.65**	**158.0**
CD(P=0.05)	**1.72**	**1.89**	**3.28**	**0.94**	**5.86**	**20.13**	**1.12**	**0.25**	**4.43**	**1.54**	**4.69**	**449.28**
CV (%)	**4.5**	**6.1**	**7.5**	**6.8**	**11.2**	**9.5**	**7.0**	**15.13**	**15.13**	**7.8**	**3.6**	**8.8**

4. RVSKVV, Gwalior

The data on reduced seed rate, methods of sowing on different varieties presented in (Table 4.10.) revealed that seed yield and yield attributing agronomic characters significantly influenced by reduced seed rate, methods of sowing on different varieties of soybean.

Seed rate

The reduced seed rate of soybean revealed that seed yield was recorded significantly highest in normal seed rate of 70kg/ha compared to reduced seed rates of 60 and 50kg/ha. Significantly higher seed yield in normal seed rate of 70kg/ha may be due to significantly higher plant population (22.58/m^2), plant height (36.57cm), branches per plant (5.14), pods per plant (84.38) and 100 seed weight (15.55g) in normal seed rate of 70kg/ha compared to reduced seed rates.

Methods of sowing

Ridge & furrow sowing methods recorded significantly highest soybean seed of 750 kg/ha compared to flatbed sowing method (694 kg/ha).Seed yield in Ridge & furrow sowing methods may be due to significantly higher plant height (37.21cm),branches per plant (4.90), pods per plant (89.08) and 100 seed weight (13.09g) compared to flatbed sowing method.

Varieties

Soybean varieties recorded significant differences for yield and its attributing characters except for pant population and pods per plant. Medium duration variety JS 20-29recorded significantly highest seed yield (892kg/ha) followed by early duration variety JS 20-34(680kg/ha) and RVS 2001-4(595 kg/ha). Significant highest seed yield of JS 20-29 may be attributed due to significantly higher plant height (36.33 cm), branches per plant (5.05), pods per plant (86.08) and 100 seed weight (15.55g) compared to early variety.

Table 4.10: Performance of soybean varieties over different seed rate and sowing methods for yield and yield attributing traits at RVSKVV, Gwalior during 2018

	Treatments	Plant population / M^2	Plant height at maturity	Branches per plant	No of pods per plant	100 seed wt	Grain yield /plot kg	grain yield kg/ha
	I. seed rates Kg/ha							
T1	70 kg/ha	22.58	36.57	5.14	84.38	15.55	0.744	1033.1
T2	60 kg/ha	17.17	31.08	4.99	64.58	12.63	0.372	516.7
T3	50 kg/ha	16.21	36.33	4.53	101.46	10.31	0.444	617.1
	SE(m)	0.32	0.43	0.04	1.23	0.00	0.009	12.3
	CD 5%	0.90	1.22	0.10	3.50	0.16	0.025	35.0
	II. Sowing methods							
S1	ridge &furrow	18.39	37.21	4.90	89.08	13.09	0.540	750.3
S2	flat bed	18.92	32.11	4.88	77.86	12.57	0.500	694.3
	SE(m)	0.44	0.34	0.07	1.73	0.13	0.012	16.0

	CD 5%	NS	0.97	0.19	4.94	0.38	0.033	45.5
	III. Varieties							
V1	JS 20-29	18.58	36.33	5.05	86.04	15.55	0.642	891.6
V2	JS 20-34	18.54	31.53	4.63	82.17	12.63	0.490	679.9
V3	RVS 2001-4	18.83	36.13	4.98	82.21	10.31	0.429	595.4
	SE(m)	0.54	0.42	0.08	2.12	0.16	0.014	19.6
	CD 5%	NS	1.45	0.28	NS	0.57	0.049	67.7

Interaction effects

Interaction effect of seed rates, sowing methods and varieties did not significantly influence the seed yield. 70 kg/ha seed rate with all 3 varieties (T1V1, T1V2, T1V3) recorded significantly higher plant population /m^2 and branches per plant compared to reduced seed rate and variety combination. 70 kg/ha seed rate of JS 20-29 (T1V1) recorded significantly higher plant population, plant height, branches per plant, pods per plant and 100 seed weight.

70 kg/ha seed rate with ridge& furrow sowing method (T1S1) recorded significantly higher plant population, plant height, branches per plant.

JS 20-29 with ridge & furrow sowing method (S1V1)recorded significantly higher branches per plant and 100 seed weight.

$T_3V_1S_2$, $T_1V_1S_1$, $T_1V_1S_2$recorded significantly Plant height at maturity, 100 seed weight, number of pods/plants, respectively.

Table 4.11: Interaction effects of soybean varieties over different seed rate and sowing methods for yield and yield attributing traits at RVSKVV, Gwalior during 2018

Treatment combination	Plant population / M^2	Plant height at maturity	Branches per plant	No of pods per plant	100 seed wt	Grain yield /plot kg	grain yield /ha
Interaction effects of soybean varieties over different seed rate							
T1V1	**21.00**	**40.13**	**5.29**	**102.75**	**19.64**	0.864	1199.8
T1V2	**22.38**	32.93	**5.03**	92.00	17.28	0.791	1099.0
T1V3	**24.38**	36.65	**5.10**	58.38	15.68	0.576	800.5
T2V1	17.88	29.30	4.90	42.00	15.68	0.552	766.5
T2V2	19.00	27.28	4.35	59.13	9.89	0.291	404.2
T2V3	14.63	36.65	5.73	92.63	6.34	0.273	379.3
T3V1	16.88	39.55	4.95	113.38	11.34	0.510	708.5
T3V2	14.25	34.38	4.51	95.38	10.74	0.386	536.6
T3V3	17.50	35.08	4.13	95.63	8.91	0.437	606.3
SE(m)	0.94	0.73	0.14	3.68	0.02	0.284	394.1
CD 5%	2.68	2.07	0.39	10.48	0.07	NS	NS

Interaction effects of different seed rate and sowing methods							
T1S1	**21.42**	**39.87**	**5.75**	70.17	17.48	0.882	1224.5
T1S2	**23.75**	33.27	**4.53**	98.58	**17.58**	0.606	841.7
T2S1	17.25	32.55	4.43	75.58	12.01	0.365	506.7
T2S2	17.08	29.60	5.56	53.58	9.26	0.379	526.6
T3S1	16.50	39.20	4.52	**121.50**	9.78	0.374	519.8
T3S2	15.92	33.47	4.54	81.42	10.88	0.514	714.5
SE(m)	0.77	0.59	0.11	3.00	0.02	0.232	321.8
CD 5%	2.19	1.69	0.32	8.55	0.06	NS	NS
Interaction effects of soybean varieties and sowing methods							
V1S1	18.17	35.70	**5.01**	80.25	**17.77**	0.821	1140.7
V1S2	19.00	**37.17**	4.78	**94.33**	11.19	0.365	507.3
V2S1	18.00	**38.75**	4.91	92.67	10.31	0.434	603.0
V2S2	19.00	36.95	**5.08**	91.83	13.33	0.463	642.5
V3S1	18.08	25.88	4.48	70.00	14.08	0.614	852.5
V3S2	19.67	33.50	5.06	71.75	10.31	0.423	587.7
SE(m)	**0.77**	**0.59**	**0.11**	**3.00**	**0.02**	**0.232**	**321.8**
CD 5%	**NS**	**1.69**	**0.32**	**8.55**	**0.06**	**NS**	**NS**
Interaction effects of soybean varieties over different seed rate and sowing methods							
T1V1S1	20.3	43.5	24.1	64.0	**20.30**	1.270	1763.9
T1V1S2	21.8	36.8	18.2	**141.5**	18.98	0.458	635.8
T1V2S1	22.8	37.4	21.9	93.3	15.45	0.640	888.9
T1V2S2	22.0	28.5	18.3	90.8	19.10	0.943	1309.0
T1V3S1	21.3	38.8	23.0	53.3	16.68	0.735	1020.8
T1V3S2	27.5	34.5	17.8	63.5	14.68	0.418	580.2
T2V1S1	17.5	32.9	18.4	48.0	16.95	0.549	762.2
T2V1S2	18.3	25.8	20.8	36.0	14.40	0.555	770.8
T2V2S1	19.3	27.9	16.2	63.0	12.03	0.248	344.8
T2V2S2	18.8	26.7	18.6	55.3	7.75	0.334	463.5
T2V3S1	15.0	36.9	18.5	115.8	7.05	0.298	413.2
T2V3S2	14.3	36.4	**27.3**	69.5	5.63	0.249	345.5
T3V1S1	16.8	30.8	17.6	128.8	16.05	0.645	896.2
T3V1S2	17.0	**48.3**	22.0	98.0	6.63	0.375	520.8
T3V2S1	15.0	46.3	19.2	126.8	6.10	0.208	288.2
T3V2S2	13.5	22.5	16.9	64.0	15.38	0.565	785.1
T3V3S1	17.8	40.6	17.4	109.0	7.20	0.270	375.0
T3V3S2	17.3	29.6	15.6	82.3	10.63	0.603	837.5
SE(m)	**1.3**	**1.0**	**0.2**	**5.2**	**0.03**	**0.401**	**557.4**
CD 5%	**NS**	**2.92**	**0.56**	**14.81**	**0.10**	**NS**	**NS**

Germination percentage

Seed samples showed germination % ranging between 86 % to 90 %and it was not significantly influenced by various treatment combination of seed rates, sowing methods and varieties.

Insect and disease infestation

Soybean crop not affected in the experiment by both diseases and insect pest during the year.

Economics of reduced seed rates

Reduction in seed rate did not enhance the seed yield nor improve quality of the seed production thus there was not enhancement in gain in terms of rupees.

5. IISR, Indore

Table 4.12 Effect of variety, sowing method and seed rate on seed yield and quality parameters of soybean

Treatments	Plant population /m^2	Plant height (cm)	Plant canopy diameter (cm)	No. of branches per plant	No. of pods per plant	Seed yield per plant (g)	Seed Yield per ha (q)	100 seed weight (g)	Germination (%)
Variety									
V_1: NRC 86	42.67	62.021	47.008	5.875	32.200	5.157	21.046	10.620	71.333
V_2: JS 20-34	40.94	41.442	39.167	4.167	23.759	6.176	24.722	13.919	92.708
SE ±	0.513	0.3676	0.1741	0.1077	0.1851	0.0813	0.2968	0.0463	0.3816
CD at 5%	2.088	1.496	0.708	0.438	0.753	0.331	1.208	0.187	1.553
Sowing method									
S_1-Flat bed	36.983	52.021	41.988	4.792	27.924	6.320	22.890	12.073	80.000
S_2-Ridges & furrow	46.629	51.442	44.188	5.250	28.035	5.013	22.877	12.466	84.042
SE ±	0.513	0.3676	0.1741	0.1077	0.1851	0.0813	0.2968	0.0463	0.3816
CD at 5%	2.577	1.832	0.868	0.536	0.922	0.405	1.479	0.229	1.902
Seed rate									
T_0 - Recommended seed rate @ 70 kg/ha	47.625	53.088	43.656	4.625	27.228	4.872	22.779	12.322	82.438
T_1 - Reduced seed rate	42.425	51.194	42.781	5.063	28.013	5.562	23.328	12.273	81.438

@ 60kg/ha									
T_2 - Reduced seed rate @ 50kg/ha	35.369	50.912	42.825	5.375	28.697	6.567	22.545	12.214	82.188
SE ±	0.6283	0.4502	0.2133	0.1319	0.2267	0.0996	0.3635	0.0567	0.4674
CD at 5%	2.557	1.832	0.868	0.536	0.922	0.405	1.4798	0.229	1.902

Table 4.13: Average performance of soybean varieties for yield and quality attributing traits as influenced by reduced seed rate and sowing method

Treatment	Plant Population per m^2	Plant Height (cm)	Canopy diameter (cm)	Number of branches per plant	Number of pods per plant	Yield per plant (g)	Yield per ha (q)	100 seed wt (g)	Germination (%)
V1S1T0	40.8	64.5	47.1	5.5	30.5	4.8	19.37	10.26	69.5
V1S1T1	35.8	61.6	46.5	5.5	31.9	5.9	21.02	10.36	71.0
V1S1T2	30.0	62.9	45.8	5.8	32.2	7.1	21.30	10.42	71.8
V1S2T0	57.3	62.4	48.0	5.8	32.5	3.8	21.57	11.11	72.5
V1S2T1	48.2	61.3	47.4	6.3	32.7	4.6	21.94	10.86	72.5
V1S2T2	43.9	59.5	47.3	6.5	33.5	4.8	21.06	10.71	70.8
V2S1T0	44.3	42.2	38.5	3.5	23.5	5.8	25.49	13.82	91.5
V2S1T1	40.7	40.3	36.4	4.0	24.3	6.3	25.83	13.72	86.8
V2S1T2	30.3	40.7	37.6	4.5	25.2	8.0	24.32	13.85	89.5
V2S2T0	48.1	43.3	41.0	3.8	22.5	5.1	24.68	14.09	96.3
V2S2T1	44.9	41.7	40.9	4.5	23.2	5.5	24.52	14.15	95.5
V2S2T2	37.3	40.6	40.6	4.8	24.0	6.3	23.49	13.88	96.8
Mean	**41.8**	**51.7**	**43.1**	**5.02**	**27.98**	**5.7**	**22.88**	**12.27**	**82**
CV%	**6.01**	**3.48**	**1.98**	**10.51**	**3.24**	**7.03**	**6.35**	**1.85**	**2.28**
CD(0.05P)									
VxSxT	**3.616**	**2.591**	**1.227**	**0.758**	**1.304**	**0.573**	**2.092**	**0.325**	**2.690**

Conclusion:

With the increase in seed rate, plant population was significantly higher in both the varieties. Plant population was higher in ridge and furrow method than flat bed method which signifies better seedling emergence and better survivability of seedlings and plants. The plant canopy was not significantly varied with the change in seed rate. The number of primary branches was significantly increased with reduced seed rate in case of ridge and furrow method of early maturing JS 20-34. In other cases there was no significant change in number of branches. The productivity was not changed with the change of seed rate but yield per plant was significantly increased with decrease in seed rate. The incidence of Rhizoctonia aerial blight and charcoal rot was high in NRC 86 as compared to JS 20-34.

The 100 seed weight was unchanged with seed rate. The seed size was found more in case of ridge and furrow method over flat bed method irrespective of varieties. The seed quality (seed germination) was significantly more in case of JS 20-34 than NRC 86 which may be due to lower incidence of diseases in JS 20-34. Seed quality was significantly improved with ridge and furrow method of sowing. The seed rate had no significant impact on seed germination.

The plant canopy in case of JS 20-34 is less than the row spacing. Thus, there is scope to reduce row spacing for maximum utilization of resources by such early maturing varieties.

6. VNMKV,Parbhani

The experiment was conducted with three seed rate, two sowing method, and two varieties in split plot design with four replication during 2018-19. The analyzed data on performance of soybean varieties for yield and yield attributing traits as influenced by reduced seed rate and sowing method was presented in Table 4.14.

Plant population per sq. meter was found significant. Reduction in seed rate resulted in reduction in plant population (m^2), where as reduction in seed rate resulted in increase in plant canopy diameter (cm). Both varieties with reduction in seed rate was found non significant for plant height. The Variety JS-93-05 was recorded significantly highest number of branches per plant as compared to MAUS-162. Whereas reduction in the seed rate was found non significant for number of branches per plant .

Reduction in seed rate was found significant for number of pods per plant and 100 seed weight (g). The variety MAUS-162 was recorded highest number of pods per plant as compared to JS-93-05. Reduction in seed rate resulted in increased in number of pods per plant and 100 seed weight (g). The variety MAUS-162 was recorded significantly highest seed yield kg/ha as compared to JS-93-05. The seed rate @ 70 kg/ha was recorded higher seed yield kg/ha but it was found at par with reduced seed rate @ 60 kg/ha as compared to seed rate @ 50 kg/ha.

Seed quality parameters recorded at 60 days after harvesting were found non significant

for germination percentage, seedling length and dry matter, vigour index-I and vigour index-II.

Soybean crop was found to be infested with the major pathogens like soybean mosaic virus (SMV), anthracnose (AN) and charcoal rot (CR) in recommended seed rate as compared to reduced seed rate.

Conclusion:

Plant population (m^2) was found decreased with reduced seed rate ranges from 42.2 to 27.0 per m^2, whereas plant canopy diameter increased with reduced seed rate. Number of pods per plant and 100 seed weight (g) were found increased with reduced seed rate as compared to recommended seed rate. The variety MAUS-162 found suitable for reduction in the recommended seed rate up to 60 kg/ha than JS-93-05. The recommended seed rate was recorded highest seed yield (2158 kg/ha) due to higher plant population but it was found at par with reduced seed rate @ 60 kg/ha (2091 kg/ha). Reduction in seed rate was found non significant for seed quality parameters, where as soybean seed was found to be infested with major pathogens in recommended seed rate as compared to reduced seed rate.

Table: 4.14.Performance of soybean verities for yield and yield attributing traits as influenced by reduced seed rate and sowing method at VNMKV, Parbhani during 2018

Treatments	Plant Population (m^2)	Plant Canopy Diameter (cm)	Plant Height (cm)	No of Branches /Plant	Pods/Plant	100 Seed Weight (g)	Seed Yield kg/ha	Seed quality Parameters at 60 DAH				
								Germination %	Seedling length (cm)	Seedling dry weight (g)	Vigour Index-I	Vigour Index-II
$T_0S_1V_1$	40.2	32.2	93.7	1.8	42.2	10.65	2158	97.7	20.4	0.90	1851	81.6
$T_1S_1V_1$	35.2	34.5	92.2	2.3	58.0	11.47	2091	90.5	23.4	0.92	2121	83.3
$T_2S_1V_1$	29.5	46.0	93.0	2.4	61.8	11.92	1678	87.5	20.6	0.97	1806	84.8
$T_0S_2V_1$	40.0	29.5	91.5	1.5	44.6	10.71	2125	90.0	22.5	0.99	2025	89.1
$T_1S_2V_1$	35.2	34.5	91.9	2.4	52.3	11.65	2078	92.0	24.1	0.89	2173	81.8
$T_2S_2V_1$	28.2	46.2	91.9	2.7	58.7	12.00	1607	90.7	21.7	0.96	1970	87.1
$T_0S_1V_2$	41.7	30.0	43.6	1.9	39.5	10.31	1939	89.5	22.1	0.96	1982	85.9
$T_1S_1V_2$	35.5	37.0	40.3	2.9	43.1	10.91	1790	90.0	24.6	0.84	2214	75.6
$T_2S_1V_2$	29.7	42.0	43.3	2.6	44.0	11.92	1482	90.5	21.4	0.93	1892	84.2
$T_0S_2V_2$	42.0	30.5	46.4	2.1	38.7	10.86	1883	89.2	22.6	0.93	2014	82.9
$T_1S_2V_2$	34.7	38.7	42.3	2.8	43.4	10.95	1734	90.5	23.9	0.91	2176	82.3
$T_2S_2V_2$	27.0	43.5	42.0	3.3	45.9	11.96	1418	90.0	20.8	0.95	1876	85.5
Mean	**34.9**	**36.9**	**67.7**	**2.4**	**47.7**	**11.23**	**1828**	**90.2**	**22.4**	**0.93**	**2008**	**83.7**
Varieties												
SE±	**0.31**	**0.39**	**0.48**	**0.11**	**0.84**	**0.12**	**22.2**	**0.41**	**0.24**	**0.02**	**23.6**	**0.51**
CD	**0.92**	**1.19**	**NS**	**0.34**	**2.55**	**0.37**	**66.7**	**NS**	**NS**	**NS**	**NS**	**NS**
Seed Rate												
SE±	**0.37**	**0.48**	**0.59**	**0.14**	**1.03**	**0.15**	**27.2**	**0.50**	**0.30**	**0.03**	**28.9**	**0.54**
CD	**1.13**	**1.46**	**NS**	**NS**	**3.12**	**0.45**	**81.7**	**NS**	**NS**	**NS**	**87.2**	**NS**

Sowing												
Method	**0.28**	**0.27**	**1.01**	**0.11**	**1.28**	**0.10**	**27.4**	**0.37**	**0.20**	**0.02**	**21.1**	**0.66**
SE±	**NS**	**NS**	**3.02**	**0.35**	**3.81**	**0.30**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
CD												
S x V	**1.19**	**1.13**	**NS**	**NS**	**5.39**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
V x T	**1.60**	**2.1**	**NS**	**NS**	**4.42**	**NS**	**115.6**	**NS**	**NS**	**NS**	**123.4**	**NS**
S x T	**NS**	**1.39**	**NS**	**NS**	**NS**	**NS**	**141.1**	**NS**	**NS**	**NS**	**NS**	**NS**
S x V x T	**NS**	**1.96**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
CV%	**4.1**	**3.9**	**7.4**	**2.4**	**13.2**	**4.6**	**9.5**	**2.4**	**4.5**	**11.7**	**5.2**	**4.9**

7. UAS, Dharwad

Table 4.15: Average performance of soybean varieties as influenced by reduced seed rate and sowing method for yield and quality attributing traits at UAS, Dharwad during 2018

Treatment	Plant population (m^2)		Plant height at maturity (cm)		Number of branches per plant		Plant canopy diameter		Number of pods per plant	
Varieties	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05
Sowing methods										
S1: Hand dibbling with ridge and furrow	127.58	178.25	39.51	47.50	6.80	6.35	41.50	36.53	90.87	79.99
S2: Flat bed	126.50	169.25	37.80	45.44	6.18	5.94	40.19	35.38	88.00	77.46
SEm±	2.04	1.75	0.61	0.74	0.10	0.09	0.38	0.34	0.84	0.74
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Seed rates										
T0 : 70 kg/ha	151.13	187.25	40.89	49.17	5.32	4.84	39.70	34.95	86.93	76.52
T1: 60 kg/ha	127.00	176.38	41.45	49.83	7.03	6.77	40.20	35.39	88.03	77.49
T2: 50 kg/ha	103.00	157.63	33.61	40.42	7.11	6.84	42.63	37.52	93.34	82.16
SEm±	1.36	1.16	0.41	0.49	0.07	0.06	0.25	0.22	0.56	0.49
CD(0.05P)	5.30	4.53	1.59	1.91	0.25	0.22	NS	NS	NS	NS
Interaction										
S1T0	147.50	182.00	41.75	50.20	5.65	4.88	40.01	35.22	87.60	77.11
S1T1	154.75	192.50	40.04	48.14	4.99	4.80	39.39	34.67	86.25	75.92
S1T2	135.50	185.00	44.22	53.17	7.45	7.16	40.74	35.86	89.20	78.52

S2T0	118.50	167.75	38.67	46.50	6.62	6.37	39.67	34.92	86.86	76.46
S2T1	99.75	167.75	32.55	39.14	7.30	7.02	43.75	38.51	95.80	84.33
S2T2	106.25	147.50	34.67	41.69	6.93	6.66	41.51	36.54	90.88	80.00
SEm±	4.09	3.49	1.23	1.47	0.20	0.17	0.76	0.67	1.67	1.47
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	12.86	8.04	12.69	12.70	12.12	11.20	7.48	7.49	8.48	7.50

Table 4.16: Average performance of soybean varieties as influenced by reduced seed rate and sowing method for yield and quality attributing traits at UAS, Dharwad during 2018.

Treatment	**Yield per plant (kg)**		**Yield per hector (q)**		**1000 seed weight (g)**		**Germination (%)**		**Seedling length (cm)**	
Varieties	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05
Sowing methods										
S1: Hand dibbling with ridge and furrow	33.61	29.59	24.34	20.24	151.69	137.63	95.42	91.50	21.95	21.05
S2: Flat bed	32.55	28.65	23.28	19.36	146.89	133.28	97.25	90.25	22.37	20.76
SEm±	0.31	0.27	0.38	0.31	1.40	1.27	0.33	0.39	0.08	0.09
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Seed rates										
T0 : 70 kg/ha	32.16	28.31	25.19	20.95	145.11	131.66	95.50	89.38	21.97	20.56
T1: 60 kg/ha	32.56	28.67	25.53	21.23	146.95	133.33	95.50	92.00	21.97	21.16
T2: 50 kg/ha	34.53	30.39	20.71	17.22	155.81	141.37	98.00	91.25	22.54	20.99

SEm±	0.21	0.18	0.25	0.21	0.93	0.84	0.22	0.26	0.05	0.06
CD(0.05P)	NS	NS	0.98	0.81	NS	NS	NS	NS	NS	NS
Interaction										
S1T0	32.41	28.53	25.72	21.39	146.24	132.68	93.75	92.75	21.56	21.33
S1T1	31.91	28.09	24.66	20.51	143.98	130.63	97.25	86.00	22.37	19.78
S1T2	33.00	29.05	27.24	22.65	148.90	135.10	95.50	91.75	21.97	21.10
S2T0	32.13	28.29	23.82	19.81	145.00	131.56	95.50	92.25	21.97	21.22
S2T1	35.44	31.20	20.05	16.68	159.92	145.10	97.00	90.00	22.31	20.70
S2T2	33.62	29.59	21.36	17.76	151.71	137.65	99.00	92.50	22.77	21.28
SEm±	0.62	0.54	0.76	0.63	2.79	2.53	0.66	0.79	0.15	0.18
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	3.07	NS	0.71
CV (%)	7.48	6.50	12.69	10.70	8.61	7.48	12.72	9.47	6.72	10.47

Table 4.17: Average performance of soybean varieties as influenced by reduced seed rate and sowing method for yield and quality attributing traits at UAS, Dharwad during 2018

Treatment	**Seedling vigour index-I**		**Seedling dry weight (mg)**		**Seedling vigour index-II**		**B: C ratio**	
Varieties	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05
Sowing methods								
S1: Hand dibbling with ridge and furrow	2097	1927	1.92	1.86	183.19	170.03	2.82	2.35
S2: Flat bed	2176	1878	2.00	1.94	194.58	174.93	2.82	2.36
SEm±	14	17	0.01	0.01	0.88	0.83	0.05	0.04

CD(0.05P)	NS	NS	0.02	0.02	3.42	NS	NS	NS
Seed rates								
T0 : 70 kg/ha	2101	1840	1.90	1.84	181.07	163.75	2.93	2.45
T1: 60 kg/ha	2098	1950	2.00	1.94	190.92	178.16	3.03	2.53
T2: 50 kg/ha	2209	1916	1.99	1.92	194.68	175.54	2.50	2.09
SEm±	9	11	0.00	0.00	0.59	0.56	0.03	0.03
CD(0.05P)	NS	NS	0.02	0.02	2.28	2.16	0.12	0.10
Interaction								
S1T0	2028	1979	1.81	1.75	169.12	162.16	2.94	2.46
S1T1	2175	1701	1.99	1.92	193.01	165.35	2.92	2.44
S1T2	2098	1938	1.99	1.92	189.59	176.41	3.15	2.63
S2T0	2098	1963	2.01	1.95	192.25	179.90	2.90	2.42
S2T1	2164	1863	1.97	1.91	190.87	171.53	2.35	1.96
S2T2	2255	1969	2.01	1.94	198.49	179.55	2.65	2.21
SEm±	0.62	0.54	0.76	0.63	2.79	2.53	0.66	0.79
CD(0.05P)	NS	NS	NS	NS	NS	NS	NS	3.07
CV (%)	5.19	7.01	5.58	2.58	6.73	8.87	12.96	10.96

Table 4.18: Average performance of soybean varieties as influenced by reduced seed rate and sowing method for yield and quality attributing traits at UAS, Dharwad during 2018

Treatment	Seedling vigour index-I		Seedling dry weight (mg)		Seedling vigour index-II		B: C ratio	
Varieties	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05
Sowing methods								
S1: HDR&F	**2097**	**1927**	**1.92**	**1.86**	**183.19**	**170.03**	**2.82**	**2.35**
S2: Flat bed	**2176**	**1878**	**2.00**	**1.94**	**194.58**	**174.93**	**2.82**	**2.36**
SEm±	**14**	**17**	**0.01**	**0.01**	**0.88**	**0.83**	**0.05**	**0.04**
CD(0.05P)	**NS**	**NS**	**0.02**	**0.02**	**3.42**	**NS**	**NS**	**NS**
Seed rates								
T0 : 70 kg/ha	**2101**	**1840**	**1.90**	**1.84**	**181.07**	**163.75**	**2.93**	**2.45**
T1: 60 kg/ha	**2098**	**1950**	**2.00**	**1.94**	**190.92**	**178.16**	**3.03**	**2.53**
T2: 50 kg/ha	**2209**	**1916**	**1.99**	**1.92**	**194.68**	**175.54**	**2.50**	**2.09**
SEm±	**9**	**11**	**0.00**	**0.00**	**0.59**	**0.56**	**0.03**	**0.03**
CD(0.05P)	**NS**	**NS**	**0.02**	**0.02**	**2.28**	**2.16**	**0.12**	**0.10**
Interaction								
S1T0	**2028**	**1979**	**1.81**	**1.75**	**169.12**	**162.16**	**2.94**	**2.46**
S1T1	**2175**	**1701**	**1.99**	**1.92**	**193.01**	**165.35**	**2.92**	**2.44**
S1T2	**2098**	**1938**	**1.99**	**1.92**	**189.59**	**176.41**	**3.15**	**2.63**
S2T0	**2098**	**1963**	**2.01**	**1.95**	**192.25**	**179.90**	**2.90**	**2.42**
S2T1	**2164**	**1863**	**1.97**	**1.91**	**190.87**	**171.53**	**2.35**	**1.96**
S2T2	**2255**	**1969**	**2.01**	**1.94**	**198.49**	**179.55**	**2.65**	**2.21**
SEm±	**28**	**33**	**0.01**	**0.01**	**1.76**	**1.67**	**0.09**	**0.08**
CD(0.05P)	**NS**	**130**	**0.05**	**0.05**	**6.85**	**NS**	**NS**	**NS**
CV (%)	5.19	7.01	**2.58**	**2.58**	**3.73**	**3.87**	**12.96**	**12.96**

Table 4.19: Effect of reduced seed rate and sowing methods on seed germination (%) during storage at UAS, Dharwad during 2018

	Storage studies at monthly interval							
	Oct-18		**Nov-18**		**Dec-18**		**Jan-19**	
Varieties	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05
Sowing methods								
S1: HDR&F	93.51	89.67	90.30	87.24	87.22	84.28	83.98	81.68
S2: Flat bed	95.31	88.45	92.31	85.83	89.43	82.81	86.51	79.98
SEm±	0.32	0.39	0.27	0.31	0.23	0.25	0.18	0.16
CD(0.05P)	NS	NS	1.03	NS	0.91	NS	0.71	0.64
Seed rates								
T0 : 70 kg/ha	93.59	87.59	90.00	84.99	86.86	82.06	83.55	79.52
T1: 60 kg/ha	93.59	90.16	90.95	88.34	87.90	85.08	85.02	81.73
T2: 50 kg/ha	96.04	89.43	92.97	86.27	90.22	83.49	87.17	81.25
SEm±	0.21	0.26	0.18	0.21	0.16	0.16	0.12	0.11
CD(0.05P)	NS	NS	0.69	0.80	0.61	0.64	0.47	0.42
Interaction								
S1T0	91.88	90.90	87.93	88.16	84.58	85.10	80.79	82.75
S1T1	95.31	84.28	92.08	81.82	89.15	79.03	86.31	76.29
S1T2	93.59	89.92	90.95	88.16	88.01	85.56	85.16	82.41
S2T0	93.59	90.41	90.95	88.52	87.78	84.61	84.88	81.05
S2T1	95.06	88.20	92.02	85.38	89.07	82.19	86.00	79.89
S2T2	97.02	90.65	93.92	87.16	91.37	84.80	88.33	82.61
SEm±	0.64	0.77	0.53	0.62	0.47	0.49	0.36	0.33
CD(0.05P)	NS	3.00	NS	2.41	NS	1.92	1.42	1.27
CV (%)	2.72	3.47	2.32	2.87	2.12	2.36	1.71	1.62

Table 4.20: Effect of reduced seed rate and sowing methods on Seedling length (cm) during storage at UAS, Dharwad during 2018

	Storage studies at monthly interval							
	Oct-18		**Nov-18**		**Dec-18**		**Jan-19**	
Varieties	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05
Sowing methods								
S1: HDR&F	21.51	20.62	20.77	20.06	20.14	19.38	19.41	18.79
S2: Flat bed	21.92	20.34	21.23	19.74	20.57	19.05	19.90	18.40
SEm±	0.07	0.09	0.06	0.07	0.06	0.06	0.05	0.04
CD(0.05P)	NS	NS	0.24	NS	0.24	NS	0.21	0.15
Seed rates								
T0 : 70 kg/ha	21.53	20.15	20.70	19.55	20.09	18.87	19.36	18.29
T1: 60 kg/ha	14.35	13.82	13.95	13.55	13.48	13.05	13.04	12.53
T2: 50 kg/ha	14.73	13.71	14.25	13.23	13.83	12.80	13.37	12.46
SEm±	NS	NS	0.04	0.05	0.04	0.04	0.04	0.03
CD(0.05P)	0.19	0.23	0.16	0.19	0.16	0.15	0.14	0.10
Interaction								
S1T0	21.13	20.91	20.22	20.28	19.68	19.57	18.86	19.03
S1T1	21.92	19.38	21.18	18.82	20.50	18.18	19.85	17.55
S1T2	21.53	20.68	20.92	20.28	20.24	19.68	19.59	18.96
S2T0	21.53	20.79	20.92	20.36	20.19	19.46	19.52	18.64
S2T1	21.86	20.29	21.16	19.64	20.49	18.90	19.78	18.37
S2T2	22.31	20.85	21.60	20.05	21.01	19.50	20.32	19.00
SEm±	0.15	0.18	0.12	0.14	0.12	0.11	0.11	0.08
CD(0.05P)	NS	0.69	NS	0.56	NS	0.44	NS	0.29
CV (%)	2.72	3.47	2.32	2.87	2.38	2.36	2.18	1.62

Table: 4.21. Effect of reduced seed rate and sowing methods on Seedling vigour-I index during storage at UAS, Dharwad during 2018

	Storage studies at monthly interval							
	Oct-18		**Nov-18**		**Dec-18**		**Jan-19**	
Varieties	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05	V1 : DSb-21	V2 : JS-93-05
Sowing methods								
S1: HDR&F	2014	1851	1878	1751	1758	1634	1632	1535
S2: Flat bed	2090	1803	1961	1698	1840	1580	1722	1473
SEm±	13	16	11	12	9	10	7	6
CD(0.05P)	NS	NS	41	NS	36	NS	29	24
Seed rates								
T0 : 70 kg/ha	2018	1767	1866	1664	1748	1551	1620	1457
T1: 60 kg/ha	1343	1249	1268	1198	1185	1111	1108	1025
T2: 50 kg/ha	1415	1227	1326	1142	1248	1069	1165	1013
SEm±	9	11	7	8	6	6	5	4
CD(0.05P)	NS	NS	NS	32	24	25	19	16
Interaction								
S1T0	1947	1901	1783	1788	1669	1666	1526	1575
S1T1	2089	1634	1950	1540	1828	1437	1713	1339
S1T2	2015	1861	1903	1788	1782	1684	1668	1562
S2T0	2015	1885	1903	1806	1772	1649	1657	1512
S2T1	2078	1790	1948	1677	1825	1554	1701	1468
S2T2	2165	1891	2029	1748	1920	1654	1795	1570
SEm±	27	32	21	25	19	19	15	12
CD(0.05P)	NS	NS	82	97	NS	74	58	47
CV (%)	5.19	7.01	4.41	5.79	4.14	4.75	3.57	3.24

Conclusion:

Among the different seed rate of soybean evaluated significantly increased plant height was recorded with higher seed rate (70 kg/ha), whereas the significantly higher number of branches , number of pods, yield per plant and seed quality parameters were significant with reduced seed rate of 60 kg / ha irrespective of varieties whereas, the total yield per ha was significantly higher in 60

kg/ha seed rate and on par with 70 kg/ ha seed rate irrespective of varieties, reduced seed rate of 60 kg/ha can be recommended to farmers since it has recorded significantly higher returns compare to 70 and 50 kg/ha seed rate.

From the storage studies it was noticed that seed cultivated with 70 kg/ha seed rate were maintained quality parameters for longer period on par with 60 kg/ha seed rate, whereas lowest quality parameters were noticed with 50 kg/ha seed rate.

8. PDKV, Akola

Method of sowing

There was no significant different between methods of sowing *viz.*, flat bed and ridges and furrow among the all character under study.

Reduced seed rate

In three treatment of seed rate i.e. (70kg/ha, 60Kg/ha and 50Kg/ha), Plant population /m2, plant height at maturity (cm), yield/ha, 100 seed weight , seed vigour index-I and seed vigour index-II has shown significant differences. The remaining character has shown Non-significant differences.

Treatment 70 kg/ha was resulted in high Plant population /m^2 (32.42), higher plant height at maturity (32.36 cm), high yield /ha (22.38q/ha), and high seed vigour index-I (2438.29) as compared to seed rate 60 and 50 kg/ha. Seed rate 50 kg/ha has shown significantly higher 100 seed weight(g) (12.87g) and Seed vigiour index-II (49.62) as compare to seed rate 70 kg/ha and 60 kg/ha.

Interaction effects for seed yield and quality parameters of Soybean (SxTxV)

Interaction effect of (SxTxV) has shown significance effect on plant population/m^2, Number of pods/plant and yield/ha. For Plant population/m2, interaction effect of S1T0V1 showed significantly high plant population/m^2 (34.45) and another interaction $S_2T_0V_2$(33.84), and $S_1T_0V_2$(33.59) showed at par value compare to other interactions.

In Number of pods / plant interaction ($S_1T_2V_1$) show significantly highest no of pods/ plant (50.60) among the all interaction. Interaction $S_2T_2V_1$ (48.58), $S_1T_1V_1$ (48.30) were at par with the other treatments. Yield/ha, the interaction S1T0V1 showed significantly highest yield/ha (23.26q/ha) and treatments S2T0V1 (22.71q), $S_1T_1V_1$(22.44q) and $S_2T_0V_2$(22.37q) showed at par result.

Interaction effects of seed rate X genotype under study

Only one character i.e. Number of pods/plant has shown significant effect. Treatment S1xV1 has recorded high number of pods/plant (46.47). Treatment S_2V_2(46.10) and S_2V_1(44.93) show at par results.

Interaction effects of Variety X Treatment

For genotype of treatment (V x T), plant population/m^2, plant height at maturity (cm), Number of branches/plant, Number of pods/plant, yield/plant, yield/ha, 100 seed weight (g) has shown significant interaction, in plant population/m^2 in interaction V_1T_0 (34.07) show high value among the treatment, followed by treatment V_2T_1(33.72) which showed at par effect.

Interaction effects of Sowing X Treatment

In interaction effects of treatment (S x T), following character, Number of pods/plant, and yield/plant has shown significant interaction, in number of pods/plant treatment S2T2 (47.61) showed highest value among the treatment. Treatment S1T0 (47.53) show at par result.

In yield/plant treatment S1T0 (21.04g) showed significantly high yield per plant among the treatment. Treatment S2T1(20.92), S2T2(20.86), S1T1(20.48g) showed at par effect.

Seed quality parameters after two months during storage

In plant height at maturity (cm) treatment V1T0(32.79cm) show significantly high value among the treatment and V2T0(31.94) &V2T1(31.63) show at par value. Treatment V1T1 significantly show high number of pods/plant(48.28) as well as high yield/plant(22.56g). For number of branches/plant, treatment V1T1(16.40) showed highest number and treatment V2T2(15.95)& V2T0(15.60) showed at par effect. In case of yield/ha, the treatment V1T1(22.98q) showed significantly highest yield/ha and treatment V2T0(21.77q) showed at par value. In 100seed weight(g), among the interaction, V1T2(13.08) showed significantly highest value.

In Seed germination (%), interaction effect (V X T) treatment S2T0 (87.00) showed significantly highest % of germination among the treatment and treatment V1T1(85.50) & V1T0(85.25) show at par effect.

1) For 70 kg seed rate /ha significantly recorded highest plant population/ha as well as plant height at maturity, highest yield/ha and high seed vigour index I.
2) For 60 kg /ha seed rate showed maximum number of at par value
3) For 50 kg/ha seed rate has showed significantly highest 100 seed weight as well as seed vigour index II

Table 4.22: Effect of sowing methods and reduced seed rate on seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatments	Plant population/m^2	Plant height at maturity (cm)	Plant canopy diameter (cm)	Number of branches/plant	Number of pods/plant	Yield/plant (g)

Sowing Methods						
Hand dibbling with ridges and furrow (S_1)	30.92	30.73	30.22	15.35	45.18	20.30
Flat bed (S_2)	30.14	30.95	30.31	15.18	45.51	20.35
SEm ±	**0.21**	**0.09**	**0.42**	**0.12**	**0.30**	**0.25**
CD at 5%	**0.96**	**NS**	**NS**	**NS**	**NS**	**NS**
Reduced seed rate						
Recommended seed rate @ 70 Kg/ha (T_0)	32.42	32.36	29.31	15.19	45.26	20.15
Reduced seed rate @ 60 Kg/ha (T_1)	30.67	30.99	30.26	15.15	45.64	20.70
Reduced seed rate @ 50 Kg/ha (T_2)	28.50	29.17	31.23	15.44	45.14	20.12
SEm ±	**0.16**	**0.44**	**0.84**	**0.27**	**0.33**	**0.32**
CD at 5%	**0.50**	**1.36**	**NS**	**NS**	**NS**	**NS**

Table 4.23: Effect of sowing methods and reduced seed rate on seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatments	**Yield/ha (q/ha)**	**100 seed weight (g)**	**Seed Germination (%)**	**Seed Vigour Index-I (SVI-I)**	**Seed Vigour Index-II (SVI-II)**
Sowing Methods					
Hand dibbling with ridges and furrow (S_1)	20.37	12.04	85.88 -67.92	2289.63	43.14
Flat bed (S_2)	20.38	12.08	87.13 -68.98	2348.16	44.96
SEm ±	**0.26**	**0.08**	**0.43**	**20.34**	**0.85**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**
Reduced seed rate					
Recommended seed rate @ 70 Kg/ha (T_0)	22.38	11.2	88.94 -70.57	2438.29	39.27
Reduced seed rate @ 60 Kg/ha (T_1)	20.54	12.11	85.94	2347.55	43.26

			-67.98		
Reduced seed rate @ 50 Kg/ha (T_2)	18.21	12.87	84.63	2170.85	49.62
			-66.92		
SEm ±	**0.35**	**0.16**	**1.34**	**67.17**	**1.1**
CD at 5%	**1.08**	**0.51**	**NS**	**206.98**	**3.4**

*Figures in parenthesis are arc sin values.

Table 4.24: Interaction effects influenced seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatment (S X T XV)	Plant population/m^2	Plant height at maturity (cm)	Plant canopy diameter (cm)	Number of branches/plant	Number of pods/plant	Yield/plant (g)
S1T0V1	34.45	33.10	28.83	15.03	46.75	20.10
S1T1V1	31.13	32.23	29.80	16.05	48.30	21.98
S1T2V1	28.71	30.78	31.60	16.68	50.60	23.04
S2T0V1	33.69	32.48	28.50	14.55	42.18	17.95
S2T1V1	30.42	31.65	30.10	15.15	43.80	20.59
S2T2V1	26.55	29.95	31.00	16.13	45.95	22.08
S1T0V2	33.59	31.25	28.55	13.80	40.08	17.92
S1T1V2	29.56	29.08	30.73	14.70	42.05	18.57
S1T2V2	28.08	27.98	31.80	15.82	43.28	20.20
S2T0V2	33.84	32.00	29.90	14.00	45.93	19.76
S2T1V1	29.59	31.18	30.78	15.15	46.65	20.34
S2T2V1	26.77	28.45	31.60	16.08	48.58	21.37
SEm ±	**0.44**	**0.62**	**1.05**	**0.44**	**1.01**	**0.71**
CD at 5%	**1.31**	**NS**	**NS**	**NS**	**2.99**	**NS**

Table 4.25: Interaction effects influenced seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatment (S X T XV)	Yield/ha (q/ha)	100 seed weight (g)	Seed Germination (%)	Seed Vigour Index-I (SVI-I)	Seed Vigour Index-II (SVI-II)
S1T0V1	23.26	11.48	87.25(69.09)	2373.65	39.27
S1T1V1	22.44	11.32	89.50(71.36)	2420.80	36.96
S1T2V1	20.80	11.44	89.00(70.64)	2362.35	38.74
S2T0V1	22.71	11.44	90.00(72.02)	2465.00	43.44
S2T1V1	21.11	10.53	89.00(70.88)	2493.70	37.40
S2T2V1	18.52	11.01	88.50(70.39)	2461.50	38.79

S1T0V2	20.47	12.80	81.00(64.42)	2240.10	45.84
S1T1V2	18.44	12.89	84.50(67.15)	2204.70	49.97
S1T2V2	16.84	12.29	84.00(66.89)	2136.20	48.04
S2T0V2	22.37	13.16	85.25(67.42)	2326.25	49.65
S2T1V1	19.91	13.26	84.50(66.84)	2084.30	48.94
S2T2V1	17.67	13.04	85.50(67.73)	2258.20	51.52
SEm ±	**0.67**	**0.41**	**1.99**	**102.31**	**2.30**
CD at 5%	**1.98**	**NS**	**NS**	**NS**	**NS**

***Figures in parenthesis are arc sin values.**



STRU Field : Soybean Crop



STRU Field : Soybean Crop

Table 4.26: Interaction effects influenced seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatment (S X V)	Plant population/m^2	Plant height at maturity (cm)	Plant canopy diameter (cm)	Number of branches/plant	Number of pods/plant	Yield/plant (g)
S1V1	30.90	30.98	30.38	15.47	46.47	20.57
S1V2	30.93	30.48	30.05	15.22	43.88	20.04
S2V1	29.94	31.20	30.09	15.28	44.93	20.12
S2V2	30.34	30.70	30.53	15.08	46.10	20.57
SEm ±	**0.25**	**0.36**	**0.61**	**0.25**	**0.58**	**0.41**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**1.727**	**NS**

Table 4.27: Interaction effects influenced seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatment (S X V)	Yield/ha (q/ha)	100 seed weight (g)	Seed Germination (%)	Seed Vigour Index-I (SVI-I)	Seed Vigour Index-II (SVI-II)
S1V1	20.83	11.94	86.92 (68.79)	2313.57	42.66
S1V2	19.92	12.14	84.83 (67.08)	2265.70	43.61
S2V1	20.38	11.91	87.67 (69.44)	2336.93	43.73
S2V2	20.38	12.25	86.58 (68.51)	2359.38	46.19
SEm ±	**0.39**	**0.23**	**1.15**	**59.07**	**1.33**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**

***Figures in parenthesis are arc sin values.**

Table 4.28: Interaction effects influenced seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatment (V X T)	Plant population/m^2	Plant height at maturity	Plant canopy diameter (cm)	Number of branches/plant	Number of pods/plant	Yield/plant (g)

		(cm)				
V1T0	34.07	32.79	28.66	14.79	44.46	19.02
V1T1	27.63	30.36	31.30	16.40	48.28	22.56
V1T2	29.57	30.13	30.75	14.93	44.35	19.46
V2T0	30.77	31.94	29.95	15.60	46.05	21.29
V2T1	33.72	31.63	29.23	13.90	43.00	18.84
V2T2	27.43	28.21	31.70	15.95	45.93	20.79
SEm ±	**0.31**	**0.44**	**0.74**	**0.31**	**0.71**	**0.50**
CD at 5%	**0.93**	**1.29**	**NS**	**0.92**	**2.12**	**1.50**

Table 4.29: Interaction effects influenced seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatment (V X T)	Yield/ha (q/ha)	100 seed weight (g)	Seed Germination (%)	Seed Vigour Index-I (SVI-I)	Seed Vigour Index-II (SVI-II)
V1T0	22.98	11.47	88.63 -70.29	2419.33	41.36
V1T1	19.66	11.23	88.75 -70.4	2411.93	38.77
V1T2	19.17	13.08	84.5 -66.81	2144.5	49.46
V2T0	21.77	10.93	89.25 -70.86	2457.25	37.18
V2T1	21.42	12.98	83.13 -65.75	2283.18	47.75
V2T2	17.26	12.67	84.75 -67.01	2197.2	49.78
SEm ±	**0.47**	**0.29**	**1.41**	**72.35**	**1.62**
CD at 5%	**1.4**	**0.85**	**NS**	**NS**	**4.83**

***Figures in parenthesis are arc sin values.**

Table 4.30: Interaction effects influenced seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatment (S X T)	Plant population/m^2	Plant height at maturity	Plant canopy diameter (cm)	Number of branches/plant	Number of pods/plant	Yield/plant (g)

		(cm)				
S1T0	32.79	32.66	29.31	15.54	47.53	21.04
S1T1	31.15	31.01	30.08	15.24	45.34	20.48
S1T2	28.82	28.53	31.26	15.26	42.66	19.39
S2T0	32.05	32.06	29.30	14.85	42.99	19.27
S2T1	30.19	30.98	30.45	15.06	45.94	20.92
S2T2	28.18	29.81	31.19	15.61	47.61	20.86
SEm ±	**0.23**	**0.62**	**1.19**	**0.39**	**0.46**	**0.45**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**1.43**	**1.38**

Table 4.31: Interaction effects influenced seed yield and quality parameters of Soybean at PDKV, Akola during 2018

Treatment (S X T)	Yield/ha (q/ha)	100 seed weight (g)	Seed Germination (%)	Seed Vigour Index-I (SVI-I)	Seed Vigour Index-II (SVI-II)
S1T0	22.85	11.41	88.38 -70.07	2397.23	38.12
S1T1	20.64	12.13	85 -67.21	2301.23	42.29
S1T2	17.64	12.59	84.25 -66.62	2170.45	49.01
S2T0	21.91	10.99	89.5 -71.09	2479.35	40.42
S2T1	20.45	12.09	86.88 -68.76	2393.88	44.23
S2T2	18.79	13.15	85 -67.21	2171.25	50.23
SEm ±	**0.5**	**0.23**	**1.89**	**94.99**	**1.56**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**

***Figures in parenthesis are arc sin values**

Table 4.32: Seed quality parameters after two months during storage of Soybean at PDKV, Akola during 2018

Treatments	Seed Germination (%)	Seedling length (cm)	Seed Vigour (GP X SL)
Sowing Methods			

Hand dibbling with ridges and furrow (S_1)	82.83 -65.52	26.5	2195.85
Flat bed (S_2)	83.67 -66.16	26.54	2220.47
SEm ±	**0.89**	**0.21**	**22.35**
CD at 5%	**NS**	**NS**	**NS**
Reduced seed rate			
Recommended seed rate @ 70 Kg/ha (T_0)	86.13 -68.13	26.7	2301.63
Reduced seed rate @ 60 Kg/ha (T_1)	82.75 -65.46	26.13	2160.36
Reduced seed rate @ 50 Kg/ha (T_2)	80.88 -64.07	26.73	2162.49
SEm ±	**1.45**	**0.4**	**54.06**
CD at 5%	**NS**	**NS**	**NS**

***Figures in parenthesis are arc sin values.**

Table 4.33: Interaction effect of Soybean at PDKV, Akola during 2018

Treatment (S X T XV)	Seed Germination (%)	Seedling length (cm)	Seed Vigour (GP X SL)
S1T0V1	84.50 (66.82)	26.85	2269.10
S1T1V1	87.50 (69.39)	27.75	2427.00
S1T2V1	86.50 (68.47)	24.55	2126.10
S2T0V1	86.00 (68.56)	26.30	2268.10
S2T1V1	86.50 (68.53)	25.90	2242.30
S2T2V1	84.50 (66.95)	25.90	2187.50
S1T0V2	77.50 (61.76)	26.20	2029.90

S1T1V2	79.50 (63.23)	26.53	2106.10
S1T2V2	81.50 (65.13)	27.13	2216.90
S2T0V2	82.50 (65.34)	27.86	2297.93
S2T1V1	81.50 (64.54)	27.26	2221.96
S2T2V1	81.00 (64.17)	26.00	2105.00
SEm ±	**1.70**	**0.94**	**108.01**
CD at 5%	**NS**	**NS**	**NS**

*Figures in parenthesis are arc sin values.

Table 4.34: Interaction effect of Soybean at PDKV, Akola during 2018

Treatment (S X V)	Seed Germination (%)	Seedling length (cm)	Seed Vigour (GP X SL)
S1V1	83.50 (66.03)	25.98	2167.10
S1V2	82.17 (65.02)	27.03	2224.60
S2V1	84.00 (66.42)	26.49	2225.86
S2V2	83.33 (65.90)	26.59	2215.08
SEm ±	**0.98**	**0.54**	**62.36**
CD at 5%	**NS**	**NS**	**NS**

***Figures in parenthesis are arc sin values.**

Table 4.35: Interaction effect of Soybean at PDKV, Akola during 2018

Treatment (V X T)	Seed Germination (%)	Seedling length (cm)	Seed Vigour (GP X SL)
V1T0	85.25 (67.41)	26.58	2268.60
V1T1	85.50 (67.61)	25.23	2156.80
V1T2	80.50 (63.79)	26.90	2164.03
V2T0	87.00 (68.86)	26.83	2334.65
V2T1	80.00	27.03	2163.92

	(63.43)		
V2T2	81.25 (64.34)	26.57	2160.95
SEm ±	**1.12**	**0.67**	**76.38**
CD at 5%	**3.56**	**NS**	**NS**

*Figures in parenthesis are arc sin values.

Table 4.36: Interaction effect of Soybean at PDKV, Akola during 2018

Treatment (S X T)	Seed Germination (%)	Seedling length (cm)	Seed Vigour (GP X SL)
S1T0	86.00 (68.03)	27.30	2348.05
S1T1	82.00 (64.89)	25.38	2078.00
S1T2	80.50 (636.79)	26.83	2161.50
S2T0	86.25 (68.23)	26.10	2255.20
S2T1	83.50 (66.03)	26.88	2242.72
S2T2	81.25 (64.34)	26.63	2163.48
SEm ±	**2.05**	**0.57**	**76.45**
CD at 5%	**NS**	**NS**	**NS**

***Figures in parenthesis are arc sin values.**

9. PJTSAU, Hyderabad

Table 4.37: Influence of seed rates and methods of sowing on Soybean yield attributes, yield and seed quality characters at PJTSAU, Hyderabad during *kharif*, 2018

Treatments	Plant height (cm)	Number of branches/ plant	Number of pods/ plant	Seed yield (kg/ha)	Straw weight (kg/ha)	HI (%)
Main plots: Seed rates						
T_0: Recommended seed rate @ 70 kg/ha	52.3	3.9	49.7	2476	4648	34.6
T_1: Reduced seed rate @ 60 kg/ha	49.1	4.7	58.1	2397	4713	33.7
T_2: Reduced seed rate @ 50 kg/ha	42.6	6.2	70.1	2305	4745	32.7
S.em±	2.8	0.46	4.1	102.0	190.0	1.5
CD (at 5%)	9.8	1.6	14.3	NS	NS	NS
CV (%)	11.8	18.7	13.9	8.5	8.0	9.2
Sub plots: Methods of sowing						
S_1: Hand dibbling with ridge & furrow	50.8	5.7	62.3	2527	4654	35.2
S_2: Flat Bed	45.2	4.2	56.4	2259	4750	32.2
S.em±	1.5	0.34	2.4	100.2	182.3	1.0
CD (at 5%)	5.0	1.0	7.7	320.7	NS	3.3
CV (%)	8.0	16.8	9.9	10.2	9.4	7.4
Interaction						
S.em±	1.6	0.36	2.5	106.3	193.4	1.0
CD (at 5%)	NS	NS	NS	NS	NS	NS
CV (%)	8.0	16.9	9.9	10.3	9.5	7.5

Table 4.38: Influence of seed rates and methods of sowing on Soybean yield attributes, yield and Seed quality characters at PJTSAU, Hyderabad during *kharif*, 2018

Treatments	Germination %	Root length(cm)	Shoot length (cm)	Total length(cm)	Seed ling vigour index
Main plots: Seed rates					
T_0: Recommended seed rate @ 70 kg/ha	97.5	8.31	6.27	14.58	1419
T_1: Reduced seed rate @ 60 kg/ha	96.6	8.00	5.98	13.98	1355
T_2: Reduced seed rate @ 50 kg/ha	95.1	8.16	6.33	14.49	1379
S.em±	0.320	0.160	0.201	0.222	21.366
CD (at 5%)	1.102	0.553	0.698	0.771	73.937
CV (%)					
Sub plots: Methods of sowing					
S_1: Hand dibbling with ridge & furrow	96.3	8.46	6.04	14.50	1397
S_2: Flat Bed	96.33	7.85	6.34	14.22	1371
S.em±	0.640	0.151	0.181	0.276	33.815
CD (at 5%)	2.047	0.483	0.581	0.771	108.181
CV (%)	2.302	6.417	10.165	6.682	8.464
Interaction					
S.em±	0.846	0.244	0.300	0.405	46.602
CD (at 5%)	2.740	0.810	0.996	1.330	151.648

Conclusion:

- Among the various seed rates, 70 kg/ha recorded highest seed yield of 2476 kg/ha seed yield, followed by 2397 kg/ha with 60 kg/ha seed rate.
- Among the different methods of sowing, hand dibbling with ridge & furrow method is found to be superior as compared to the flat bed method in terms of soybean yield (2527 kg/ha)
- Interaction effect between seed rates and methods of sowing was found to be non-significant for all the yield attributes including seed yield & straw weight.

Experiment 5: Redefining isolation distance of IMSCS 2013 in pigeonpea, cotton and maize.

Year of start: 2018-19

Objectives: To redefine isolation distance of contaminants for foundation and certified seed production of pigeon pea, cotton and maize.

Centers:

Crop	**Centres**
Pigeon pea	PJTSAU, Hyderabad; MPKV, Rahuri, GBPUAT, Pantnagar
Cotton	PDKV, Akola; CICR, Nagpur; HAU, Hisar; UAS, Dharwad; JAU, Jamnagar
Maize	IARI, New Delhi; UAS, Dharwad; PAU, Ludhiana and GBPUAT, Pantnagar

Observation to be recorded: Seed setting percentage in contaminator line should be recorded from all four directions at different distances in the following format.

Pigeon pea (Foundation: 250m and certified seed: 100m as per IMSCS 2013 norms)

% Seed Set					
Directions	100m	150m	200m	250m	300m
West					
East					
North					
South					

Cotton (Foundation: 50m and certified seed: 30m as per IMSCS 2013 norms)

% Seed set				
Directions	25m	50m	75m	100m

West				
East				
North				
South				

Maize (Foundation: 600m and certified seed: 400m as per IMSCS 2013 Norms)

% Seed Set							
Directions	400m	450m	500m	550m	600m	650m	700m
West							
East							
North							
South							

Unified observation

1. **Cotton**

   The experiment was allotted to five centres and four centres viz., PDKV Akola, UAS Dharwad, JAU Jamnagar and HAU Hissar conducted the experiment during Kharif, 2018. Average over the locations revealed that seed setting in A-line at all isolation distance from 25m to 100 m was reported. The boll set was also observed in large isolation distance (75 m and 100m) may be due to presence of fertile plant in respective CMS lines. The fertile plant in test plots may be due to either breaking of male sterility or mixture of CMS line with B line. Therefore, it is suggested that centre (PDKV Akola) should supply stable and pure CMS line seeds at the right time to executing centers.

2. **Pigeonpea**

   The experiment was allotted to three centres however, only two centres conducted the experiments namely PJTSAU, Hyderabad and MPKV, Rahuri. Average over the locations revealed that the no. of flowers/plant (660), no of pods per plant (499), pod setting (75.96%), no of seeds/pod (4.00), no of seeds/plant (1762) and seed weight/plant (123.3gm) was significantly highest in the recipient A line at the isolation distance of 100m from the pollinator B line. The pod setting percentage was gradually decreased to 68.90, 39.37, 27.40 and 18.33 in the isolation distance of 150m, 200m, 250 and 300m respectively. Since pod setting is noticed even at isolation distance of 300m, further study will be continued with increased isolation upto 500m.

3. **Maize**

   The experiment was allotted to four centres namely; IARI, New Delhi, UAS, Dharwad, GBPUAT, Pantnagar and PAU, Ludhiana. However, the experiment was not concluded because the experiment was failed due to damage of crop by the attack of Neel Gai at two centres *viz.,* IARI, New Delhi, and PAU, Ludhiana except UAS, Dharwad who does

not conducted the experiment and GBPUAT, Pantnagar the experiment was failed due to damage of crop by heavy rainfall.

Significant observation:

In cotton, seed setting in A-line at all isolation distance from 25m to 100 m was reported. The boll set was also observed in large isolation distance (75 m and 100m) may be due to presence of fertile plant in respective CMS lines. Therefore, it is suggested that centre (PDKV Akola) should supply stable and pure CMS line seeds at the right time to executing centres. In pigeon pea, pod setting was even noticed at distance of 300m, study may be continued at higher isolation distance upto 500m. In maize, the experiment does not reach into any conclusion, because the experiment was failed due to damage of crop by the attack of Neel Gai at two centres viz., IARI, New Delhi, and PAU, Ludhiana except UAS, Dharwad who does not conducted the experiment and GBPUAT, Pantnagar the experiment was failed due to damage of crop by heavy rainfall.

Pigeon Pea

MPKV, Rahuri

The isolation distance showed significant effect on pod and seed characteristics of pigeon pea recipient A-line (ICP 2043 A) and presented in table 5.1.

It was observed that the number of flowers per plant (660), number of pods per plant (499), pod setting (75.96 %), number of seeds per pod (4.00), number of seeds per plant (1762) and seed weight per plant (123.35 g) was significantly highest in the recipient A line (ICP 2043 A) at the isolation distance of 100 m. from the pollinator B line (ICP 2043 B). The pod setting % was gradually decreased to 68.90, 39.37, 27.40 and 18.33 in the isolation distance of 150, 200, 250 and 300m respectively. The other pod characters also followed same trend.

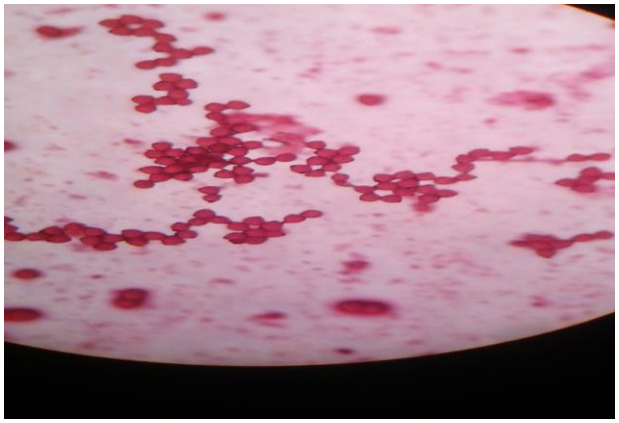
Table 5.1: Effect of isolation distance on pod and seed characteristics of pigeon pea recipient A line (ICP 2043 A) at MPKV, Rahuri

Isolation distance (m)	Number of flowers/plant	Number of pods/plant	Pod setting (%)	Number of seeds/ pod	Number of seeds/ plant	Seed weight/plant (g)
100 m	659.80	498.60	75.96 (60.64)	4.00	1762.20	123.35
150 m	581.00	398.80	68.90 (56.10)	3.20	1178.40	82.49
200 m	554.60	218.20	39.37 (38.86)	2.80	491.80	34.43

250 m	470.60	126.60	27.40 (31.56)	2.20	189.40	11.74
300 m	384.20	68.60	18.33 (25.35)	1.40	58.20	3.96
SE ±	46.464	20.627	2.141	0.259	79.620	5.561
CD at 5%	139.306	61.842	6.418	0.776	238.711	16.673



Field view of experiment



Viable pollen grains in A line (Recipient) ICP-2043 A

Table 5.2: Percentage seed set in pigeon pea during 2018 at PJTSAU, Hyderabad

Directions	Seed Set				
	100 m	150 m	200 m	250 m	300 m
West	-	68.4	-	-	-
East	46.8	-	-	-	-
North	-	-	77.76	120	-
South	-	-	-	-	0

Table 5.3: Influence of isolation distance on the performance of yield contributing characters during 2018 at PJTSAU, Hyderabad

Isolation distance(m)	No. of flowers per	No. of pods per	Pod setting	No .of seeds per	No. of seeds per	Seed weight per

	plant	plant	(%)	pod	plant	plant (g)
100m	572.6	25.0	4.36	3.4	46.8	56.4
150m	582.6	18.0	3.08	3.8	68.4	62.8
200m	602.8	21.6	3.85	3.6	77.76	58.4
250m	612.0	39.0	6.37	3.8	120.8	29.35
300m	512.0	Nil	Nil	Nil	Nil	Nil

Conclusion: After observing the percentage seed set on A-lines planted at different isolation distances, maximum seed set (120) is observed in 250 m isolation distance between A & B lines when compared to other isolation distances, which is followed by 200m and 100m isolation distances. No seed set (0%) is observed in 300m isolation distance between A&B lines.

Cotton

JAU, Jamnagar

The isolation distance was verified from 25 to 100m towards all the four directions *i.e.* East, West, North & South as per technical programme. The total ball set as well as number of plant are counted in each test plot (CMS lines) in all four direction & all isolation distances. Average ball set per plant was calculated in test plot as shown in Table 5.4.

The results revealed that maximum mean ball set per plant (9.76) was recorded at 25m isolation distance, while, minimum mean ball set per plant (3.22) was observed at 100m isolation distance. As the distance of test plot (CMS line) increased from the contaminant plot (male plot), mean ball set per plant in test plot decreased. The ball set was also observed in large isolation distances (i.e. at 75m & 100m), it may be due to presence of fertile plants in respective test plots. The fertile plants in test plots may be due to either breaking of male sterility or mixture of CMS line with B-line.

Suggestion(s), if any: The seeds of female line should be supplied stable CMS line seeds as well as pure seeds.

Table 5.4: Average ball set per plant and plant stand in test plot (CMS line) of cotton at JAU, Jamnagar (Gujarat) during *kharif*-2018.

	Isolation Distance (ID)									
	25 m		50 m		75 m		100 m		(Mean D)	
	Av. Ball set/plant	Plant stand	Av. Ball set/plant	Plant stand	Av. Ball set/plant	Plant stand	Av. Ball set/plant	Plant stand	Av. Ball set/plant	Plant stand
West	11.13	16 [3]*	6.79	14 [2]	4.73	15 [2]	5.33	24 [4]	**7.00**	**17.25[2.75]**
East	12.58	19 [4]	6.63	16 [2]	5.60	10 [2]	1.50	12 [0]	**6.58**	**14.25[2.00]**
North	6.85	13 [1]	7.11	9 [2]	3.83	6 [0]	3.42	12[2]	**5.30**	**10.00[1.25]**
South	8.47	17 [1]	6.94	17 [3]	4.25	24 [1]	2.64	25 [1]	**5.58**	**20.75[1.50]**
(Mean ID)	**9.76**	**16.25 [2.25]**	**6.87**	**14.00 [2.25]**	**4.60**	**13.25 [1.25]**	**3.22**	**18.25 [1.75]**	--	--

***In brackets indicated number of fertile plant observed in test plot (CMS line).

PDKV, Akola

Due to break down of male sterility of A line or mechanical admixture in parental CMS line (CAK-023A), bolls setting was occurred at all isolation distance (25m, 50m, 75m, 100m.)

Percentage of Boll setting = (Total number of bolls setting per plant/ Total number of flowers per plant) X 100

Direction	**25m**	**50m**	**75m**	**100m**
East	44.42	53.98	40.21	32.42
South	61.12	55.20	39.33	46.33

(Observation was recorded on the basis of 10 plants at all isolation distance i.e. 25m, 50m, 75m, 100m)

CCSHAU, Hisar

Seeds from all the distances were harvested and grow out test will be conducted in coming kharif season to know the effect of pollen. Due to late receiving of seed from Seed Technology Research Unit, Dr. PDKV, Akola the quality of seed is very poor.

Conclusion or Salient Finding(s): Conclusion will be drawn after completion of the experiment.

Suggestion(s), if any: The seed should be supplied in time *i.e.* before April so that the experiment may be laid out well in time.

UAS, Dharwad

	Percentage of seed setting			
Distance	25 m	50 m	75 m	100 m
Along the wind direction	99.6 %	83.7. %	67.3 %	21.50 %

Conclusion or salient findings:

Seed setting percentage (99.60) was highest at 25 m and decreased with increase in distance between pollen parent and seed parent and observed lowest (21.50 %) seed setting at a distance of 100 m. Since seed setting was recorded at 100 m distance, experiment need to continue next season with increased distance of 125 m and 150 m until seed setting percentage on seed parent becomes zero.

Experiment 6: Redefining IMSCS 2013 for seed standard ODV in rice.

Year of start: 2018-19

Centres: PJTSAU, Hyderabad, TNAU, Coimbatore, PAU, Ludhiana (Punjab), IARI New Delhi, OUAT, Bhubaneshwar, ICAR-IISS, Mau, NDUAT, Faizabad

Rationale

Foundation Seed: Spacing of 20×10 cm leads to 500000 plant population; SMR of paddy is 80; field standard (off-type) of 0.05% corresponds to 250 off types plants/ha i.e 250*80= 20000 seed /25 q, whereas ODV/kg corresponds to 8/kg through field standard calculation however prescribe limit for ODV is 10/kg as per IMSCS standard, 2013.

Certified Seed: Spacing of 20×10 cm leads to 500000 plant population; as SMR of paddy is 80; field standard (off-type) of 0.2% corresponds to 1000 off-type plants/ha i.e. 1000*80= 80000 seeds/25 q and whereas ODV/kg corresponding to 32/kg through field standard calculation however prescribed seed standard for ODV is 20/kg, corresponds to disparity among field and seed standards as per IMSCS, 2013. Hence seed standard i.e., ODVs limit for paddy needs to be redefined.

Objective

1. To redefine IMSCS 2013 norms for ODVs (No/kg) in foundation seed class of rice
2. To redefine IMSCS 2013 norms for ODVs (No/kg) in certified seed class of rice

Methodology

Plot size: 10×4 cm (40 cm^2 approximate plant population shall be 2000 plants) with spacing of 20×10 cm

Replication: 3

Treatment

A. Foundation Seed class (maximum permitted off-types as per IMSCS, 2013 is 0.05%)
   Treatment: 2000 seeds (Breeder seed) with one admixture (ODV)
   Whereas, 2000 seeds (Breeder seed) of popular rice varieties (at least three varieties, one from each distinct group *viz.,* small, medium and long) may be taken and a single seed (ODV) should be intentionally mixed for referred study.
B. Certified Seed class (maximum permitted off-types as per IMSCS, 2013 is 0.2%)
   Treatment: 2000 seeds (Foundation seed) with four admixtures (ODV)
   Whereas 2000 seeds (Foundation seed) of popular rice varieties (at least three varieties, one from each distinct group viz., small, medium and long) may be taken and four seeds (ODV) should be intentionally mixed for referred study.

Observation to be recorded

Entire quantity of seed produce (each replication of a variety should be handled separately) shall be bulked and mixed thoroughly (BS to FS and FS to CS), from this, 400 g of sample may be extracted by proper mixing and dividing. Referred samples may be carefully analyzed for presence of ODV by keeping reference samples as check.

Unified observation

This experiment was conducted at five centres *viz.,* NDUAT Faizabad, IISS Mau, OUAT Bhubaneshwar, PAU Ludhiana and PJTSAU Hyderabad.

In case of foundation seed, there is no need to redefine ODV standards, as ODV observed (10.19 No./Kg.) was at par with ODV as per IMSCS, 2013 (10 No./Kg.).

In case of certified category of seed, there is a need to redefine ODV standards, as ODV observed (35 No./Kg. of seed) is significantly higher than standard referral ODV as per IMSCS, 2013 (20 No./Kg.).

Significant observation:

In case of foundation seed, there is no need to redefine ODV as per IMSCS, 2013 as ODV observed (10.19 No./Kg.) was at par with ODV as per IMSCS, 2013 (10 No./Kg.). In case of certified category of seed, there is a need to redefine referral ODV, as ODV observed (35 No./Kg. of seed) is significantly higher than standard referral ODV as per IMSCS, 2013 (20 No./Kg.).

Table: 6.1 Average no. of ODV Observed in foundation and certified classes over the location

Class of seed	ODV observed	ODV as per IMSCS, 2013 (No./Kg)
Foundation		
Small (Swarna)	12.38	10
Medium (Sarjoo 52)	8.17	10
Long (PB 1)	10.03	10
Mean	**10.19**	**10.00**
Certified		
Small (Swarna)	41.33	20
Medium (Sarjoo 52)	30.33	20
Long (PB 1)	32.67	20
Mean	**34.78**	**20.00**

OUAT, Bhubaneshwar

The samples were carefully analyzed for presence of ODV by keeping reference samples as check.Result obtained from 400 g working sample (three replications) was extrapolated to 1000 g to get the no. of ODVs/kg, which are presented in Tables 6.2 and 6.3.

Table 6.2: ODVs observed in FS samples at OUAT, Bhubaneshwar during *Kharif*2018

Class of seed	ODV observed in 400 g working sample	ODV (no./kg)	ODV as per IMSCS, 2013 (no/ kg)
Small			10
R_1	2	5.0	
R_2	2	5.0	
R_3	3	7.5	
Medium			

R_1	1	2.5	
R_2	3	7.5	
R_3	2	5.0	
Long			
R_1	3	7.5	
R_2	2	5.0	
R_3	3	7.5	

Table 6.3: ODVs observed in CS samples at OUAT, Bhubaneshwar during *Kharif*2018

Class of seed	ODV observed in 400 g working sample	ODV (no./kg)	ODV as per IMSCS, 2013 (no/ kg)
Small			20
R_1	6	15.0	
R_2	9	22.5	
R_3	7	17.5	
Medium			
R_1	8	20.0	
R_2	10	25.0	
R_3	5	12.5	
Long			
R_1	9	22.5	
R_2	6	15.0	
R_3	9	22.5	



Experimental plot



Separation of ODVs from samples

TNAU, Coimbatore

Foundation seed

The results revealed that as per IMSCS, 2013 in small grain paddy, seeds produced from without admixture plot recorded lower number of ODV (14 numbers) than the seeds harvested from the plot with admixture added (36 numbers). In medium grain paddy also same trend of results were obtained. In the admixture added plots more number of ODV (32.0 numbers) was observed than control plot (12.0 numbers). In long grain also more numbers of ODV was observed in admixture plot (22 numbers) than control (9 numbers).

Certified seed

The results revealed that as per IMSCS, 2013 in small grain paddy, seeds produced from without admixture plot recorded lower number of ODV (8 numbers) than the seeds harvested from the plot with admixture added (19 numbers). In medium grain paddy also same trend of results were obtained. In the admixture added plots more number of ODV (23.0 numbers) was observed than control plot (7.0 numbers). In long grain also more numbers of ODV was observed in admixture plot (22 numbers) than control (11 numbers).

Salient findings

Paddy seeds produced from control plot i.e. without addition of admixture plant recorded the IMSCS prescribed standard of ODV both in foundation and certified seeds. In case of admixture added plots more numbers of ODV was recorded than the IMSCS prescribed standard.

Paddy verities selected for ODV Experiment



CR 1009 **TRY 3 (Ad)** **TKM13** **ADT 39 (Ad)** **MDU6** **Anna (R) 4 (Ad)**

PAU, Ludhiana

Results: Table 6.4 gives the observed ODV values as per the conducted experiment. In the foundation seed of both the medium seeded and long seeded varieties, none of the replications had any mixture (ODV). However, in the certified seed of medium seeded variety, ODV was found to be present @ 3/kg of seed in only 1 replication while in the certified seed of long seeded variety, ODV was found to be present @ 3/kg of seed in 2 of the 3 replications.

Table 6.4: Observed ODV in Foundation and Certified seed of rice at PAU, Ludhiana during 2018.

Class of seed	ODV observed (No/ kg)	Class of seed	ODV observed (No/ kg)
Foundation		**Certified**	
Medium seeded variety		Medium seeded variety	
R_1	0	R_1	3
R_2	0	R_2	0
R_3	0	R_3	0
Long seeded variety		Long seeded variety	
R_1	0	R_1	0

R_2	0	R_2	3
R_3	0	R_3	3

PJTSAU, Hyderabad

Quantity of seed produced per plot (replication-wise and variety-wise) were mixed thoroughly (BS to FS and FS to CS). From the produce of each plot, 400 g working sample was extracted by proper mixing and dividing. The samples were carefully analyzed for presence of ODV by keeping reference samples as check. Result obtained from 400 g working sample (three replications) was extrapolated to 1000 g to get the no. of ODVs/kg, which are presented in the below table 6.5.

Table 6.5: Observed ODV in Foundation and Certified seed of rice at PJTSAU, Hyderabad during 2018.

Class of seed	ODV observed in 400 g working sample	ODV observed (No/kg)	ODV as per IMSCS,2013 (No/kg)
Foundation			
Small (RNR 15048)			
R1	5	13	10
R2	4	10	10
R3	4	10	10
Medium (BPT 5204)			
R1	4	10	10
R2	4	10	10
R3	3	7.5	10
Long (KNM 118)			
R1	4	10	10
R2	3	7.5	10
R3	4	10	10
Certified			
Small (RNR 15048)			
R1	15	37.5	20
R2	16	40	20
R3	15	37.5	20
Medium (BPT 5204)			
R1	15	37.5	20
R2	14	35	20
R3	12	30	20
Long (KNM 118)			
R1	13	32.5	20
R2	14	35	20
R3	11	27.5	20



Rice crop in the field at SRTC, Hyderabad

ICAR, IISS, Mau

Results: Three samples each of 1000 g were drawn from each group as replications in laboratory. The ODV was determined on entire 1000 g of sample drawn. In foundation seed multiplication stage, observed ODVs (no/kg) in all three groups i.e. small, medium and long was found to be within prescribed limit of 10/kg of seed. While in certified seed production stage of small, medium and long type, observed ODVs (no/kg) were higher than the prescribed limit of 20/ kg i.e. 23.3 seeds/kg, 23.7 seeds/kg and 21.0 seeds/kg, respectively.

Table 6.6: Cultivars employed in the study at ICAR, IISS, Mau during 2018

Group	**Breeder to Foundation multiplication** (Breeder seed used)	**Foundation to Certified multiplication** (Foundation seed used)
Small (S)	RajendraSwetha- 2000 plant MTU 7029- 01 plant	RajendraSwetha- 2000 plant MTU 7029- 04 plant
Medium (M)	CO 51- 2000 plant RajendraSwetha- 01 plant	CO 51- 2000 plant RajendraSwetha- 04 plant
Long (L)	HUR 105- 2000 plant Pusa Basmati 1- 01 plant	HUR 105- 2000 plant Pusa Basmati 1- 04 plant

Table 6.7: Observed ODVs (no/kg) among small, medium and long type in foundation and certified seed multiplication plots at ICAR-IISS, Mau during Kharif, 2018

Class of seed	**ODV observed(No/ kg)**	**ODV as per IMSCS, 2013 (No/ kg)**

Foundation		
Small		
R1	7	10
R2	11	
R3	8	
Mean	**8.7**	
Medium		
R1	4	
R2	10	
R3	9	
Mean	**7.7**	
Long		
R1	12	
R2	7	
R3	6	
Mean	**8.3**	
Certified		
Small		20
R1	31	
R2	22	
R3	18	
Mean	**23.7**	
Medium		
R1	16	
R2	26	
R3	28	
Mean	**23.3**	
Long		
R1	18	
R2	21	
R3	24	
Mean	**21.0**	

Conclusion: First year results suggest that, there is need to relax ODV standards for certified seed class in IMSCS, 2013 from 20/kg to 25/kg.

NDUAT, Faizabad

Results: The ODV observed (No./kg) seed in three categories is presented in table 6.8. The results are very conspicuous over varieties as well as seed classes.

Table 6.8: ODV observed (No./kg) over seed classes and varieties in rice at Ayodhya center during *Kharif* 2018.

Class of seed	ODV observed (No./kg)	ODVas pr IMSCS 2013 (No./kg)
Foundation		
Small (Swarna)		10/kg

R1	24/kg	
R2	25/kg	
R3	23/kg	
Medium (Sarjoo 52)		
R1	19/kg	
R2	20/kg	
R3	18/kg	
Long (PB 1)		
R1	26/kg	
R2	25/kg	
R3	27/kg	
Certified		
Small (Swarna)		20/kg
R1	88/kg	
R2	82/kg	
R3	85/kg	
Medium (Sarjoo 52)		
R1	76/kg	
R2	72/kg	
R3	74/kg	
Long (PB 1)		
R1	90/kg	
R2	87/kg	
R3	89/kg	

Experiment 7: Standardization of seed production technology in green manure crops (Validation through demonstration)

Year of Start: 2015-16

Crops	**Centers**
Dhaincha (*Sesbania aculeata*)	TNAU, Coimbatore; AAU, Jorhat; MPKV, Rahuri; UAS, Dharwad; PJTSAU, Hyderabad; RPCAU, Pusa; BCKV, Nadia, PAJANCOA&RI, Karaikal; JAU, Junagadh; OUAT, Bhubneswar; HPKV, Palampur and CCSHAU, Hissar
Sunhemp (*Crotolaria juncea*)	TNAU, Coimbatore; AAU, Jorhat; MPKV, Rahuri; UAS, Dharwad; ANGRAU, Guntur; BCKV, Nadia, JAU, Junagadh (Jamnagar).
Pillipesara (*Vigna trilobata)*	TNAU, Coimbatore; MPKV, Rahuri; UAS, Dharwad; ANGRAU, Guntur; JAU, Junagadh (Jamnagar).

Objectives:

- To study the influence of nipping or pinching of terminal buds on the number and intervals of pod pickings, seed shattering loss, seed yield and quality.
- To study the influence of phosphorous application on seed yield and quality.
- To study the effect of DAP 2 % as foliar spray to enhance seed yield and quality.

Methodology

1. Nitrogen application: 30kg/ha

2. Phosphorous application: 50 kg/ha as basal

3. Foliar spray: Two sprayings of the following nutrients as detailed below.

4. Effect of nipping or pinching of tendrils

- Being an indeterminate crop, pinching or nipping of terminal buds may have influence on seed yield and quality. Nipping should be done on *Sesbania aculeata* at 60 DAS, *Vigna trilobata* between 20 and 40 DAS. In sunhemp, the main stem of sunhemp when attains a height of 90 cm to break apical dominance and more branching.
- However a control may be maintained without nipping and cutting in all crops.

Treatments

- **Main plot: Pinching**
  - M1: With pinching
  - M2: Without pinching
- **Sub plot: Foliar application**
  - T1-Foliar spray with DAP @ 2%
  - T2-Foliar spray with MN Mixture (ZnSO4@ 0.5% + Boric acid @ 0.3%)
  - T3-Foliar spray with NAA @ 40 ppm
  - T4-Foliar spray with DAP 2%+MN Mixture (Zn+B)+ NAA @ 40ppm
  - T5-Control

- The total fertilizer application be split into two, one as basal and other as top dressing.
- Foliar spray should be done at flowering. In addition, the recommended agronomic packages and plant protection practices should be followed.

Design	:	Split plot
Replications	:	4
Spacing	:	Dhaincha -60 x 20 cm Sunhemp -30 x 30 cm Pillipesara -60 x 30 cm
Plot size	:	20 m^2 (5 x 4 m^2)

Observations to be made

1. No. of pods / plant
2. No. of seeds / pod (excluding shriveled and under developed seeds)
3. Pod yield / plant & plot
4. Seed yield / plant, plot and ha.
5. Seed recovery (%)
6. No. of pods shattered / plant before each pickings (Shattering loss)

7. No. of pickings made
8. 100 seed weight (g)
9. Seed germination (%)
10. Seedling vigour (length, dry weight and vigour index)
11. Cost Benefit ratio
12. Weather data should be recorded

Sunhemp (*Crotolaria juncea*)

In sunhemp, demonstration trials were conducted in six centers (TNAU, Coimbatore, UAS, Dharwad, MPKV, Rahuri, JAU, Junagadh, BCKV, Nadia and RVSKVV, Gwalior). Average over the location revealed that, treatment M_1T_4 (Foliar spray with DAP 2% + MN Mixture (Zn+B) + NAA @ 40ppm with pinching) was found to be statistically superior in terms of seed yield (11.29 q/ha), no. of pods per plant (173), no. of seeds per pod (17), germination percentage (91%) as compared to control. Enhancement of 17%, 151%, 55% and 11% with respect to seed yield, no. of pods per plant, no. of seeds per pod and germination percentage, was noticed over control. The benefit cost ratio is 1.97 which is 80 % higher as compare to control (1.09).

Therefore, recommendation of foliar spray with DAP 2%+MN Mixture (Zn+B) + NAA @ 40 ppm with pinching for sunhemp was validated on the basis of result of demonstration trials conducted over the locations in 2018.

Table 7.1: Comparison of recommendation and demonstration trials results for validation of superior treatment in sunhemp.

Parameter	Recommendation on the basis of Multi-location trials over the years.	Demonstration result on the basis of Multi-location trials in 2018	Percentage increase over Control (Recommendation)	Percentage increase over Control (Demonstration)
Seed Yield (q/ha)	10.39	11.29	75.0	17.0
No. of Pods Per Plant	149	173	64.0	151.0
No. of seeds per pod	12	16.72	12.0	55.0

Germination percentage	91	90	7.0	10.8

Dhaincha (*Sesbania aculeata*)

In Dhaincha, a demonstration trial was conducted in ten centers (TNAU, Coimbatore; MPKV, Rahuri; JAU, Junagadh; OUAT, Bhubaneshwar; UAS, Dharwad; BCKV, Nadia; RPCAU, Pusa; RVSKVV, Gwalior, AAU, Jorhat and PJTSAU, Hyderabad). Average over the locations revealed that, treatment M_1T_3 (Foliar spray with DAP 2%+MN Mixture (Zn+B) + NAA @ 40ppm with pinching) was found to be statistically superior in terms of seed yield (12.0 q/ha) and germination percentage (100%) as compared to control. Enhancement of 19% and 10% with respect to seed yield and germination percentage was noticed over control. The benefit cost ratio is 1.18 which is 24% higher as compare to control (0.95).

Therefore, recommendation of foliar spray with DAP 2%+MN Mixture (Zn+B) + NAA @ 40ppm with pinching with pinching for Pillipesara was validated on the basis of demonstration trials conducted over the locations in 2018.

Table 7.2: Comparison of recommendation and demonstration trials results for validation of superior treatment in Dhaincha

Parameter	Recommendation on the basis of Multi-location trials over the years.	Demonstration result on the basis of Multi-location trials in 2018	Percentage increase over control (Recommendation)	Percentage increase over control (Demonstration)
Seed Yield (q/ha)	13.39	12.0	25.9	19
Germination percentage (%)	83	100	3.6	10

Pillipesara (*Vigna trilobata*)

In Pillipesara, a demonstration trial was conducted in three centers (MPKV, Rahuri, UAS, Dharwad and JAU, Junagadh). Average over the location revealed that, treatment M_1T_4 (Foliar spray with DAP 2%+MN Mixture (Zn+B) + NAA @ 40 ppm with pinching) was found to be statistically superior in terms of seed yield (11.07 q/ha), no. of pods per plant

(140), no. of seeds per pod (12), germination percentage (93%) as compared to control. Enhancement of 100.4%, 38.6%, 39.0 % and 12.6% with respect to seed yield, no. of pods per plant, no. of seeds per pod and germination percentage, was noticed over control. The benefit cost ratio is 1.83 which is 56% higher as compare to control (1.17).

Therefore, recommendation of foliar spray with DAP 2%+MN Mixture (Zn+B) + NAA @ 40ppm with pinching for Pillipesara was validated on the basis of demonstration trials conducted over the locations in 2018.

Table 7.3: Comparison of recommendation and demonstration trials results for validation of superior treatment in Pillipesara

Parameter	Recommendation on the basis of Multi-location trials over the years.	Demonstration result on the basis of Multi-location trials in 2018	Percentage increase over Control (Recommendation)	Percentage increase over Control (Demonstration)
Seed Yield (q/ha)	10.6	11.0	100.4	48.0
No. of Pods Per Plant	105	140	38.6	31.0
No. of seeds per pod	12	12	39.0	12.0
Germination percentage	92	93	12.6	7.8

Sunhemp (*Crotalaria juncea)*

1. TNAU, Coimbatore

Result:

The combined results of three demonstrations in sunhemp also revealed that pinching at 90 cm height of main stem combined with foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at

flowering stage recorded the maximum number of pods per plant (129), seed per pod (13.6) compared to the control (87 and 10.5) respectively. Pinching with foliar treatment also recorded maximum yield of 14.1 g/plant, 10.0 q/ha with maximum 100 seed weight 2.02 g than the control (11.5 g/plant, 7.30 q/ha and 1.94 g) (Table 8). With respect to resultant seed quality parameters, pinching the sunnhemp crop at 90 cm height of main stem combined with foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage recorded the maximum germination (89 %) and vigour index (1833) than the without pinching plot (82 % and 1550) respectively (Table 3.4, 3.5, 3.6 and 3.7).

Salient findings

In sunhemp, pinching at 90 cm height of main stem combined with foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage increased the seed yield and also resultant seed quality characteristics. Hence the farmer could be achieved higher yield in sunhemp through adopting pinching with foliar spray treatment.





Pinching + foliar treatment (More numbers of pods)



Maturity stage at farmer's field

I. Demonstration conducted at Easternblock, TNAU, Coimbatore during *Kharif* 2018-19

Table 7.4: Effect of pinching and foliar spray during flower initiation on seed yield attributing characters, seed yield and resultant seed quality in Sunhemp

Treatment	Plant height (cm)	No. of pods / plant	No. of seeds /pod	Seed yield per plant (gm)	Seed yield (q/ha)	100 seed weight (gm)	No of pickings	Shattering loss (%)	Germination (%)	Seedling length (cm)	Vigour index
With pinching (at stem height 90 cm)+ foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage	96	125	15.3	14.2	9.85	2.17	2.0	5.2	92	22.4	2061
Control (Without pinching +foliar spray)	112	86	11.3	11.6	7.20	2.06	2.0	6.3	86	21.6	1858

II. Demonstration conducted at Eastern block, TNAU, Coimbatore during *Rabi* 2018-19

Table 7.5. : Effect of pinching and foliar spray during flower initiation on seed yield attributing characters, seed yield and seed quality in Sunhemp

Treatment	Plant height (cm)	Number of pods / plant	Number of seeds /pod	Seed yield per plant (gm)	Seed yield (q/ha)	100 seed weight (gm)	No of pickings	Shattering loss (%)	Germination (%)	Seedling length (cm)	Vigour index
With pinching(at stem height 90 cm)+ foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage	102	142	13.2	15.0	10.70	2.05	2.0	4.8	86	20.7	1780
Control (Without pinching +foliar spray)	123	97	10.6	12.2	7.90	1.97	2.0	5.2	80	18.2	1456

III. Demonstration conducted at Farmer's field, Karichipalayam, Coimbatore during *Rabi* 2019

Table 7.6. : Effect of pinching and foliar spray during flower initiation on seed yield attributing characters, seed yield and seed quality in Sunnhemp

Treatment	Plant	Number	Number	Seed	Seed	100	No	Shattering	Germinat	Seedli	Vigour

	height (cm)	of pods / plant	of seeds /pod	yield per plant (gm)	yield (q/ha)	seed weight (gm)	of pickings	loss (%)	ion (%)	ng length (cm)	index
With pinching(at stem height 90 cm)+ foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage	94	120	12.2	13.2	9.55	1.86	2.0	5.6	88	18.6	1637
Control (Without pinching +foliar spray)	115	77	9.6	10.6	6.80	1.80	2.0	6.0	80	17.0	1360

(Combined mean of three locations)

Table 7.7: Effect of pinching and foliar spray during flower initiation on seed yield attributing characters, seed yield and seed quality in Sunhemp

Treatment	Plant height (cm)	Number of pods / plant	Number of seeds /pod	Seed yield per plant (gm)	Seed yield (q/ha)	100 seed wt. (gm)	No of pickings	Shattering loss (%)	Germination (%)	Seedling length (cm)	Vigour index
With pinching(at stem height 90 cm)+ foliar	97	129	13.6	14.1	10.0	2.02	2.0	5.2	89	20.6	1833

spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage											
Control (Without pinching +foliar spray)	117	87	10.5	11.5	7.3	1.94	2.0	5.8	82	18.9	1550

2. UAS, Dharwad

Treatment details: Removal of terminal bud followed by foliar spray with DAP 2% + Mixture ($ZnSO_4$+ Boric acid @ 0.3 %)

Table 7.8: Effect of pinching by foliar spray with DAP 2% + Mixture ($ZnSO_4$+ Boric acid @ 0.3 %)

Treatment details	No. of pods/plant	Pod Yield /plant (g)	Seed yield (q/ha)	100 seed weight (g)	Germination (%)	Root length (cm)	Shoot length (cm)	Seedling vigour index	Seed recovery (%)	Cost benefit ratio
Foliar spray	19.62	187.27	20.85	2.53	92.0	19.31	10.50	2743	93.17	2.93
Control	17.15	110.15	11.25	2.34	79.0	17.25	9.40	2105	90.11	2.02

Results:

- ✓ Demonstration was conducted with recommended treatment *i.e.* removal of terminal bud at pre-flowering stage followed by foliar spray with DAP 2% + Mixture ($ZnSO_4$+ Boric acid @ 0.3 %) and also a control plot (without foliar spray and pinching) was maintained.
- ✓ Removal of terminal bud at pre-flowering stage (pinching) and foliar spray with DAP 2% + Mixture ($ZnSO_4$+ Boric acid @ 0.3 %) significantly affected plant growth and yield parameters over control (without pinching) in sunhemp.
- ✓ Since the pinched plants produced significantly higher number of branches, pods and seed yield per plant, seed yield per hectare and seed quality parameters *viz*., seed test weight, germination percentage, seedling root and shoot length, seedling vigour index and seed recovery were significantly higher and cost benefit ratio was also higher.

3. MPKV, Rahuri

The pinching practice and foliar spray with micronutrient and plant growth promoters recorded significant influence on seed yield and quality parameters of sunhemp and presented in table no 3.9 and 3.10.

The treatment M_2T_3 (Pinching+ Foliar spray with DAP (2%) + MN Mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)] + NAA (40 ppm) recorded significantly higher seed yield attributes *viz*., no. of pods / plant (173), no. of seeds / pod (17), 100 seed weight (2.84 g), seed yield per plot (56.45 kg), seed yield per hector (1129 kg) as well as seed quality parameters *viz.,* seed germination (90.33%), root shoot length (29.70 cm), seedling dry weight (0.287 g), vigour index I (2684) and

vigour index II (25.91) . The treatment M_2T_2 (Pinching + Foliar spray with DAP (2%) + MN Mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]) recorded at par seed yield and quality parameters.

Table 7.9: Effects of pinching and foliar applications on seed yield and quality parameters of sunhemp.

Treatments	No. of pods / plant	No. of seeds / pod	No. of pods shattered	100 seed weight (g)	Seed yield / plot (kg)	Seed yield / ha (kg)	B:C ratio
M_1T_1: Without pinching and Foliar spray (Control)	81.04	11.80	7.28	2.04	30.23	604.50	1.15
M_2T_2: Pinching + Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]	162.44	15.08	4.44	2.73	49.47	989.47	1.74
M_2T_2: Pinching +Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]+ NAA (40 ppm)	173.00	16.72	3.20	2.84	56.45	1129.00	1.97

Table 7.10: Effects of pinching and foliar applications on seed quality parameters of sunhemp.

Treatments	Germination (%)	Root shoot length (cm)	Dry matter content (g)	Vigour index I	Vigour index II
M_1T_1: Without pinching and Foliar spray (Control)	83.67 (66.20)	20.17	0.215	1682	17.95
M_2T_2: Pinching + Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]	88.67 (70.40)	27.77	0.261	2461	23.11

M_2T_3: Pinching + Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]+ NAA (40 ppm)	90.33 (72.08)	29.70	0.287	2684	25.91

(Figur es in parenthesis are arc sin transformed values)

4. RVSKVV, Gwalior

Demonstration on sunhemp (*Crotolaria juncea*) recorded highest seed production of 17.86 q/ha in T1 (package application of Foliage application of DAP (20g/10L water) + micronutrient mixture containing Zinc as Zinc sulphate (5g/L water) + Boron as Boric acid (3g/L water) at flowering stage and removal of nipping at 60 DAS) compared to control (13.36 q/ha). (Table 3.11)Seed yield was increased 33.66% in package application compared to control plot. Similarly branches / plant and pods / plant was also recorded highest in T_1 (package application) compared to control.

Table 7.11: Demonstration of pinching and spraying of fertilizer with micronutrients on Seed production of Sun-hemp (*Crotolaria juncea)*

Treatment	Branches / plant	Pods / plant	Yield / plot	Yield q/ha	% Increase over Check
T_1: Foliage application of DAP (20g/10 L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/L water) + Boron as Boric acid (3g/L water) at flowering stage and Removal of terminal bud (pinching or nipping) Nipping done at 60 DAS	10.3	179.6	7.23	17.86	33.66
Control	3.5	53.2	5.41	13.36	-

5. JAU, Jamnagar

The results of demonstration trial showed that pinching of terminal buds during attainment of a plant height of 90 cm along with foliage application of DAP (20g/1L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/1L water) + Boron as Boric acid (3g/1L water) (M_1T_1) at flowering stage was produced the higher seed yield (6.74 q/ha) as compared to control (M_2T_2) (5.81 q/ha) in Sun hemp (Table 3). The treatment (T_1M_1) was also produced higher number of pods per plant, seeds per pod, dry pods yield per plant and

some seed quality parameters than control (M_2T_2). The Cost: Benefit ratio obtained to be 1: 0.13 and 1: 0.10 in treated and control plot, respectively. This cost: benefit ratio indicated that the more profit of Rs. 0.03 was gained on investment of Rs. one in treated plot area as compared to control area. Thus, sunhemp seed production is remaining more profitable in treated plot areas.

Table 7.12: Seed yield and ancillary observations in Sun hemp at Pearl Millet Research Station, JAU, Jamnagar during *Kharif*-2018

Sr. No.	Character	Sun hemp			
		Treatments		Total	Mean
		M_1T_1	M_2T_2 (Control)		
1	Seed yield/plant (g)	4.01	3.50	7.51	3.76
2	Seed yield (q/ha)	6.74	5.81	12.55	6.28
3	No. of pods/plant	118.95	105.13	224.08	112.04
4	No. of seeds/pod	10.63	10.10	20.73	10.36
5	Dry pods yield per plant (g)	22.49	20.23	42.71	21.36
6	Plant height (cm)	193.80	230.35	424.15	212.08
7	100 seeds weight (g)	1.58	1.60	3.18	1.59
8	Seed germination (%)	83.25	81.25	164.50	82.25
9	Seedling length (cm)	12.53	11.58	24.11	12.05
10	Seedling dry weight (g)	1.173	1.208	2.380	1.190
11	Seed vigour Index –I (%)	1042.7	940.5	1983.2	991.6
12	Seed vigour Index –II (%)	97.61	98.11	195.72	97.86
13	Cost : Benefit ratio	1 : 0.13	1 : 0.10	--	--

Where: M_1=With pinching, M_2= Without pinching (Control), T_1= Foliar spray of DAP (20g/ L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/1L water) + Boron as Boric acid (3g/1L water), and T_2=Control.

6. BCKV, Nadia

Table 7.13: Seed yield and ancillary observations in Sun hemp at BCKV, Nadia

Treatment	Location	Sunhemp (Seed yield, kg/ha)		Average over locations (Seed yield, kg/ha)	Yield advantage over Non-pinching
		With Pinching (at a height of 90 cm)	Without Pinching		

		[Area=0.2ha]		[Area=0.2ha]				(%)
		Yield/ Plot (0.2 ha)	**Yield (kg/ ha)**	**Yield/ Plot (0.2 ha)**	**Yield (kg/ ha)**	**Yield/Plot (0.2 ha)**	**Yield (kg/ha)**	
Without application of DAP, Zinc Sulphate and Boric acid	RRS, Gayeshpur, BCKV, Nadia	340	1700	306	1530	323	1615	11.1 %
	RRS, Raghunathpur, BCKV, Purulia	300	1500	260	1300	280	1400	15.4 %
With Foliar application of DAP(20gm/L of Water)+Zinc Sulphate (5gm/L of Water)+Boric acid (3gm/L of Water)	RRS, Gayeshpur, BCKV, Nadia	380	1900	340	1700	360	1800	11.8%
	RRS, Raghunathpur, BCKV, Purulia	365	1825	295	1475	330	1650	23.7 %
Yield advantage over Foliar application of DAP(20gm/L of Water)+Zinc Sulphate (5gm/L of Water)+Boric acid (3gm/L of Water) (%)							RRS Gayeshpur, BCKV, Nadia	11.5 %
							RRS Raghunathpur, BCKV, Purulia	17.9 %

Dhaincha (*Sesbania aculeate*)

1. MPKV, Rahuri

The pinching practice and foliar spray with micronutrient and plant growth promoters recorded significant influence on seed yield and quality parameters of Dhainchaand presented in table 3.14 and 3.15.

The treatment M_2T_3(Pinching+ Foliar spray with DAP (2%) + MN Mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)] + NAA (40 ppm) recorded significantly highest seed yield attributes *viz.*, no. of pods/plant (99), no. of seeds/pod (37), 100 seed weight (1.90 g), seed yield per plot (56.30 kg), seed yield per hector (1126.00 kg) as well as seed quality parameters *viz.,* seed germination (90.00%), root shoot length (30.90 cm), seedling dry weight (0.152 g), vigour index I (2781) and vigour index II (13.67) . The treatment M_2T_2 (Pinching + Foliar spray with DAP (2%) + MN Mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]) recorded at par seed quality and yield parameters.

Table 7.14: Effects of pinching and foliar applications on seed yield of Dhaincha.

Treatments	No. of pods /	No. of seeds /	No. of pods	100 seed weight	Seed yield /	Seed yield /	B:C ratio
M_1T_1: Without pinching and foliar spray(Control)	62.88	25.52	9.36	1.643	37.76	755.17	0.95
M_2T_2: Pinching +Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]	95.52	37.08	7.08	1.878	50.35	1007.00	1.18
M_2T_2: Pinching +Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]+ NAA (40 ppm)	99.16	37.36	5.96	1.903	56.30	1126.00	1.31

Table 7.15: Effects of pinching and foliar applications on seed quality parameters of Dhaincha.

Treatments	Germination (%)	Root shoot length (cm)	Dry matter content (g)	Vigour index I	Vigour index II

M_1T_1: Without pinching and Foliar spray (Control)	81.00 (64.18)*	22.73	0.121	1840	9.81
M_2T_2: Pinching +Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]	88.00 (69.77)	29.37	0.143	2584	12.61
M_2T_2: Pinching Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]+ NAA (40 ppm)	90.00 (71.70)	30.90	0.152	2781	13.67

*Figures in parenthesis are arc sin transformed values

2. OUAT, Bhubaneshwar

In Dhaincha, three demonstrations were conducted at Central Farm, OUAT, Bhubaneswar and in two farmers' fields in a total of 4.8 acres area. Foliar application of DAP @ 20g/10 litre water incorporated with MN mixture (Zinc sulphate @ 5g/litre water + Boric acid 3g/litre water) at flowering stage was done. This was followed by removal of terminal bud (pinching) at 60 DAS.

The yields obtained from each plot are as given below:

Table 7.16: Effects of pinching and foliar applications on seed yield of Dhaincha.

Sl. No.	Location	Area (acre)	Seed produced (q)	Seed yield (q/ha)
1.	Central Farm, OUAT, Bhubaneswar	2.00	11.78	14.72
2.	Vill: Mahalaxmipur, GP: Kanderi, Block: Athagarh, Dist: Cuttack	1.50	8.51	14.18
3.	Vill: Parichala, Block: Begunia, Dist: Khurda	1.30	7.45	14.33
	TOTAL	**4.80**	**27.74**	**14.45**



Dhaincha crop at Central Farm, OUAT, Bhubaneswar

3. RPCAU, Pusa

Pinching of terminal buds has significantly affected on the No. of pods/plant, seed yield (g/plot) and seed yield (Kg/ha). The higher seed yield was due to higher pods yield/plant and seed yield/plant but they did not turned out to be significant. The highest No. of pods/plant (48.89) was recorded in without pinching while the higher seed yield/plot (696.85 g) and seed yield/ha (348.43Kg.) were recorded with pinching of terminal buds respectively. (Table 3.17)

Foliar spray of DAP @ 2% recorded highest number of pods / plant but statistically at par with control and significantly higher than rest of the treatments. In respect to pods yield/plant, the foliar application of nutrients significantly reduced pods yield/plant than control except foliar spray with DAP @2% (F1) and foliar spray with NAA @40 ppm(F3). However seed yield/plot (kg/ha) was higher with F2 foliar spray with MN mixture ($ZnSo_4$ + Boric acid@ 0.3%) but found at par with foliar spray with DAP @2% (F1) and control (F5) and significantly higher over rest of the treatments. (Table 3.17)

Foliar spray of DAP 2%,MN mixture(ZnSo4)@ 0.5% and,NAA@40 ppm /L of water(F4) showed higher seed germination% but was statistically at par with control and significantly higher over rest of the treatments. The interaction between pinching and foliar spray of nutrients was found to be significant on no. of pods/plant. Foliar spray of nutrients in pinched and un-pinched plots reduced the number of pods/plant than control in un-pinched plot (70.55). Similarly interaction between pinching and foliar spray of nutrients was also found to be significant on seed yield (kg/h). Foliar application of (F3)NAA@40ppm in pinching plot produced significantly higher seed yield (1017.50Kg) than foliar application of other nutrients in pinched, un-pinched plot and control. (Table 3.17 a and 3.18 b)

Table 7.17: Effect of Pinching and foliar application on seed yield and quality parameters in Dhaincha at DRPCAU, Dholi centre during Kharif - 2018.

Sl.	Treatment	No. of pods/plant	No. of seeds /pod	Pods yield/plant (g)	Seed yield/plant (g)	Seed yield/plot (g)	Seed yield Kg/h	Seed recovery (%)	No. of shattered seeds/pods	100 seed weight (g)	Seed germination (%)	Seedling vigor
A.	**Pinching**											
	With Pinching (P_1)	45.08	25.86	25.58	11.72	696.85	348.43	82.99	4.43	2.23	45.00	738.60
	Without Pinching (P_2)	48.89	25.73	23.87	10.89	613.00	306.50	83.66	4.15	2.31	43.60	707.97
	SE(m)±	0.40	0.78	1.08	0.20	10.86	5043	0.55	0.27	0.04	3.79	71.40
	C.D. at 5%	1.88	NS	NS	NS	50.60	25.30	NS	NS	NS	NS	NS
B.	**Foliar application**											
	F_1	57.05	27.20	25.61	11.74	746.25	373.13	84.99	4.08	2.31	40.13	673.32
	F_2	37.66	24.79	19.45	9.17	511.88	255.94	84.94	3.79	2.19	39.75	648.22
	F_3	48.93	24.96	26.78	11.45	815.00	407.50	82.69	4.29	2.23	43.25	715.39
	F_4	37.87	26.25	20.78	9.62	464.38	232.19	83.71	4.21	2.32	51.50	840.91
	F_5 Control.	53.39	25.79	30.99	14.53	737.13	368.56	80.30	5.08	2.30	46.88	738.59
	SE(m)±	1.89	1.12	2.29	0.86	43.18	21.59	1.40	0.35	0.08	4.88	105.06
	C.D. at 5%	5.54	NS	6.75	2.53	126.77	63.39	NS	NS	NS	6.91	NS

Interaction effect of pinching and foliar application on No. of pods/plant

Factor B / Factor A	F_1	F_2	F_3	F_4	F_5	mean
P_1 With Pinching	62.33	32.25	50.41	44.17	36.25	45.08
P_2 Without Pinching	51.77	43.08	47.44	31.58	70.55	48.89
MEAN	57.05	37.66	48.93	37.87	53.39	

Table 3.17 (a) Interaction effect of pinching and foliar application on No. of pods/plant and Seed yield Kg/ha

Factor (B) at same level of A – SEm ± 90 C.D : 7.97

Factor (A) at same level of B – SEm±2.42 C.D : 7.23

Table 7.17 (b): Interaction effect of pinching and foliar application on Seed yield Kg/ha

Interaction effect of pinching and foliar application on Seed yield Kg/h						
Factor B / Factor A	F_1	F_2	F_3	F_4	F_5	mean
P_1 With Pinching	845.00	343.75	1017.50	682.50	595.50	696.85
P_2 Without Pinching	647.50	680.00	612.50	246.25	878.75	613.00
MEAN	746.25	511.88	815.00	464.38	737.13	

Factor (B) at same level of A – SEm± 12.14 C.D-91.65

Factor (A) at same level of B – SEm ± 27.84 C.D-83.57

4. PJTSAU, Hyderabad

Table 7.18: Influence of pinching on yield attributing characters of dhaincha during *kharif*, 2018

Treatments	Days to 50% flowering				Plant height (cm)				Branches/plant (no.)			
	Without pinching		Pinching	Mean	Without pinching		Pinching	Mean	Without pinching		Pinching	Mean
Foliar spray with DAP 2%	32.13		32.1	32.12	178.65		138.3	158.47	8.33		10.33	9.33
Foliar spray with MN Mixture ($ZnSO_4$ 0.5% + Boric acid 0.3%)	31.73		32.57	32.15	177.71		138.99	158.35	7.66		10	8.83
Foliar spray with NAA 40 ppm	31.8		32	31.90	176.63		133.82	155.22	6.53		9.6	8.06
Foliar spray with DAP 2%+ MN Mixture (Zn +B) + NAA @ 40 ppm	31.57		31.90	31.73	177.19		140.36	158.78	7.53		11.36	9.44
Control	31.1		31.53	31.32	182.35		140.23	161.29	6.46		9.2	7.83
Mean	31.7		32	31.85	178.5		138.3	158.42	7.31		10.10	8.70
	S.Em±.	S.Ed	C.D.	C.V. (%)	S.Em±.	S.Ed	C.D.	C.V. (%)	S.Em±.	S.Ed	C.D.	C.V. (%)
Ai.-Aj.	0.06	0.094	0.404	1.873	3.28	4.64	19.98	6.091%	0.80	1.13	4.88	12.96
Bi.-Bj.	0.24	0.344	0.730		3.93	5.57	11.81		0.46	0.65	1.38	
AiBi-AiBj	0.34	0.487	1.032		5.57	7.87	16.71		0.65	0.92	1.95	
AiBi-AjBi	0.31	0.445	0.987		5.96	8.44	23.47		0.99	1.4	4.98	

Table 7.19: Influence of pinching on yield attributing characters of dhaincha during *kharif*, 2018

Treatments	Pods/plant (no.)				Pod length (cm)				Seeds/pod (no.)			
	Without pinching	Pinching	Mean		Without pinching	Pinching	Mean		Without pinching	Pinching	Mean	
Foliar spray with DAP 2%	36.07	60.7	48.38		22.07	22.59	22.33		32.47	32.47	32.47	
Foliar spray with MN Mixture ($ZnSO_4$ 0.5% + Boric acid 0.3%)	45.8	47.73	46.77		22.79	23.45	23.12		32.67	32.67	32.67	
Foliar spray with NAA 40 ppm	34.8	51.53	43.17		22.68	25.76	24.22		32.6	32.6	32.6	
Foliar spray with DAP 2%+ MN Mixture (Zn +B) + NAA @ 40 ppm	40.73	56.27	48.5		22.08	22.25	22.16		32.67	32.67	32.67	
Control	38.93	44.27	41.6		22.31	22.36	22.34		32.6	32.6	32.6	
Mean	39.3	52.1	45.7		22.4	23.3	22.85		32.6	32.6	32.6	
	S.Em±.	S.Ed	C.D.	C.V. (%)	S.Em±.	S.Ed	C.D.	C.V. (%)	S.Em±.	S.Ed	C.D.	C.V. (%)
Ai.-Aj.	1.54	2.18	9.41	13.095	0.59	0.83	3.59	5.116	0.00	0.00	0.00	3.264
Bi.-Bj.	2.44	3.45	7.32		0.47	0.67	1.42		0.43	0.61	1.30	
AiBi-AiBj	3.45	4.88	10.35		0.67	0.95	2.02		0.61	0.86	1.84	
AiBi-AjBi	3.45	4.88	12.49		0.84	1.19	3.8		0.54	0.77	1.64	

Table 7.20: Influence of pinching on yield and yield attributing characters of dhaincha during *kharif*, 2018

Treatments	Test weight (g)			Seed yield/plant (g)			Seed yield/plot (kg)			Seed yield/ha (q)		
	Without pinching	Pinching	Mean	Without pinching	Pinching	Mean	Without pinching	Pinching	Mean	Without pinching	Pinching	Mean
Foliar spray with DAP 2%	1.94	1.91	1.92	13.320	15.420	14.370	2.33	2.697	2.513	11.090	12.813	11.952
Foliar spray with MN Mixture ($ZnSO_4$ 0.5% + Boric acid 0.3%)	1.88	1.91	1.90	15.183	15.853	15.518	2.643	2.773	2.708	12.583	13.200	12.892
Foliar spray with NAA 40 ppm	1.90	1.91	1.90	14.480	15.763	15.122	2.533	2.840	2.687	12.057	13.520	12.788
Foliar spray with DAP 2%+ MN Mixture (Zn +B) + NAA @ 40 ppm	1.87	1.91	1.89	15.417	17.163	16.290	2.693	3.000	2.847	12.830	14.283	13.557
Control	1.86	1.93	1.89	13.450	12.960	13.205	2.327	2.263	2.295	11.073	10.770	10.922
Mean	1.89	1.91	1.90	14.37	15.43	14.9	2.51	2.71	2.61	11.93	12.92	12.42

	S.Em±	S.Ed	C.D.	C.V. (%)	S.Em±	S.Ed	C.D.	C.V. (%)	S.Em±	S.Ed	C.D.	C.V. (%)	S.Em±	S.Ed	C.D.	C.V. (%)
Ai.-Aj.	0.014	0.02	0.086	3.093	0.452	0.639	2.751	7.158	0.067	0.096	0.413	7.324	0.321	0.454	1.954	7.307
Bi.-Bj.	0.024	0.034	0.072		0.435	0.615	1.305		0.078	0.110	0.233		0.370	0.524	1.110	
AiBi-AiBj	0.034	0.048	0.101		0.615	0.870	1.846		0.110	0.156	0.330		0.524	0.741	1.571	
AiBi-AjBi	0.033	0.047	0.118		0.712	1.007	3.022		0.119	0.169	0.478		0.568	0.803	2.263	

Table 7.21: Influence of pinching on seed quality characters of dhaincha during *kharif*, 2018

Treatments	Germination (%)				Root length (cm)				Shoot length (cm)			
	Without pinching		Pinching	Mean	Without pinching		Pinching	Mean	Without pinching		Pinching	Mean
Foliar spray with DAP 2%	98.33		100.00	99.17	8.383		7.630	8.007	18.750		20.193	19.472
Foliar spray with MN Mixture ($ZnSO_4$ 0.5% + Boric acid 0.3%)	86.00		97.67	91.83	7.693		7.753	7.723	19.577		19.440	19.508
Foliar spray with NAA 40 ppm	92.33		100.00	96.17	8.137		7.807	7.972	19.250		19.890	19.570
Foliar spray with DAP 2%+ MN Mixture (Zn +B) + NAA @ 40 ppm	90.00		100.00	95.00	7.213		6.503	6.858	16.833		18.200	17.517
Control	94.00		96.33	95.17	6.813		7.220	7.017	18.113		19.437	18.775
Mean	92.1		98.8	95.45	7.65		7.38	7.515	18.50		19.43	18.96
	S.Em±.	S.Ed	C.D.	C.V. (%)	S.Em±.	S.Ed	C.D.	C.V. (%)	S.Em±.	S.Ed	C.D.	C.V. (%)
Ai.-Aj.	0.984	1.392	5.989	5.929	0.294	0.416	1.794	6.012	0.178	0.252	1.086	6.515
Bi.-Bj.	2.310	3.267	6.927		0.184	0.260	0.553		0.504	0.713	1.512	
AiBi-AiBj	3.267	4.621	9.796		0.260	0.368	0.782		0.713	1.009	2.139	
AiBi-AjBi	3.084	4.361	10.215		0.376	0.531	1.840		0.662	0.937	2.135	

Table 7.22: Influence of pinching on seed quality characters of dhaincha during *kharif*, 2018

Treatments	Seedling length (cm)			Seedling vigour index I		
	Without pinching	Pinching	Mean	Without pinching	Pinching	Mean
Foliar spray with DAP 2%	27.16	27.82	27.49	2670	2782	2726
Foliar spray with MN Mixture ($ZnSO_4$ 0.5% + Boric acid 0.3%)	27.37	27.19	27.28	2353	2655	2504
Foliar spray with NAA 40 ppm	27.39	27.79	27.59	2528	2779	2653
Foliar spray with DAP 2%+ MN Mixture (Zn +B) + NAA	24.07	24.70	24.38	2166	2470	2318

Control	24.93		26.67	25.80	2343	2569	2455
Mean	26.2		26.8	26.5	2412	2651	2531
	S.Em±.	S.Ed	C.D.	C.V. (%)	S.Em±.	S.Ed	C.D.	C.V. (%)
Ai.-Aj.	0.256	0.363	1.563	4.757	0.342	0.342	1.482	4.252
Bi.-Bj.	0.514	0.728	1.543		0.254	0.698	1.623	
AiBi-AiBj	0.728	1.029	2.182		0.584	1.024	2.241	
AiBi-AjBi	0.700	0.990	2.389		0.658	0.985	2.248	

Conclusión:

Pinching had significant influence in reducing plant height, increasing branches/plant, pods/plant, pod length, seeds/pod, seed yield/plant and seed yield/ha. Pinching recorded significant improvement in seed yield/ha over control. Among the sub treatments, foliar application with DAP 2% + MN Mixture (Zn 0.5% + B 0.3%) + NAA @ 40 ppm resulted in higher seed yield (11.22 q/ha). Among various combinations of pinching and foliar sprays, pinching of the terminal buds and spray of DAP 2% + $ZnSO_4$ 0.5% + Boric acid 0.3% + NAA @ 40 ppm at flower initiation and peak flowering stage contributed to increased yield (14.283 q/ha).

5. BCKV, Nadia

Table 7.23: Influence of pinching on yield attributing characters of dhaincha at BCKV, Nadia

Treatment	Location	Dhaincha (Seed yield, kg/ha)				Average over locations (Seed yield, kg/ha)		Yield advantage over Non-pinching (%)
		With Pinching (at 60 DAS)		Without Pinching [Area=0.2ha]				
		Yield/Plot (0.2 ha)	Yield (kg/ha)	Yield/Plot (0.2 ha)	Yield (kg/ha)	Yield/Plot (0.2 ha)	Yield (kg/ha)	
Without application of	RRS, Gayeshpur, BCKV, Nadia	283	1415	245	1225	264	1320	15.5 %

DAP, Zinc Sulphate and Boric acid	RRS, Raghunathpur, BCKV, Purulia	216	1075	180	900	198	990	20 %
With Foliar application of DAP(20gm/L of Water)+Zinc Sulphate (5gm/L of Water)+Boric acid (3gm/L of Water)	RRS, Gayeshpur, BCKV, Nadia	315	1575	285	1425	300	1500	10.5 %
	RRS, Raghunathpur, BCKV, Purulia	236	1175	200	1000	218	1090	18 %
Yield advantage over Foliar application of DAP(20gm/L of Water)+Zinc Sulphate (5gm/L of Water)+Boric acid (3gm/L of Water) (%)							RRS Gayeshpur, BCKV, Nadia	13.6 %
							RRS Raghunathpur, BCKV, Purulia	10.1 %

6. UAS, Dharwad

Table 7.24: Influence of pinching on yield attributing characters of dhaincha during UAS, Dharwad

Treatment	No. of pods/plant	Pod yield (g)	Seed yield (q/ha)	100 seed weight (g)	Seed germination (%)	Root length (cm)	Shoot length (cm)	Seedling vigour index	Seed recovery (%)	Cost benefit ratio
Foliar spray	235	189.23	29.19	3.17	89.50	18.50	13.20	2837	89.15	3.71
Control	197	159.05	21.33	2.97	85.25	17.95	12.54	2599	83.25	2.54

7. TNAU, Coimbatore

The combined results of three demonstrations in dhaincha showed that pinching at 60 DAS combined with foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage recorded the maximum number of pods per plant (174), seed per pod (24.5) compared to the control (128, 21.0, respectively). Pinching with foliar treatment also recorded maximum yield of 26.8 g/plant, 14.54 q/ha with maximum 100 seed weight 1.90 g than the control (22.1 g/plant, 10.55 q/ha and 1.81 g) (Table 4). Shattering loss of seeds was observed in both the treatment and control plot. With respect to seed quality parameters, pinching the dhaincha crop at 60 DAS and foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage recorded the maximum germination (95 %) and vigour index (1743) than the without pinching plot (91 % and 1530) respectively. (Table 3.25, 3.26, 3.27 & 3.28).

Salient findings

In dhaincha, pinching at 60 Days after Sowing (DAS) combined with foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage increased the seed yield and also resultant seed quality characteristics. Hence the farmer could be achieved higher yield in dhaincha through adopting pinching with foliar spray treatment.



Pinching + foliar spray (More number of pods/plant)



Control (Less number of pods/plant)





Field demonstration of seed production technology in greenmanure crops

I. Demonstration conducted at Eastern block, TNAU, Coimbatore during *Kharif* 2018-19 -Dhaincha

Table 7.25: Effect of pinching and foliar spray during flower initiation on seed yield attributing characters, seed yield and seed quality in dhaincha

Treatment	Plant height (cm)	Number of pods / plant	Number of seeds /pod	Seed yield per plant (gm)	Seed yield (q/ha)	100 seed weight (gm)	No of pickings	Shattering loss (%)	Germination (%)	Seedling length (cm)	Vigour index
With pinching(60DAS) + foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage	166	144	26.2	27.6	14.56	1.96	2.0	8.3	96	18.15	1752
Control (Without pinching +foliar spray)	194	113	20.3	22.4	10.54	1.82	2.0	8.0	92	16.72	1538

II. Demonstration conducted at Eastern block, TNAU, Coimbatore during *Rabi* 2019

Table 7.26: Effect of pinching and foliar spray during flower initiation on seed yield attributing characters, seed yield and seed quality in dhaincha

Treatment	Plant height (cm)	Number of pods / plant	Number of seeds /pod	Seed yield per plant (gm)	Seed yield (q/ha)	100 seed weight (gm)	No of pickings	Shattering loss (%)	Germination (%)	Seedling length (cm)	Vigour index
With pinching(60DAS) + foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage	142	162	25.3	24.3	13.20	1.85	2.0	7.1	94	17.36	**1632**
Control (Without pinching +foliar spray)	187	126	21.5	19.6	9.50	1.77	2.0	7.8	89	16.10	**1433**

III. Demonstration conducted at Farmers' field, Karichipalayam, Coimbatore during *Rabi* 2019

Table 7.27: Effect of pinching and foliar spray during flower initiation on seed yield attributing characters, seed yield and seed quality in dhaincha

Treatment	Plant height (cm)	Number of pods / plant	Number of seeds /pod	Seed yield per plant (gm)	Seed yield (q/ha)	100 seed weight (gm)	No of pickings	Shattering loss (%)	Germination (%)	Seedling length (cm)	Vigour index
With pinching(60DAS)+ foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage	126	217	22.1	28.4	15.85	1.90	2.0	6.3	96	19.23	**1846**
Control **(**Without pinching +foliar spray)	175	146	21.3	24.3	11.60	1.84	2.0	6.8	93	17.42	**1620**

Combined mean of three locations

Table 7.28: Effect of pinching and foliar spray during flower initiation on seed yield attributing characters, seed yield and seed quality in dhaincha

Treatment	Plant height (cm)	Number of pods / plant	Number of seeds /pod	Seed yield per plant (gm)	Seed yield (q/ha)	100 seed weight (gm)	No of pickings	Shattering loss (%)	Germination (%)	Seedling length (cm)	Vigour index
With pinching(60DAS)+ foliar spray of DAP (20 g/l water) + micronutrient mixture Zinc as ZnSo4 (5g/l water) + Boron as boric acid (3 g/l water) at flowering stage	145	174	24.5	26.8	14.54	1.90	2.0	7.2	95	18.25	1743
Control (Without pinching +foliar spray)	185	128	21.0	22.1	10.55	1.81	2.0	7.5	91	16.75	1530

8. AAU, Jorhat

The performance of dhaincha in demonstration trials conducted at three locations in 2018 is given in Table 3.29 Among the three locations, Diphu location has registered best performance of pod and seed attributing characters in treated area *viz*. Pod yield (1520 kg/ha), seed yield (1316 kg/ha) followed by Biswanath Chariali and Jorhat. Similarly, the results exhibited the same trend in untreated (Control) plots also. It is interesting to note that although the best productivities of pod and seed yields were exhibited by the Diphu location, the highest increase of pod (22.44 %) and seed (23.19 %) yields over the control in treated plot was sown by the Biswanath Chariali location. Validation trials conducted at Diphu and Biswanath Chariali have shown the similar and positive trend i.e. both the locations have shown the increase of pod and seed yields of at least 16.03 % over the control. Thus, based on the performance of these two locations, the new technique could be proposed for recommendation in Assam.

Application of DAP (20g/ L of water) along with micronutrient mixture of zinc as zinc sulphate (5 g/ L of water) and Boron as Boric acid (3 g/L of water) in two sprayings in treated plots of dhaincha did not have marked difference with the control plots for seed quality parameters like seed germination (%) and seedling vigour index although the treated plots had slightly higher 100 seed weight (g).

It is also noteworthy that the productivity trend over the three locations is directly related to the total amount of rainfall (mm) received by the dhaincha crop and its distribution pattern. The rainfall data have shown that the productivity is negatively correlated with the total amount of rainfall (mm) i.e. higher the rainfall lower is the pod and seed yields and yield attributing characters. This might be one of the causes of low productivity of the crop in Jorhat location among the three locations in the validation trial.

The productivity of the crop in the validation trials is also associated with the nutritional status of the experimental sites over the locations. It is observed from the soil test data of the experimental site in Jorhat location just before the experimentation that the soil had higher amount of Zn, Mn and Fe but it is deficient in Boron content (0.5 ppm is the critical limit). While the soil has already higher amount of these micro nutrients, the trial was designed with two sprayings of micronutrients at flowering stage with Zinc as zinc sulphate (5 g/ L of water) in addition to other treatment.



Validation of new seed technology at Biswanath Chariali in 2018

Table 7.29: Seed yield and other ancillary characters of green manure crop Dhaincha (*Sesbania aculeata*) during 2018 in demonstration trials at AAU, Jorhat

Sl. No.	Location	Pod yield (kg/ ha)			Seed yield (kg/ha)		
		1			2		
		Treated	Untreated (Control)	Increase (+) or decrease (-) in Pod yield over the control (%)	Treated	Untreated (Control)	Increase (+) or decrease (-) in seed yield over the control (%)
1	Jorhat	1095	1145	-4.37	828	876	-5.48
2	BiswanathChariali	1386	1132	+22.44	1174	953	+23.19
3	Diphu	1520	1310	16.03	1316	1090	+20.73
Mean over locations		**1333.67**	**1195.67**	**+11.54**	**1106.00**	**973.00**	**+13.69**

Table 7.29 cont.

Sl. No.	Location	Pod yield/ plant (g)			Seed yield/ plant (g)		
		3			4		
		Treated	Untreated (Control)	Increase (+) or decrease (-	Treated	Untreated (Control)	Increase (+) or decrease (-) in seed

				) in Pod yield/ plant over the control (%)			yield/ plant over the control (%)
1	Jorhat	63.9	64.4	-0.78	54.0	53.5	-0.01
2	BiswanathChariali	68.5	61.5	+11.38	60.3	54.5	+10.64
3	Diphu	101.4	94.3	+7.53	74.7	68.9	+8.42
Mean over locations		**77.93**	**73.4**	**+6.17**	**63.00**	**58.97**	**+6.83**

Table 7.29 cont.

Sl. No	Location	Pods/ plant			Pod length (cm)		
		5			6		
		Treated	Untreated (Control)	Increase (+) or decrease (-) of Pods / plant over	Treated	Untreated (Control)	Increase (+) or decrease (-) of Pod length (cm) over the

				the control (%) (%)			control (%)
1	Jorhat	63.3	67.5	-6.22	24.2	23.4	+3.42
2	BiswanathChariali	80.5	70.4	+14.35	23.6	23.2	+1.72
3	Diphu	89.8	80.6	+11.41	23.9	23.5	+1.70
Mean over locations		**77.87**	**72.83**	**+6.92**	**23.90**	**23.37**	**+2.27**

Sl. No	**Location**	**Pods shattered / plant**			**Seeds/ pod**		
		7			**8**		
		Treated	**Untreated (Control)**	**Increase (+) or decrease (-) in Pods scattered / plant over the control (%)**	**Treated**	**Untreated (Control)**	**Increase (+) or decrease (-) in seeds/plant over the control (%)**
1	Jorhat	2.57	1.90	-35.26	26.6	27.8	-4.32
2	BiswanathChariali	2.42	2.90	+16.55	34.7	32.9	+5.47
3	Diphu	1.74	2.01	+13.43	36.7	34.4	+6.69
Mean over locations		**2.24**	**2.27**	**-1.32**	**32.67**	**31.70**	**+3.06**

Table 7.29 cont.

Sl. No	**Location**	**Seed recovery (%)**			**100 seed weight (g)**		
		9			**10**		
		Treated	**Untreated**	**Increase (+) or decrease**	**Treated**	**Untreated**	**Increase (+) or decrease (-**

			(Control)	(-) in seed recovery over the control (%)		(Control)	) in 100 seed weight (g) over the control (%)
1	Jorhat	96.2	97.6	-1.40	1.560	1.571	-0.70
2	BiswanathChariali	99.8	98.5	+1.30	1.640	1.565	+4.79
3	Diphu	99.8	98.3	+1.50	1.73	1.69	+2.36
Mean over locations		**98.60**	**98.13**	**+0.48**	**1.643**	**1.609**	**+2.11**

Table 7.30: Seed quality of Dhaincha (*Sesbania aculeata*) during 2018 in demonstration trials at AAU, Jorhat

Sl. No	Location	Seed germination (%)			Seedling vigour (Germination % x Seedling height)		
		11			12		
		Treated	Untreated (Control)	Increase (+) or decrease (-) of seed germination (%) over the control	Treated	Untreated (Control)	Increase (+) or decrease (-) of seedling vigour over the control (%) (%)
1	Jorhat	96.5	96.8	-0.30	818.3	834.4	-1.93
2	BiswanathChariali	98.8	97.4	+1.4	913.9	894.1	+2.21
3	Diphu	96.8	98.3	-1.5	898.3	904.4	-0.76
Mean over locations		**97.37**	**97.5**	**-0.13**	**876.83**	**877.63**	**-0.0009**

Constraints faced and solution suggested:

The Annual Group Meeting of AICRP on NSP (Crops) was held on May 9-11, 2018 and a proceeding was received after the meeting. By the time, the monthly rainfall had been increasing up to August, 2018 and then in the decreasing trend w.e.f. September, 2018. The erratic and high rainfall had made land preparation impracticable / difficult for green manuring crops like dhaincha and sunhemp. Thus, water logging coupled with excessive rainfall particularly at the time of land preparation, seed sowing and early growth phases are really problems for the location like Jorhat where soil type is mostly of clay type. The trials conducted in the low/ scanty rainfall months with increasing temperature of 25-28^{0}C (March-April) might solve these problems, but the crop will take longer duration.

9. RVSKVV, Gwalior

Demonstration on Dhaincha (*Sesbania aculeata*) recorded highest seed production of 15.34 q/ha in T_1 (Foliage application of DAP (20g/10L water) + micronutrient mixture containing Zinc as Zinc sulphate (5g/L water) + Boron as Boric acid (3g/L water) at flowering stage and removal of nipping at 60 DAS) compared to control (12.62 q/ha). Seed yield was increased 21.53 % in package application compared to control plot. Similarly branches / plant and pods / plant also recorded highest in T_1 compared to control.

Table 7.30: Demonstration of pinching and spraying of fertilizer with micronutrients on Seed production of Dhaincha (*Sesbania aculeata*)

Treatment	Branches / plant	Pods / plant	Yield / plot	Yield q/ha	% Increase over control
T_1: Foliage application of DAP (20g/10L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/L water) + Boron as Boric acid (3g/L water) at flowering stage and Removal of terminal bud (pinching or nipping) Nipping done at 60 DAS	10.2	176.7	6.21	15.34	21.55
T_2: Control	2.8	82.3	5.11	12.62	

10. JAU, Jamnagar

The results of demonstration trial revealed that pinching of terminal buds at 60 DAS along with the foliage spray of DAP (20g/1L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/1L water) + Boron as Boric acid (3g/1L water) (M_1T_1) at flowering stage was produced the higher seed yield (7.95 q/ha) as compared to control (M_2T_2) (6.82 q/ha) in Dhaincha (Table 3). The same treatment (M_1T_1) was also recorded higher number of pods per plant, seeds per pod, dry pods yield per plant and seed quality

characters than control (M_2T_2). The Cost: Benefit ratio obtained to be 1: 0.13 and 1: 0.09 in treated and control plot, respectively. This cost: benefit ratio indicated that the more profit of Rs. 0.04 was gained on investment of Rs. one in treated plot area as compared to control area. Thus, Dhaincha seed production is remaining more profitable in treated plot areas.

Table 7.31: Seed yield and ancillary observations in Dhaincha at Pearl Millet Research Station, JAU, Jamnagar during *Kharif*-2018

Sr. No.	Character	Dhaincha			
		Treatments		Total	Mean
		M_1T_1	M_2T_2 (Control)		
1	Seed yield/plant (g)	24.61	21.96	46.57	23.28
2	Seed yield (q/ha)	7.95	6.82	14.76	7.38
3	No. of pods/plant	134.50	122.50	257.00	128.50
4	No. of seeds/pod	31.30	29.85	61.15	30.57
5	Dry pods yield per plant (g)	46.44	42.26	88.70	44.35
6	Plant height (cm)	252.05	277.85	529.90	264.95
7	100 seeds weight (g)	1.52	1.49	3.01	1.50
8	Seed germination (%)	80.25	79.75	160.00	80.00
9	Seedling length (cm)	14.23	13.98	28.20	14.10
10	Seedling dry weight (g)	0.840	0.768	1.608	0.804
11	Seed vigour Index –I (%)	1141.6	1114.5	2256.1	1128.0
12	Seed vigour Index –II (%)	67.41	61.21	128.62	64.31
13	Cost : Benefit ratio	1 : 0.13	1 : 0.09	--	--

Where: M_1=with pinching, M_2= without pinching (Control), T_1= Foliar spray of DAP (20g/ L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/1L water) + Boron as Boric acid (3g/1L water), and T_2=Control.

Pillipesara (*Vigna trilobata)*

1. MPKV, Rahuri

The pinching practice and foliar spray with micronutrient and plant growth promoters recorded significant influence on seed yield and quality parameters of pillipesara and presented in table no 3.32 and 3.33. The treatment M_2T_3 (Pinching + Foliar spray with DAP (2%) + MN Mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)] + NAA (40 ppm) recorded significantly highest seed yield attributes *viz.,* no. of pods / plant (140), no. of seeds / pod (12), 100 seed weight (1.15 g), seed yield per plot (55.37 kg), seed yield per hector (1107.33 kg) as well as seed quality parameters *viz.*, seed germination (92.67%), root shoot length (21.94 cm), seedling dry weight (0.10 g), vigour index I (2034) and vigour index II (8.93) . The treatment M_2T_2 (Pinching + Foliar spray with DAP (2%) + MN Mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]) recorded at par seed quality and yield parameters.

Table 7.32: Effects of pinching and foliar applications on seed yield and quality parameters of pillipesara.

Treatments	No. of pods /	No. of seeds	No. of pods	100 seed	Seed yield /	Seed yield /	B:C ratio
M_1T_1: Without pinching and Foliar spray (Control)	113.84	8.16	7.88	1.040	29.38	587.50	1.06
M_2T_2: Pinching +Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]	137.64	10.80	4.12	1.128	51.99	1039.83	1.73
M_2T_2: Pinching Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]+ NAA (40 ppm)	139.80	11.96	3.68	1.150	55.37	1107.33	1.83

Table 7.33: Effects of pinching and foliar applications on seed yield and quality parameters of pillipesara.

Treatments	Germination (%)	Root shoot length (cm)	Dry matter content (g)	Vigour index I	Vigour index II
M_1T_1: Without pinching and Foliar spray (Control)	81.33 (64.44)	17.17	0.0593	1398	4.82
M_2T_2: Pinching +Spay with	91.67 (73.34)	20.28	0.0870	1861	7.98

DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]					
M_2T_2: Pinching Spay with DAP (2%) + MN mixture [$ZnSO_4$ (0.5%) + Boric acid (0.3%)]+ NAA (40 ppm)	92.67 (74.53)	21.94	0.0963	2034	8.93

(Figures in parenthesis are arc sin transformed values)

2. UAS, Dharwad

Table 7.34: Effects of pinching and foliar applications on seed yield and quality parameters of pillipesara.

Treatment details	No. of pods/ plant	Pod Yield/ plant (g)	Seed yield (q/ha)	100 seed weight (g)	Seed germination (%)	Root length (cm)	Shoot length (cm)	Seedling vigour index	Seed recovery (%)	Cost benefit ratio
Foliar spray	141.3	83.17	19.50	0.81	93.0	14.50	9.10	2195	83.50	2.45
Control	91.90	61.15	8.25	0.79	88.0	11.95	8.96	1840	77.13	1.97

3. JAU, Jamnagar

The results of demonstration trial manifested that the foliage application of DAP (20g/1L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/1L water) + Boron as Boric acid (3g/1L water) at flowering stage with pinching of terminal bud at 40 DAS (M_1T_1) was produced the higher seed yield (2.64 q/ha) as compared to control (M_2T_2) (2.03 q/ha) in Pillipesara (Table 3.35). The treatment (T_1M_1) was also reflected more number of pods per plant, dry pods yield per plant and seed quality characters than control (M_2T_2). The Cost: Benefit ratio obtained to be 1: (-) 0.40 and 1: (-) 0.47 in treated and control plot, respectively. This Cost: Benefit ratio indicated that there is no profit in both treated as well as control plot area. This was due to more vegetative growth of crop in both treated and control plot, hence, pod setting was remaining low in both plots, resulting low yield in pillipesara.

The results of demonstration trial showed that pinching of terminal buds during attainment of a plant height of 90 cm along with foliage application of DAP (20g/1L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/1L water) + Boron as Boric acid (3g/1L water) (M_1T_1) at flowering stage was produced the higher seed

yield (6.74 q/ha) as compared to control (M_2T_2) (5.81 q/ha) in Sun hemp (Table 3). The treatment (T_1M_1) was also produced higher number of pods per plant, seeds per pod, dry pods yield per plant and some seed quality parameters than control (M_2T_2). The Cost: Benefit ratio obtained to be 1: 0.13 and 1 : 0.10 in treated and control plot, respectively. This cost: benefit ratio indicated that the more profit of Rs. 0.03 was gained on investment of Rs. one in treated plot area as compared to control area. Thus, Sun hemp seed production is remaining more profitable in treated plot areas.

Conclusion

It is concluded that in Dhaincha, Sun hemp and Pillipesara, foliage application of DAP (20g/1L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/1L water) + Boron as Boric acid (3g/1L water) at flowering stage with removal of terminal bud (pinching or nipping) enhance the number of pods/plant, seeds per pod, dry pods yield per plant and seed quality characters resulting in higher yield. Pinching was done on Dhaincha at 60 DAS, Pillipesara at 40 DAS. In sun hemp, the main stem when attains a height of 90 cm, pinching was done to break apical dominance and more branching. The cost : benefit ratio indicated that the seed production of Dhaincha and sun hemp was remain more profitable in treated areas (M_1T_1) as compare to control (M_2T_2).

Table 7.35: Seed yield and ancillary observations Pillipesara at Pearl Millet Research Station, JAU, Jamnagar during *Kharif*-2018

Sr. No.	Character	Pillipesara			
		Treatments		Total	Mean
		M_1T_1	M_2T_2 (Control)		
1	Seed yield/plant (g)	6.13	5.39	11.52	5.76
2	Seed yield (q/ha)	2.64	2.03	4.67	2.34
3	No. of pods/plant	126.95	112.30	239.25	119.63
4	No. of seeds/pod	8.50	8.50	17.00	8.50
5	Dry pods yield per plant (g)	15.86	14.00	29.86	14.93
6	Plant height (cm)	68.35	73.05	141.40	70.70
7	100 seeds weight (g)	0.73	0.69	1.42	0.71
8	Seed germination (%)	83.50	81.25	164.75	82.38
9	Seedling length (cm)	10.14	10.04	20.18	10.09
10	Seedling dry weight (g)	0.580	0.536	1.116	0.558
11	Seed vigour Index –I	846.8	815.5	1662.3	831.2

	(%)				
12	Seed vigour Index –II (%)	48.43	43.57	92.00	46.00
13	Cost : Benefit ratio	1 : (-) 0.40	1 : (-) 0.47	--	--

Where: M_1=with pinching, M_2= without pinching (Control), T_1= Foliar spray of DAP (20g/ L water) incorporated with micronutrient mixture containing Zinc as Zinc sulphate (5g/1L water) + Boron as Boric acid (3g/1L water), and T_2=Control.



Pinching done in Pillipesara

B. Seed Physiology, Storage and Testing

Experiment 1: To validate the validity periods of certified seeds of field crops (as per the IMSC regulations)

Year of Start: 2017

Introduction:

Seed vigour is an important quality parameter which needs to be assessed to supplement germination and viability tests to know the performance of a seed lot in the field or in storage. As the germination test is conducted in an optimum condition specific to different species, it is not always possible to get an idea of the performance of a seed lot in the field on the basis of germination test in the laboratory. It is mainly because of the reason that field conditions are seldom optimum and the emerging seedling suffers from one or other kind of stress. In many cases, seed lots having similar laboratory germinations may give widely differing field emergence values. This indicate the incompleteness of germination test in assessing the performance of a seed lot and offers scope and possibility to determine vigour of a seed lot so that its field performance can be assessed and leftover seed lots can be revalidated.

Objective: To study the planting values of seeds to examine the prescribed periods of validity of fresh and revalidated certified seed lots of some major field crops.

Crops		Centres
Wheat	:	ICAR-IARI, New Delhi; GBPUAT, Pantnagar; VNMKV, Parbhani; SKNAU, Durgapura; MPKV, Rahuri; HAU, Hisar; NDUAT, Faizabad; CSAUAT, Kanpur; SKUAST, Kashmir, Srinagar and CSKHPKV, Palampur
Rice	:	ICAR-IARI, New Delhi; PAU, Ludhiana; PJTSAU, Hyderabad; TNAU, Coimbatore; UAS, Bengaluru; PAJANCOA&RI, Karaikal; KAU, RARS, Pattambi; AAU, Jorhat; SKUAST, Kashmir, Srinagar and OUAT, Bhubaneswar
Maize	:	ICAR-IARI, New Delhi; TNAU, Coimbatore and PAU, Ludhiana
Sorghum	:	ICAR-IIMR, Hyderabad; VNMKV, Parbhani; MPKV, Rahuri and UAS, Dharwad
Cotton	:	ICAR-CICR, Nagpur; PJTSAU, Hyderabad and UAS, Dharwad
Soybean	:	ICAR-IARI, New Delhi; GBPUAT, Pantnagar; JNKVV, Jabalpur; VNMKV, Parbhani; MPKV, Rahuri and UAS, Dharwad
Chickpea	:	ICAR-IARI, New Delhi; JNKVV, Jabalpur; VNMKV, Parbhani; SKNAU, Jobner and CSAUAT, Kanpur
Castor	:	PJTSAU, Hyderabad; JAU, Jamnagar; AAU, Anand; ICAR-IIOR, Hyderabad and SKNAU, Durgapura;
Groundnut	:	AAU, Anand; OUAT, Bhubaneswar; JAU, Jamnagar; MPKV, Rahuri; UAS, Bengaluru and UAS, Dharwad; SKNAU, Durgapura; BSKKV, Dapoli and BCKV, Mohanpur

Technical Programme:

Materials:

Seed lots: Sufficient quantities of certified seeds (fresh) of minimum two most popular varieties in each crop and revalidated (Once or twice) seeds of same varieties, if available, have procured from State Seed Corporations/Agencies or its vendors. Date of harvesting, date of test and validity period have been noted. Wherever the revalidated (Once or twice) seeds are not available, sufficient quantities of seeds of same varieties was procured and stored at prescribed packaging material under seed godown conditions.

Evaluation for Vigour:

The seed lots; fresh and revalidated or stored seeds were periodically tested for Moisture content (MC), First count and Germination and vigour indices at one month interval for at least 24 months from date of harvesting. The seed lots were also field tested at an interval of every 2 months for seedling emergence, speed of emergence and the experiment was terminated with recording of final plant stand establishment. The final plant stand establishment was recorded/ taken 6 weeks after sowing for cotton and all cereal crops, whereas it was 3-4 weeks after sowing for groundnut and pulses.

Laboratory Observations:

- Seed Moisture content (ISTA)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)

Field observations:

- Speed of emergence (Maguire, 1962)
- Final plant stand establishment (%)

Crop-wise and centre-wise research findings during 2018-19

Crop: Wheat

Centre: ICAR-IARI, New Delhi (Not Reported)

Centre: GBPUAT, Pantnagar

Experimental details:

Two lots of foundation seed (S1= Revalidated and S2=Fresh) of each of the five varieties of wheat *viz.,* HD2967, CBW 38, PBW550, DPW621-50 and UP 2565 were included in study. The five revalidated seed lots of wheat was brought from UP Seed Certification Agency regional station, Bilaspur and fresh seed lots were brought from University Research Station.

Results:

All the seed lots were tested for seed moisture content, germination (%), seedling length, seedling dry mass and days taken to radicle emergence. The seed moisture content of all the lots ranges from 11 to 13.5 %. Seed germination of revalidated seed lot was 87.8% which is more than IMSCS (85%), however it was significantly lower than fresh seed lot (98.3%). The same trend was observed with seedling length and seedling dry mass. Revalidated seed lot also took significantly more time to radicle emergence than fresh seed lot.

Among the varieties, the highest germination (%) was observed with HD 2967 and CBW 38 which were at par with DPW621-50 and UP 2565. The lowest germination was recorded with variety PBW 550 which was significantly lower than rest of the varieties. The maximum seedling length and seedling dry mass was recorded with variety UP 2565 which differ significantly than rest of the varieties (Table 1.1).

The crop was planted in the field (Fig. 1.1) on November 25, 2017 in factorial RBD with three replications and the observations are being recorded as per technical programme.



Fig.1.1: Field view of crop grown with revalidated and fresh/new seed lot of four varieties of wheat

Table 1.1: Seed germination and seedling vigour of revalidated and fresh seed in five varieties of wheat

Varieties	Germination (%)			Seedling length (cm)			Seedling dry mass (mg/seedling)			Days to radicle emergence (days)		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
V1	89.0	98.7	93.8	18.7	22.6	20.7	17.7	19.3	18.5	4.3	2.3	3.3
V2	88.3	99.3	93.8	19.6	22.6	21.1	18.3	19.8	19.1	4.6	2.0	3.3
V3	87.0	97.3	92.2	20.5	23.4	22.0	19.1	21.5	20.3	4.3	2.6	3.5
V4	87.3	98.0	92.7	21.2	23.5	22.3	18.9	21.2	20.1	4.3	2.3	3.3
V5	87.6	98.3	92.9	21.2	27.0	24.1	19.4	21.6	20.5	4.3	2.3	3.3
Mean	87.8	98.3	93.1	20.2	23.8	22.0	18.7	20.7	19.7	4.4	2.3	3.3
	V	S	VxS	V	S	VxS	V	S	VxS	V	S	VxS
SEm(±)	0.55	0.35	0.77	0.20	0.13	0.28	0.30	0.19	0.43	0.22	0.14	0.31
CD(p=0.05)	1.6	1.0	NS	0.6	0.4	NS	0.9	0.6	NS	NS	0.4	NS

V1=HD2967; V2=CBW 38; V3=PBW 550; V4=DPW621-50 and V5=UP 2565 S1=Revalidated seed lot and S2= Fresh seed lot

Centre: VNMKV, Parbhani

Experimental details:

Two lots; Fresh Seed (Lot No.1: April17-13-2205VNMKV794) of April 2017 harvest and Leftover Seed (Lot No.2: April16-13-2205VNMKV551) of April 2016 harvest of wheat variety; NIAW301 were taken for the study (Fig. 1.2).

Results:

Among all the laboratory parameters, the final germination in both the lots was more than the IMSCS, however, the first count was found very much less (13) in left over seed lot than that of fresh seed lot, which is an indicator of low vigour. Though, there were no differences in days to 50% flowering and days to maturity, but the grain yields was much higher in fresh seed lot (Table 1.2) that could be attributed to higher test weight.

Table 1.2: Various laboratory and field parameters observed in fresh and left over seed lots of wheat

Seed Lots	Seed Moisture Content %	Radical emergence	First Count	Final Count	Seedling dry mass (gm)
Fresh	10.7	96	42	96	0.130
Left over	10.9	90	13	90	0.122

Seed Lots	Field emergence (m^2)	Days to 50% Flowering	Days to Maturity	Grain Yield (gm per m^2)	1000 Seed Weight (gm)
Fresh	35	60	103	393.42	40.06
Left over	34	60	103	312.14	37.04



Fig.1.2: Field view of crop raised from fresh and left over seed lots of wheat

Centre: SKNAU, RARI, Durgapura

Experimental details:

Certified fresh and stored seeds of two popular varieties of wheat i.e. Raj 4238 and Raj 4079 were taken for study. Initially moisture content was measured in fresh and old seed lots at one moth intervals. Simultaneously, seeds of both the varieties were grown in laboratory with paper towel method at one month interval. Observations were taken for various parameters using standard methods.

Results:

Seed moisture content declined over the storage period in both the varieties. There was not much genotypic variations in first count and final germination per cent in 6 months old seed lots. Over the storage period, there was significant decrease in first count and germination per cent in both the varieties and varietal differences were also statistically significant. Considerable higher values of first counts were observed even after 22 months of storage i.e., 78.2% and 77% in RAJ 4238 and RAJ 4079, respectively. Germination per cent was higher than IMSCS even after 22 months of storage in both the varieties (Table 1.3). However, at the end of storage (22 months), there was mean decrease of seedling vigour index –I and II to the tune of 57% and 65% in comparison to 6 months old seeds in both the varieties (Table 1.3)

Similarly, field emergence of 85% and 84.25% was noticed in RAJ 4238 and RAJ 4079, respectively after 20 months of storage, while final plant stand of 81 and 79.2 were maintained per m^2 after 20 months of storage in comparison to 6 months old seed lot of in RAJ 4238 and RAJ 4079, respectively (92 and 89.5 per m^2) which indicates maintenance of seed vigour for considerable period of storage in both the wheat varieties tested (Table 1.5).

Table 1.3: Effect of storage period on moisture content, first count and germination per cent in two varieties of wheat at SKNAU, Durgapur

Storage period	Moisture content (%)			First Count (%)			Germination %		
	RAJ 4238	RAJ 4079	Mean	RAJ 4238	RAJ 4079	Mean	RAJ 4238	RAJ 4079	Mean
6 months	12.55 (20.75)	12.43 (20.64)	12.49 (20.69)	94.00 (75.84)	93.25 (74.97)	93.63 (75.41)	94.25 (76.23)	93.75 (75.63)	94.00 (75.93)
7 months	12.08 (20.33)	12.00 (20.27)	12.04 (20.30)	92.00 (73.65)	91.00 (72.55)	91.50 (73.10)	93.75 (75.69)	92.50 (74.18)	93.13 (74.93)
8 months	11.80 (20.09)	11.53 (19.85)	11.66 (19.97)	91.00 (72.61)	90.00 (71.65)	90.50 (72.13)	93.00 (74.82)	92.00 (73.65)	92.50 (74.24)
9 months	11.30 (19.64)	11.10 (19.46)	11.20 (19.55)	90.00 (71.75)	88.25 (69.99)	89.13 (70.87)	92.50 (74.19)	91.75 (73.40)	92.13 (73.79)
10 months	10.95 (19.32)	10.85 (19.23)	10.90 (19.28)	88.25 (69.99)	87.00 (69.08)	87.63 (69.53)	92.00 (73.86)	91.25 (72.81)	91.63 (73.34)
18 months	10.25 (18.67)	10.18 (18.60)	10.21 (18.64)	86.75 (68.73)	84.00 (66.52)	85.38 (67.63)	91.50 (73.23)	89.75 (71.37)	90.63 (72.30)

19 months	10.10 (18.53)	10.08 (18.51)	10.09 (18.52)	85.25 (67.51)	81.00 (64.22)	83.13 (65.87)	91.00 (72.73)	89.00 (70.66)	90.00 (71.69)
20 months	10.03 (18.46)	10.00 (18.43)	10.01 (18.45)	82.75 (65.50)	80.00 (63.51)	81.38 (64.51)	90.50 (72.16)	88.25 (70.02)	89.38 (71.09)
21 months	9.98 (18.41)	9.95 (18.39)	9.96 (18.40)	80.25 (63.69)	79.25 (62.91)	79.75 (63.30)	89.50 (71.16)	88.00 (69.84)	88.75 (70.50)
22 months	9.83 (18.27)	9.83 (18.27)	9.83 (18.27)	78.25 (62.21)	77.00 (61.38)	77.63 (61.79)	89.00 (70.65)	87.00 (68.95)	88.00 (69.80)
Mean	10.89 (19.25)	10.79 (19.16)		86.85 (69.15)	85.08 (67.68)		91.70 (73.47)	90.33 (72.05)	
	V	SP	Vx SP	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	0.02	0.04	0.05	0.35	0.77	1.09	0.36	0.81	1.15
CD(p=0.05)	0.05	0.10	NS	0.98	2.19	NS	1.03	2.30	NS

Table 1.4: Effect of storage periods on seedling index I and seedling index II in two varieties of wheat at SKNAU, Durgapura

Storage period	Seedling Index-I			Seedling Index-II		
	RAJ 4238	RAJ 4079	Mean	RAJ 4238	RAJ 4079	Mean
6 months	2964	2876	2920	22.14	20.74	21.44
7 months	2746	2630	2688	20.69	18.90	19.79
8 months	2524	2389	2457	19.08	17.61	18.34
9 months	2402	2212	2307	17.00	15.81	16.40
10 months	2058	2044	2051	15.66	14.67	15.17
18 months	1829	1913	1871	14.52	13.97	14.25
19 months	1691	1719	1705	12.77	12.11	12.44
20 months	1639	1567	1603	11.94	11.05	11.49
21 months	1465	1392	1429	9.46	8.77	9.12
22 months	1299	1200	1250	7.83	7.11	7.47
Mean	2062	1994		15.11	14.07	
	V	SP	VxSP	V	SP	Vx SP
SEm(±)	10.66	23.85	33.72	0.17	0.38	0.53
CD(p=0.05)	30.17	67.46	95.40	0.48	1.07	NS

Table 1.5: Effect of storage periods on field emergence and final plant stand establishment in two varieties of wheat at SKNAU, Durgapura

Storage period	Field emergence (%)			Final plant stand (per m^2)		
	RAJ 4238	RAJ 4079	Mean	RAJ 4238	RAJ 4079	Mean
6 months	94.25 (76.23)	93.25 (74.97)	93.75 (75.60)	92.00	89.50	90.75

8 months	90.00 (71.77)	89.25 (70.97)	89.63 (71.37)	86.25	84.50	85.38
18 months	87.00 (69.13)	85.50 (67.89)	86.25 (68.51)	83.00	81.75	82.38
20 months	85.00 (67.34)	84.25 (66.84)	84.63 (67.09)	81.00	79.25	80.13
Mean	89.06 (71.12)	88.06 (70.17)		85.56	83.75	
	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	1.03	1.45	2.05	0.80	1.14	1.61
CD(p=0.05)	NS	4.23	NS	NS	3.32	NS

Centre: MPKV, Rahuri

Experimental details:

Variety (Four): V1: Panchavti V2: Godavari V3 : Tapovan V4 : Trimbak
Seed Lot (Two): L1: Lot 1 L2: Lot 2
Seed type (Three): L1: Fresh L2: RVD Ist L3: RVD IInd

Details of seed samples

Crop	Variety	Stage	Lot. No	Date of Harvest	Age of the seed on July 2018 from date of harvest (month)
Wheat	Panchvati (NIDW-15)	Nucleus	Lot. No-1	April -2017-18 (Fresh)	14
				April -2016-17 (RVD-I)	26
				April -2015-16 (RVD-II)	38
	Panchvati (NIDW-15)	Nucleus	Lot. No-2	April -2017-18 (Fresh)	14
				April -2016-17 (RVD-I)	26
				April -2015-16 (RVD-II)	38
Wheat	Godavari (NIAW-295)	Nucleus	Lot. No-1	April -2017-18 (Fresh)	14
				April -2016-17 (RVD-I)	26
				April -2015-16 (RVD-II)	38
	Godavari (NIAW-295)	Nucleus	Lot. No-2	April -2017-18 (Fresh)	14
				April -2016-17 (RVD-I)	26
				April -2015-16 (RVD-II)	38
Wheat	Tapovan (NIAW-917)	Nucleus	Lot. No-1	April -2017-18 (Fresh)	14
				April -2016-17 (RVD-I)	26
				April -2015-16 (RVD-II)	38
	Tapovan (NIAW-917)	Nucleus	Lot. No-2	April -2017-18 (Fresh)	14
				April -2016-17 (RVD-I)	26
				April -2015-16 (RVD-II)	38
Wheat	Trimbak	Nucleus	Lot. No-1	April -2017-18 (Fresh)	14

	(NIAW-301)			April -2016-17 (RVD-I)	26
				April -2015-16 (RVD-II)	38
	Trimbak (NIAW-301)	Nucleus	Lot. No-2	April -2017-18 (Fresh)	14
				April -2016-17 (RVD-I)	26
				April -2015-16 (RVD-II)	38

Results:

Seed of four wheat varieties of two different lots with fresh and revalidated (RVD I, RVD II) each of were collected as per the objective of the experiment to validate the validity period as per the Indian Minimum Seed Certification Standards. Accordingly the samples were tested for germination and seed quality parameters.

a. Effect of variety. The germination percentage and moisture content was not influenced significantly due to varieties. However, the variety Godavari recorded significantly higher values of seed quality parameter *viz.,* vigour index I (2908), vigour index II (26.35) and field emergence (81.67 %).

b. Effect of Seed lot: The germination and other seed quality parameters were not influenced significantly due to seed lots.

c. Effect of Seed types: The seed type had significant effect on seed quality of wheat. The fresh seed recorded significantly higher germination (94%) at the age of 14th month after harvest, while it was (88 .63 %) at the age of 20th month. The RVD I seed maintained germination (85.75%) even at the age of 31st month which is above IMSCS (85%). Whereas, RVD II seed had 83.50 % germination at the age of 38th month from date of harvest (Table 1.6). There was marginal decrease of 8.1%, 8.1% and 7.2% in seedling vigour index-I (SVI-I) of fresh, RVD-I and RVD-II seed at the age of 20, 32 and 44 months of storage, respectively in comparison to their respective SVI-I at 14, 26 and 38 months (Table 1.10). Similar results were also recorded with respect to SVI-II (Table 1.12).

Fresh, RVD-I and RVD-II seed shown 79.8, 75.5 and 68.7% field emergence at the age of 20, 32 and 44 months of storage, respectively in comparison to 85, 80.8 and 75.3% field emergence at their 14, 26 and 38 months, respectively (Table 1.14) showing only 6, 6.3 and 8.8% decrease over a period of 6 months. This shows that, all the four wheat varieties maintained seed vigour for considerably longer storage period.

d. Interaction effect of variety, lot and seed type on seed quality parameters of wheat. The data on interaction effect of variety, lot and seed type are not influenced significantly.

Table 1.6: Effect of variety, lot and seed types on germination (%) of wheat

Treatments		July	August	September	October	November	December	January
Variety								
V_1: Panchavati		88.67(71.01)	88.33(70.64)	87.67(70.20)	87.33(69.75)	86.17(69.07)	85.17(67.94)	84.17(66.96)
V_2: Godavari		90.17(72.42)	89.50(71.55)	89.00(71.10)	88.33(70.53)	87.50(69.83)	86.50(68.95)	85.17(67.68)
V_3: Tapovan		89.83(71.84)	88.00(70.06)	87.67(69.78)	86.83(69.10)	86.00(68.28)	85.00(67.46)	84.00(66.77)
V_4:Trimbak		88.50(70.51)	87.50(69.76)	86.50(68.73)	85.67(68.02)	84.67(67.26)	83.33(66.13)	81.83(65.12)
SEm(±)		0.726	0.697	0.908	0.796	1.071	0.960	0.937
CD(p=0.05)		NS	NS	NS	NS	NS	NS	NS
Seed lot								
L_1: Lot 1		89.83(72.00)	88.75(70.92)	88.00(70.17)	87.67(69.89)	86.58(69.04)	85.58(68.07)	84.33(67.06)
L2: Lot 2		88.75(70.89)	87.92(70.09)	87.42(69.74)	86.42(68.81)	85.58(68.18)	84.42(67.17)	83.25(66.20)
SEm(±)		0.513	0.493	0.642	0.563	0.757	0.679	0.662
CD(p=0.05)		NS	NS	NS	NS	NS	NS	NS
Seed type								
S_1: Fresh		94.00(76.19)	93.25(75.26)	92.63(74.45)	92.00(73.83)	91.25(73.08)	90.00(71.73)	88.63(70.62)
S_2: RVD I^{st}		90.38(72.05)	89.00(70.76)	88.50(70.31)	87.75(69.75)	86.75(68.87)	85.75(67.98)	84.75(67.11)
S_3: RVD II^{nd}		83.50(66.10)	82.75(65.49)	82.00(65.10)	81.38(64.48)	80.25(63.88)	79.25(63.15)	78.00(62.17)
SEm(±)		0.629	0.603	0.786	0.690	0.927	0.831	0.811
CD(p=0.05)		1.788	1.716	2.235	1.961	2.638	2.364	2.308
Age of seed on July 2018 from date of harvest (Month)	Fresh	14	15	16	17	18	19	20
	RVD I	26	27	28	29	30	31	32
	RVD II	38	39	40	41	42	43	44

*Figures in parenthesis are arc sin transformed values

Table 1.7: Interaction effect of variety, lot and seed types on germination (%) of wheat

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	95.00 (77.48)	95.00 (77.09)	94.00 (76.00)	94.00 (76.10)	93.00 (74.94)	92.00 (73.70)	91.00 (72.80)
$V_1L_1R_1$	90.00 (71.65)	89.00 (70.69)	89.00 (70.77)	88.00 (69.86)	87.00 (69.17)	86.00 (68.15)	85.00 (67.36)
$V_1L_1R_2$	82.00 (64.91)	82.00 (64.89)	81.00 (64.20)	81.00 (64.15)	79.00 (63.77)	78.00 (62.81)	77.00 (61.34)
$V_1L_2R_0$	94.00 (76.10)	94.00 (76.00)	93.00 (74.73)	93.00 (74.79)	92.00 (73.79)	90.00 (71.65)	89.00 (70.89)
$V_1L_2R_1$	90.00 (71.74)	90.00 (71.74)	89.00 (70.68)	89.00 (70.89)	88.00 (69.95)	87.00 (69.28)	86.00 (68.03)
$V_1L_2R_2$	81.00 (64.20)	80.00 (63.44)	80.00 (64.83)	79.00 (62.73)	78.00 (62.81)	78.00 (62.04)	77.00 (61.34)
$V_2L_1R_0$	96.00 (79.02)	95.00 (77.22)	94.00 (76.00)	94.00 (75.82)	93.00 (75.02)	92.00 (73.60)	90.00 (71.74)
$V_2L_1R_1$	91.00 (72.67)	90.00 (71.65)	89.00 (70.75)	89.00 (70.71)	88.00 (69.78)	87.00 (68.97)	86.00 (68.19)
$V_2L_1R_2$	85.00 (67.22)	85.00 (67.21)	84.00 (66.46)	84.00 (66.55)	83.00 (65.65)	82.00 (64.91)	81.00 (64.15)
$V_2L_2R_0$	95.00 (77.48)	94.00 (75.90)	94.00 (76.10)	93.00 (75.02)	93.00 (74.79)	92.00 (73.60)	90.00 (71.74)
$V_2L_2R_1$	90.00 (71.65)	90.00 (71.65)	90.00 (71.65)	88.00 (70.18)	87.00 (69.55)	87.00 (68.87)	86.00 (68.19)
$V_2L_2R_2$	84.00 (66.49)	83.00 (65.71)	83.00 (65.66)	82.00 (64.91)	81.00 (64.20)	79.00 (63.77)	78.00 (62.05)
$V_3L_1R_0$	94.00 (76.05)	93.00 (74.73)	93.00 (74.71)	92.00 (73.70)	91.00 (72.57)	90.00 (71.58)	89.00 (70.68)
$V_3L_1R_1$	93.00 (74.71)	87.00 (68.92)	88.00 (69.86)	88.00 (70.35)	87.00 (68.97)	86.00 (68.12)	85.00 (67.28)
$V_3L_1R_2$	85.00 (67.28)	84.00 (66.44)	83.00 (65.68)	83.00 (65.71)	82.00 (64.92)	81.00 (64.15)	80.00 (63.44)
$V_3L_2R_0$	93.00 (74.87)	92.00 (73.70)	92.00 (73.70)	90.00 (71.65)	90.00 (71.65)	89.00 (70.64)	88.00 (69.95)
$V_3L_2R_1$	90.00 (71.65)	89.00 (70.89)	88.00 (69.86)	87.00 (68.97)	86.00 (68.10)	85.00 (67.52)	84.00 (66.44)
$V_3L_2R_2$	84.00 (66.48)	83.00 (65.65)	82.00 (64.91)	81.00 (64.20)	80.00 (63.47)	79.00 (62.76)	78.00 (62.81)
$V_4L_1R_0$	93.00 (74.87)	92.00 (74.87)	91.00 (72.72)	91.00 (72.62)	90.00 (72.07)	89.00 (70.89)	87.00 (69.93)
$V_4L_1R_1$	90.00 (71.65)	90.00 (71.65)	88.00 (69.95)	87.00 (68.97)	86.00 (68.19)	84.00 (66.55)	83.00 (65.67)
$V_4L_1R_2$	84.00 (66.49)	83.00 (65.68)	82.00 (64.91)	81.00 (64.15)	80.00 (63.44)	80.00 (63.41)	78.00 (62.18)
$V_4L_2R_0$	92.00 (73.70)	91.00 (72.58)	90.00 (71.65)	89.00 (70.89)	88.00 (69.84)	86.00 (68.19)	85.00 (67.24)
$V_4L_2R_1$	89.00 (70.68)	87.00 (68.88)	87.00 (68.97)	86.00 (68.03)	85.00 (67.24)	84.00 (66.40)	83.00 (65.71)
$V_4L_2R_2$	83.00 (65.71)	82.00 (64.91)	81.00 (64.17)	80.00 (63.47)	79.00 (62.79)	77.00 (61.34)	75.00 (60.02)
SEm(±)	1.778	1.706	2.223	1.950	2.623	2.351	2.295
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in parenthesis are arc sin transformed values

Table 1.8: Effect of variety, lot and seed types on moisture content (%) of wheat

Treatments		July	August	September	October	November	December	January
Variety								
V_1: Panchavati		8.83	8.96	8.95	8.83	8.91	9.10	8.87
V_2: Godavari		8.64	8.86	8.91	8.83	8.88	8.89	8.81
V_3: Tapovan		8.89	8.97	8.98	8.90	8.93	8.91	8.81
V_4:Trimbak		8.86	9.04	8.96	8.84	8.90	8.89	8.80
SEm(±)		0.086	0.091	0.105	0.072	0.079	0.048	0.052
CD(p=0.05)		NS	NS	NS	NS	NS	0.136	NS
Seed lot								
L_1: Lot 1		8.85	8.98	8.94	8.84	8.92	8.91	8.81
L2: Lot 2		8.76	8.94	8.96	8.86	8.89	8.99	8.83
SEm(±)		0.061	0.064	0.074	0.051	0.056	0.034	0.037
CD(p=0.05)		NS	NS	NS	NS	NS	NS	NS
Seed type								
S_1: Fresh		8.93	9.11	9.02	8.93	8.95	8.98	8.86
S_2: RVD Ist		8.81	8.93	8.95	8.88	8.93	9.01	8.85
S_3: RVD IInd		8.67	8.83	8.89	8.75	8.85	8.85	8.77
SEm(±)		0.074	0.079	0.091	0.062	0.068	0.042	0.045
CD(p=0.05)		NS	NS	NS	NS	NS	0.118	NS
Age of seed on July 2018 from date of harvest (Month)	Fresh	14	15	16	17	18	19	20
	RVD I	26	27	28	29	30	31	32
	RVD II	38	39	40	41	42	43	44

Table 1.9: Interaction effect of variety, lot and seed types on moisture content (%) of wheat

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	9.15	9.10	9.05	8.98	9.05	9.04	8.96
$V_1L_1R_1$	8.90	8.98	8.95	8.90	8.97	8.98	8.88
$V_1L_1R_2$	8.85	8.90	8.88	8.50	8.90	8.92	8.78
$V_1L_2R_0$	8.65	9.07	9.03	8.92	8.68	8.98	8.93
$V_1L_2R_1$	8.82	8.93	8.95	8.90	8.97	9.88	8.87
$V_1L_2R_2$	8.60	8.80	8.85	8.80	8.90	8.78	8.81
$V_2L_1R_0$	8.95	9.03	8.97	8.90	8.95	8.98	8.88
$V_2L_1R_1$	8.60	8.80	8.90	8.87	8.87	8.76	8.85

$V_2L_1R_2$	8.47	8.72	8.80	8.75	8.80	8.82	8.76
$V_2L_2R_0$	8.60	8.98	8.99	8.90	8.95	8.99	8.85
$V_2L_2R_1$	8.70	8.89	8.92	8.88	8.92	8.90	8.80
$V_2L_2R_2$	8.50	8.72	8.87	8.70	8.80	8.90	8.70
$V_3L_1R_0$	9.10	9.10	9.03	8.94	8.99	8.95	8.59
$V_3L_1R_1$	8.93	8.99	8.98	8.90	8.95	8.90	8.88
$V_3L_1R_2$	8.82	8.90	8.93	8.85	8.87	8.88	8.80
$V_3L_2R_0$	8.97	9.04	9.03	8.96	8.99	8.97	8.91
$V_3L_2R_1$	8.80	8.95	8.98	8.90	8.91	8.90	8.90
$V_3L_2R_2$	8.72	8.85	8.90	8.85	8.88	8.85	8.80
$V_4L_1R_0$	8.95	9.39	8.98	8.90	8.97	8.96	8.85
$V_4L_1R_1$	8.82	8.95	8.93	8.85	8.90	8.88	8.80
$V_4L_1R_2$	8.60	8.88	8.90	8.72	8.81	8.85	8.73
$V_4L_2R_0$	9.07	9.15	9.05	8.91	8.98	8.95	8.90
$V_4L_2R_1$	8.92	8.98	8.97	8.85	8.91	8.90	8.80
$V_4L_2R_2$	8.81	8.90	8.95	8.80	8.85	8.82	8.74
SEm(±)	0.210	0.223	0.256	0.177	0.192	0.118	0.128
CD(p=0.05)	NS	NS	NS	NS	NS	0.334	NS

Table 1.10: Effect of variety, lot and seed types on Vigour index I of wheat

Treatments		July	August	September	October	November	December	January
Variety								
V_1: Panchavati		2810	2798	2764	2750	2702	2663	2628
V_2: Godavari		2908	2879	2851	2822	2792	2726	2661
V_3: Tapovan		2781	2712	2694	2677	2634	2615	2569
V_4:Trimbak		2757	2723	2702	2655	2629	2575	2515
SEm(±)		38.12	36.09	46.54	32.91	54.42	46.92	41.14
CD(p=0.05)		108.42	105.58	NS	93.61	NS	NS	NS
Seed lot								
L_1: Lot 1		2814	2763	2733	2722	2685	2631	2579
L2: Lot 2		2813	2792	2773	2730	2694	2658	2607
SEm(±)		29.56	25.50	32.91	23.27	38.48	33.18	29.09
CD(p=0.05)		NS	NS	NS	NS	NS	NS	NS
Seed type								
S_1: Fresh		3063	3033	3004	2967	2939	2871	2814
S_2: RVD I^{st}		2857	2796	2774	2751	2718	2687	2625
S_3: RVD II^{nd}		2522	2504	2481	2460	2411	2376	2340
SEm(±)		33.01	31.24	40.31	28.50	47.13	40.64	35.63
CD(p=0.05)		93.90	88.84	114.64	81.07	134.04	115.57	101.50
Age of seed on July 2018	Fresh	14	15	16	17	18	19	20
	RVD I	26	27	28	29	30	31	32
	RVD II	38	39	40	41	42	43	44

from date of harvest (Month)								

Table 1.11: Interaction effect of variety, lot and seed types on Vigour index I of wheat

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	3134	3088	3044	3032	2997	2953	2911
$V_1L_1R_1$	2877	2793	2779	2746	2709	2669	2639
$V_1L_1R_2$	2492	2482	2445	2442	2380	2346	2312
$V_1L_2R_0$	3019	3117	3066	3060	3027	2957	2920
$V_1L_2R_1$	2893	2896	2850	2849	2817	2781	2735
$V_1L_2R_2$	2447	2410	2403	2369	2282	2272	2249
$V_2L_1R_0$	3207	3152	3104	3103	3069	2845	2780
$V_2L_1R_1$	2928	2891	2850	2852	2818	2780	2647
$V_2L_1R_2$	2573	2568	2553	2526	2486	2462	2431
$V_2L_2R_0$	3133	3090	3048	3008	3006	2963	2882
$V_2L_2R_1$	2918	2913	2895	2826	2789	2785	2751
$V_2L_2R_2$	2687	2658	2654	2615	2584	2517	2473
$V_3L_1R_0$	3000	2931	2903	2861	2820	2796	2760
$V_3L_1R_1$	2840	2653	2684	2683	2644	2607	2568
$V_3L_1R_2$	2556	2515	2482	2527	2451	2414	2401
$V_3L_2R_0$	2969	2927	2915	2848	2846	2804	2763
$V_3L_2R_1$	2788	2746	2713	2707	2643	2703	2576
$V_3L_2R_2$	2530	2497	2466	2432	2400	2365	2346
$V_4L_1R_0$	2994	2958	2908	2916	2884	2856	2752
$V_4L_1R_1$	2718	2699	2644	2616	2630	2523	2490
$V_4L_1R_2$	2452	2426	2396	2356	2328	2320	2262
$V_4L_2R_0$	3047	3000	3048	2904	2860	2792	2746
$V_4L_2R_1$	2891	2777	2773	2726	2693	2646	2590
$V_4L_2R_2$	2437	2476	2446	2410	2377	2312	2250
SEm(±)	93.37	88.35	114.01	80.62	133.30	114.94	100.77
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 1.12: Effect of variety, lot and seed types on Vigour index II of wheat

Treatments	July	August	September	October	November	December	January
Variety							
V_1: Panchavati	25.30	24.35	24.44	24.65	23.55	23.56	23.92
V_2: Godavari	25.42	25.24	24.95	26.35	23.76	23.11	23.71
V_3: Tapovan	25.34	23.81	23.81	23.50	23.13	22.55	22.72
V_4:Trimbak	24.82	23.66	23.25	23.17	22.07	22.56	21.46

SEm(±)		0.383	0.409	0.434	0.524	0.537	0.399	0.390
CD(p=0.05)		NS	1.164	1.235	1.489	NS	NS	1.110
Seed lot								
L_1: Lot 1		25.49	24.38	24.44	24.85	23.16	23.00	23.31
L2: Lot 2		24.95	24.15	23.78	23.98	23.10	22.89	22.59
SEm(±)		0.271	0.289	0.307	0.370	0.379	0.282	0.276
CD(p=0.05)		NS	NS	NS	NS	NS	NS	NS
Seed type								
S_1: Fresh		27.16	26.35	26.10	26.12	25.35	25.10	24.79
S_2: RVD I^{st}		25.43	24.50	24.49	24.39	23.38	23.05	23.29
S_3: RVD II^{nd}		23.08	21.94	21.75	22.74	20.66	20.69	20.78
SEm(±)		0.332	0.354	0.376	0.453	0.465	0.346	0.338
CD(p=0.05)		0.944	1.008	1.070	1.290	1.322	0.983	0.961
Age of seed on July 2018 from date of harvest (Month)	Fresh	14	15	16	17	18	19	20
	RVD I	26	27	28	29	30	31	32
	RVD II	38	39	40	41	42	43	44

Table 1.13: Interaction effect of variety, lot and seed types on Vigour index II of wheat

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	27.57	26.61	27.27	26.30	26.06	26.70	25.49
$V_1L_1R_1$	26.08	24.05	24.94	24.66	24.43	24.11	24.08
$V_1L_1R_2$	22.98	21.33	22.70	22.69	20.60	21.56	21.57
$V_1L_2R_0$	27.28	27.26	26.01	27.02	25.80	25.20	25.82
$V_1L_2R_1$	25.22	25.22	24.92	25.84	24.08	23.50	24.94
$V_1L_2R_2$	22.66	21.60	20.82	21.37	20.34	20.29	21.59
$V_2L_1R_0$	27.86	27.54	27.28	27.27	26.06	25.77	25.18
$V_2L_1R_1$	25.50	26.11	25.83	25.83	22.91	22.63	24.07
$V_2L_1R_2$	23.81	23.81	22.70	30.27	20.73	20.50	22.68
$V_2L_2R_0$	26.58	26.31	26.30	26.99	26.06	25.76	25.18
$V_2L_2R_1$	25.23	25.23	25.18	24.75	24.35	23.49	24.09
$V_2L_2R_2$	23.54	22.46	22.43	23.00	22.45	20.52	21.07
$V_3L_1R_0$	27.28	26.07	26.96	25.78	25.47	24.29	25.82
$V_3L_1R_1$	26.05	23.50	24.66	23.81	23.51	22.37	23.80
$V_3L_1R_2$	23.82	21.83	22.43	21.60	21.34	20.25	21.60
$V_3L_2R_0$	26.99	25.78	24.86	25.20	25.21	24.92	23.77
$V_3L_2R_1$	25.21	24.06	22.60	23.49	23.23	22.96	21.84
$V_3L_2R_2$	22.69	21.59	21.34	21.11	20.00	20.53	19.47
$V_4L_1R_0$	26.99	25.77	24.93	25.43	24.34	24.05	24.08
$V_4L_1R_1$	25.21	24.33	23.10	23.51	22.39	22.69	21.88
$V_4L_1R_2$	22.70	21.59	20.52	21.07	20.02	21.07	19.52

$V_4L_2R_0$	26.70	25.47	25.19	24.95	23.78	24.09	22.95
$V_4L_2R_1$	24.90	23.48	24.68	23.23	22.13	22.68	21.59
$V_4L_2R_2$	22.43	21.34	21.06	20.82	19.78	20.79	18.76
SEm(±)	0.939	1.002	1.064	1.282	1.315	0.978	0.956
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 1.14: Effect of variety, lot and seed types on field emergence % of wheat

Treatments		July	August	September	October	November	December	January
Variety								
V_1: Panchavati		80.33 (63.67)	79.17 (62.85)	78.83 (62.61)	78.50 (62.38)	77.83 (61.91)	76.44 (60.96)	76.17 (60.78)
V_2: Godavari		81.67 (64.65)	81.00 (64.16)	80.50 (63.79)	79.83 (63.31)	79.00 (62.73)	78.00 (62.03)	76.00 (60.67)
V_3: Tapovan		80.83 (64.03)	79.83 (63.31)	80.00 (63.44)	77.50 (61.68)	77.06 (61.38)	75.67 (60.45)	74.00 (59.34)
V_4:Trimbak		78.83 (62.61)	78.00 (62.03)	77.67 (61.80)	76.83 (61.23)	76.28 (60.85)	74.67(59.78)	73.00 (58.69)
SEm(±)		0.467	0.334	0.360	0.463	0.329	0.400	0.364
CD(p=0.05)		1.330	0.952	1.024	1.318	0.938	1.138	1.035
Seed lot								
L_1: Lot 1		80.08(63.49)	79.33 (62.96)	78.83 (62.61)	78.42 (62.32)	77.81 (61.90)	76.31 (60.87)	75.00 (60.00)
L2: Lot 2		80.75(63.98)	79.67 (63.20)	79.67 (63.20)	77.92 (61.97)	77.28 (61.53)	76.08 (60.72)	74.58 (59.72)
SEm(±)		0.330	0.236	0.254	0.327	0.233	0.283	0.257
CD(p=0.05)		NS	NS	NS	NS	NS	NS	NS
Seed type								
S_1: Fresh		85.00 (67.21)	84.25 (66.62)	83.88 (66.33)	83.25 (65.84)	82.71 (65.43)	81.50 (64.53)	79.88 (63.35)
S_2: RVD I^{st}		80.88 (64.07)	79.75 (63.26)	79.75 (63.26)	78.38 (62.29)	77.75 (61.86)	76.58 (61.06)	75.75 (60.50)
S_3: RVD II^{nd}		75.38 (60.25)	74.50(59.67)	74.13(59.43)	72.88 (58.62)	72.17 (58.16)	70.50 (57.10)	68.75 (56.01)
SEm(±)		0.404	0.289	0.312	0.401	0.285	0.346	0.315
CD(p=0.05)		1.151	0.824	0.887	1.141	0.812	0.985	0.897
Age of seed on July 2018 from date of harvest (Month)	Fresh	14	15	16	17	18	19	20
	RVD I	26	27	28	29	30	31	32
	RVD II	38	39	40	41	42	43	44

*Figures in parenthesis are arc sin transformed values

Table 1.15: Interaction effect of variety, lot and seed types on field emergence % of wheat

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	84.00 (66.42)	85.00 (67.21)	84.00 (66.42)	84.00 (66.42)	83.00 (65.65)	82.00 (64.90)	81.00 (64.16)
$V_1L_1R_1$	81.00 (64.16)	81.00 (64.16)	80.00 (63.44)	80.00 (63.44)	80.00 (63.44)	75.67 (60.45)	78.00 (62.03)
$V_1L_1R_2$	74.00 (59.34)	71.00 (57.42)	70.00 (56.79)	70.00 (56.79)	69.00 (56.17)	68.00 (55.55)	67.00 (54.94)
$V_1L_2R_0$	86.00 (68.03)	85.00 (67.21)	84.00 (66.42)	83.00 (65.65)	82.00 (64.90)	81.00 (64.16)	80.00 (63.44)
$V_1L_2R_1$	82.00 (64.90)	78.00 (62.03)	80.00 (63.44)	80.00 (63.44)	80.00 (63.44)	79.00 (62.73)	78.00 (62.03)
$V_1L_2R_2$	75.00 (60.00)	75.00 (60.00)	75.00 (60.00)	74.00 (59.34)	73.00 (58.69)	73.00 (58.69)	73.00 (58.69)
$V_2L_1R_0$	87.00 (68.87)	86.00 (68.03)	85.00 (67.21)	85.00 (67.21)	84.00 (66.42)	83.00 (65.65)	80.00 (63.44)
$V_2L_1R_1$	80.00 (63.44)	79.00 (62.73)	79.00 (62.73)	78.00 (62.03)	77.00 (61.34)	76.00 (60.67)	75.00 (60.00)
$V_2L_1R_2$	76.00 (60.67)	76.00 (60.67)	75.00 (60.00)	75.00 (60.00)	74.00 (59.34)	71.00 (57.42)	70.00 (56.79)
$V_2L_2R_0$	88.00 (69.73)	87.00 (68.87)	87.00 (68.87)	86.00 (68.03)	85.00 (67.21)	85.00 (67.21)	83.00 (65.65)
$V_2L_2R_1$	82.00 (64.90)	81.00 (64.16)	81.00 (64.16)	80.00 (63.44)	80.00 (63.44)	80.00 (63.44)	78.00 (62.03)
$V_2L_2R_2$	77.00 (61.34)	77.00 (61.34)	76.00 (60.67)	75.00 (60.00)	74.00 (59.34)	73.00 (58.69)	70.00 (56.79)
$V_3L_1R_0$	85.00 (67.21)	84.00 (66.42)	85.00 (67.21)	84.00 (66.42)	83.00 (65.65)	82.00 (64.90)	80.00 (63.44)
$V_3L_1R_1$	82.00 (64.90)	81.00 (64.16)	81.00 (64.16)	81.00 (64.16)	80.00 (63.44)	80.00 (63.44)	78.00 (62.03)
$V_3L_1R_2$	76.00 (60.67)	75.00 (60.00)	75.00 (60.00)	74.00 (59.34)	73.00 (58.69)	72.00 (58.05)	70.00 (56.79)
$V_3L_2R_0$	85.00 (67.21)	84.00 (66.42)	84.00 (66.42)	83.00 (65.65)	82.00 (64.90)	81.00 (64.16)	80.00 (63.44)
$V_3L_2R_1$	81.00 (64.16)	80.00 (63.44)	80.00 (63.44)	73.00 (58.69)	72.00 (58.05)	71.00 (57.42)	70.00 (56.79)
$V_3L_2R_2$	76.00 (60.67)	75.00 (60.00)	75.00 (60.00)	70.00 (56.79)	72.33 (58.26)	68.00 (55.55)	66.00 (54.33)
$V_4L_1R_0$	82.00 (64.90)	81.00 (64.16)	80.00 (63.44)	80.00 (63.44)	82.67 (65.40)	80.00 (63.44)	78.00 (62.03)
$V_4L_1R_1$	79.00 (62.73)	79.00 (62.73)	78.00 (62.03)	77.00 (61.34)	76.00 (60.67)	75.00 (60.00)	74.00 (59.34)
$V_4L_1R_2$	75.00 (60.00)	74.00 (59.34)	74.00 (59.34)	73.00 (58.69)	72.00 (58.05)	71.00 (57.42)	69.00 (56.17)
$V_4L_2R_0$	83.00 (65.65)	82.00 (64.90)	82.00 (64.90)	81.00 (64.16)	80.00 (63.44)	78.00 (62.03)	77.00 (61.34)
$V_4L_2R_1$	80.00 (63.44)	79.00 (62.73)	79.00 (62.73)	78.00 (62.03)	77.00 (61.34)	76.00 (60.67)	75.00 (60.00)
$V_4L_2R_2$	74.00 (59.34)	73.00 (58.69)	73.00 (58.69)	72.00 (58.05)	70.00 (56.79)	68.00 (55.55)	65.00 (53.73)
SE(±)	1.144	0.819	0.881	1.133	0.807	0.979	0.891
CD(p=0.05)	NS	NS	NS	NS	2.298	2.787	2.536

Centre: CCSHAU, Hisar

Experimental details:

Varieties: Two (HD 2967 & C 306)

Class of Seeds used: Foundation Seed

Details of Seed Lots: (2 of different storage period)

L_1-6 Months old stored seed (Fresh), harvested in April 2018, processed & tested in October 2018, Validated for 9 months, stored in jute canvas bag under ambient storage conditions.

L_2-18 Months old stored seed (Revalidated Once), harvested in April 2017, processed & tested in October 2017, Revalidated once for 6months in October 2018, stored in jute canvas bag under ambient storage conditions.

Design: CRD for laboratory parameters, RBD- for field parameters

Replications: Four

Both seed lots *viz.,* 6 months old (L_1) & 18 months old (L_2-Revalidated once) of two varieties viz., HD 2967 & C 306 of wheat were evaluated in lab and field for seed quality parameters. The seed lots were also tested in field at an interval of every 2 months during Rabi 2018-19 in October & December, 2018 and February, 2019.

Results:

Seed moisture content (Table 1.16) was varied in different lots but it was not varied significantly during storage period. The fresh seed of both varieties were significant better in mean germination percentage in first and final count (Table 1.17 &1.18) along with both vigour-I & II (Table 1.19 & 1.20) as compared to revalidated. Fresh seed was also shown significantly higher speed of emergence (Table 1.21) along with better plant stand (Table 1.22).

Table 1.16: **Effect of storage period on seed moisture content (%) in two lots and varieties of wheat**

Storage period (SP)	Varieties (V) / Lot (L)						Mean
	HD 2967			C 306			
	L_1	L_2	Mean	L_1	L_2	Mean	
0 month	8.55	7.80	8.18	8.70	8.33	8.51	8.34
1 month	8.65	7.86	8.26	8.72	8.35	8.53	8.40
2 months	8.60	7.90	8.25	8.80	8.40	8.60	8.43
3 months	8.59	7.88	8.23	8.77	8.37	8.57	8.40
4 months	8.55	7.82	8.18	8.74	8.35	8.54	8.36
Mean	8.59	7.85		8.74	8.36		
SEm(±)	0.025	0.025	0.039	0.035	0.056	0.056	0.079
CD (p=0.05)	(V)	(L)	(SP)	(VxL)	(VxSP)	(LxSP)	(VxLxSP)
	0.05	0.05	NS	0.07	NS	NS	NS

L_1-6 Months old storage seed (Fresh)
L_2-18 Months old storage seed (Revalidated Once)

Table 1.17: **Effect of storage period on first count (%) in two lots and varieties of wheat**

Storage period (SP)	Varieties (V) / Lot (L)						Mean
	HD 2967			C 306			
	L_1	L_2	Mean	L_1	L_2	Mean	
0 months	75.00 (59.98)	68.25 (55.68)	71.63 (57.83)	73.00 (58.67)	62.00 (51.92)	67.50 (55.30)	69.56 (55.93)
1 months	73.00 (58.68)	65.00 (53.71)	69.00 (56.19)	70.00 (56.77)	60.25 (50.90)	65.13 (53.83)	67.06 (54.42)
2 months	72.25 (58.20)	63.00 (52.52)	67.63 (55.36)	68.25 (55.69)	59.25 (50.31)	63.75 (53.00)	65.69 (53.59)
3 months	71.00 (57.40)	62.50 (52.22)	66.75 (54.81)	66.25 (54.46)	58.00 (49.59)	62.13 (52.02)	64.44 (52.72)
4 months	70.00 (56.77)	61.25 (51.48)	65.63 (54.13)	65.00 (53.71)	58.00 (49.59)	61.50 (51.65)	63.56 (52.27)
Mean	72.25 (58.20)	64.00 (53.12)		68.50 (55.86)	59.50 (50.46)		
SEm(±)	0.179	0.179	0.283	0.253	0.400	0.400	0.566
CD (p=0.05)	(V)	(L)	(SP)	(VxL)	(VxSP)	(LxSP)	(VxLxSP)
	0.358	0.358	0.566	NS	NS	NS	1.132

L_1-6 Months old storage seed (Fresh)
L_2-18 Months old storage seed (Revalidated Once)
*Figures in the parenthesis are arc-sine values

Table 1.18: **Effect of storage period on germination (%) in two lots and varieties of wheat**

Storage period (SP)	Varieties (V) / Lot (L)						Mean
	HD 2967			C 306			
	L_1	L_2	Mean	L_1	L_2	Mean	
0 months	92.25 (73.83)	85.75 (67.80)	89.00 (70.82)	90.00 (71.55)	85.00 (67.19)	87.50 (69.37)	88.25 (70.09)
1 months	91.50 (73.06)	83.50 (66.02)	87.50 (69.54)	89.75 (71.32)	83.25 (65.83)	86.50 (68.58)	87.00 (69.06)
2 months	87.75 (69.50)	83.00 (65.64)	85.38 (67.57)	87.75 (69.50)	83.50 (66.02)	85.63 (67.76)	85.50 (67.66)
3 months	86.25 (68.41)	82.50 (65.26)	84.38 (66.84)	85.75 (67.81)	82.50 (65.25)	84.13 (66.53)	84.25 (66.43)
4 months	85.50 (66.73)	82.00 (64.87)	83.75 (65.80)	85.00 (66.40)	80.00 (63.41)	82.50 (64.91)	83.13 (65.35)
Mean	88.65 (70.31)	83.35 (65.92)		87.65 (69.32)	82.85 (65.54)		
SEm(±)	0.210	0.210	0.333	0.298	0.470	0.470	0.665

CD (p=0.05)	(V)	(L)	(SP)	(VxL)	(VxSP)	(LxSP)	(VxLxSP)
	0.421	0.421	0.665	NS	NS	0.941	1.331

L_1-6 Months old storage seed (Fresh)
L_2-18 Months old storage seed (Revalidated Once)
*Figures in the parenthesis are arc-sine values

Table 1.19: Effect on Vigour Index-I of storage period or lot(s) and varieties in wheat.

Storage period (SP)	Varieties (V) / Lot (L)						Mean
	HD 2967			C 306			
	L_1	L_2	Mean	L_1	L_2	Mean	
0 months	3,236	2,671	2,953	3,610	3,047	3,329	3,141
1 months	3,127	2,579	2,853	3,560	2,869	3,214	3,034
2 months	2,751	2,347	2,549	3,081	2,788	2,935	2,742
3 months	2,335	2,183	2,259	2,769	2,511	2,640	2,450
4 months	2,249	2,148	2,199	2,679	2,403	2,541	2,370
Mean	2,740	2,386		3,140	2,724		
SEm(±)	9.87	9.87	15.60	13.96	22.07	22.07	31.21
CD (p=0.05)	(V)	(L)	(SP)	(VxL)	(VxSP)	(LxSP)	(VxLxSP)
	19.74	19.74	31.22	27.92	NS	44.15	62.44

L_1-6 Months old storage seed (Fresh)
L_2-18 Months old storage seed (Revalidated Once)

Table 1.20: Effect of storage period on Vigour Index-II in two lots and varieties of wheat

Storage period (SP)	Varieties (V) / Lot (L)						Mean
	HD 2967			C 306			
	L_1	L_2	Mean	L_1	L_2	Mean	
0 months	1,506	1,304	1,405	1,287	1,177	1,232	1,318
1 months	1,480	1,265	1,373	1,270	1,129	1,200	1,286
2 months	1,336	1,234	1,285	1,220	1,109	1,164	1,225
3 months	1,243	1,157	1,200	1,189	1,070	1,130	1,165
4 months	1,205	1,142	1,174	1,162	1,034	1,098	1,136
Mean	1,354	1,221		1,226	1,104		
SEm(±)	5.43	5.43	8.59	7.69	12.15	12.15	17.18
CD (p=0.05)	(V)	(L)	(SP)	(VxL)	(VxSP)	(LxSP)	(VxLxSP)
	10.87	10.87	17.19	NS	24.31	24.31	34.38

L_1-6 Months old storage seed (Fresh)
L_2-18 Months old storage seed (Revalidated Once)

Table 1.21: Effect of storage period on speed of emergence in two lots and varieties of wheat

Storage period (SP)	Varieties (V) / Lot (L)						Mean
	HD 2967			C 306			
	L_1	L_2	Mean	L_1	L_2	Mean	
0 months	1.368	0.910	1.139	0.960	0.763	0.862	1.000
2months	1.200	0.720	0.960	0.865	0.590	0.728	0.844
4 months	1.150	0.700	0.925	0.818	0.575	0.697	0.811
Mean	1.239	0.777		0.881	0.643		
SEm(±)	0.012	0.012	0.015	0.017	0.021	0.021	0.03
CD (p=0.05)	(V)	(L)	(SP)	(VxL)	(VxSP)	(LxSP)	(VxLxSP)
	0.025	0.025	0.03	0.035	NS	NS	NS

L_1-6 Months old storage seed (Fresh)

L_2-18 Months old storage seed (Revalidated Once)

Table 1.22: Effect of storage period on final plant stand establishment (%) in two lots and varieties of wheat.

Storage period (SP)	Varieties (V) / Lot (L)						Mean
	HD 2967			C 306			
	L_1	L_2	Mean	L_1	L_2	Mean	
0 months	75.00 (59.98)	65.25 (53.86)	70.13 (56.92)	70.50 (57.08)	60.25 (50.90)	65.38 (53.99)	67.75 (55.45)
2 months	71.25 (57.56)	62.25 (52.08)	66.75 (54.82)	66.25 (54.46)	58.25 (49.73)	62.25 (52.10)	64.50 (53.46)
4 months	70.50 (57.08)	61.00 (51.34)	65.75 (54.21)	63.00 (52.52)	54.75 (47.71)	58.88 (50.11)	62.31 (52.16)
Mean	72.25 (58.21)	62.83 (52.42)		66.58 (54.69)	57.75 (49.44)		
SEm(±)	0.203	0.203	0.248	0.287	0.351	0.351	0.497
CD (p=0.05)	(V)	(L)	(SP)	(VxL)	(VxSP)	(LxSP)	(VxLxSP)
	0.413	0.413	0.505	NS	0.715	NS	NS

L_1-6 Months old storage seed (Fresh)

L_2-18 Months old storage seed (Revalidated Once)

*Figures in the parenthesis are arc-sine values

Centre: NDUAT, Faizabad

Experimental details:

Varieties: NW-5054, DBW-107 and HD-2967

Three seed lots of three varieties namely, NW-5054, DBW-107 and HD-2967 were obtained from Seed Processing Plant at three different time intervals.

Variety	Fresh Seed Lot (Harvested April, 2018)	Old Seed Lots (Harvested April, 2017)
NW-5054	April, 2108-24-559-05	April, 2107-24-559-07
	April, 2108-24-559-06	April, 2107-24-559-08
	April, 2108-24-559-12	April, 2107-24-559-09
DBW-107	April, 2108-24-559-07	April, 2107-24-559-02
	April, 2108-24-559-08	April, 2107-24-559-03
	April, 2108-24-559-09	April, 2107-24-559-04
HD-2967	April, 2108-24-40-02	April, 2107-24-40-11
	April, 2108-24-559-03	April, 2107-24-40-12
	April, 2108-24-559-04	April, 2107-24-40-13

Results:

The results revealed that first count, germination *per cent*, vigour index-I and vigour index-II were decreased significantly in stored seed lots in comparison to fresh seed lots (Table 1.23 to 1.28). The germination per cent in old seed lot was observed lower than Indian Minimum Seed Certification Standard of 85%.

Table 1.23: Seed germination and vigour status of different seed lots of wheat variety NW-5054

Lot No./ 3 different periods (one month interval)		M. C. (%)		First count (%)		Germination (%)		Vigour Index-I		Vigour Index-II	
		Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed
Lot No. A	Sample No. 1	12.25	13.65	78	36	91	45	1561	572	175	59
	Sample No. 2	12.37	13.80	76	32	89	41	1442	433	166	51
	Sample No. 3	12.63	14.10	72	29	87	37	1340	337	152	44
Lot No. B	Sample No. 1	12.10	13.85	77	34	88	41	1452	539	167	52
	Sample No. 2	12.40	14.00	75	28	87	36	1392	418	160	43
	Sample No. 3	12.55	14.25	70	26	85	34	1296	321	145	37
Lot No. C	Sample No. 1	12.40	13.69	75	32	89	40	1531	512	163	51
	Sample No. 2	12.61	14.20	73	30	86	38	1415	422	153	44
	Sample No. 3	12.75	14.35	71	27	85	35	1292	341	146	36

Table 1.24: Seed germination and vigour status of different seed lots of wheat variety DBW-107

Lot No./ 3 different periods (one month interval)		M. C. (%)		First count (%)		Germination (%)		Vigour Index-I		Vigour Index-II	
		Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed
Lot No. A	Sample No. 1	12.00	13.15	75	38	94	46	1711	610	189	67
	Sample No. 2	12.15	13.50	71	35	90	39	1544	472	173	50
	Sample No. 3	12.30	13.80	67	31	88	36	1439	373	163	41
Lot No. B	Sample No. 1	12.20	13.50	73	39	92	43	1592	559	178	58
	Sample No. 2	12.35	13.80	70	36	89	40	1446	494	160	52
	Sample No. 3	12.50	14.00	67	30	87	34	1344	332	152	36
Lot No. C	Sample No. 1	12.10	13.65	70	36	88	45	1496	635	167	63
	Sample No. 2	12.25	13.90	68	33	86	38	1389	488	151	49
	Sample No. 3	12.40	14.20	65	28	85	36	1284	360	140	40

Table 1.25: Seed germination and vigour status of different seed lots of wheat variety HD-2967

Lot No./ 3 different periods (one month interval)		M. C. (%)		First count (%)		G (%)		Vigour Index-I		Vigour Index-II	
		Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed	Fresh seed	Stored seed
Lot No. A	Sample No. 1	12.35	13.00	75	32	90	40	1508	480	162	51
	Sample No. 2	12.50	13.25	73	30	88	38	1342	422	145	44
	Sample No. 3	12.70	13.40	71	28	86	35	1204	320	129	35
Lot No. B	Sample No. 1	12.15	13.10	73	35	88	43	1408	531	151	52
	Sample No. 2	12.30	13.20	71	33	88	40	1329	452	140	46
	Sample No. 3	12.55	13.50	69	29	86	34	1230	306	129	36
Lot No. C	Sample No. 1	12.00	12.85	76	30	89	39	1522	507	157	46
	Sample No. 2	12.35	13.00	74	27	87	35	1436	394	139	39
	Sample No. 3	12.45	13.15	72	25	85	32	1275	301	126	32

(B): Field condition:

Table 1.26: Vigour status of different seed lots of wheat variety NW-5054

Lot No./ 3 different periods (one month interval)		Speed of emergence		Final plant stand establishment (%)	
		Fresh seed	Stored seed	Fresh seed	Stored seed
Lot No. A	Sample No. 1	11.25	5.38	80	32
	Sample No. 2	10.60	4.56	78	30
	Sample No. 3	9.74	3.75	75	26
Lot No. B	Sample No. 1	11.00	5.73	78	33
	Sample No. 2	10.15	4.80	74	30
	Sample No. 3	9.00	3.60	72	25
Lot No. C	Sample No. 1	10.79	5.57	79	29
	Sample No. 2	10.00	5.00	75	27
	Sample No. 3	9.30	3.15	71	24

Table 1.27: Vigour status of different seed lots of wheat variety DBW-107

Lot No./ 3 different periods (one month interval)		Speed of emergence		Final plant stand establishment (%)	
		Fresh seed	Stored seed	Fresh seed	Stored seed
Lot No. A	Sample No. 1	12.18	5.55	83	34
	Sample No. 2	11.25	4.70	79	31
	Sample No. 3	9.20	3.30	76	28
Lot No. B	Sample No. 1	12.00	5.60	80	36
	Sample No. 2	11.10	4.58	77	32
	Sample No. 3	9.75	3.70	74	29
Lot No. C	Sample No. 1	11.60	5.10	80	33
	Sample No. 2	11.00	4.50	77	30
	Sample No. 3	9.45	3.82	72	27

Table 1.28: Vigour status of different seed lots of wheat variety HD-2967

Lot No./ 3 different periods (one month interval)		Speed of emergence		Final plant stand establishment (%)	
		Fresh seed	Stored seed	Fresh seed	Stored seed
Lot No. A	Sample No. 1	11.65	5.21	81	30
	Sample No. 2	10.21	4.34	78	27
	Sample No. 3	9.33	3.69	77	25
Lot No. B	Sample No. 1	11.10	5.70	80	28
	Sample No. 2	10.05	4.55	76	26
	Sample No. 3	9.14	3.49	73	23
Lot No. C	Sample No. 1	11.43	5.13	84	32
	Sample No. 2	10.35	4.00	81	29
	Sample No. 3	9.27	3.22	78	26

Centre: CSAUAT, Kanpur

Experimental details:

The experiment has started with one year old seed lots of five varieties of wheat *viz.,* K 9423, K 9107, DBW-39, DBW-107 and HUW-234.

Results: Out of the five varieties tested, only two varieties viz., K 9423 and K 9107 maintained germination per cent as per IMSCS, 2013 (85%) and other three varieties failed to meet the germination standard as per IMSC, 2013 at 12 months itself.

Table 1.29: Effect of storage period on seed moisture content and vigour index in wheat.

Variety	Initial Moisture (%)	Seed Vigour Index-I				Seed Vigour Index-II			
		June-2018	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18
K-9423	12.74	1694	1634	1463	1426.00	13.50	12.30	11.45	10.40
K-9107	12.00	1577	1546	1352	1352.00	13.05	13.92	12.00	12.64
DBW-107	13.20	1518	1515	1326	1231.00	10.88	11.77	10.67	10.50
DBW-39	12.63	1396	1395	1256	1170.00	12.06	12.40	10.98	10.53
HUW-234	12.82	1350	1272	1237	1222.00	11.02	11.20	10.11	10.72

Table 1.30: Effect of storage period on final plant stand and days to 50% mergence in wheat.

Variety	Final Plant Stand				Days to 50% Emergence			
	June-18	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18
K-9423	82.50	80.25	73.25	72.00	148.50	129.25	117.75	122.75
K-9107	83.75	82.75	76.00	73.50	127.50	119.50	111.75	112.00
DBW-107	83.50	81.00	77.50	72.80	123.75	117.50	111.00	111.25
DBW-39	82.25	80.50	79.20	76.30	131.25	122.00	114.75	115.25
HUW-234	81.50	80.50	74.70	72.20	133.50	127.25	117.25	120.25

Table 1.31: Effect of storage period on first count and germination per cent in wheat.

Variety	First Count %				Germination (%)			
	June-18	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18
K-9423	87.00	82.00	78.00	76.00	90.00	87.75	81.75	80.00
K-9107	80.00	78.00	76.00	75.00	87.00	87.00	80.00	79.00
DBW-107	72.00	71.00	71.00	70.00	77.75	78.50	76.25	75.00
DBW-39	73.00	71.00	70.00	69.00	78.75	77.50	73.25	70.20
HUW-234	74.00	73.00	71.00	70.00	78.75	75.00	72.25	71.50

Centre: CSKHPAU, Palampur

Experimental details:

Name of varieties: HPW 155 and HPW 349; Class of seeds used: Breeder seed
Details of seed lots: L_1-Fresh; L_2-Nine month's old seed after germination test
Date of harvesting of old and fresh seed lots: 3rd week of May 2017 and 2018, respectively.
Date of testing of old seed lots: 19.9.2017
Date of start of experiment: 22.6.2018
Storage container: Jute canvas bags.
Design of experiment: The design of the experiment adopted was Completely Randomized Design (CRD) Factorial.
Replications: 4

Storage period

S_0 - initial month of storage; S_1 - 1 month of storage; S_2 - 2 months of storage; S_3 - 3 months of storage; S_4 - 4 months of storage; S_5 - 5 months of storage; S_6 - 6 months of storage; S_7 - 7 months of storage in case of lab study.

While, S_0 - initial month of storage; S_1 - 2 months of storage; S_2 - 4 months of storage; S_3 - 6 months of storage in case of field study (speed of germination, field emergence (%) and final plant stand).

Methods of storage:

The seeds of HPW 155 and HPW 349 with two seed lots each (fresh and nine months old) were packed in Jute canvas bags and stored under ambient condition in the seed godown of Department of Seed Science and Technology, CSKHPKV, Palampur. Evaluation of seed quality parameters was made initially.

Observations recorded at monthly interval

i) Moisture content (%) ii) Germination (%): a) First count (%) and b) Final count (%)

iii) Seedling length (cm) iv) Seedling dry weight (mg)

v) Seedling vigour index I & II

Observations recorded at bimonthly interval

i) Speed of germination ii) Field emergence (%) iii) Final plant stand

Results:

Effect of variety: Significantly higher first count (84.94%), final count (85.16%), seedling dry weight (17.61 mg), VI-II (1505.48), speed of germination (52.51), field emergence (76.53%), final plant stand (76.53) and low moisture content (12.70%) were recorded in HPW 155 wheat variety,

however, higher seedling length (20.89 cm) and VI-I (1772.10) were recorded in HPW 349 variety (Table 1.32 and 1.33).

Effect of seed lot: Significantly higher first count (87.39%), final count (87.50%), seedling length (20.83 cm), seedling dry weight (17.78 mg), VI-I (1830.49), VI-II (1562.54), speed of germination (53.01), field emergence (79.59%) and final plant stand (79.59) were recorded for L_1 - fresh seed lot as compared to L_2 - nine months old seed lot (Table 1.32 and 1.33).

Effect of storage period: All the seed quality parameters declined gradually with the advancement in storage period (Table 1.32 and 1.33). In the initial month of storage, significantly higher first count (91.31 %), final count (91.31%), seedling length (21.86 cm), seedling dry weight (19.19 mg), VI-I (1997.99), VI - II (1752.57), speed of germination (55.76), field emergence (79.25%) and final plant stand (79.25) was recorded, however, first count (72.94%), final count (73.31%), seedling length (16.45 cm), seedling dry weight (15.44 mg), VI-I (1590.11)), VI-II (1133.35), speed of germination (46.39), field emergence (72.31%) and final plant stand (72.31) reduced significantly after seven months of storage period.

HPW 155 fresh seed lot could maintain germination per cent of 86.75% ($V_1L_1S_6$) above IMSCS up to six months of storage, while HPW 155 nine months old seed lot could maintain the germination per cent of 87.50 % ($V_1L_2S_2$) above IMSCS up to two months of storage. Further, HPW 349 fresh seed lot could maintain the germination per cent 88.00% ($V_2L_1S_4$) above IMSCS up to four months of storage, while HPW 349 nine months old seed lot could maintain the germination per cent of 87.25 % ($V_2L_2S_3$) above IMSCS up to three months of storage. Though the germination per cent of fresh seed lot of HPW 349 initially was high but it reduced drastically with the advancement of storage period, probably may be due to fungal infection since high fungal infection was observed for fresh seed lot of HPW 349 during the storage.

Table 1.32: Effect of variety, seed lot and storage period on seed quality parameters in wheat

Treatment	MC (%)	First count (%)	Final count (%)	Seedling length (cm)	Seedling dry weight (mg)	SVI-I	SVI-II
Variety (V)							
V_1	12.70	84.97 (67.42)	85.16 (67.56)	20.14	17.61	1720.50	1505.48
V_2	12.93	83.83 (67.21)	84.03 (67.35)	20.89	17.16	1772.10	1455.72
SEm(±)	0.01	0.08	0.08	0.02	0.01	2.59	1.96
CD (p=0.05)	0.03	0.16	0.16	0.04	0.03	5.15	3.89
Lot (L)							
L_1	12.92	87.39 (69.67)	87.50 (69.56)	20.83	17.78	1830.49	1562.54
L_2	12.72	81.41 (64.96)	81.69 (65.15)	20.21	17.00	1662.12	1398.66
SE(±)	0.01	0.08	0.08	0.02	0.01	2.59	1.96
CD (p=0.05)	0.03	0.16	0.16	0.04	0.03	5.15	3.89
Storage period (S)							
S_0	10.71	91.31 (73.02)	91.31 (73.02)	21.86	19.19	1997.99	1752.57

S_1	14.62	90.34 (72.64)	90.94 (76.64)	21.79	18.94	1983.22	1722.96
S_2	14.65	90.69 (72.38)	90.69 (72.38)	21.73	18.80	1792.00	1705.41
S_3	14.67	87.25 (69.16)	87.31 (69.21)	20.77	17.59	1814.50	1536.08
S_4	13.91	84.44 (66.89)	84.69 (67.08)	20.67	16.60	1751.35	1407.22
S_5	11.26	80.31 (63.91)	80.69 (64.18)	20.46	16.44	1652.67	1329.76
S_6	11.51	77.31 (61.79)	77.81 (62.13)	20.42	16.11	1590.11	1257.46
S_7	11.22	72.94 (58.74)	73.31 (58.95)	16.45	15.44	1208.59	1133.35
SEm(±)	0.03	0.16	0.16	0.04	0.03	5.19	3.92
CD (p=0.05)	0.05	0.31	0.32	0.08	0.05	10.30	7.79

V_1 - HPW 155; V_2 - HPW 349; L_1 - Fresh seed lot; L_2 - 9 months old seed lot; S_0 - initial month of storage; S_1 - 1 month of storage; S_2 - 2 months of storage; S_3 - 3 months of storage; S_4 - 4 months of storage; S_5 - 5 months of storage; S_6 –6 months of storage; S_7 - 7 months of storage

Table 1.33: Effect of variety, seed lot and storage period on seed quality parameters in wheat

Treatment	Speed of germination	Field emergence (%)	Final Plant stand
Variety (V)			
V_1	52.51	76.53 (61.11)	76.53
V_2	50.12	75.03 (60.09)	75.03
SEm(±)	0.04	0.08	0.13
CD (P=0.05)	0.08	0.16	0.26
Lot (L)			
L_1	53.01	79.59 (63.17)	79.59
L_2	49.63	71.97 (58.03)	72.00
SEm(±)	0.04	0.08	0.13
CD (p=0.05)	0.08	0.16	0.26
Storage period (S)			
S_0	55.76	79.25 (62.96)	79.25
S_1	54.03	76.81 (61.28)	76.81
S_2	49.09	74.75 (59.89)	74.75
S_3	46.39	72.31 (58.28)	72.31
SEm(±)	0.07	0.16	0.18
CD (p=0.05)	0.11	0.32	0.36

V_1 - HPW 155;V_2 - HPW 349;L_1 - Fresh seed lot; L_2- 9 months old seed lot; S_0 - initial month of storage; S_1 - 2 months of storage; S_2 - 4 months of storage; S_3 - 6 months of storage. Figures in parenthesis are arc sin transformed value.

Table 1.34: Interaction effect of variety, seed lot and storage period on seed quality parameters

Interaction	MC (%)	First count (%)	Final count (%)	Seedling length (cm)	Seedling dry weight (mg)	SVI-I	SVI-II
V_1L_1	12.80	87.81 (69.75)	87.94 (69.75)	20.39	17.92	1796.79	1578.38
V_1L_2	12.61	82.12 (65.37)	82.37 (65.37)	19.89	17.31	1644.22	1432.58
V_2L_1	13.03	86.97 (69.77)	87.06 (69.77)	21.26	17.64	1864.18	1546.71
V_2L_2	12.83	80.69 (65.15)	81.00 (65.15)	20.52	16.68	1680.02	1364.73
SEm(±)	0.018	0.11	0.11	0.03	0.02	3.67	2.77
CD(p=0.05)	NS	0.22	0.23	0.06	0.04	7.28	5.51
V_1S_0	10.72	89.25 (70.88)	89.25 (70.87)	21.17	19.16	1890.18	1710.59
V_1S_1	14.56	88.75 (70.39)	88.75 (70.39)	21.10	19.02	1873.60	1688.71
V_1S_2	14.57	88.62 (70.29)	88.62 (70.29)	21.04	18.90	1865.27	1675.37
V_1S_3	14.45	85.75 (68.00)	85.87 (68.00)	20.29	18.36	1742.18	1578.06
V_1S_4	13.71	85.12 (67.61)	85.37 (67.61)	20.28	16.80	1731.18	1434.94
V_1S_5	11.15	84.25 (66.98)	84.62 (66.98)	20.23	16.67	1712.15	1411.77
V_1S_6	11.42	81.25 (64.83)	81.62 (64.83)	20.18	16.35	1647.59	1337.12
V_1S_7	11.02	76.75 (61.50)	77.12 (61.50)	16.84	15.64	1301.21	1207.27
V_2S_0	10.70	93.37 (75.17)	93.37 (75.17)	22.55	19.21	2105.79	1794.56
V_2S_1	14.67	93.12 (74.88)	93.12 (74.88)	22.47	18.86	2092.84	1757.20
V_2S_2	14.74	92.75 (74.47)	92.75 (74.47)	22.41	18.70	2078.74	1735.44
V_2S_3	14.89	88.75 (70.42)	88.75 (70.42)	21.24	16.82	1886.16	1494.09
V_2S_4	14.10	83.75 (66.56)	84.00 (66.56)	21.06	16.40	1771.51	1379.50
V_2S_5	11.36	76.38 61.39)	76.75 (61.39)	20.29	16.20	1593.19	1247.74
V_2S_6	11.59	73.37 (59.43)	74.00 (59.43)	20.65	15.87	1532.62	1177.80
V_2S_7	11.41	69.12 (56.46)	69.50 (56.46)	16.05	15.24	1115.97	1059.42
SEm(±)	0.04	0.22	0.23	0.06	0.04	7.34	5.55
CD(p=0.05)	0.07	0.44	0.45	0.11	0.07	14.57	11.01
L_1S_0	10.65	92.88 (74.66)	92.87 (74.66)	22.10	19.49	2053.40	1810.07
L_1S_1	14.71	92.25 (74.02)	92.25 (74.02)	21.98	19.26	2029.20	1776.94
L_1S_2	14.69	92.12 (73.86)	92.12 (73.86)	21.95	19.25	2023.79	1773.45
L_1S_3	14.94	89.50 (71.08)	89.50 (71.08)	21.05	18.09	1884.40	1618.31
L_1S_4	14.13	88.12 (69.93)	88.25 (69.93)	20.94	16.94	1848.12	1494.76
L_1S_5	11.29	85.25 (67.64)	85.50 (67.64)	20.90	16.87	1785.52	1442.86
L_1S_6	11.64	82.88 (65.86)	83.12 (65.86)	20.87	16.64	1732.90	1383.74
L_1S_7	11.27	76.12 (61.03)	76.37 (61.03)	16.81	15.70	1286.56	1200.21
L_2S_0	10.77	89.75 (71.39)	89.75 (71.39)	21.62	18.89	1942.57	1695.07
L_2S_1	14.52	89.62 (71.26)	89.62 (71.26)	21.60	18.62	1937.23	1668.97
L_2S_2	14.62	89.25 (70.90)	89.25 (70.90)	21.50	18.35	1920.21	1637.36
L_2S_3	14.40	85.00 (67.34)	85.12 (67.34)	20.49	17.10	1744.60	1453.84
L_2S_4	13.67	80.75 (64.23)	81.12 (64.23)	20.40	16.26	1654.57	1319.67
L_2S_5	11.22	75.37 (60.73)	75.87 (60.73)	20.02	16.00	1519.82	1216.65

L_2S_6	11.37	71.75 (58.40)	72.50 (58.40)	19.96	15.59	1447.32	1131.79
L_2S_7	11.16	69.75 (56.94)	70.25 (56.94)	16.09	15.17	1130.63	1066.49
SEm(±)	0.04	0.22	0.23	0.06	0.04	7.34	5.55
CD(p=0.05)	0.07	0.44	0.45	0.11	0.07	14.57	11.01
$V_1L_1S_0$	10.65	90.75 72.27)	90.75 (72.27	21.95	19.40	1959.80	1760.52
$V_1L_1S_1$	14.62	89.75 (71.30)	89.75 (71.30)	21.51	19.27	1930.34	1729.92
$V_1L_1S_2$	14.60	89.75 (71.30)	89.75 (71.30)	21.46	19.22	1926.06	1725.42
$V_1L_1S_3$	14.70	88.75 (70.38)	88.75 (70.38)	20.33	18.77	1804.51	1666.27
$V_1L_1S_4$	14.02	88.25 (70.15)	88.50 (70.15)	20.31	17.00	1797.42	1504.52
$V_1L_1S_5$	11.15	87.25 (69.27)	87.50 (69.27)	20.30	16.90	1776.44	1478.75
$V_1L_1S_6$	11.55	86.75 (68.84)	87.00 (68.84)	20.27	16.82	1763.70	1463.77
$V_1L_1S_7$	11.10	81.25 (64.50)	81.50 (64.50)	17.37	15.92	1416.04	1297.85
$V_1L_2S_0$	10.80	87.75 (69.49)	87.75 (69.49)	20.75	18.92	1820.57	1660.65
$V_1L_2S_1$	14.50	87.75 (69.49)	87.75 (69.49)	20.71	18.77	1816.87	1647.50
$V_1L_2S_2$	14.55	87.50 (69.27)	87.50 (69.27)	20.62	18.57	1804.47	1625.32
$V_1L_2S_3$	14.20	82.75 (65.62)	83.00 (65.62)	20.25	17.95	1681.16	1489.85
$V_1L_2S_4$	13.40	82.00 (65.06)	82.25 (65.06)	20.24	16.60	1664.94	1365.35
$V_1L_2S_5$	11.15	81.25 (64.68)	81.75 (64.68)	20.16	16.45	1647.86	1344.80
$V_1L_2S_6$	11.30	75.75 (60.81)	76.25 (60.81)	20.08	15.87	1531.48	1210.47
$V_1L_2S_7$	10.95	72.25 (58.51)	72.75 (58.51)	16.31	15.35	1186.38	1116.70
$V_2L_1S_0$	10.65	95.00 (77.05)	95.00 (77.05)	22.60	19.57	2147.00	1859.62
$V_2L_1S_1$	14.80	94.75 (76.73)	94.75 (76.73)	22.46	19.25	2128.07	1823.95
$V_2L_1S_2$	14.77	94.50 (76.42)	94.50 (76.42)	22.45	19.27	2121.52	1821.47
$V_2L_1S_3$	15.17	90.25 (71.78)	90.25 (71.78)	21.76	17.40	1964.29	1570.35
$V_2L_1S_4$	14.25	88.00 (69.70)	88.00 (69.70)	21.58	16.87	1898.82	1485.00
$V_2L_1S_5$	11.42	83.25 (66.01)	83.50 (66.01)	21.49	16.85	1794.60	1406.97
$V_2L_1S_6$	11.72	79.00 (62.88)	79.25 (62.88)	21.48	16.45	1702.10	1303.70
$V_2L_1S_7$	11.45	71.00 (57.55)	71.25 (57.55)	16.24	15.47	1157.07	1102.57
$V_2L_2S_0$	10.75	91.75 (73.28)	91.75 (73.28)	22.50	18.85	2064.58	1729.50
$V_2L_2S_1$	14.55	91.50 (73.03)	91.50 (73.03)	22.48	18.47	2057.60	1690.45
$V_2L_2S_2$	14.70	91.00 (72.53)	91.00 (72.53)	22.37	18.12	2035.95	1649.40
$V_2L_2S_3$	14.60	87.25 (69.06)	87.25 (69.05)	20.72	16.25	1808.03	1417.82
$V_2L_2S_4$	13.95	79.50 (63.41)	80.00 (63.41)	20.55	15.92	1644.20	1274.00
$V_2L_2S_5$	11.30	69.50 (56.77)	70.00 (56.77)	19.88	15.55	1391.77	1088.50
$V_2L_2S_6$	11.45	67.75 (55.99)	68.75 (55.99)	19.83	15.30	1363.15	1051.90
$V_2L_2S_7$	11.37	67.25 (55.37)	67.75 (55.37)	15.86	15.00	1074.87	1016.27
SEm(±)	0.05	0.31	0.32	0.08	0.05	1038	7.84
CD(p=0.05)	0.10	0.62	0.64	0.16	0.10	20.60	15.57

V_1 - HPW 155;V_2 - HPW 349;L_1 - Fresh seed lot; L_2 - 9 months old seed lot; S_0 - initial month of storage; S_1 - 1 month of storage; S_2 - 2 months of storage; S_3 - 3 months of storage; S_4 - 4 months of storage; S_5 - 5 months of storage; S_6 – 6 months of storage; S_7 - 7 months of storage. Figures in parenthesis are arc sin transformed value.

Table 1.35. Interaction effect of variety, seed lot and storage period on seed quality parameters in Wheat

Interaction	Speed of germination	Field emergence (%)	Final Plant stand
V_1L_1	54.04	80.69 (63.94)	80.69
V_1L_2	50.99	72.37 (58.29)	72.37
V_2L_1	51.97	78.50 (62.41)	78.50
V_2L_2	48.28	71.56 (57.77)	71.56
SEm(±)	0.06	0.11	0.18
CD(p=0.05)	0.11	0.23	0.36
V_1S_0	56.42	79.62 (63.23)	79.62
V_1S_1	55.04	77.37 (61.68)	77.37
V_1S_2	50.51	75.75 (60.57)	75.75
V_1S_3	48.07	73.37 (58.90)	73.37
V_2S_0	55.11	78.87 (62.69)	78.87
V_2S_1	53.02	76.25 (60.88)	76.25
V_2S_2	47.66	73.75 (59.21)	73.75
V_2S_3	44.71	71.25 (57.58)	71.25
SEm(±)	0.08	0.23	0.25
CD(p=0.05)	0.16	0.45	0.51
L_1S_0	57.05	82.87 (65.53)	82.87
L_1S_1	55.35	80.87 (64.05)	80.87
L_1S_2	50.70	78.75 (62.54)	78.75
L_1S_3	48.92	75.87 (60.57)	75.87
L_2S_0	54.47	75.62 (60.39)	75.62
L_2S_1	52.71	72.75 (58.51)	72.75
L_2S_2	47.47	70.75 (57.24)	70.75
L_2S_3	43.87	68.75 (55.99)	68.75
SEm(±)	0.08	0.23	0.25
CD(p=0.05)	0.16	0.45	0.51
$V_1L_1S_0$	57.47	83.25 (65.82)	83.25
$V_1L_1S_1$	56.36	81.75 (64.68)	81.75
$V_1L_1S_2$	51.94	80.25 (63.59)	80.25
$V_1L_1S_3$	50.37	77.50 (61.66)	77.50
$V_1L_2S_0$	55.37	76.00 (60.64)	76.00
$V_1L_2S_1$	53.72	73.00 (59.67)	73.00
$V_1L_2S_2$	49.08	71.25 (57.55)	71.25
$V_1L_2S_3$	45.76	69.25 (56.30)	69.25
$V_2L_1S_0$	56.63	82.50 (65.25)	82.50
$V_2L_1S_1$	54.34	80.00 (63.41)	80.00
$V_2L_1S_2$	49.46	77.25 (61.49)	77.25
$V_2L_1S_3$	47.46	74.25 (59.48)	74.25
$V_2L_2S_0$	53.58	75.25 (60.14)	75.25
$V_2L_2S_1$	51.70	72.50 (58.35)	72.50
$V_2L_2S_2$	45.85	70.25 (56.92)	70.25

$V_2L_2S_3$	41.97	68.25 (55.68)	68.25
SEm(±)	0.11	0.32	0.36
CD(p=0.05)	0.23	0.64	0.73

V_1 - HPW 155;V_2 - HPW 349;L_1 - Fresh seed lot; L_2- 9 months old seed lot; S_0 - initial month of storage; S_1 - 2 months of storage; S_2 - 4 months of storage; S_3 - 6 months of storage. Figures in parenthesis are arc sin transformed value.

Crop: Rice

Centre: ICAR-IARI, New Delhi (Not reported)

Centre: PAU, Ludhiana (Not reported)

Centre: PJTSAU, Hyderabad (Not reported)

Centre: TNAU, Coimbatore

Experimental details:
Materials
Fresh certified lots of rice seeds CO 51 & CO 52 from the Department of Farm Management, TNAU, Coimbatore.

Crop and Variety	Class of seeds	Date of harvest	Date of test
Rice CO 51	Certified seeds	02.06.2018	19.07.2018
Rice CO 52	Certified seeds	08.06.2018	23.07.2018

Seeds of both the varieties were dried to same moisture content and seeds were stored in polylined gada cloth bag (August 2018 onwards) under ambient condition at Seed Centre, TNAU, Coimbatore. Stored seeds were evaluated initially and at monthly intervals seed quality parameters.

Results:

The significant increase in moisture content irrespective of varieties was observed over a period of storage. The moisture content of rice CO 51 (10.7 %) and CO 52 (10.6 %) after six months of storage is significantly increased than initial moisture content (10.2 %). At initial period, the value for first count was significantly higher in both the varieties (78 % for CO 51 and 82 % for CO 52) than six months after storage (73 % and 76 %, respectively). The same trend was also recorded for germination. At initial period, germination was higher in both the varieties (96 % for CO 51 and 97 % for CO 52). After six months, the values were declined to 93 % and 92 %, respectively. In case of vigour index I and II, the same trend was noticed. Significantly higher vigour index I and II was observed at initial (3312, 3560; 1286, 1436) than six months after storage (2521, 2772; 1113, 1246).
The maximum speed of emergence was recorded at initial in both the varieties (10.3 & 11.2 %) and field establishment was also reflected the same trend. At initial period field establishment was higher (94 % & 95 %) than six months after storage (92 % & 94 %).

Fresh seeds (initial period) recorded significantly higher values for all the seed quality parameters in both the rice varieties compared to six months of storage. But both the varieties were maintained germination more than IMSCS (80%) i.e., 92 % in CO 51 and 93% in CO 52 even after six months of storage (Table 1.36 and 1.37).

Table 1.36: Effect of storage period and varieties on seed quality parameters in rice

Storage period of seed lot	Varieties / Parameters													
	Seed moisture content (%)		Mean	First count (%)		Mean	Germination (%)		Mean	Vigour index I		Mean	Vigour index II		Mean
	CO 51	CO 52		CO 51	CO 52		CO 51	CO 52		CO 51	CO 52		CO 51	CO 52	
0 month	10.2	10.2	10.2	78	82	80	96	97	97	3312	3560	3436	1286	1436	1361
1 month	10.3	10.2	10.3	79	81	80	96	98	97	3250	3538	3394	1268	1421	1344
2 months	10.3	10.4	10.4	78	80	79	95	97	96	3173	3414	3293	1235	1397	1316
3 months	10.5	10.4	10.5	77	78	78	95	96	96	3107	3264	3185	1235	1354	1294
4 months	10.5	10.6	10.6	75	77	76	93	95	94	2957	3107	3032	1172	1320	1246
5 months	10.7	10.6	10.7	75	78	77	94	95	95	2680	2945	2812	1156	1302	1229
6 months	10.7	10.6	10.7	73	76	75	92	93	93	2521	2772	2646	1113	1246	1179
Mean	10.5	10.4	10.4	76	78	78	94	96	95	3000	3228	3114	1209	1353	1281
	V	P	VXP	V	P	VXP	V	P	VXP	V	P	VXP	V	P	VXP
SEm (±)	0.09	0.07	0.16	0.42	0.81	1.21	0.32	0.51	1.62	4.31	8.7	11.2	3.5	7.1	9.2
CD (p=0.05)	NS	0.15	NS	0.86	1.63	NS	0.66	1.03	NS	8.52	17.8	22.5	7.2	14.3	18.4

Table 1.37: Effect of storage period and varieties on seed quality parameters in rice

Storage period of seed lot	Varieties/Parameters					
	Speed of emergence		Mean	Final plant stand establishment (%)		Mean
	CO 51	CO 52		CO 51	CO 52	
0 month	10.3	11.2	10.7	94	95	95
2 months	10.2	10.8	10.5	94	95	95
4 months	10.0	10.7	10.4	93	94	94
6 months	9.6	10.2	9.9	92	93	93
Mean	10.0	10.7	10.4	93	93	94
	V	P	VXP	V	P	VXP
SEm (±)	0.021	0.063	0.208	0.42	0.52	1.26
CD (p=0.05)	0.044	0.126	NS	NS	1.06	NS



Seed storage



Monitoring team visit





Seedling evaluation in rice

Centre: UAS, Bengaluru

Experimental details:

Two seed lots (Fresh, I-Revalidated & II-Revalidated); three paddy varieties (IR-64, Jaya, MTU-1001) were procured (Fig. 1.3). Initial seed quality parameters were recorded as per ISTA, 2017. Three replications of each variety were raised in experimental plot of 8m x 4m size (Fig 1.4) to study the vigour status of seeds for consideration to revalidate the leftover seed lots for sowing purpose.

Results:

Among the varieties, IR-64 recorded highest seed vigour parameters *viz*., seedling vigour index-I (3048) and seedling vigour index-II (600) with good germination (84%) and field emergence (86%) compared to other varieties (Table 1.38). Among the seed lots, fresh lot recorded highest seed quality parameters in all the varieties compared to revalidated lots. Whereas, in interaction, variety IR-64 with fresh lot recorded highest vigour parameters followed by revalidated lots of IR-64 and fresh and revalidated lots of other varieties. There was variation in seed germination of variety IR-64, but there was no difference in seedling vigour among the seed lots.



Fig 1.3: Paddy varieties used in the study at UAS, Bengaluru centre



Fig 1.4: Field layout of paddy experimental plots at UAS, Bengaluru centre

Table 1.38: Seed quality of paddy varieties with different lots

Treatments	Seed moisture (%)	Germination (%)	Seedling vigour index I	Seedling vigour index II	Field emergence (%)	Days to emergence
Varieties						
IR-64	13.16	86	3048	600	86	8
Jaya	13.41	94	2792	588	93	7
MTU-1001	13.21	93	2743	587	90	7
Lots						
Fresh	13.70	94	2941	617	92	7
R-I	12.82	88	2781	566	87	8
R-II	11.73	80	2589	512	85	8
Interaction						
IR-64x fresh	13.77	93	3396	669	91	7
IR-64x R-I	12.55	79	2700	531	80	8
IR-64 x R-II	11.73	80	2589	512	85	8
Jaya x Fresh	13.62	95	2763	600	95	7
Jaya x R-I	13.20	92	2821	576	91	7
MTU-1001x Fresh	13.71	93	2665	582	90	7
MTU-1001x R-	12.71	92	2822	592	91	8

I						
Mean	13.04	90	2822	580	89	7.42
SEm(±)	0.029	1.020	107.64	16.2	0.62	0.21
CD (p=0.05)	0.086	3.034	320.2	48.31	1.06	0.361
CV (%)	0.39	1.95	6.52	4.75	1.20	4.98

R-I: First time revalidated, R-II: Second time revalidated

Centre: PAJANCOA&RI, Karaikal

Experimental details:

Varieties: V_1 – ADT 39; V_2 – ADT (R) 49; V_3 – TKM 13; V_4 – ADT (R) 46

Replications: Three

Results

The results on three months stored certified seeds of four rice varieties revealed that a significant loss in seed vigour traits to the tune of 34.3%, 38.2% and 21.6% were observed in speed of germination, vigour index I and vigour index II, respectively. However, the loss in seed germination was 22.6%. Among the varieties, the loss in seed germination and vigour was significantly less in ADT 39 followed by ADT (R) 46.



Fig. 1.5: Validation of seed lots on vigour attributes in Paddy at PAJANCOA & RI, Karaikal

Table 1.39: Validation of seed lots on vigour attributes in Paddy at PAJANCOA & RI, Karaikal

Varieties	Seed moisture content (%)			Speed of emergence (Field)			Seed germination (%)			First count (%)		
	0	3	Mean	0	3	Mean	0	3	Mean	0	3	Mean
ADT 39	10.2	10.0	10.1	28.88	29.56	29.22	97	95	96	92	87	89
ADT (R) 49	10.6	10.4	10.5	27.84	13.52	20.68	90	81	85	88	58	73
TKM 13	10.3	10.1	10.2	27.86	14.23	21.05	92	84	88	72	57	65
ADT (R) 46	10.4	10.3	10.4	28.23	16.76	22.50	95	92	93	84	60	72
Mean	10.4	10.2	10.3	28.20	18.52	23.36	93	88	91	84	65	75
	V	P	V x P	V	P	V x P	V	P	V x P	V	P	V x P
SEm(±)	0.06	0.04	NS	1.28	0.91	1.82	0.43	0.31	0.61	0.71	0.50	1.00
CD (P=0.05)	0.12	0.09		2.65	1.87	3.75	0.89	0.63	1.26	1.46	1.03	2.06

Varieties	Vigour index I			Vigour index II		
	0	3	Mean	0	3	Mean
ADT 39	2743	2160	2451	12.67	12.24	12.45
ADT (R) 49	2626	1404	2015	9.78	6.65	8.22
TKM 13	1785	1113	1449	7.69	6.13	6.91
ADT (R) 46	2591	1704	2147	14.75	10.19	12.47
Mean	2436	1595	2016	11.22	8.80	10.01
	V	P	V x P	V	P	V x P
SEm(±)	3.15	2.23	4.46	0.06	0.04	0.08
CD (P=0.05)	6.51	4.60	9.20	0.12	0.09	0.17

Centre: KAU, RARS, Pattambi

Experimental details:

Variety: 2 Jyothi (variety 1) and Uma (variety 2)
LOT : 3 Lot 1- Revalidated once, Lot2- 5 month old and Lot 3- Fresh lot
Storage period: 5 (1 MAS, 2 MAS, 3MAS, 4MAS, 5 MAS)
Replication : 4

Three lots of paddy seeds of two varieties, Jyothi and Uma were used for conducting the study of validity periods. The seed lots included Foundation/certified seeds, which were Revalidated once (Lot 1), 5 month old (Lot 2) and freshly harvested (Lot 3). The seeds were packed in jute bags and stored under ambient storage conditions. The weather during the storage period is rainy and is highly humid with average temperature of 30^{o}C and 80-90% RH. The initial germination, moisture content and vigour were tested during May 2018 in 4 replications. The germination and vigour were tested in every month of storage. The field emergence and speed of emergence of seed lots were tested in alternate months.
In addition to the above observations, the performance of the seed lots were also checked in the field condition in randomized block designs with 4 replications. Date of sowing was done on 24/5/2018 and transplanting was on 21/6/2018. Observations were taken in the field on field establishment, days to flowering and maturity, grain yield and yield components.

Results:
Seed lots did not show any significant difference among each other in days to flowering and field establishment under transplanted condition during initial period of storage (Table 1.40).
At initial stages, all seed lots showed high germination and vigour index. During storage, the revalidated lots were observed to lose the germination at a faster rate compared to the lots with moderate level of storage of 5 months and fresh lot (Table 1.41). The seed lots which were revalidated once (8 month old at initial stage) lost germination within 3 months of storage. The speed of emergence of seedlings of revalidated seed lots in field had significant reduction under storage (Table 1.43). Five month after storage, the fresh lots (Lot 3) of both varieties showed germination above IMSCS and showed significant superiority over other lots in seed quality characters like germination, vigour index and field emergence (Table 1.44 and 1.45). The lot 2 with 5month old storage period was observed to lose germination after 4 months of storage, which may be due to very high rain fall and humidity in Kerala during the period of study, causing faster deterioration of seed quality at ambient storage condition.

Table 1.40: Performance of the seed lots during initial period under field and lab conditions at RARS, KAU Pattambi during 2018-19

VARIETY	LOT	D/H	Storage Period	CLASS OF SEED	Initial						
					MC %	1st count	Germination %	SVI-I	SVI-II	Field Emergence	Field Establishment
JYOTHI	LOT 1	30/9/17	Revalidated once 9 months	FS	12.6	95.25	95.5	4776.9	4.2	96	88.8
JYOTHI	LOT 2	23/2/18	5 months	FS	13	97.75	97.75	4547.3	4.5	97.5	84.7
JYOTHI	LOT 3	25/4/18	Fresh	FS	13	94.5	95.5	4264.1	3.7	96.75	84.7
UMA	LOT 1	2/11/17	Revalidated once 8 months	CS	13.5	94.25	95	3850.4	4.18	94.5	81.25
UMA	LOT 2	15/2/18	5 months	CS	13.5	96.75	96.75	4064.47	3.48	95.75	80.5
UMA	LOT 3	26/4/18	Fresh	CS	14	96	96.75	4045.1	3.77	98.5	83.3

Table 1.41: Mean germination percentage of seed lots under storage at RARS, KAU Pattambi

VARIETY	LOT	Storage Period	1 MAS		2MAS		3 MAS		4 MAS		5 MAS	
			1st count	GERMN %	1st count	GERMN %	1st count	GERMN %	1st count	GERMN %	1st count	GERMN %
JYOTHI	LOT 1	Revalidated	93.75	95.75	71.5	92	71.5	83.5	57.5	71.25	6.25	7.5
JYOTHI	LOT 2	5 months	96.75	97.5	69.5	92	78.5	85	58.75	80	37.5	47.5
JYOTHI	LOT 3	FRESH	94.75	96.75	91.25	95.5	87	90.5	85	88.75	81.25	88.75
UMA	LOT 1	Revalidated	85.75	94	90.25	93.75	82	91	91.25	95	5	6.25
UMA	LOT 2	5 months	90.75	95.5	92.5	94.25	85	95	88.75	95	22.5	32.5
UMA	LOT 3	FRESH	96	98.5	91.5	96.25	92	95	95	96.25	73.75	88.75

Table 1.42: Mean vigour indices of seed lots under storage at RARS, KAU Pattambi

VARIETY	LOT	Storage Period	1 MAS		2MAS		3 MAS		4 MAS		5 MAS	
			SVI -I	SVI-II	SVI -I	SVI-II	SVI -I	SVI-II	SVI -I	SVI-II	SVI -I	SVI-II
JYOTHI	LOT 1	Revalidated	4180.45	2.01	4016.72	1.932	1874.58	1.837	1599.56	1.57		
JYOTHI	LOT 2	5 months	4079.4	2.24	3849.28	2.116	2091	2.04	3352.8	1.92	1999.75	0.475
JYOTHI	LOT 3	FRESH	3675.5	1.84	3628.04	1.814	3811.86	2.26	4058.53	2.22	4072.73	2.04
UMA	LOT 1	Revalidated	3616.18	1.59	3606.56	1.593	3297.84	0.91	3479.85	0.95	230.06	0.14
UMA	LOT 2	5 months	3679.6	1.72	3631.45	1.697	3426.65	1.71	3276.55	1.71	1125.15	0.87

UMA	LOT 3	FRESH	3858.25	1.67	3770.11	1.636	3465.6	1.71	3541.04	1.73	3280.2	1.775

Table 1.43: Speed of Emergence of the seed lots with different storage periods under field conditional RARS, KAU Pattambi

VARIETY	Storage Period	INITIAL					2 MAS					4 MAS					6 MAS				
		3rd Day	5th Day	7th Day	10th Day	14th Day	3rd Day	5th Day	7th Day	10th Day	14th Day	3rd Day	5th Day	7th Day	10th Day	14th Day	3rd Day	5th Day	7th Day	10th Day	14th Day
JYOTHI	Revalidated	93.75	95	95.75	96	96	5	17	89	91	91	26.7	56.7	63.3	66.7	66.7	0	0	0	0	0
JYOTHI	5 months	96.75	97	97.5	97.5	97.5	5	54	87	89	89	23.3	50	60	66.7	70	0	7.5	7.5	7.5	7.5
JYOTHI	FRESH	94.75	96.5	96.75	96.75	96.75	0	5	83	87	87	83.3	86.7	93.3	93.3	93.3	17.5	50	57.5	57.5	50
UMA	Revalidated	85.75	92.25	94	94.5	94.5	3	36	91	92	93	60	83.3	83.3	83.3	83.3	0	0	7.5	12.5	12.5
UMA	5 months	90.75	94.75	95.5	95.75	95.75	6	59	88	89	89	43.3	83.3	83.3	83.3	83.3	0	7.5	12.5	17.5	15
UMA	FRESH	96	98.5	98.5	98.5	98.5	7	63	99	99	99	73.3	83.3	86.7	90	93.3	5	27.5	40	42.5	45

Table 1.44: Analysis of seed quality parameters in seed lots of different storage period at RARS KAU Pattambi

VARIETY		GERMINATION %		Vigour Index (G x SL)		Vigour Index (G x SDW)	
		JYOTHI	UMA	JYOTHI	UMA	JYOTHI	UMA
1 MAS	LOT 1 (Revald)	95.75^{a}	94^{abc}	4180.45^{a}	3616.18^{bcd}	$2.01c^{def}$	1.598^{cd}
	LOT 2 (5 mon)	97.5^{a}	95.5^{ab}	4079.4^{ab}	3679.62^{abc}	2.24^{ab}	1.719^{ab}
	LOT 3 (Fresh)	96.75^{a}	98.5^{a}	3675.53^{cde}	3858.25^{a}	1.84^{ef}	1.675^{abcd}
2 MAS	LOT 1 (Revald)	92^{ab}	93.75^{abc}	4016.72^{abc}	3606.56^{bcd}	1.93^{def}	1.594^{d}
	LOT 2 (5 mon)	92^{ab}	94.25^{abc}	3849.28^{abcd}	3631.45^{bcd}	2.12^{abcd}	1.697^{abcd}
	LOT 3 (Fresh)	95.5^{a}	96.25^{ab}	3628.05^{de}	3770.11^{ab}	1.81^{f}	1.636^{bcd}
3 MAS	LOT 1 (Revald)	83.5^{bc}	$91b^{c}$	1874.58^{fg}	3297.84^{e}	1.84^{ef}	0.91^{e}
	LOT 2 (5 mon)	85^{bc}	95^{ab}	2091^{f}	3426.65^{de}	2.04^{bcde}	1.71^{abc}

	LOT 3 (Fresh)	90.5^{ab}	95^{ab}	3811.86^{bcd}	3465.6^{cde}	2.26^{a}	1.71^{abc}
	LOT 1 (Revald)	71.25^{d}	95^{ab}	1599.56^{g}	3479.85^{cde}	1.57^{g}	0.95^{e}
	LOT 2 (5 mon)	80^{cd}	95^{ab}	3352.8^{e}	3276.55^{e}	1.92^{def}	1.71^{abc}
4 MAS	LOT 3 (Fresh)	88.75^{abc}	96.25^{ab}	4058.54^{ab}	3541.04^{cd}	2.22^{abc}	1.733^{ab}
	LOT 1 (Revald)	7.5^{f}	6.25^{e}	0^{h}	230.06^{g}	0^{i}	0.138^{f}
	LOT 2 (5 mon)	47.5^{e}	32.5^{d}	1999.75^{f}	1125.15^{f}	0.48^{h}	0.867^{e}
5 MAS	LOT 3 (Fresh)	88.75^{abc}	88.75^{c}	4072.74^{ab}	3280.2^{e}	2.04^{bcde}	1.775^{a}
CV %		8.25	4.74	8	4.666	8.472	5.371
CD (p=0.05)		9.514	5.714	361.891	209.889	0.212	0.109

Table 1.45: Analysis of field emergence in seed lots of different storage period at RARS KAU Pattambi

VARIETY		Field emergence	
		JYOTHI	UMA
	LOT 1 (Revald)	96	94.5
	LOT 2 (5 mon)	97.5	95.75
INITIAL	LOT 3 (Fresh)	96.75	98.5
	LOT 1 (Revald)	45.5	46.5
	LOT 2 (5 mon)	44.5	44.5
2 MAS	LOT 3 (Fresh)	43.5	49.5
	LOT 1 (Revald)	52.5	62.5
	LOT 2 (5 mon)	50	62.5
4 MAS	LOT 3 (Fresh)	70	70
	LOT 1 (Revald)	0	12.5
	LOT 2 (5 mon)	7.5	15
6 MAS	LOT 3 (Fresh)	50	45
CV %		48.676	51.017
CD (p=0.05)		38.158	42.624

Centre: AAU, Jorhat

Experimental details:
Name of the Varieties: Manuhar Sali and Luit
Class of Seeds used: Foundation

Seeds are procured from ICR Far AAU, Jorhat in the month of May. *Manuhar Sali* was harvested in the month of December 2017 and *Luit* in November 2017. Seeds were packed in HDPE interwoven bags and stored in ambient storage condition. Observations were taken at bimonthly interval.

Results:

Fresh and stored seeds is periodically tested for Moisture content (MC), First count and Germination and vigour indices at one month interval for 8 months. The seed lots are also field tested at an interval of every 2 months for seedling emergence, speed of emergence and the experiment is terminated with recording of final plant stand establishment. The final plant stand establishment is recorded at 6 weeks after sowing. Results are presented in the table 1.46. Both the varieties exhibited germination above 80% after 12 months of storage. The vigour indices declined gradually, more importantly germination first count.

Table 1.46: Seed quality parameters over period of storage duration in rice under Assam condition

Sl no.	Variety	Storage period (months)	Mean						
			Seed Moisture content	First count %	Germination %	Vigour index-I	Vigour index-II	Speed of emergence	Final plant stand establishment
1.	Manuhar Sali	0	12.25	77.37	86.75	8726.49	793.36	5.95	81.88
		2	13.25	76.37	85.75	28293.60	667.70	5.33	82.13
		4	13.88	74.00	84.75	8344.92	596.38	5.83	79.30
		6	13.13	61.00	82.375	7328.22	591.78	5.48	78.75
		8	14.13	59.37	81.00	6108.24	584.26	5.55	74.50
		Mean	13.33	69.62	84.12	11760.29	646.69	5.63	79.31
2.	Luit	0	12.63	74.25	84.125	8713.78	579.54	5.33	81.00
		2	13.50	71.00	83.00	7301.33	630.31	5.83	78.75
		4	14.13	70.12	81.625	6349.99	568.39	5.83	75.75
		6	13.63	58.67	81.25	6284.81	574.60	5.48	73.78
		8	14.25	56.37	80.25	5772.69	584.11	5.18	72.50
		Mean	13.63	66.08	82.05	6884.52	587.39	5.53	76.356
		Total variety mean	13.48	67.85	83.085	9322.405	617.04	5.58	77.833
	SE (M)		0.095	0.447	0.208	4009.6	22.02	0.140	0.405
	CD (0.05)		0.282	1.328	0.620	11907.91	65.38	0.416	1.645
	CV		2.235	2.08498	0.795	136.010	11.28	7.962	1.645
	V=		43.056	25622.8	21386.39	5.9E+08	4530454	15776.83	9027.3
	SP/L=		119.037	5487.678	50407.88	93718960	520809	10354.81	1822.804
	V x SP/L=		9.0375	10138.7	71778.2	3.52E+08	1461004	13509.7	3541.08

Centre: SKUAST, Kashmir, Srinagar(Not reported)

Centre: OUAT, Bhubaneswar

Experimental details:

Fresh and 7-month old seeds of two rice varieties MTU-7029 (V_1) and Hiranmayee (V_2) were procured from BSP Unit, OUAT.

The 7-month old seeds were of *Kharif* 2017 harvest (L_1) and had been tested in December 2017 prior to packing and labelling, while the fresh seeds were of Rabi 2017-18 harvests (L_2) and had been tested in May 2018 prior to packing and labelling. The storage experiment was initiated in first week of July 2018 and set up in CRD with four replications. Two kilogram seed per replication of each seed lot were stored in inter-woven HDPE bags. The seed lots were tested for moisture content (%), first count (%), germination (%) and vigour indices at monthly interval. The seed lots were also tested in the field at 2 months interval for seedling emergence, speed of emergence and final plant stand establishment at 6 weeks stage. The results up to 6 months storage are presented in Tables 1.47 to 1.53.

Results:

The fresh and 7-month old seeds of two rice varieties had moisture content in the range of 11.23% to 11.40% at the start of storage experiment. Subsequently, there was only slight increase in moisture content over the period of storage. Moisture content of the seeds ranged from 12.13% to 12.33% after 6 months. The mean initial germination of fresh and old seeds was 91.75% and 81.88%, respectively. The germination of *Kharif* 2017 seeds (L_1) declined below MSCS (80%) after one month storage. However, the Rabi 2017-18 seeds (L_2) still continue to maintain germination above MSCS after 6 months of storage (86.63%). Similar trend of decline in seed vigour parameters was observed over the period of storage, with the Rabi 2017-18 seeds (L_2) showing a slower decline in these parameters than the *Kharif* 2017 seeds (L_1). In the field, seedling emergence and final plant stand at 6 weeks stage of *Rabi* 2017-18 seeds (L_2) were 81.88% and 77.88%, respectively, after 6 months of storage.

Table 1.47: Seed quality parameters of two seed lots of two rice varieties at the start of storage experiment

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II
V_1 (MTU-7029)	11.33	34.25 (35.68)	87.13 (9.33)	27.26	0.078	2388.9	6.84
V_2 (Hiranmayee)	11.30	34.38 (35.77)	86.50 (9.30)	27.05	0.077	2350.7	6.72
SEm(±)	0.053	0.331	0.030	0.175	0.0005	30.84	0.086
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	11.24	26.63 (31.05)	81.88 (9.05)	24.81	0.071	2031.9	5.80
L_2 (Rabi 2017-18 harvest)	11.39	42.00 (40.40)	91.75 (9.58)	29.50	0.085	2707.7	7.76
SEm(±)	0.053	0.331	0.030	0.175	0.0005	30.84	0.086
CD(P=0.05)	NS	1.019	0.092	0.540	0.0015	95.04	0.266
V_1L_1	11.25	26.25 (30.82)	81.75 (9.04)	24.77	0.071	2025.8	5.79
V_1L_2	11.40	42.25 (40.54)	92.50 (9.62)	29.74	0.085	2751.9	7.89
V_2L_1	11.23	27.00 (31.29)	82.00 (9.06)	24.85	0.071	2038.0	5.82
V_2L_2	11.38	41.75 (40.25)	91.00 (9.54)	29.26	0.084	2663.5	7.62
SEm(±)	0.092	0.573	0.052	0.303	0.0009	53.42	0.149
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine / square root transformed values

Table 1.48: Seed quality parameters of two seed lots of two rice varieties after one month storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II
V_1 (MTU-7029)	11.53	33.75 (35.35)	85.50 (9.24)	26.74	0.076	2303.0	6.52
V_2 (Hiranmayee)	11.50	33.88 (35.45)	85.00 (9.22)	26.54	0.075	2268.4	6.41
SEm(±)	0.053	0.333	0.028	0.172	0.0006	29.30	0.089
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

L_1 (Kharif 2017 harvest)	11.44	25.63 (30.40)	79.75 (8.93)	24.07	0.068	1919.9	5.41
L_2 (Rabi 2017-18 harvest)	11.59	42.00 (40.40)	90.75 (9.53)	29.21	0.083	2651.5	7.51
SEm(±)	0.053	0.333	0.028	0.172	0.0006	29.30	0.089
CD(p=0.05)	NS	1.027	0.087	0.529	0.0017	90.29	0.274
V_1L_1	11.45	25.25 (30.16)	79.50 (8.92)	24.03	0.068	1910.9	5.39
V_1L_2	11.60	42.25 (40.54)	91.50 (9.57)	29.45	0.084	2695.2	7.64
V_2L_1	11.43	26.00 (30.64)	80.00 (8.94)	24.11	0.068	1928.8	5.44
V_2L_2	11.58	41.75 (40.25)	90.00 (9.49)	28.97	0.082	2607.9	7.38
SEm(±)	0.092	0.578	0.049	0.297	0.0010	50.75	0.154
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine / square root transformed values

Table 1.49: Seed quality parameters of two seed lots of two rice varieties after two months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II	Seedling emergence (%)	Speed of emergence	Final plant stand (%) at 6 weeks
V_1 (MTU-7029)	11.81	32.88 (34.81)	83.63 (9.14)	25.96	0.073	2191.7	6.19	79.00 (8.88)	14.55	74.00 (59.59)
V_2 (Hiranmayee)	11.78	33.00 (34.91)	83.00 (9.10)	25.76	0.073	2154.6	6.08	78.50 (8.85)	14.42	73.75 (59.37)
SEm(±)	0.061	0.290	0.031	0.168	0.0005	29.02	0.081	0.030	0.096	0.330
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	11.70	24.88 (29.91)	76.88 (8.77)	23.10	0.065	1776.5	5.02	71.88 (8.48)	11.54	66.75 (54.79)
L_2 (Rabi 2017-18 harvest)	11.89	41.00 (39.81)	89.75 (9.47)	28.62	0.081	2569.8	7.26	85.63 (9.25)	17.43	81.00 (64.17)

SEm(±)	0.061	0.290	0.031	0.168	0.0005	29.02	0.081	0.030	0.096	0.330
CD(p=0.05)	NS	0.892	0.094	0.516	0.0014	89.43	0.250	0.091	0.295	1.015
V_1L_1	11.73	24.50 (29.66)	76.75 (8.76)	23.07	0.065	1771.0	5.01	71.75 (8.47)	11.52	66.50 (54.64)
V_1L_2	11.90	41.25 (39.96)	90.50 (9.51)	28.86	0.082	2612.3	7.38	86.25 (9.29)	17.58	81.50 (64.54)
V_2L_1	11.68	25.25 (30.16)	77.00 (8.77)	23.14	0.065	1782.0	5.03	72.00 (8.48)	11.56	67.00 (54.94)
V_2L_2	11.88	40.75 (39.67)	89.00 (9.43)	28.39	0.080	2527.3	7.14	85.00 (9.22)	17.29	80.50 (63.80)
SEm(±)	0.106	0.502	0.053	0.290	0.0008	50.27	0.141	0.051	0.166	0.571
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine / square root transformed values

Table 1.50: Seed quality parameters of two seed lots of two rice varieties after three months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II
V_1 (MTU-7029)	12.03	32.75 (34.73)	82.13 (65.49)	25.21	0.071	2093.8	5.93
V_2 (Hiranmayee)	12.00	32.75 (34.74)	81.50 (64.89)	25.02	0.071	2057.5	5.83
SEm(±)	0.053	0.317	0.458	0.163	0.0005	28.02	0.078
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	11.94	24.50 (29.66)	74.88 (59.93)	22.18	0.063	1661.0	4.70
L_2 (Rabi 2017-18 harvest)	12.09	41.00 (39.81)	88.75 (70.46)	28.05	0.080	2490.3	7.06
SEm(±)	0.053	0.317	0.458	0.163	0.0005	28.02	0.078
CD(p=0.05)	NS	0.977	1.411	0.501	0.0014	86.32	0.239
V_1L_1	11.95	24.25 (29.50)	74.75 (59.84)	22.15	0.063	1655.9	4.67
V_1L_2	12.10	41.25 (39.96)	89.50 (71.14)	28.28	0.080	2531.7	7.18

V_2L_1	11.93	24.75 (29.82)	75.00 (60.01)	22.21	0.063	1666.2	4.73
V_2L_2	12.08	40.75 (39.67)	88.00 (69.77)	27.82	0.079	2448.9	6.93
SEm(±)	0.092	0.549	0.793	0.282	0.0008	48.52	0.135
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Table 1.51: Seed quality parameters of two seed lots of two rice varieties after four months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II	Seedling emergence (%)	Speed of emergence	Final plant stand (%) at 6 weeks
V_1 (MTU-7029)	12.13	31.75 (34.10)	80.50 (8.96)	24.48	0.069	1997.2	5.66	76.00 (61.04)	14.03	71.38 (57.93)
V_2 (Hiranmayee)	12.10	31.88 (34.20)	79.75 (8.92)	24.29	0.069	1959.3	5.54	75.25 (60.46)	13.91	71.00 (57.64)
SEm(±)	0.053	0.341	0.027	0.158	0.0005	25.89	0.078	0.369	0.092	0.324
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	12.04	23.63 (29.07)	72.50 (8.51)	21.29	0.060	1543.7	4.37	67.50 (55.25)	10.86	62.75 (52.39)
L_2 (Rabi 2017-18 harvest)	12.19	40.00 (39.23)	87.75 (9.37)	27.49	0.078	2412.8	6.83	83.75 (66.26)	17.09	79.63 (63.18)
SEm(±)	0.053	0.341	0.027	0.158	0.0005	25.89	0.078	0.369	0.092	0.324
CD(p=0.05)	NS	1.050	0.085	0.487	0.0015	79.79	0.240	1.136	0.282	0.997
V_1L_1	12.05	23.25 (28.82)	72.50 (8.51)	21.26	0.060	1541.4	4.37	67.50 (55.25)	10.84	62.50 (52.24)
V_1L_2	12.20	40.25 (39.38)	88.50 (9.41)	27.71	0.079	2453.0	6.95	84.50 (66.84)	17.23	80.25 (63.62)
V_2L_1	12.03	24.00 (29.32)	72.50 (8.51)	21.32	0.060	1546.0	4.37	67.50 (55.25)	10.87	63.00 (52.54)

V_2L_2	12.18	39.75 (39.08)	87.00 (9.33)	27.26	0.077	2372.6	6.70	83.00 (65.67)	16.95	79.00 (62.74)
SEm(±)	0.092	0.590	0.048	0.274	0.0009	44.85	0.135	0.639	0.159	0.560
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine / square root transformed values

Table 1.52: Seed quality parameters of two seed lots of two rice varieties after five months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II
V_1 (MTU-7029)	12.19	31.25 (33.76)	79.00 (63.24)	23.78	0.067	1908.8	5.39
V_2 (Hiranmayee)	12.16	31.50 (33.95)	78.38 (62.70)	23.60	0.067	1875.0	5.30
SEm(±)	0.071	0.308	0.333	0.154	0.0005	22.85	0.066
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	12.11	22.75 (28.48)	70.25 (56.95)	20.44	0.058	1436.1	4.06
L_2 (Rabi 2017-18 harvest)	12.24	40.00 (39.23)	87.13 (69.00)	26.94	0.076	2347.7	6.63
SEm(±)	0.071	0.308	0.333	0.154	0.0005	22.85	0.066
CD(p=0.05)	NS	0.949	1.025	0.474	0.0014	70.41	0.202
V_1L_1	12.13	22.25 (28.14)	70.25 (56.95)	20.41	0.058	1434.0	4.04
V_1L_2	12.25	40.25 (39.38)	87.75 (69.54)	27.16	0.077	2383.6	6.74
V_2L_1	12.10	23.25 (28.82)	70.25 (56.95)	20.47	0.058	1438.3	4.08
V_2L_2	12.23	39.75 (39.08)	86.50 (68.46)	26.72	0.076	2311.8	6.53
SEm(±)	0.123	0.533	0.576	0.267	0.0008	39.58	0.114
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Table 1.53: Seed quality parameters of two seed lots of two rice varieties after six months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II	Seedling emergence (%)	Speed of emergence	Final plant stand (%) at 6 weeks
V_1 (MTU-7029)	12.24	31.00 (33.60)	77.63 (62.33)	23.10	0.065	1827.6	5.17	73.00 (59.06)	13.54	68.75 (56.29)
V_2 (Hiranmayee)	12.21	30.75 (33.46)	77.13 (61.88)	22.92	0.065	1797.0	5.08	72.38 (58.59)	13.42	68.25 (55.93)
SEm(±)	0.061	0.251	0.357	0.150	0.0005	23.25	0.068	0.330	0.089	0.314
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	12.14	22.13 (28.05)	68.13 (55.63)	19.62	0.056	1336.9	3.78	63.50 (52.83)	10.21	59.13 (50.26)
L_2 (Rabi 2017-18 harvest)	12.31	39.63 (39.01)	86.63 (68.58)	26.40	0.075	2287.6	6.47	81.88 (64.82)	16.75	77.88 (61.96)
SEm(±)	0.061	0.251	0.357	0.150	0.0005	23.25	0.068	0.330	0.089	0.314
CD(p=0.05)	NS	0.773	1.100	0.462	0.0014	71.64	0.210	1.018	0.275	0.967
V_1L_1	12.15	22.00 (27.97)	68.00 (55.55)	19.59	0.056	1332.5	3.78	63.50 (52.83)	10.20	59.00 (50.19)
V_1L_2	12.33	40.00 (39.23)	87.25 (69.10)	26.62	0.075	2322.6	6.57	82.50 (65.29)	16.88	78.50 (62.39)
V_2L_1	12.13	22.25 (28.13)	68.25 (55.71)	19.65	0.056	1341.4	3.79	63.50 (52.83)	10.23	59.25 (50.33)
V_2L_2	12.30	39.25 (38.79)	86.00 (68.06)	26.19	0.074	2252.6	6.37	81.25 (64.35)	16.61	77.25 (61.52)
SEm(±)	0.106	0.434	0.618	0.260	0.0008	40.27	0.118	0.572	0.155	0.543
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Crop: Maize
Centre: ICAR-IARI, New Delhi (Not reported)

Centre: TNAU, Coimbatore

Experimental Details

Materials
Fresh certified lots of maize seeds COH (M) 6 & COH (M) 8 were collected from the Dept. of Millets, TNAU, Coimbatore.

Crop and Variety	Class of seeds	Date of harvest	Date of test
Maize COH (M) 6	Certified seeds	14.05.2018	25.07.2018
Maize COH (M) 8	Certified seeds	21.05.2018	30.07.2018

Both the varieties were dried to same moisture content and seeds were stored in poly lined gada cloth bag (August 2018 onwards) under ambient condition at Seed Centre, TNAU, Coimbatore. The stored seeds were evaluated initially and at monthly intervals for seed quality parameters.

Table 1.54: Monthly average temperature and relative humidity during storage

Month	Temperature (°C)	Relative humidity (%)
Aug'17	27.9	56.7
Sep'17	27.4	60.0
Oct'17	28.3	53.0
Nov'17	27.9	54.2
Dec'17	27.1	50.8
Jan'18	26.5	41.5
Feb'18	28.07	36.11
Mar'18	29.40	37.20
Apr'18	30.73	45.66
May'18	28.58	54.15
Jun'18	27.21	56.82
Jul'18	27.15	55.35
Aug'18	26.35	58.16
Sep'18	27.69	54.07
Oct'18	27.11	57.47
Nov'18	26.88	57.07
Dec'18	26.61	53.56
Jan'19	25.37	43.17

Results:

The increase in moisture content irrespective of varieties was observed over a period of storage. The moisture content of maize was increased at six months of storage in CO 6

(9.8%) %) and CO 8 (9.9 %) when compared to initial moisture content (9.4 %). The value for first count was significantly higher in both the varieties at initial period (92 % for CO 6 and 94 % for CO 8) than six months after storage (88 % in both the varieties). The same trend was also recorded for germination. At initial period, the germination was higher in both the varieties (98 % for CO 6 and 100 % for CO 8) but after six months of storage the germination declined in to 93 % and 95 %, respectively. In case of vigour index I and II the same trend was noticed. Higher vigour index I and II was observed at initial (4371, 4570; 162, 173) than six months after storage (3562, 3800; 138, 152).

The maximum speed of emergence was recorded at initial period in both the varieties (13.4 & 14.4 %) and field establishment was also reflected the same trend. At initial period, field establishment was higher (94 % & 95 %) than six months after storage (92 % & 94 %). Both the varieties were maintained the germination of 96 % (CO 6) and 97% (CO 8) even after six months of storage (Table 1.55).

Table 1.55.Effect of storage period and varieties on seed quality parameters in maize

Storage period of seed lot	Varieties/Parameters														
	Seed moisture content (%)		Mean	First count (%)		Mean	Germination (%)		Mean	Vigour index I		Mean	Vigour index II		Mean
	CO 6	CO 8		CO 6	CO 8		CO 6	CO 8		CO 6	CO 8		CO 6	CO 8	
0 month	9.4	9.4	9.4	92	94	93	98	100	99	4371	4570	4470	162	173	168
1 month	9.3	9.4	9.4	92	93	93	97	99	98	4239	4465	4352	158	168	163
2 months	9.4	9.4	9.4	90	93	92	97	99	98	4191	4415	4303	155	166	161
3 months	9.5	9.5	9.5	90	91	91	97	98	98	4055	4244	4149	150	163	157
4 months	9.6	9.5	9.6	88	90	89	96	96	96	3936	4109	4025	146	157	152
5 months	9.8	9.7	9.8	87	90	89	94	95	95	3751	3857	3804	140	154	147
6 months	9.8	9.9	9.9	88	88	88	93	95	94	3562	3800	3681	138	152	145
Mean	9.5	9.5	9.5	90	91	90	96	97	97	4015	4208	4112	150	161	156
	V	P	VXP	V	P	VXP	V	P	VXP	V	P	VXP	V	P	VXP
SEm (±)	0.08	0.04	0.12	0.23	0.84	1.62	0.42	0.92	1.21	6.4	10.2	13.2	4.5	7.2	11.3
CD (p=0.05)	NS	0.08	NS	0.45	1.70	NS	0.81	1.84	NS	12.6	20.4	26.5	9.0	17.5	NS

Table 1.56: Effect of storage period and varieties on seed quality parameters in maize

Storage period of seed lot	Varieties/Parameters					
	Speed of emergence		Mean	Final plant stand establishment (%)		Mean
	CO 6	CO 8		CO 6	CO 8	
0 month	13.4	14.4	13.9	96	97	97
2 months	13.2	14.1	13.7	95	97	96
4 months	12.9	13.8	13.4	93	96	95
6 months	12.6	13.3	13.0	92	93	93
Mean	13.0	13.9	13.5	94	96	95
	V	P	VXP	V	P	VXP
SEm (±)	0.03	0.11	0.76	0.32	0.44	1.23
CD (p=0.05)	0.07	0.23	NS	0.65	0.86	NS



Fig 1.6: Seedling evaluation in Maize

Centre: PAU, Ludhiana

Experimental details:
Name of the hybrids: PMH 1 and Parkash
Class of Seeds used: Certified seed
Details of Seed Lots:
Lot 1: Three months of storage (Fresh)
Lot 2: Eleven months of storage (Revalidated once)
Lot 3*: Eighteen months of storage (Revalidated twice) - This lot of both varieties had initial mean germination percentage less than recommended under IMSC regulations. So, this lot was not tested further.

Lot 1 and Lot 2 were tested for germination parameters using between the germination paper method under laboratory conditions immediately after procuring them (denoted as 0 months of storage) and then at monthly intervals. Field emergence was also recorded immediately (August) after procuring the seed lots and then at an interval of two months (October). The field emergence after 4 months of storage was conducted during the month of December; however results are not representable due to very less germination recorded due to low temperature.

Table 1.57: Weather conditions during the conduct of field emergence studies

Week No.	Max. Temp. (°C)	Min. Temp (° C)	Max. RH (%)	Min. RH (%)	Sunshine hrs (h)	Rainfall (mm)
1st week of August	33.9	26.8	84.0	69.6	4.3	13.0
2nd week of August	34.2	27.3	83.3	67.7	5.7	0.0
3rd week of August	34.8	27.5	85.7	63.1	4.9	7.2
4th week of August	33.4	26.1	87.7	64.0	5.3	35.6
1st week of October	30.8	18.6	84.9	40.1	8.0	0.0
2nd week of October	31.7	16.0	87.6	32.9	8.9	0.0
3rd week of October	30.4	14.2	90.1	34.9	8.2	0.0
4th week of October	28.9	16.2	89.0	43.9	2.1	2.6
1st week of December	22.7	7.7	94.9	43.0	4.8	0.0
2nd week of December	20.3	7.4	92.7	49.6	4.8	0.0
3rd week of December	20.3	3.5	93.9	39.3	6.3	0.0
4th week of December	18.4	2.8	94.6	41.9	5.5	0.0

Experimental design: Factorial Split Plot Design

Results:

Maize hybrid Parkash had significantly higher first count, germination, seedling vigour index I and II than PMH 1. Lot 1 which consisted of fresh certified seeds had significantly higher first count, germination, seedling vigour index I and II than revalidated seed Lot 2. Effects of hybrids, lots and storage periods for different durations had significant

interaction effects on various germination parameters studied. Up to four months of storage, revalidated seed lot of Parkash had first count, germination, seedling vigour index I and II statistically at par with fresh certified seeds stored for 0-5 months. However, revalidated seed lot of Parkash stored for five months had significantly less first count, germination, seedling vigour index I and II as compared to fresh certified seeds stored for 0-5 months. Initially (0 months of storage) revalidated seed lot of PMH 1 had first count, germination, seedling vigour index I and II statistically at par with fresh certified seeds stored for 2-5 months. However, revalidated seed lot of PMH 1 after 1-5 months of storage recorded significantly less first count, germination, seedling vigour index I and II as compared to fresh certified seeds stored for any duration of period (Tables 1.58-1.61).

Under field conditions, hybrid Parkash had significantly faster speed of emergence than PMH 1; however final plant stand establishment of both hybrids was statistically at par with each other. Revalidated seed Lot 2 had significantly less speed of emergence and final plant stand establishment as compared to fresh seed Lot 1. The reduced speed of emergence and final plant stand establishment recorded after two months of storage could be attributed to differences in weather conditions prevailing during the month of October as compared to August. There were significant interaction effects of hybrids, lots and storage periods for different durations on speed of emergence and final plant stand establishment. Initially, revalidated seed lots of both the hybrids had speed of emergence and final stand establishment statistically at par with fresh seed lots. But after 2 months of storage, speed of emergence and final stand establishment of PMH 1 revalidated seed lot was significantly reduced as compared to fresh lot. However, speed of emergence and final stand establishment of Parkash revalidated seed lot was statistically at par with fresh seed lot even after 2 months of storage (Tables 1.62-1.63).

Up to four months of storage, revalidated seed lot of Parkash had first count, germination, seedling vigour index I and II statistically at par with fresh certified seeds stored for 0-5 months. However, revalidated seed lot of PMH 1 after 1-5 months of storage recorded significantly less first count, germination, seedling vigour index I and II as compared to fresh certified seeds stored for any duration of period.

Suggestions:

The field emergence studies after every two months should be omitted as there are huge differences in temperature during the different months of year affecting the speed of emergence and final stand establishment (Table of weather conditions given in Annexure).

Table 1.58: Effect of storage period, lot age and hybrids on mean seed moisture content (%), first count (%), germination (%), seedling vigour index I and II in maize under controlled conditions in the laboratory.

Treatment	Seed moisture content (%)	First count (%)	Germination (%)	Seedling vigour index I	Seedling vigour index II
Hybrid					
PMH 1	9.92	74.5	79.2	2142	5017
Parkash	9.83	82.1	90.6	2771	5496
SEm (±)	0.01	0.61	0.34	17.9	47.4

CD (p=0.05)	0.03	1.38	0.78	40.4	107.4
Lot					
Lot 1	9.97	84.3	91.8	2795	5644
Lot 2	9.78	72.3	78.1	2117	4869
SEm (±)	0.01	0.61	0.34	17.9	47.4
CD (p=0.05)	0.03	1.38	0.78	40.4	107.4
Storage Period					
0 Months	10.23	83.8	91.9	2826	5688
1 Months	10.61	83.0	90.8	2650	5445
2 Months	9.57	83.8	86.2	2430	5402
3 Months	9.68	74.3	80.9	2366	5038
4 Months	9.64	73.4	80.7	2293	5090
5 Months	9.52	71.4	79.0	2174	4877
SEm (±)	0.04	0.69	0.63	36.7	95.2
CD (p=0.05)	0.07	1.39	1.73	73.5	190.4
InteractionCD (p=0.05)	S	S	S	S	S

Table 1.59: Interaction effect of storage period, lot age and hybrids of maize on mean seed moisture content (%) under controlled conditions in the laboratory

Storage Periods (SP)	PMH 1		Parkash	
	Lot 1	Lot 2	Lot 1	Lot 2
0 months	10.22	10.22	10.66	9.82
1 months	10.37	10.47	11.31	10.30
2 months	9.52	9.74	9.69	9.31
3 months	9.65	9.86	9.82	9.40
4 months	9.71	9.88	9.63	9.33
5 months	9.72	9.71	9.30	9.36
SEm (±)	Vx L =0.02	VxSP =0.05	LxSP= 0.05	VxLxSP= 0.07
CD (p=0.05)	Vx L =0.05	VxSP =0.10	LxSP= 0.10	VxLxSP= 0.14

Table 1.60: Interaction effect of storage period, lot age and hybrids of maize on mean first count and germination percentage under controlled conditions in the laboratory

Storage Periods (SP)	PMH 1		Parkash	
	Lot 1	Lot 2	Lot 1	Lot 2
First count (%)				
0 months	87.3	82.5	82.5	83.0
1 months	89.5	79.5	82.5	80.5
2 months	89.0	83.8	82.0	80.5
3 months	85.0	44.3	82.3	85.5
4 months	83.5	43.5	82.8	84.0

5 months	84.0	42.0	81.5	78.3
SEm (±)	Vx L =0.86	VxSP =0.98	LxSP= 0.98	VxLxSP= 1.39
CD (p=0.05)	Vx L =1.95	VxSP =1.96	LxSP=1.96	VxLxSP= 2.77
Germination (%)				
0 months	94.5	90.8	91.0	91.3
1 months	95.0	86.5	90.3	91.5
2 months	92.3	69.8	91.0	91.8
3 months	91.5	49.8	91.8	90.8
4 months	90.8	50.8	91.0	90.3
5 months	91.0	48.0	91.3	85.8
SEm (±)	Vx L =0. 47	VxSP =0.88	LxSP= 0.88	VxLxSP= 1.25
CD (p=0.05)	Vx L =1.11	VxSP =2.45	LxSP=2.45	VxLxSP= 3.46

Table 1.61: Interaction effect of storage period, lot age and hybrids of maize on mean seedling vigour index I and II of storage period, lot age and hybrids in maize under controlled conditions in the laboratory

Storage Periods (SP)	PMH 1		Parkash	
	Lot 1	Lot 2	Lot 1	Lot 2
Seedling vigour index I				
0 months	2886	2632	2919	2865
1 months	2792	2267	2823	2719
2 months	2707	1461	2815	2737
3 months	2781	1169	2793	2722
4 months	2654	923	2855	2741
5 months	2617	812	2902	2369
SEm (±)	Vx L =25.3	VxSP =52.0	LxSP= 52.0	VxLxSP= 73.5
CD (p=0.05)	Vx L = 57.2	VxSP = 103.9	LxSP= 103.9	VxLxSP= 147.0
Seedling vigour index II				
0 months	6105	5603	5520	5523
1 months	6133	4345	5781	5524
2 months	5505	4896	5671	5535
3 months	5497	3517	5521	5617
4 months	5500	3810	5522	5530
5 months	5554	3745	5425	4785
SEm (±)	Vx L =67.1	VxSP =134.6	LxSP= 134.6	VxLxSP= 190.3
CD (p=0.05)	Vx L = 151.8	VxSP = 269.2	LxSP= 269.2	VxLxSP= 380.7

Table 1.62: Effect on speed of emergence and final plant stand establishment (%) of storage period, lot age and hybrids in maize under controlled conditions in the laboratory

Treatment	Speed of emergence	Final plant stand establishment (%)
Hybrid		
PMH 1	20.2	60.6
Parkash	23.1	63.6
SEm (±)	0.87	1.54
CD (p=0.05)	1.98	NS
Lot		
Lot 1	22.8	65.4
Lot 2	20.5	58.8
SEm (±)	0.87	1.54
CD (p=0.05)	1.98	3.48
Storage Period		
0 Months	30.5	79.3
2 Months	12.8	44.9
SEm (±)	0.51	2.10
CD (p=0.05)	1.58	4.57
InteractionCD (p=0.05)	S	S

Table 1.63: Interaction effect of storage period, lot age and hybrids of maize on speed of emergence and final plant stand establishment (%) under field conditions

Storage Periods (SP)	PMH 1		Parkash	
	Lot 1	Lot 2	Lot 1	Lot 2
Speed of emergence				
0 months*	30.9	29.4	30.2	31.6
2 months**	14.3	6.4	15.9	14.7
SEm (±)	Vx L =1.23	VxSP =1.03	LxSP= 1.03	VxLxSP= 1.45
CD (p=0.05)	Vx L = 2.79	VxSP = 2.24	LxSP= 2.24	VxLxSP= NS
Final plant stand establishment (%)				
0 months	81.8	78.5	77.3	79.8
2 months	51.3	30.8	51.5	46.0
SEm (±)	Vx L =2.18	VxSP =2.96	LxSP= 2.96	VxLxSP= 4.19
CD (p=0.05)	Vx L = 4.92	VxSP = 6.45	LxSP= 6.45	VxLxSP= NS

***** Experiment conducted during August** Experiment conducted during October *** The results of experiment conducted during December were not represented because of very less germination recorded due to low temperature (see Table in Annexure)

Crop: Sorghum

Centre: ICAR-IIMR, Hyderabad (Not reported)

Centre: VNMKV, Parbhani (Not reported)

Centre: MPKV, Rahuri
Experimental details:
Variety (Two): V1: Phule vasudha and V2: Phule Rohini
Seed Lot (Two) : L1: Lot 1 L2: Lot 2
Seed type (Three): L1: Fresh; L2: RVD Ist; L3: RVD IInd

Details of seed samples

Sr. No	Crop	Variety	Stage	Lot. No	Date of Harvest	Date of Test	Valid up to	Age of seed on Sept. 2018 from date of test (month)
1	Jawar	P. Vasudha	F/S	Feb18-13-1601-1303	Feb-2018	21/8/18	20/5/19	1
2				Apr17-13-1601-1712	Apr-2017	11/8/17	10/5/18	13
3				Feb16-13-1601-1303	Feb-2016	23/8/16	22/5/17	25
4	Jawar	P. Vasudha	Breeder	Feb18-13MPKVK-05	Feb-2018	27/8/18	26/5/19	1
5				Mar17-13MPKVK-12	Mar-2017	8/8/17	7/5/18	13
6				Feb16-13MPKVK-04	Feb-2016	23/8/16	22/5/17	25
7	Jawar	P. Rohini	Breeder	Feb18-13MPKVK-09	Feb-2018	21/8/18	20/5/19	1
8				Apr17-13MPKVK-05	Apr-2017	8/8/17	7/5/18	13
9				Feb16-13MPKVK-06	Feb-2016	23/8/16	22/5/17	25
10	Jawar	P. Rohini	Breeder	Feb18-13MPKVK-13	Feb-2018	20/8/18	19/5/19	1
11				Apr17-13MPKVK-9	Apr-2017	8/8/17	7/5/18	13
12				Jan16-13MPKVK-9	Jan-2016	23/8/16	22/5/17	25

Results:
The data on effect of variety, seed lot and seed type on seed quality of sorghum are presented in table 1.64 to 1.77.

Effect of variety: The germination percentage, seedling dry weight, vigour index II and field emergence are not influenced significantly. However, the moisture content of the sorghum seed was varying as it was stored in cloth bag at ambient condition. The variety Phule Vasudha recorded significantly higher values of root shoot length (31.50 cm) and vigour index I (2735).

Effect of seed lot: The germination & other seed quality parameters of sorghum seed were not influenced significantly irrespective of varieties and seed types.

Effect of seed type: The fresh seed recorded significantly higher germination (90.25 %) at the age of one month & maintained (86.25%) at the age of 5th month from date of testing. The RVD I seed recorded significantly higher germination (88%) at the age of 13th month and was (83.25 %) at the age of 17th month from the date of testing. However, The RVD II seed had 81.75% germination at the age of 25th months from the date of testing and maintained 75 % germination at the age of 29th month.

Interaction effect of variety, seed lot & seed type on seed quality parameters of sorghum: The data on interaction effect of variety, seed lot & seed type revealed non-significant effect.

Table 1.64: Effect of variety, lot and seed types on germination (%) of sorghum

Treatments		September	October	November	December	January
Variety						
V_1: P. Vasudha		87.17 (69.36)	86.17 (68.44)	84.17 (66.84)	82.33 (65.44)	81.67 (64.92)
V_2: P. Rohini		86.17 (68.34)	85.00 (67.36)	83.67 (66.28)	82.16 (65.16)	81.33 (64.59)
SEm(±)		0.600	0.603	0.634	0.593	0.604
CD(p=0.05)		NS	NS	NS	NS	NS
Seed lot						
L_1: Lot 1		86.00 (68.32)	85.50 (67.81)	83.50 (66.24)	82.00 (65.10)	81.00 (64.32)
L_2: Lot 2		87.33 (69.38)	85.67 (67.98)	84.33 (66.88)	82.50 (65.50)	82.00 (65.19)
SEm(±)		0.600	0.603	0.634	0.593	0.604
CD(p=0.05)		NS	NS	NS	NS	NS
Seed type						
S_1: Fresh		90.25 (71.97)	89.00 (70.76)	87.25 (69.23)	86.50 (68.53)	86.25 (68.35)
S_2: RVD Ist		88.00 (69.85)	87.00 (68.93)	85.75 (67.86)	84.25 (66.70)	83.25 (65.90)
S_3: RVD IInd		81.75 (64.73)	80.75 (64.00)	78.75 (62.59)	76.00 (60.68)	75.00 (60.01)
SEm(±)		0.735	0.739	0.777	0.726	0.739
CD(p=0.05)		2.146	2.156	2.267	2.120	2.158
Age of seed on Sept. 2018 from date of test (Month)	Fresh	1	2	3	4	5
	RVD I	13	14	15	16	17
	RVD II	25	26	27	28	29

*Figures in parenthesis are arc sin transformed values

Table 1.65: Interaction effect of variety, lot and seed types on germination (%) in sorghum

Treatments	September	October	November	December	January
$V_1L_1R_0$	92.00 (73.57)	90.00 (71.57)	88.00 (69.73)	87.00 (68.87)	87.00 (68.87)
$V_1L_1R_1$	89.00 (70.63)	88.00 (69.73)	87.00 (68.87)	85.00 (67.21)	83.00 (65.65)
$V_1L_1R_2$	80.00 (63.44)	80.00 (63.44)	77.00 (61.34)	75.00 (60.00)	75.00 (60.00)
$V_1L_2R_0$	90.00 (71.57)	90.00 (71.57)	88.00 (69.73)	88.00 (69.73)	87.00 (68.87)
$V_1L_2R_1$	89.00 (70.63)	88.00 (69.73)	87.00 (68.87)	85.00 (67.21)	85.00 (67.21)
$V_1L_2R_2$	83.00 (65.65)	81.00 (64.16)	78.00 (62.03)	74.00 (59.34)	73.00 (58.69)
$V_2L_1R_0$	88.00 (69.73)	88.00 (69.73)	86.00 (68.03)	85.00 (67.21)	85.00 (67.21)
$V_2L_1R_1$	85.00 (67.21)	85.00 (67.21)	83.00 (65.65)	82.00 (64.90)	80.00 (63.44)

$V_2L_1R_2$	82.00 (64.90)	82.00 (64.90)	80.00 (63.44)	78.00 (62.03)	76.00 (60.67)
$V_2L_2R_0$	91.00 (72.54)	88.00 (69.73)	87.00 (68.87)	86.00 (68.03)	86.00 (68.03)
$V_2L_2R_1$	89.00 (70.63)	87.00 (68.87)	86.00 (68.03)	85.00 (67.21)	85.00 (67.21)
$V_2L_2R_2$	82.00 (64.90)	80.00 (63.44)	80.00 (63.44)	77.00 (61.34)	76.00 (60.67)
SEm(±)	1.470	1.477	1.553	1.42	1.478
CD(p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**

*Figures in parenthesis are arc sin transformed values

Table 1.66: Effect of variety, lot and seed types on moisture (%) in sorghum

Treatments		**September**	**October**	**November**	**December**	**January**
Variety						
V_1: P. Vasudha		8.53	8.38	8.60	8.53	8.47
V_2: P. Rohini		8.60	8.52	8.62	8.59	8.55
SEm(±)		0.011	0.013	0.012	0.016	0.010
CD(p=0.05)		0.033	0.038	NS	0.046	0.030
Seed lot						
L_1: Lot 1		8.57	8.45	8.67	8.61	8.56
L_2: Lot 2		8.56	8.45	8.55	8.52	8.46
SEm(±)		0.011	0.013	0.012	0.016	0.010
CD(p=0.05)		NS	NS	NS	0.046	0.030
Seed type						
S_1: Fresh		8.63	8.51	8.70	8.65	8.60
S_2: RVD Ist		8.60	8.46	8.63	8.58	8.53
S_3: RVD IInd		8.46	8.37	8.51	8.46	8.41
SE(±)		0.014	0.016	0.014	0.019	0.013
CD(p=0.05)		0.041	0.047	0.041	0.057	0.037
Age of seed on Sept. 2018 from date of test (Month)	Fresh	1	2	3	4	5
	RVD I	13	14	15	16	17
	RVD II	25	26	27	28	29

Table 1.67: Interaction effect of variety, lot and seed types on moisture (%) of sorghum

Treatments	**September**	**October**	**November**	**December**	**January**
$V_1L_1R_0$	8.60	8.45	8.80	8.72	8.64
$V_1L_1R_1$	8.56	8.38	8.76	8.65	8.58
$V_1L_1R_2$	8.43	8.27	8.60	8.49	8.45

$V_1L_2R_0$	8.61	8.43	8.57	8.50	8.46
$V_1L_2R_1$	8.57	8.42	8.48	8.46	8.41
$V_1L_2R_2$	8.42	8.30	8.40	8.38	8.30
$V_2L_1R_0$	8.68	8.56	8.70	8.70	8.62
$V_2L_1R_1$	8.65	8.53	8.65	8.60	8.60
$V_2L_1R_2$	8.52	8.50	8.53	8.50	8.47
$V_2L_2R_0$	8.64	8.60	8.72	8.70	8.66
$V_2L_2R_1$	8.61	8.52	8.64	8.61	8.53
$V_2L_2R_2$	8.49	8.42	8.50	8.45	8.40
SEm(±)	0.028	0.032	0.028	0.039	0.025
CD(p=0.05)	NS	NS	NS	NS	NS

Table 1.68: Effect of variety, lot and seed types on root shoot length (cm) in sorghum

Treatments		September	October	November	December	January
Variety						
V_1: P. Vasudha		31.33	31.50	30.34	30.17	29.50
V_2: P. Rohini		30.00	30.00	29.52	29.00	29.00
SEm(±)		0.338	0.346	0.281	0.279	0.250
CD(p=0.05)		0.988	1.009	NS	0.815	NS
Seed lot						
L_1: Lot 1		36.67	31.00	30.00	29.67	29.50
L_2: Lot 2		30.67	30.50	29.86	29.50	29.00
SEm(±)		0.338	0.346	0.281	0.279	0.250
CD(p=0.05)		NS	NS	NS	NS	NS
Seed type						
S_1: Fresh		31.50	31.76	31.01	30.75	30.25
S_2: RVD I^{st}		30.75	30.75	30.00	29.50	29.25
S_3: RVD II^{nd}		29.75	29.75	28.78	28.50	28.25
SEm(±)		0.415	0.423	0.344	0.342	0.306
CD(p=0.05)		1.210	1.236	1.004	0.998	0.894
Age of seed on Sept. 2018 from date of test (Month)	Fresh	1	2	3	4	5
	RVD I	13	14	15	16	17
	RVD II	25	26	27	28	29

Table 1.69: Interaction effect of variety, lot and seed types root shoot length (cm) of sorghum

Treatments	September	October	November	December	January
$V_1L_1R_0$	32.00	33.00	31.03	32.00	31.00
$V_1L_1R_1$	31.00	32.00	30.00	30.00	30.00
$V_1L_1R_2$	30.00	31.00	29.00	29.00	29.00
$V_1L_2R_0$	33.00	32.00	32.00	31.00	30.00
$V_1L_2R_1$	32.00	31.00	31.00	30.00	29.00
$V_1L_2R_2$	30.00	30.00	29.00	29.00	28.00
$V_2L_1R_0$	31.00	31.00	31.00	30.00	30.00
$V_2L_1R_1$	30.00	30.00	30.00	29.00	29.00
$V_2L_1R_2$	30.00	29.00	29.00	28.00	28.00
$V_2L_2R_0$	30.00	31.02	30.00	30.00	30.00
$V_2L_2R_1$	30.00	30.00	29.00	29.00	29.00
$V_2L_2R_2$	29.00	29.00	28.13	28.00	28.00
SEm(±)	0.829	0.847	0.688	0.684	0.613
CD(p=0.05)	NS	NS	NS	NS	NS

Table 1.70: Effect of variety, lot and seed types on seedling dry weight (g) in sorghum

Treatments		September	October	November	December	January
Variety						
V_1: P. Vasudha		0.250	0.245	0.233	0.225	0.222
V_2: P. Rohini		0.237	0.235	0.221	0.213	0.207
SEm(±)		**0.007**	**0.007**	**0.006**	**0.006**	**0.006**
CD(p=0.05)		**NS**	**NS**	**NS**	**NS**	**NS**
Seed lot						
L_1: Lot 1		0.242	0.240	0.228	0.220	0.218
L_2: Lot 2		0.245	0.240	0.226	0.218	0.210
SEm(±)		**0.007**	**0.007**	**0.006**	**0.006**	**0.006**
CD(p=0.05)		**NS**	**NS**	**NS**	**NS**	**NS**
Seed type						
S_1: Fresh		0.263	0.258	0.248	0.238	0.235
S_2: RVD I^{st}		0.245	0.243	0.228	0.225	0.215
S_3: RVD II^{nd}		0.223	0.220	0.205	0.195	0.193
SEm(±)		**0.008**	**0.008**	**0.007**	**0.008**	**0.008**
CD(p=0.05)		**0.024**	**0.024**	**0.020**	**0.022**	**0.023**
Age of seed on Sept. 2018 from date of test (Month)	Fresh	**1**	**2**	**3**	**4**	**5**
	RVD I	**13**	**14**	**15**	**16**	**17**
	RVD II	**25**	**26**	**27**	**28**	**29**

Table 1.71: Interaction effect of variety, lot and seed types' seedling dry weight (g) of sorghum

Treatments	September	October	November	December	January
$V_1L_1R_0$	0.270	0.270	0.260	0.250	0.250
$V_1L_1R_1$	0.250	0.250	0.240	0.230	0.240
$V_1L_1R_2$	0.230	0.220	0.210	0.200	0.200
$V_1L_2R_0$	0.270	0.260	0.250	0.240	0.240
$V_1L_2R_1$	0.260	0.250	0.240	0.230	0.200
$V_1L_2R_2$	0.220	0.220	0.200	0.200	0.200
$V_2L_1R_0$	0.250	0.250	0.240	0.230	0.220
$V_2L_1R_1$	0.230	0.230	0.220	0.220	0.210
$V_2L_1R_2$	0.220	0.220	0.200	0.190	0.190
$V_2L_2R_0$	0.260	0.250	0.240	0.230	0.230
$V_2L_2R_1$	0.240	0.240	0.213	0.220	0.210
$V_2L_2R_2$	0.220	0.220	0.210	0.190	0.180
SEm(±)	0.016	0.017	0.014	0.015	0.016
CD(p=0.05)	NS	NS	NS	NS	NS

Table 1.72: Effect of variety, lot and seed types on vigour index I of sorghum

Treatments		September	October	November	December	January
Variety						
V_1: P. Vasudha		2735	2718	2560	2491	2414
V_2: P. Rohini		2586	2555	2474	2387	2363
SEm(±)		34.63	43.24	44.42	42.29	34.98
CD(p=0.05)		101.10	126.23	NS	NS	NS
Seed lot						
L_1: Lot 1		2640	2654	2511	2439	2393
L_2: Lot 2		2681	2618	2524	2439	2384
SE(±)		34.63	43.24	44.42	42.29	34.98
CD(p=0.05)		NS	NS	NS	NS	NS
Seed type						
S_1: Fresh		2842	2828	2708	2663	2610
S_2: RVD Ist		2707	2678	2574	2488	2435
S_3: RVD IInd		2433	2403	2269	2167	2120
SEm(±)		42.41	52.96	54.40	51.80	42.84
CD(p=0.05)		123.83	154.61	158.82	151.23	125.08
Age of seed on Sept. 2018 from date of test (Month)	Fresh	1	2	3	4	5
	RVD I	13	14	15	16	17
	RVD II	25	26	27	28	29

Table 1.73: Interaction effect of variety, lot and seed types vigour index I of sorghum

Treatments	September	October	November	December	January
$V_1L_1R_0$	2942	2966	2734	2786	2697
$V_1L_1R_1$	2756	2818	2611	2553	2488
$V_1L_1R_2$	2399	2478	2235	2177	2177
$V_1L_2R_0$	2968	2881	2817	2730	2613
$V_1L_2R_1$	2851	2731	2698	2552	2467
$V_1L_2R_2$	2492	2433	2264	2145	2042
$V_2L_1R_0$	2730	2731	2669	2553	2548
$V_2L_1R_1$	2551	2552	2492	2379	2319
$V_2L_1R_2$	2461	2379	2323	2186	2129
$V_2L_2R_0$	2729	2732	2612	2581	2583
$V_2L_2R_1$	2669	2611	2496	2467	2467
$V_2L_2R_2$	2377	2322	2254	2157	2131
SEm(±)	84.82	105.91	108.80	103.60	85.68
CD(p=0.5)	NS	NS	NS	NS	NS

Table 1.74: Effect of variety, lot and seed types on vigour index II of sorghum

Treatments		September	October	November	December	January
Variety						
V_1: P. Vasudha		21.90	21.23	19.78	18.69	18.23
V_2: P. Rohini		20.46	20.02	18.54	17.60	16.88
SEm(±)		0.688	0.676	0.640	0.652	0.622
CD(p=0.05)		NS	NS	NS	NS	NS
Seed lot						
L_1: Lot 1		20.86	20.59	19.19	18.17	17.78
L_2: Lot 2		21.50	20.68	19.13	18.12	17.33
SEm(±)		0.688	0.676	0.640	0.652	0.622
CD(p=0.05)		NS	NS	NS	NS	NS
Seed type						
S_1: Fresh		23.72	22.92	21.66	20.57	20.30
S_2: RVD I^{st}		21.62	21.15	19.63	19.01	17.91
S_3: RVD II^{nd}		18.19	17.79	16.19	14.85	14.46
SEm(±)		0.842	0.828	0.784	0.798	0.762
CD(p=0.05)		2.459	2.418	2.288	2.330	2.226
Age of seed on Sept. 2018 from date of test (Month)	Fresh	1	2	3	4	5
	RVD I	13	14	15	16	17
	RVD II	25	26	27	28	29

*Figures in parenthesis are arc sin transformed values

Table 1.75: Interaction effect of variety, lot and seed types vigour index II of sorghum

Treatments	September	October	November	December	January
$V_1L_1R_0$	24.84	24.30	22.88	21.75	21.75
$V_1L_1R_1$	22.25	22.00	20.88	19.55	19.92
$V_1L_1R_2$	18.40	17.60	16.17	15.00	15.00
$V_1L_2R_0$	24.30	23.40	22.00	21.12	20.88
$V_1L_2R_1$	23.14	22.00	20.88	19.55	17.00
$V_1L_2R_2$	18.26	17.82	15.60	14.80	14.60
$V_2L_1R_0$	22.00	22.00	20.64	19.55	18.70
$V_2L_1R_1$	19.55	19.55	18.26	18.04	16.80
$V_2L_1R_2$	18.04	18.04	16.00	14.82	14.44
$V_2L_2R_0$	23.66	22.00	20.88	19.78	19.78
$V_2L_2R_1$	21.36	20.88	18.35	18.70	17.85
$V_2L_2R_2$	18.04	17.60	16.80	14.63	13.68
SEm(±)	1.685	1.657	1.567	1.596	1.525
CD(p=0.05)	NS	NS	NS	NS	NS

Table 1.76: Effect of variety, lot and seed types on field emergence (%) of sorghum

Treatments	September	October	November	December	January
Variety					
V_1: P. Vasudha	81.00 (64.33)	80.33 (63.82)	79.33 (63.09)	76.50(61.12)	75.94(60.76)
V_2: P. Rohini	79.50 (63.20)	78.83 (62.69)	77.67 (61.86)	74.83(59.97)	72.39(58.40)
SEm(±)	0.589	0.557	0.506	0.484	0.633
CD(p=0.05)	NS	NS	NS	NS	NS
Seed lot					
L_1: Lot 1	80.00 (63.57)	79.00 (62.84)	78.33 (62.36)	76.17(60.90)	75.61(60.51)
L_2: Lot 2	80.50 (63.96)	80.17 (63.68)	78.67 (62.59)	75.17(60.19)	72.72(58.65)
SEm(±)	0.589	0.557	0.506	0.484	0.633

CD(p=0.05)		NS	NS	NS	NS	NS
Seed type						
S_1: Fresh		84.00(66.51)	83.00(65.72)	81.75(64.75)	80.50(63.81)	79.33(63.02)
S_2: RVD I^{st}		81.75(64.76)	81.25(64.36)	80.25(63.62)	76.50(60.35)	74.33(59.62)
S_3: RVD II^{nd}		75.00(60.02)	74.50(59.69)	73.50(59.03)	70.00(56.79)	68.83(56.10)
SEm(±)		0.722	0.682	0.620	0.593	0.775
CD(p=0.05)		2.107	1.991	1.811	1.730	2.264
Age of seed on Sept. 2018 from date of test (Month)	Fresh	1	2	3	4	5
	RVD I	13	14	15	16	17
	RVD II	25	26	27	28	29

*Figures in parenthesis are arc sin transformed values

Table 1.77: Interaction effect of variety, lot and seed types on field emergence (%) in sorghum

Treatments	September	October	November	December	January
$V_1L_1R_0$	85.00 (67.21)	84.00 (66.42)	83.00 (65.65)	82.00 (64.90)	81.00 (64.16)
$V_1L_1R_1$	84.00 (66.42)	83.00 (65.65)	82.00 (64.90)	80.00 (63.44)	78.33 (62.26)
$V_1L_1R_2$	75.00 (60.00)	74.00 (59.34)	74.00 (59.34)	70.00 (56.79)	73.33 (58.91)
$V_1L_2R_0$	84.00 (66.42)	84.00 (66.42)	83.00 (65.65)	80.00 (63.44)	80.00 (63.44)
$V_1L_2R_1$	82.00 (64.90)	82.00 (64.90)	81.00 (64.16)	77.00 (61.34)	75.00 (60.00)
$V_1L_2R_2$	76.00 (60.67)	75.00 (60.00)	73.00 (58.69)	70.00 (56.79)	68.00 (55.55)
$V_2L_1R_0$	81.00 (64.16)	80.00 (63.44)	80.00 (63.44)	80.00 (63.44)	79.00 (62.73)
$V_2L_1R_1$	80.00 (63.44)	79.00 (62.73)	78.00 (62.03)	75.00 (60.00)	74.00 (59.34)
$V_2L_1R_2$	75.00 (60.00)	74.00 (59.34)	73.00 (58.69)	70.00 (56.79)	68.00 (55.55)
$V_2L_2R_0$	86.00 (68.03)	84.00 (66.42)	81.00 (64.16)	80.00 (63.44)	77.33 (61.57)
$V_2L_2R_1$	81.00 (64.16)	81.00 (64.16)	80.00 (63.44)	74.00 (59.34)	70.00 (56.79)
$V_2L_2R_2$	74.00 (59.34)	75.00 (60.00)	74.00 (59.34)	70.00 (56.79)	66.00 (54.33)
SEm(±)	1.364	1.385	1.241	1.185	1.551
CD(p=0.05)	NS	NS	NS	NS	NS

P*Figures in parenthesis are arc sin transformed values

Centre: UAS, Dharwad
Experimental details:

Class of seed used: Certified seed

Technical details:

Design: FRBD, Factor (1): Varieties, Factor (2) : Seed lots, Replication: Five

Results:

Experiment was conducted to test the validity period of sorghum seed lots for aged seed lots (14-15 months old) of cultivar M-35-1 and SPV-2217 against two freshly harvested seed lots (5-6 month old) of same varieties. From the results, it was found that there was a gradual reduction in seed quality parameters in both seed lot, performance of fresh seed lots were significantly higher compare to the aged seeds lots. Among the varieties SPV-2217 was significantly superior since it recorded significantly higher first count, germination percentage, seedling vigour index –I & II and final plant stand as compared to the M-35-1 at the end of storage period.

Crop	Varieties	Lots	Storage Period (Months)	Date of harvest	Date of test	Validity up to	Germination (%)
Sorghum	M-35-1	Fresh lot	6	7-01-2018	15-01-2018	16-10-2018	83.0
		Aged lot	15	3-02-2017	17-02-2017	18-11-2017	75.0
	SPV-2217	Fresh lot	5	2-02-2018	13-02-2018	14-11-2018	79.0
		Aged lot	14	7-02-2017	15-03-2017	16-12-2018	76.0

Table 1.78: Effect of variety, lot and storage period on seed moisture content in sorghum

Treatment	Seed moisture content (%) of fresh and aged seed lots in sorghum					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: M-35-1	16.06	15.69	15.51	15.32	14.25	13.47
V2: SPV-2217	16.00	15.63	15.61	15.57	14.75	13.42
SE.m±	**0.01**	**0.01**	**0.03**	**0.03**	**0.02**	**0.02**
CD(p=0.05)	**0.04**	**0.04**	**NS**	**0.09**	**NS**	**NS**
Seed lots						
L1: Fresh seed lot	16.35	15.98	15.41	15.05	14.52	13.42
L2: Aged seed lot	15.71	15.35	15.71	15.84	14.48	13.47
SE.m±	**0.01**	**0.01**	**0.03**	**0.03**	**0.02**	**0.02**
CD(p=0.05)	**NS**	**NS**	**NS**	**NS**	**0.06**	**NS**
Interaction						
V1L1	16.67	16.29	15.57	15.00	14.35	13.47
V1L2	15.44	15.09	15.44	15.63	14.15	13.46
V2L1	16.03	15.66	15.24	15.09	14.68	13.36
V2L2	15.97	15.60	15.97	16.04	14.81	13.47
SE.m±	**0.02**	**0.02**	**0.07**	**0.06**	**0.04**	**0.05**
CD(p=0.05)	**0.07**	**0.07**	**0.21**	**NS**	**NS**	**NS**
CV	**0.74**	**0.74**	**2.23**	**1.99**	**1.26**	**1.80**

Table 1.79: Effect of variety, lot and storage period on first count in sorghum

Treatment Combination	First count (%) of fresh and aged seed lots in sorghum					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: M-35-1	39.95	42.10	40.75	38.97	35.85	23.84
V2: SPV-2217	42.63	37.57	36.06	35.26	34.38	26.54
SE.m±	**0.21**	**0.17**	**0.19**	**0.11**	**0.11**	**0.15**
CD(p=0.05)	**0.65**	**0.51**	**0.59**	**0.33**	**0.35**	**0.45**
Seed lots						
L1: Fresh seed lot	51.90	52.95	50.30	47.78	45.39	43.13
L2: Aged seed lot	38.90	35.20	33.44	31.77	30.98	30.17
SE.m±	**0.21**	**0.17**	**0.19**	**0.11**	**0.11**	**0.15**
CD(p=0.05)	**0.65**	**0.51**	**0.59**	**0.33**	**0.35**	**0.45**
Interaction						
V1L1	50.67	53.39	50.72	48.19	45.78	43.49
V1L2	37.80	34.60	32.87	31.23	29.67	29.18
V2L1	53.13	52.50	49.88	47.38	45.01	42.76
V2L2	40.00	35.80	34.01	32.31	30.69	29.16
SE.m±	**0.42**	**0.33**	**0.38**	**0.22**	**0.23**	**0.29**
CD(p=0.05)	**NS**	**1.02**	**NS**	**NS**	**NS**	**0.90**
CV	**5.08**	**4.17**	**4.97**	**2.90**	**3.21**	**5.77**

Table 1.80: Effect of variety, lot and storage period on seed germination (%) in sorghum

Treatment Combination	Seed germination (%) of fresh and aged seed lots in sorghum					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: M-35-1	75.59	74.54	73.49	72.46	71.45	70.45
V2: SPV-2217	79.28	78.17	77.07	75.99	74.93	73.88
SE.m±	**0.32**	**0.33**	**0.31**	**0.27**	**0.30**	**0.29**
CD(p=0.05)	**0.98**	**0.99**	**0.95**	**0.88**	**0.92**	**0.89**
Seed lots						
L1: Fresh seed lot	82.05	80.90	79.77	78.65	77.55	76.47
L2: Aged seed lot	72.82	71.80	70.79	69.80	68.83	67.86
SE.m±	**0.32**	**0.33**	**0.31**	**0.27**	**0.30**	**0.29**
CD(p=0.05)	**0.98**	**0.99**	**0.95**	**0.88**	**0.92**	**0.89**
Interaction						
V1L1	80.10	78.98	77.87	76.78	75.71	74.65
V1L2	71.09	70.09	69.11	68.14	67.19	66.25
V2L1	84.00	82.82	81.66	80.52	79.39	78.28
V2L2	74.55	73.51	72.48	71.46	70.46	69.48
SE.m±	0.66	0.38	0.43	0.44	0.37	0.52
CD(p=0.05)	**NS**	**1.17**	**NS**	**NS**	**1.13**	**1.61**
CV	**5.08**	**3.03**	**3.57**	**3.74**	**3.33**	**4.58**

Table 1.81: Effect of variety, lot and storage period on seedling vigour index-I in sorghum

Treatment Combination	Seedling vigour index-I of fresh and aged seed lots in sorghum					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: M-35-1	2201	2262	2188	2060	1964	1797
V2: SPV-2217	2305	2181	2329	2242	2125	2017
SE.m±	**10**	**9**	**18**	**10**	**12**	**13**
CD(p=0.05)	**31**	**28**	**NS**	**32**	**37**	**41**
Seed lots						
L1: Fresh seed lot	2390	2358	2341	2277	2147	2092
L2: Aged seed lot	2116	2085	2177	2026	1942	1722
SE.m±	**10**	**9**	**18**	**10**	**12**	**13**
CD(p=0.05)	**31**	**NS**	**NS**	**32**	**37**	**41**
Interaction						
V1L1	2347	2379	2179	2133	2033	2012
V1L2	2055	2144	2197	1987	1896	1583
V2L1	2434	2336	2502	2421	2262	2172
V2L2	2177	2027	2157	2064	1989	1862
SE.m±	**16**	**16**	**27**	**15**	**14**	**16**
CD(p=0.05)	**NS**	**49**	**83**	**46**	**44**	**49**
CV	**4.46**	**4.10**	**4.18**	**4.86**	**5.79**	**5.01**

Table 1.82: Effect of variety, lot and storage period on seedling vigour index-II in sorghum

Treatment Combination	Seedling vigour index-II of fresh and aged seed lots in sorghum					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: M-35-1	19.63	18.39	16.87	16.28	15.85	14.92
V2: SPV-2217	18.88	17.69	18.56	17.57	15.58	15.26
SE.m±	**0.26**	**0.24**	**0.22**	**0.19**	**0.08**	**0.06**
CD(p=0.05)	**0.79**	**0.74**	**0.69**	**0.58**	**0.25**	**0.19**
Seed lots						
L1: Fresh seed lot	20.43	19.15	18.96	18.85	16.90	15.58
L2: Aged seed lot	18.08	17.54	17.27	17.00	15.63	14.60
SE.m±	**0.26**	**0.24**	**0.22**	**0.19**	**0.08**	**0.06**
CD(p=0.05)	**NS**	**0.74**	**NS**	**0.58**	**0.25**	**0.19**
Interaction						
V1L1	20.83	19.51	17.40	16.28	15.99	15.76
V1L2	18.43	17.27	16.33	16.28	15.71	14.08
V2L1	20.04	18.78	18.91	17.41	15.61	15.39
V2L2	17.73	16.61	18.22	17.72	15.55	15.13
SE.m±	**0.51**	**0.48**	**0.45**	**0.37**	**0.16**	**0.12**
CD(p=0.05)	**NS**	**NS**	**NS**	**NS**	**0.50**	**0.38**
CV	**3.37**	**4.37**	**2.62**	**3.07**	**5.17**	**4.10**

Table 1.83: Effect of variety, lot and storage period on speed of germination in sorghum

Treatment Combination	Speed of germination of fresh and aged seed lots in sorghum					
	July -18	**Aug-18**	**Sept-18**	**Oct-18**	**Nov-18**	**Dec-18**
Varieties						
V1: M-35-1	15.53	15.04	14.28	13.57	12.89	12.25
V2: SPV-2217	16.25	15.24	14.48	13.75	13.07	12.41
SE.m±	**0.07**	**0.10**	**0.09**	**0.09**	**0.08**	**0.08**
CD(p=0.05)	**0.22**	**0.30**	**0.28**	**0.27**	**0.26**	**0.24**
Seed lots						
L1: Fresh seed lot	18.17	18.08	17.18	16.32	15.50	14.73
L2: Aged seed lot	13.62	12.20	11.59	11.01	10.46	9.93
SE.m±	**0.07**	**0.10**	**0.09**	**0.09**	**0.08**	**0.08**
CD(p=0.05)	**0.22**	**0.30**	**0.28**	**0.27**	**0.26**	**0.24**
Interaction						
V1L1	17.73	17.82	16.93	16.08	15.28	14.52
V1L2	13.34	12.25	11.64	11.06	10.50	9.98
V2L1	18.60	18.34	17.42	16.55	15.72	14.94
V2L2	13.90	12.15	11.54	10.96	10.41	9.89
SE.m±	**0.14**	**0.19**	**0.18**	**0.17**	**0.17**	**0.16**
CD(p=0.05)	**0.44**	**0.60**	**0.57**	**0.54**	**0.51**	**0.49**
CV	**5.08**	**4.35**	**5.07**	**2.71**	**3.15**	**5.39**

Table 1.84: Effect of variety, lot and storage period on final plant stand in sorghum

Treatment Combination	Bimonthly final plant stand of fresh and aged seed lots in sorghum		
	July -18	Sept-18	Nov-18
Varieties			
V1: M-35-1	53.00	48.20	43.35
V2: SPV-2217	54.10	50.70	46.75
SE.m±	**0.27**	**0.81**	**0.42**
CD(p=0.05)	**0.82**	**2.51**	**1.28**
Seed lots			
L1: Fresh seed lot	84.00	73.55	57.00
L2: Aged seed lot	69.10	63.35	49.10
SE.m±	**0.27**	**0.81**	**0.42**
CD(p=0.05)	**NS**	**2.51**	**1.28**
Interaction			
V1L1	79.00	72.80	67.00
V1L2	77.00	69.60	53.70
V2L1	89.00	81.30	69.00
V2L2	77.20	73.10	65.50
SE.m±	**0.53**	**1.63**	**0.83**
CD(p=0.05)	**1.64**	**4.95**	**2.57**
CV	**9.95**	**7.31**	**8.90**

Crop: Cotton

Centre: ICAR-CICR, Nagpur

Experimental details:

For this experiment, since revalidated seed lots were not available at the department of Seed Certification, Coimbatore, seeds produced at CICR, Regional Station in 2016-17 and 2017-18 for cotton variety Surabhi (V1) and Suraj (V2) has been utilized. Seeds produced during 2017-18 (harvested in Feb.2018 and tested in May 2018) were kept as fresh seed lot (L2), whereas seeds produced during 2016-17 (harvested in Feb. 2017 and tested in May 2017) and stored under ambient condition were assumed as revalidated seed lot (L1). The seeds were sown in a miniature plot for the observation of field emergence (%), Speed of emergence (Maguire, 1962), vigour Index I & II and Final plant stand establishment (%) were taken at 45th day. Seeds were sown in FRBD following four replications. The data recorded were analysed statistically and mean table presented below.

Results:

Seed quality evaluation was conducted in at bimonthly interval for both laboratory and field environment from July 2018 to January 2019. In the laboratory studies, moisture content of the seeds was estimated before being evaluated. Variation for seed moisture between seed lot was observed over the period of storage in both the varieties. In both the varieties between the lots, the fresh lots (L2) has comparatively high moisture than revalidated lots (L1).

Germination (%) was higher invariably in the fresh lots of two varieties when compared to revalidated lots. Between varieties, Suraj recorded higher germination percent over Surabhi. As the storage period progresses, the per cent germination decreases due to action of metabolic reaction when kept under ambient conditions. But the germination percent was well above the minimum seed certification standard (65%) in both the varieties and seed lots. Vigour index I and II were also found to be higher in fresh lots of both varieties when compared to revalidated seed lots. As like above, the storage period also influences the seedling parameters in a decreasing trend. The vigour index I and II was also reduced with increase in storage period in both the varieties and seed lots.

In the field experiment, the characters recorded were speed of germination, field emergence %, vigour index and plant stand. Like the laboratory studies, field evaluation showed decline in seedlings when stored under ambient conditions. Also speed of emergence, field emergence % was higher in fresh seed lots of both varieties. The vigour index I and II and plant stand shows a decreasing order with the period of storage.

Table 1.85: Effect of variety, lot and storage period on seed moisture content in cotton varieties Surabhi and Suraj

Variety	Seed lot	July 18 (E1)	September 18 (E2)	November 18 (E3)	January 19 (E4)	Mean

Surabhi (V1)	2016-17 (L1)	7.58	6.61	6.01	5.92	6.53
	2017-18 (L2)	7.43	6.38	6.57	6.18	6.64
Mean		7.51	6.49	6.29	6.05	6.59
Suraj (V2)	2016-17 (L1)	8.21	6.56	5.93	5.98	6.67
	2017-18 (L2)	7.62	7.23	6.66	6.15	6.92
Mean		7.91	6.90	6.30	6.07	6.79
G.Mean		7.71	6.70	6.29	6.06	6.69
	V	L	E	VL	VE	LE
SEd	0.18	0.18	0.32	0.32	0.48	0.48
CD 1%	0.54	0.54	0.96	0.96	1.46	1.46

Table 1.86: Effect of variety, lot and storage period on germination (%) in cotton varieties Surabhi and Suraj

Variety	Seed lot	July 18 (E1)	September 18 (E2)	November 18 (E3)	January 19(E4)	Mean
Surabhi (V1)	2016-17 (L1)	74	72	71	69	71
	2017-18 (L2)	85	83	82	79	82
Mean		79	77	76	74	77
Suraj (V2)	2016-17 (L1)	73	72	70	68	71
	2017-18 (L2)	89	85	81	79	83
Mean		81	78	76	73	77
G.Mean		80	78	76	74	77
	V	L	E	VL	VE	LE
SEd	0.34	0.34	0.48	0.48	0.68	0.68
CD 1%	0.91	0.91	1.28	1.28	1.82	1.82

Table 1.87: Effect of variety, lot and storage period on seedling vigour index-I in cotton varieties Surabhi and Suraj

Variety	Seed lot	July 18 (E1)	September 18 (E2)	November 18 (E3)	January 19 (E4)	Mean
Surabhi (V1)	2016-17 (L1)	2289	2384	2117	1736	2131
	2017-18 (L2)	3032	2750	2358	1997	2534
Mean		2660	2567	2237	1866	2333
Suraj (V2)	2016-17 (L1)	2112	2258	1950	1456	1944
	2017-18 (L2)	3288	2957	2843	2252	2835
Mean		2700	2607	2397	1854	2389
G.Mean		2680	2587	2317	1860	2361
	V	L	E	VL	VE	LE

SEd	52.71	52.71	74.54	74.54	105.42	105
CD 1%	141.4	141.4	199.98	199.98	282.81	282

Table 1.88: Effect of variety, lot and storage period on seedling vigour index-II in cotton varieties Surabhi and Suraj

Variety	Seed lot	July 18 (E1)	September 18 (E2)	November 18 (E3)	January 19 (E4)	Mean
Surabhi (V1)	2016-17 (L1)	13	13	9	13	12
	2017-18 (L2)	17	17	14	16	16
Mean		15	15	11	15	14
Suraj (V2)	2016-17 (L1)	18	12	9	9	12
	2017-18 (L2)	24	21	20	19	21
Mean		21	16	14	14	16
G.Mean		18	16	13	14	15
	V	L	E	VL	VE	LE
SEd	0.74	0.74	1.04	1.04	1.48	1.48
CD 1%	1.98	1.98	2.8	2.8	3.96	3.96

Table 1.89: Effect of variety, lot and storage period on speed of germination in cotton varieties Surabhi and Suraj

Variety	Seed lot	July 18 (E1)	September 18 (E2)	November 18 (E3)	January 19 (E4)	Mean
Surabhi (V1)	2016-17 (L1)	9.97	7.41	5.37	5.24	7.00
	2017-18 (L2)	10.99	10.13	7.15	7.18	8.86
Mean		10.48	8.77	6.26	6.21	7.93
Suraj (V2)	2016-17 (L1)	5.62	3.54	2.84	4.95	4.24
	2017-18 (L2)	10.43	9.29	7.64	8.02	8.84
Mean		8.03	6.41	5.24	6.48	6.54
G.Mean		9.25	7.59	5.75	6.35	7.23
	V	L	E	VL	VE	LE
SEd	0.20	0.20	0.29	0.29	0.41	0.41
CD 1%	0.55	0.55	0.77	0.77	1.1	1.1

Table 1.90: Effect of variety, lot and storage period on filed emergence (%) in cotton varieties Surabhi and Suraj

Variety	Seed lot	July 18 (E1)	September 18 (E2)	November 18 (E3)	January 19 (E4)	Mean

Surabhi (V1)	2016-17 (L1)	73	70	69	68	70
	2017-18 (L2)	82	81	80	77	80
Mean		77	75	74	72	75
Suraj (V2)	2016-17 (L1)	71	68	65	67	68
	2017-18 (L2)	85	83	81	78	82
Mean		78	75	73	72	75
G.Mean		78	75	74	72	75
	V	L	E	VL	VE	LE
SEd	0.27	0.27	0.39	0.39	0.55	0.55
CD 1%	0.74	0.74	1.04	1.04	1.47	1.47

Table 1.91: Effect of variety, lot and storage period on plant stand (%) in cotton varieties Surabhi and Suraj

Variety	Seed lot	July 18 (E1)	September 18 (E2)	November 18 (E3)	January 19 (E4)	Mean
Surabhi (V1)	2016-17 (L1)	72	69	68	66	69
	2017-18 (L2)	81	80	79	77	79
Mean		76	74	74	71	74
Suraj (V2)	2016-17 (L1)	70	68	65	65	67
	2017-18 (L2)	83	82	81	77	81
Mean		76	75	73	71	74
G.Mean		76	75	73	71	74
	V	L	E	VL	VE	LE
SEd	0.30	0.30	0.42	0.42	0.59	0.59
CD 1%	0.80	0.80	1.13	1.13	1.59	1.59

Centre: PJTSAU, Hyderabad

Experimental details:
Cotton Varieties: ADB 542; Warangal; Ankur seeds; Bayer seeds
Results:

Germination percentage was higher in ADB 542 but low in WGCV 48. Root and shoot length was higher in Bayer superb. In field, plant stand was comparatively low than the germination percentage, but it is higher in ADB 542 and low in WGCV 79

Table 1.92: Seed germination, shoot and root length and plant stand of cotton varieties

Crop/Variety	Germination (%)	Root length (cm)	Shoot length (cm)	Plant stand In field (%)

ADB 542	99	12.5	10.0	72
WGCV 79	90	11.5	11.5	60
WGCV 48	88	11.5	9.5	65
Ankur 3224	95	11.5	11.0	62
Bayer- Super B	97	15.5	13.2	65

Centre: UAS, Dharwad

Experimental details:
Class of seed used: Certified seed
Design: FRBD, Factor (1): Varieties, Factor (2): Seed lots, Replication: Five

Crop	Varieties	Lots	Date of harvest	Date of test	Validity up to	Germination (%)
Cotton	Brahma BG-II	First Lot	17-02-2018	7-04-2018	6-01-2019	75.0
	NCS 145 Bt-2	Second Lot	15-02-2018	18-05-2018	17-11-2018	75.0

Bt-cotton seeds purchased and stored at ambient conditions for ageing, subsequently fresh seeds of same varieties of Bt-cotton seed were purchased and experiment will be continued during 2019.

Crop: Soybean

Centre: ICAR-IARI, New Delhi (Not reported)

Centre: GBPUAT, Pantnagar

Experimental details:

Soybean Variety: Three (PS 1042, PS1225 and PS 1347)
Design: RBD
Month of start: June, 2018

Results:

The experiment was conducted with three varieties of soybean (PS1024, PS1225 and PS1347) for assessment of validity period of seed crop. The seed material used for assessment of validity of different varieties were procured from breeder seed production centre. It was the harvest produce of December, 2017. All the observations were recorded at monthly interval till the germination of the all varieties drop down to IMSCS i.e. 70 %.

In the month of June, 2018, germination per cent of all the varieties was above 70 %. In the month of June, 2018 the maximum germination was recorded in PS1347 variety followed by PS1225 and the lowest in PS1347, however the differences were non-significant. At the end of September, 2018 the germination per cent of variety PS1347 was 70.3 % which was significantly superior to variety PS 1042 (63%) and was at par with PS1225 (69%). The variety PS1347, only maintained germination per cent up to IMSCS level. The germination per cent of variety PS1042 was 63%. The moisture content of all the three varieties ranged from 9.8 to 13.7 % during storage period. The maximum fluctuation in seed moisture content was recorded in the month of Aug., 2018. The Seeding vigour index-I differed significantly in the month of June, 2018 and September, 2018 whereas seedling vigour index –II differed significantly throughout the investigation period except in the month of June, 2018. Field emergence was recorded in the month of July, 2018.The highest field emergence was recorded in variety PS1347 (71.6%) which was at par with PS1225 (71%).The lowest 67.3% field emergence was recorded in variety PS1042. On the basis of storage studies on soybean, it can be summarized that germination per cent of soybean seed can be maintained 11 month of storage period up to IMSC standard. It depends upon the storage environment condition and initial quality of produce.

The fresh harvested produce (December-2018) of soybean varieties (PS 1042, PS1225 and PS 1347) is used for assessment of validity period of soybean seed crop. Observations are being recorded at bimonthly interval. In the month of February, 2019, there was no significant differences were recorded in seed germination and seedling vigour parameters except SVI-II.

Centre: JNKVV, Jabalpur

Experimental details:

Soybean Varieties: Certified seed lot of JS9560 and JS335
Lot No. : JS 9560 (Oct-2017-12-1091-41659-CI)

JS335 (Oct-2017-12-157-32597-CI)
Date of testing: 20/12/2017 (JS9560); 25/12/2017 (JS335)

Results:

Revalidation studies in soybean showed that germination and field emergence significantly reduced well before first revalidation (nine months). Mean germination reduced after nine months across the varieties i.e., 68.1% at 11 months after harvesting and failed to comply with the IMSCS *w.r.t.* germination, confirming the poor storage potential of soybean seeds. Similarly mean field emergence over the varieties was also reduced significantly with 62.66% at eleventh month after testing.

Table 1.93: Effect of Storage Period and Varieties on the Seedling Vigour Index I of soybean varieties

Storage period after testing (SP)	Varieties		Mean (VxSP)
	JS9560	JS335	
Six months SP	1361.66	1414.33	1388.00
Seven months SP	1393.33	1459.33	1426.33
Eight months SP	1282.66	1339.33	1311.00
Nine months SP	1066.33	1066.00	1066.16
Ten months SP	980.33	930.00	955.16
Eleven months SP	736.33	717.66	727.00
Twelve months SP	663.33	626.33	644.83
MEAN (Varieties)	1069.14	1079.00	
CD(p=0.05)	V=83.82	SP=156.82	V x SP=221.78

Table 1.94: Effect of Storage Period and Varieties on the Seedling Vigour Index II of soybean varieties

Storage period after testing (SP)	Varieties		Mean (VxSP)
	JS9560	JS335	
Six months SP	86.83	90.26	88.55
Seven months SP	83.63	87.43	85.53
Eight months SP	75.23	78.56	76.90
Nine months SP	69.75	69.75	69.75
Ten months SP	59.51	56.45	57.98
Eleven months SP	53.10	51.70	52.40
Twelve months SP	45.65	43.11	44.38
MEAN (Varieties)	67.67	68.1	
CD(p=0.05)	V=3.42	SP= 6.40	V x SP=9.05

Table 1.95: Effect of Storage Period and Varieties on the germination percentage of Soybean varieties

Storage period after testing (SP)	Varieties		Mean (VxSP)
	JS9560	JS335	
Six months SP	76.67	79.67	78.17
Seven months SP	76.00	79.67	77.83
Eight months SP	75.33	78.67	77.00
Nine months SP	72.67	72.67	72.67
Ten months SP	70.00	66.33	68.17
Eleven months SP	65.00	63.33	64.17
Twelve months SP	60.33	57.00	58.67
MEAN (Varieties)	70.85	71.04	
CD(p=0.05)	V=1.29	SP=2.42	V x SP=3.42

Table 1.96: Effect of Storage Period and Varieties on the Field emergence of Soybean varieties

Storage period after testing(SP)	Varieties		Mean (VxSP)
	JS9560	JS335	
Six months SP	76.00	77.33	76.66
Eight months SP	72.66	73.00	72.83
Ten months SP	68.66	68.33	68.50
Eleven months SP	63.00	62.33	62.66
MEAN (Varieties)	70.08	70.25	
CD(p=0.05)	V=1.41	SPH=2.00	Vx SP=2.83

Table 1.97: Effect of Storage Period and Varieties on the seed moisture Content (%) of Soybean varieties

Storage period after testing (SP)	Varieties		MEAN (VxSP)
	JS9560	JS335	
Six months SP	12.00	11.89	78.17
Seven months SP	11,56	11.65	77.83
Eight months SP	11.30	11.30	77.00
Nine months SP	10.90	11.25	72.67
Ten months SP	10.50	11.10	68.17
Eleven months SP	10.54	11.00	64.17
Twelve months SP	10.20	10.86	58.67
MEAN (Varieties)	70.85	71.04	
CD(p=0.05)	V=0.52	SP=0.34	V x SP=0.90

Centre: VNMKV, Parbhani

Experimental details:

Name of the varieties: MAUS-162; MAUS- 71

Class of seeds used: Certified

Details of seed lots	06
Lot – 1	08 Months storage after harvest
Lot- 2	10 Months storage after harvest
Lot- 3	12 Months storage after harvest
Lot- 4	20 Months storage after harvest
Lot- 5	22 Months storage after harvest
Lot- 6	24 Months storage after harvest

Date of sowing: 30/06/2018, 29/08/2018 and 30/10/2018

Design: FRBD

Replication: 05

Table 1.98: Metrological data during the experiment:

Month	Rainfall	Temperature		Humidity	
		Max	Min	RH I	RH II
June 2018	325.8	34.1	22.7	83	52
July 2018	193.8	30.3	21.9	87	69
August 2018	274.6	30.1	21.4	87	67
September 2018	8.20	32.6	20.6	82	50
October 2018	00.00	34.7	16.8	74	28
November 2018	00.00	32.7	14.2	75	30
December 2018	00.00	29.2	11.3	79	30

Results:

From the above analysed data, it is found that both varieties *viz.,* MAUS 162 and MAUS 71 stored for 8 months after harvest recorded germination as per seed certification standards (Minimum germination 70%) followed by 10 months and 12months after harvest. But due to climatic conditions, final plant stand was less in 12 months stored seeds. Speed of emergence was also varied as per seed age and field climatic conditions.

Table 1.99: Effect of storage period on seed moisture content and first count in two varieties of soybean

Storage Periods (SP) or Lots (L)	Seed Moisture			First Count		
	Varieties (V)			Varieties (V)		
	V1- MAUS-162	V2- MAUS-71	Mean	V1- MAUS-162	V2- MAUS-71	Mean
8 M/Lot 1	8.04	7.94	7.99	12.20	53.20	32.70
10 M/Lot 2	10.38	10.12	10.25	9.80	32.20	21.00

12 M/Lot3	10.14	10.04	10.09	8.20	19.20	13.70
20 M/Lot 4	7.72	7.82	7.77	44.60	2.60	23.60
22 M/ Lot 5	9.70	10.40	10.05	48.40	51.60	50.00
24 M/Lot 6	9.54	10.16	9.85	29.60	28.40	29.00
Mean	9.25	9.41	GM 9.33	25.46	31.20	GM 28.33
SEm(±)	V=0.03	L=0.05	VxL=0.08	0.83	1.45	VxL=2.05
CD (p=0.05)	0.09	0.16	0.23	2.32	4.02	5.68

Table 1.100: Effect of storage period on germination % and final plant stand % in two varieties of soybean

Storage Periods (SP) or Lots (L)	Germination %			Final Plant Stand %		
	Varieties (V)			Varieties (V)		
	V1- MAUS-162	V2- MAUS-71	Mean	V1- MAUS-162	V2- MAUS-71	Mean
8 M/Lot 1	79.60	91.60	85.60	86.50	82.00	84.25
10 M/Lot 2	79.00	89.80	84.40	74.50	62.50	68.50
12 M/Lot3	75.80	78.00	76.90	18.50	22.50	20.50
20 M/Lot 4	69.80	67.20	68.50	82.00	75.00	78.50
22 M/ Lot 5	70.40	72.40	71.40	64.00	55.50	59.75
24 M/Lot 6	69.80	72.60	71.20	9.50	15.00	12.25
Mean	74.06	78.60	GM 76.33	55.83	52.08	GM 53.95
SEm(±)	V=0.54	L=0.93	VxL=1.32	V=0.59	L=1.02	VxL=1.44
CD (p=0.05)	1.50	2.59	3.67	1.63	2.83	4.00

Table 1.101: Effect of storage period on vigour index-I and vigour index-II in two varieties of soybean

Storage Periods (SP) or Lots (L)	Vigour Index-I			Vigour Index-II		
	Varieties (V)			Varieties (V)		
	V1- MAUS-162	V2- MAUS-71	Mean	V1- MAUS-162	V2- MAUS-71	Mean
8 M/Lot 1	1555.2	2903.4	2229.3	6.33	8.76	7.54
10 M/Lot 2	1823.4	1422.7	1623.0	5.31	7.36	6.34
12 M/Lot3	966.46	1257.7	1112.1	5.86	7.14	6.50
20 M/Lot 4	953.05	1213.7	1083.4	5.05	8.20	6.62
22 M/ Lot 5	930.82	1278.0	1104.4	5.39	7.21	6.30
24 M/Lot 6	763.56	985.64	874.6	4.74	6.99	5.86
Mean	1165.4	1510.2	GM 1337.8	5.45	7.61	GM 6.53
SEm(±)	V=28.84	L=49.95	VxL=70.64	V=0.22	L=0.38	VxL=0.54
CD (p=0.05)	79.81	138.24	195.50	0.61	1.06	1.50

Table 1.102: Effect of storage period on speed of emergence in two varieties of soybean

Storage Periods (SP) or Lots (L)	Speed of Field emergence		
	Varieties (V)		
	V1- MAUS-162	V2- MAUS-71	Mean
8 M/Lot 1	7.48	6.68	7.08
10 M/Lot 2	4.82	4.01	4.42
12 M/Lot3	1.08	1.38	1.23
20 M/Lot 4	6.95	5.64	6.29
22 M/ Lot 5	3.91	3.54	3.72
24 M/Lot 6	0.53	0.92	0.73
Mean	4.13	3.69	GM 3.91
SEm(±)	V=0.07	L=0.13	VxL=0.19
CD (p=0.05)	0.21	0.37	0.53

Centre: MPKV, Rahuri

Experimental details:

Soybean variety (Two): V1: Phule Agrani; V2: DS 228

Seed Lot (Two) : L1: Lot 1; L2: Lot 2

Seed type (Three): S1: Fresh; S2: RVD I$^{st;}$ S3: RVD IInd

Details of seed samples

Sr. No	Crop	Variety	Stage	Lot. No	Date of Harvest	Date of Test	Valid up to	Age of seed on July 2018 from date of test (Month)
1	Soybean	P. Agrani	Breeder	Oct17-13MPKVK-21	Oct-2017	5/3/18	4/12/18	5
2				Oct16-13MPKVK-10	Oct-2016	5/5/17	1/2/18	14
3				Oct15-13MPKVK-44	Oct-2015	16/4/16	15/1/17	27
4	Soybean	P. Agrani	Breeder	Oct17-13MPKVK-18	Oct-2017	14/3/18	13/12/18	4
5				Oct16-13MPKVK-12	Oct-2016	5/5/17	4/2/18	14
6				Oct15-13MPKVK-26	Oct-2015	1/4/16	31/1/17	27
7	Soybean	DS-228	F/S	Nov17-13-1601-1559	Nov-2017	3/3/18	2/12/18	4
8				Oct16-13-1601-2033	Oct-2016	30/3/17	29/12/17	16
9				Nov15-13-1601-1617	Nov-2015	2/4/16	1/1/17	27
10	Soybean	DS-228	F/S	Nov17-13-1601-	Nov-	3/3/18	2/12/18	4

				1559	2017			
11			Breeder	Oct16-13MPKVK - 15	Oct-2016	5/5/17	4/2/18	14
12				Oct15-13MPKVK - 20	Oct-2015	31/3/16	30/12/17	28

Results:

The data on effect of variety, seed lot & seed type on seed quality of soybean are presented in table 1.103 to 1.116

Effect of variety: The seed quality parameters were influenced due to varieties irrespective of seed lot & seed type. The germination percentage of variety DS-228 was the higher (69.50%). The moisture content of the seed was varying as it ranged from (6.91% to 8.95%). The root shoot length of the variety DS-228 was significantly higher (25.85cm). However, seedling dry weight was not influenced significantly.

The variety DS- 228 recorded significantly higher values of vigour index I which ranged from 1814 to 1334, vigour index II (30.47 to 20.99) and field emergence (63.83 to 43.50 %).

Effect of seed lot: The germination and other seed quality parameters were not influenced significantly except moisture content which range from (6.77 to 8.95%).

Effect of Seed types: The fresh seed recorded significantly highest germination (90.75 %) at the age of 5th months from the date of testing. The germination was gradually reduced from 6th month and recorded 73.50% at the age of 11 month from date of testing which is above IMSCS (70%). However, in the RVD I seed the germination was reduced significantly and was (64.75 %) at the age of 14th months and reduced thereafter up to (44.75 %) at the age of 20th month from date of testing.

Interaction effect of variety, lot and seed type: The data on interaction effect of variety, lot and seed type of soybean are not influenced significantly.

Hence, it is essential to use fresh seed of soybean for sowing and the use of revalidated seed is not possible.

Table 1.103: Effect of variety, lot and seed types on germination (%) of soybean

Treatments		July	August	September	October	November	December	January
Variety								
V_1: P. Agrani		66.83 (55.85)	64.17 (54.23)	60.83 (52.01)	56.67 (49.35)	53.33 (47.22)	49.50 (44.80)	46.00 (42.59)
V_2: DS 228		69.50 (57.80)	67.50 (56.29)	64.50 (54.23)	61.50 (52.25)	57.83 (49.89)	54.00 (47.52)	51.17 (45.76)
SEm(±)		0.537	0.420	0.437	0.500	0.419	0.421	0.448
CD(p=0.05)		1.569	1.226	1.275	1.459	1.224	1.229	1.307
Seed lot								
L_1: Lot 1		68.44 (57.06)	66.67 (55.80)	63.50 (53.60)	59.83 (51.24)	56.33 (49.01)	52.50 (46.61)	49.33 (44.61)
L_2: Lot 2		67.89 (56.60)	65.00 (54.72)	61.83 (52.64)	58.33 (50.35)	54.83 (48.11)	51.00 (45.71)	47.83 (43.74)
SEm(±)		0.537	0.420	0.437	0.500	0.419	0.421	0.448
CD(p=0.05)		NS	NS	NS	NS	NS	NS	NS
Seed type								
S_1: Fresh		90.75 (72.49)	89.50 (71.15)	86.50 (68.51)	83.25 (65.91)	80.00 (63.45)	76.25 (60.84)	73.50 (59.02)
S_2: RVD I^{st}		64.75 (53.58)	61.75 (51.81)	59.00 (50.19)	54.75 (47.72)	51.50 (45.84)	47.50 (43.54)	44.75 (41.95)
S_3: RVD II^{nd}		49.00 (44.41)	46.25 (42.83)	42.50 (40.66)	39.25 (38.76)	35.25 (36.39)	31.50 (34.09)	27.50 (31.55)
SEm(±)		0.658	0.514	0.535	0.612	0.514	0.515	0.548
CD(p=0.05)		1.921	1.502	1.561	1.787	1.500	1.505	1.600
Age of seed on July 2018 from date of test (Month)	Fresh	5	6	7	8	9	10	11
	RVD I	14	15	16	17	18	19	20
	RVD II	27	28	29	30	31	32	33

*Figures in parenthesis are arc sin transformed values

Table 1.104: Interaction effect of variety, lot and seed types on germination (%) in soybean

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	91.00 (72.54)	90.00 (71.57)	87.00 (68.87)	84.00 (66.42)	81.00 (64.16)	76.00 (60.67)	73.00 (58.69)
$V_1L_1R_1$	66.67 (54.74)	64.00 (53.13)	61.00 (51.35)	54.00 (47.29)	51.00 (45.57)	48.00 (43.85)	45.00 (42.13)
$V_1L_1R_2$	45.00 (42.13)	43.00 (40.98)	39.00 (38.65)	36.00 (36.87)	32.00 (34.45)	28.00 (31.95)	24.00 (29.33)
$V_1L_2R_0$	88.00 (69.73)	88.00 (69.73)	85.00 (67.21)	81.00 (64.16)	78.00 (62.03)	75.00 (60.00)	72.00 (58.05)
$V_1L_2R_1$	60.33 (50.96)	54.00 (47.29)	51.00 (45.57)	47.00 (43.28)	44.00 (41.55)	40.00 (39.23)	37.00 (37.47)
$V_1L_2R_2$	50.00 (45.00)	46.00 (42.71)	42.00 (40.40)	38.00 (38.06)	34.00 (35.67)	30.00 (33.21)	25.00 (30.00)
$V_2L_1R_0$	92.00 (73.57)	90.00 (71.57)	86.00 (68.03)	83.00 (65.65)	80.00 (63.44)	78.00 (62.03)	75.00 (60.00)
$V_2L_1R_1$	67.00 (54.94)	66.00 (54.33)	63.00 (52.54)	60.00 (50.77)	56.00 (48.45)	51.00 (45.57)	49.00 (44.43)
$V_2L_1R_2$	49.00 (44.43)	47.00 (43.28)	45.00 (42.13)	42.00 (40.40)	38.00 (38.06)	34.00 (35.67)	30.00 (33.21)
$V_2L_2R_0$	92.00 (73.57)	90.00 (71.57)	88.00 (69.73)	85.00 (67.21)	81.00 (64.16)	76.00 (60.67)	74.00 (59.34)
$V_2L_2R_1$	65.00 (53.73)	63.00 (52.54)	61.00 (51.35)	58.00 (49.60)	55.00 (47.87)	51.00 (45.57)	48.00 (43.85)
$V_2L_2R_2$	52.00 (46.15)	49.00 (44.43)	44.00 (41.55)	41.00 (39.82)	37.00 (37.47)	34.00 (35.67)	31.00 (33.83)
SEm(±)	1.316	1.029	1.070	1.224	1.027	1.031	1.096
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in parenthesis are arc sin transformed values

Table 1.105: Effect of variety, lot and seed types on moisture (%) in soybean

Treatments	July	August	September	October	November	December	January
Variety							
V_1: P. Agrani	6.91	8.67	8.80	8.48	8.93	8.78	8.95
V_2: DS 228	6.99	8.14	8.55	8.35	8.70	8.60	8.75
SEm(±)	0.118	0.053	0.024	0.024	0.030	0.021	0.025
CD(p=0.05)	NS	0.155	0.070	0.070	0.088	0.061	0.072
Seed lot							
L_1: Lot 1	6.77	8.26	8.62	8.36	8.95	8.79	8.90
L_2: Lot 2	7.14	8.55	8.73	8.47	8.67	8.59	8.80

SEm(±)		0.118	0.053	0.024	0.024	0.030	0.021	0.025
CD(p=0.05)		0.344	0.155	0.070	0.070	0.088	0.061	0.072
Seed type								
S_1: Fresh		6.83	8.89	8.80	8.59	9.02	8.81	8.96
S_2: RVD I^{st}		7.07	8.22	8.68	8.41	8.84	8.76	8.90
S_3: RVD II^{nd}		6.96	8.10	8.54	8.23	8.58	8.51	8.69
SEm(±)		0.144	0.065	0.029	0.029	0.037	0.026	0.030
CD(p=0.05)		NS	0.190	0.086	0.086	0.107	0.075	0.088
Age of seed on July 2018 from date of test (Month)	Fresh	5	6	7	8	9	10	11
	RVD I	14	15	16	17	18	19	20
	RVD II	27	28	29	30	31	32	33

*Figures in parenthesis are arc sin transformed values

Table 1.106: Interaction effect of variety, lot and seed types on moisture (%) of soybean

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	6.69	8.85	8.90	8.50	9.15	8.87	9.10
$V_1L_1R_1$	7.05	8.40	8.57	8.30	8.97	8.92	9.15
$V_1L_1R_2$	6.76	8.09	8.62	8.10	8.82	8.70	9.05
$V_1L_2R_0$	6.80	9.10	8.93	8.80	9.10	8.69	8.92
$V_1L_2R_1$	7.30	8.64	8.95	8.62	8.92	8.87	8.90
$V_1L_2R_2$	6.89	8.92	8.80	8.53	8.60	8.62	8.60
$V_2L_1R_0$	6.55	8.70	8.70	8.60	9.15	8.97	8.87
$V_2L_1R_1$	6.65	7.90	8.55	8.43	8.95	8.78	8.80
$V_2L_1R_2$	6.89	7.63	8.37	8.20	8.67	8.50	8.47
$V_2L_2R_0$	7.26	8.92	8.68	8.47	8.69	8.70	8.95
$V_2L_2R_1$	7.29	7.95	8.65	8.30	8.50	8.45	8.78
$V_2L_2R_2$	7.29	7.76	8.35	8.10	8.23	8.20	8.65

SEm(±)	0.288	0.130	0.059	0.059	0.073	0.051	0.061
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 1.107: Effect of variety, lot and seed types on root shoot length (cm) in soybean

Treatments		July	August	September	October	November	December	January
Variety								
V_1: P. Agrani		25.05	24.97	25.12	25.10	25.07	25.06	25.04
V_2: DS 228		25.85	25.82	25.69	25.85	25.75	25.76	25.73
SEm(±)		0.194	0.364	0.256	0.242	0.369	0.370	0.284
CD(p=0.05)		0.567	NS	NS	0.706	NS	NS	NS
Seed lot								
L_1: Lot 1		24.73	24.55	24.69	24.67	24.64	24.64	24.62
L_2: Lot 2		26.16	26.24	26.12	26.27	26.19	26.18	26.15
SEm(±)		0.194	0.364	0.256	0.242	0.369	0.370	0.284
CD(p=0.05)		0.567	1.062	0.746	0.706	1.078	1.081	0.829
Seed type								
S_1: Fresh		27.56	27.46	27.69	27.67	27.64	27.62	27.61
S_2: RVD I^{st}		24.95	24.93	24.91	24.91	24.87	24.90	24.86
S_3: RVD II^{nd}		23.84	23.79	23.61	23.84	23.72	23.70	23.68
SEm(±)		0.238	0.446	0.313	0.296	0.452	0.453	0.348
CD(p=0.05)		0.694	1.301	0.914	0.864	1.320	1.324	1.015
Age of seed on July 2018 from date of test (Month)	Fresh	5	6	7	8	9	10	11
	RVD I	14	15	16	17	18	19	20
	RVD II	27	28	29	30	31	32	33

Table 1.108: Interaction effect of variety, lot and seed types on root shoot length (cm) of soybean

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	26.64	25.60	26.53	26.50	26.50	26.51	26.50
$V_1L_1R_1$	23.34	23.30	23.29	23.30	23.25	23.26	23.25
$V_1L_1R_2$	21.92	21.90	21.89	21.85	21.80	21.78	21.80
$V_1L_2R_0$	29.20	29.90	29.88	29.85	29.80	29.78	29.80
$V_1L_2R_1$	25.24	25.20	25.21	25.20	25.18	25.15	25.10
$V_1L_2R_2$	23.94	23.91	23.90	23.90	23.87	23.85	23.80
$V_2L_1R_0$	26.81	26.80	26.81	26.80	26.75	26.71	26.70
$V_2L_1R_1$	25.18	25.18	25.15	25.13	25.10	25.15	25.10
$V_2L_1R_2$	24.53	24.50	24.47	24.45	24.41	24.40	24.35
$V_2L_2R_0$	27.57	27.55	27.53	27.52	27.50	27.48	27.45
$V_2L_2R_1$	26.03	26.03	26.00	26.01	25.97	26.03	26.00
$V_2L_2R_2$	24.98	24.85	24.17	25.16	24.80	24.76	24.75
SEm(±)	0.475	0.891	0.626	0.592	0.905	0.907	0.695
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 1.109: Effect of variety, lot and seed types on seedling dry weight (g) in soybean

Treatments	July	August	September	October	November	December	January
Variety							
V_1: P. Agrani	0.410	0.412	0.417	0.410	0.407	0.398	0.390
V_2: DS 228	0.433	0.425	0.420	0.418	0.408	0.402	0.402
SEm(±)	0.006	0.007	0.006	0.004	0.004	0.005	0.006
CD(p=0.05)	0.017	NS	NS	NS	NS	NS	NS
Seed lot							
L_1: Lot 1	0.415	0.407	0.410	0.413	0.412	0.400	0.395
L_2: Lot 2	0.428	0.430	0.427	0.415	0.403	0.400	0.397
SEm(±)	0.006	0.007	0.006	0.004	0.004	0.005	0.006

CD(p=0.05)		NS	0.021	NS	NS	NS	NS	NS
Seed type								
S_1: Fresh		0.450	0.445	0.443	0.435	0.428	0.428	0.423
S_2: RVD Ist		0.420	0.425	0.418	0.413	0.410	0.400	0.396
S_3: RVD IInd		0.395	0.385	0.395	0.395	0.385	0.373	0.370
SEm(±)		0.007	0.009	0.008	0.005	0.005	0.006	0.007
CD(p=0.05)		0.020	0.025	0.022	0.015	0.015	0.019	0.020
Age of seed on July 2018 from date of test (Month)	Fresh	5	6	7	8	9	10	11
	RVD I	14	15	16	17	18	19	20
	RVD II	27	28	29	30	31	32	33

Table 1.110: Interaction effect of variety, lot and seed types on seedling dry weight (g) of soybean

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	0.430	0.440	0.430	0.420	0.410	0.400	0.400
$V_1L_1R_1$	0.400	0.400	0.410	0.400	0.410	0.390	0.380
$V_1L_1R_2$	0.360	0.350	0.380	0.390	0.400	0.380	0.370
$V_1L_2R_0$	0.450	0.440	0.450	0.440	0.440	0.450	0.440
$V_1L_2R_1$	0.420	0.440	0.420	0.410	0.400	0.390	0.380
$V_1L_2R_2$	0.400	0.400	0.410	0.400	0.380	0.380	0.370
$V_2L_1R_0$	0.470	0.450	0.440	0.450	0.440	0.440	0.440
$V_2L_1R_1$	0.430	0.420	0.410	0.420	0.430	0.420	0.410
$V_2L_1R_2$	0.400	0.380	0.390	0.400	0.380	0.370	0.370
$V_2L_2R_0$	0.450	0.450	0.450	0.430	0.420	0.420	0.410
$V_2L_2R_1$	0.430	0.440	0.430	0.420	0.400	0.400	0.413
$V_2L_2R_2$	0.420	0.410	0.400	0.390	0.380	0.360	0.370
SEm(±)	0.014	0.017	0.015	0.010	0.011	0.013	0.014
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 1.111: Effect of variety, lot and seed types on vigourindex I in soybean

Treatments		July	August	September	October	November	December	January
Variety								
V_1: P. Agrani		1709	1637	1568	1463	1378	1283	1195
V_2: DS 228		1814	1761	1677	1606	1507	1408	1334
SEm(±)		23.30	29.26	21.400	21.09	26.01	28.20	19.22
CD(p=0.05)		68.03	85.43	62.48	61.58	75.94	82.32	56.12
Seed lot								
L_1: Lot 1		1720	1660	1595	1504	1417	1323	1245
L_2: Lot 2		1803	1737	1650	1565	1469	1368	1284
SEm(±)		23.30	29.26	21.40	21.09	26.01	28.20	19.22
CD(p=0.05)		68.03	NS	NS	NS	NS	NS	NS
Seed type								
S_1: Fresh		2499	2457	2394	2302	2209	2104	2028
S_2: RVD I^{st}		1615	1537	1468	1364	1283	1184	1113
S_3: RVD II^{nd}		1171	1103	1005	938	837	748	654
SEm(±)		28.54	35.84	26.21	25.83	31.86	34.53	23.54
CD(p=0.05)		83.32	104.63	76.52	75.42	93.01	100.83	68.73
Age of seed on July 2018 from date of test (Month)	Fresh	5	6	7	8	9	10	11
	RVD I	14	15	16	17	18	19	20
	RVD II	27	28	29	30	31	32	33

Table 1.112: Interaction effect of variety, lot and seed types on vigour index I of soybean

Treatments	July	August	September	October	November	December	January

$V_1L_1R_0$	2424	2303	2310	2223	2144	2016	1934
$V_1L_1R_1$	1557	1490	1418	1256	1188	1118	1044
$V_1L_1R_2$	986	940	853	789	696	612	525
$V_1L_2R_0$	2569	2631	2538	2420	2323	2232	2143
$V_1L_2R_1$	1523	1357	1286	1186	1106	1005	930
$V_1L_2R_2$	1197	1099	1004	906	812	714	594
$V_2L_1R_0$	2466	2414	2308	2227	2142	2081	2004
$V_2L_1R_1$	1686	1663	1583	1506	1408	1282	1230
$V_2L_1R_2$	1203	1153	1100	1025	925	828	732
$V_2L_2R_0$	2536	2478	2421	2337	2226	2087	2029
$V_2L_2R_1$	1692	1640	1586	1507	1429	1330	1245
$V_2L_2R_2$	1299	1219	1064	1031	914	839	765
SEm(±)	57.08	71.68	52.42	51.67	63.71	69.07	47.08
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

Table 1.113 : Effect of variety, lot and seed types on vigour index II in soybean

Treatments	July	August	September	October	November	December	January
Variety							
V_1: P. Agrani	27.84	26.86	25.69	23.52	21.96	20.10	18.38
V_2: DS 228	30.47	29.04	27.42	26.03	23.99	22.16	20.99
SE(±)	0.589	0.480	0.474	0.399	0.388	0.423	0.474
CD(p=0.05)	1.719	1.402	1.385	1.166	1.134	1.236	1.385
Seed lot							
L_1: Lot 1	28.95	27.70	26.40	25.06	23.46	21.36	19.89
L_2: Lot 2	29.36	28.20	26.71	24.49	22.49	20.90	19.48
SE(±)	0.589	0.480	0.474	0.399	0.388	0.423	0.474
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

Seed type								
S_1: Fresh		40.88	39.83	38.26	36.20	34.18	32.59	31.07
S_2: RVD Ist		27.20	26.19	24.64	22.63	21.16	19.05	17.78
S_3: RVD IInd		19.39	17.84	16.77	15.50	13.58	11.76	10.21
SEm(±)		0.721	0.588	0.581	0.489	0.476	0.519	0.581
CD(p=0.05)		2.105	1.718	1.696	1.428	1.389	1.514	1.696
Age of seed on July 2018 from date of test (Month)	Fresh	5	6	7	8	9	10	11
	RVD I	14	15	16	17	18	19	20
	RVD II	27	28	29	30	31	32	33

Table 1.114 : Interaction effect of variety, lot and seed types on vigour index II of soybean

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	39.18	39.57	37.37	35.33	33.22	30.35	29.22
$V_1L_1R_1$	26.70	25.58	25.03	21.65	20.86	18.73	17.05
$V_1L_1R_2$	16.18	15.05	14.80	14.09	12.82	10.71	8.86
$V_1L_2R_0$	39.61	38.78	38.33	35.63	34.30	33.74	31.75
$V_1L_2R_1$	25.35	23.78	21.43	19.28	17.65	15.62	14.11
$V_1L_2R_2$	20.02	18.41	17.18	15.15	12.91	11.45	9.30
$V_2L_1R_0$	43.26	40.48	37.79	37.31	35.18	34.36	33.01
$V_2L_1R_1$	28.81	27.71	25.89	25.17	24.15	21.41	20.08
$V_2L_1R_2$	19.57	17.81	17.53	16.80	14.51	12.61	11.15
$V_2L_2R_0$	41.48	40.47	39.55	36.51	34.03	31.89	30.30
$V_2L_2R_1$	27.95	27.71	26.19	24.40	21.97	20.45	19.89
$V_2L_2R_2$	21.77	20.07	17.58	15.97	14.08	12.27	11.53
SEm(±)	1.442	1.177	1.162	0.978	0.951	1.037	1.135

CD(p=0.05)	NS	NS	NS	NS	NS	3.028	NS

Table 1.115: Effect of variety, lot and seed types on field emergence (%) of soybean

Treatments		July	August	September	October	November	December	January
Variety								
V_1: P. Agrani		60.17 (51.32)	58.33 (50.26)	57.00 (49.35)	51.17 (45.82)	47.33 (43.44)	43.67 (41.18)	40.11 (38.91)
V_2: DS 228		63.83 (53.67)	60.67 (51.75)	58.83 (50.44)	56.33 (48.90)	51.33 (45.81)	49.67 (44.82)	43.50 (41.10)
SEm(±)		0.437	0.834	0.329	0.500	0.478	0.540	0.280
CD(p=0.05)		1.277	NS	0.965	1.459	1.394	1.583	0.821
Seed lot								
L_1: Lot 1		62.33 (52.69)	61.33 (52.12)	57.67 (49.73)	54.33 (47.70)	49.83 (44.91)	48.17 (43.88)	43.50 (41.01)
L_2: Lot 2		61.67 (52.30)	57.67 (49.89)	58.17 (50.06)	53.17 (47.01)	48.83 (44.33)	45.17 (42.11)	40.11 (39.00)
SEm(±)		0.437	0.834	0.329	0.500	0.478	0.540	0.280
CD(p=0.05)		NS	NS	NS	NS	NS	1.583	0.821
Seed type								
S_1: Fresh		83.25 (65.93)	82.75 (65.53)	79.25 (62.93)	76.00 (60.70)	70.75 (57.25)	68.50 (55.86)	63.50 (52.86)
S_2: RVD I^{st}		57.75 (49.45)	53.25 (46.83)	55.75 (48.29)	49.25 (44.55)	45.75 (42.53)	43.75 (41.39)	38.75 (38.44)
S_3: RVD II^{nd}		45.00 (42.11)	42.50 (40.66)	38.75 (38.46)	36.00 (36.83)	31.50 (34.08)	27.75 (31.73)	23.17 (28.71)
SEm(±)		0.536	1.021	0.403	0.612	0.585	0.661	0.343
CD(p=0.05)		1.564	2.982	1.182	1.787	1.708	1.939	1.006
Age of seed on July 2018 from date of test (Month)	Fresh	5	6	7	8	9	10	11
	RVD I	14	15	16	17	18	19	20
	RVD II	27	28	29	30	31	32	33

*Figures in parenthesis are arc sin transformed values

Table 1.116: Interaction effect of variety, lot and seed types on field emergence (%) of soybean

Treatments	July	August	September	October	November	December	January
$V_1L_1R_0$	83.00 (65.65)	83.00 (65.65)	80.00 (63.44)	77.00 (61.34)	72.00 (58.05)	67.00 (54.94)	65.00 (53.73)
$V_1L_1R_1$	60.00 (50.77)	58.00 (49.60)	55.00 (47.87)	48.00 (43.85)	44.00 (41.55)	42.00 (40.40)	39.00 (38.65)
$V_1L_1R_2$	41.00 (39.82)	39.00 (38.65)	35.00 (36.27)	32.00 (34.45)	28.00 (31.95)	25.00 (30.00)	20.00 (26.57)
$V_1L_2R_0$	80.00 (63.44)	80.00 (63.44)	78.00 (62.03)	73.00 (58.69)	70.00 (56.79)	68.00 (55.55)	65.00 (53.73)
$V_1L_2R_1$	51.00 (45.57)	48.00 (43.85)	55.00 (47.87)	42.00 (40.40)	40.00 (39.23)	34.00 (35.67)	31.00 (33.83)
$V_1L_2R_2$	46.00 (42.71)	42.00 (40.40)	39.00 (38.65)	35.00 (36.27)	30.00 (33.21)	26.00 (30.66)	20.67 (27.04)
$V_2L_1R_0$	84.00 (66.42)	84.00 (66.42)	78.00 (62.03)	76.00 (60.67)	71.00 (57.42)	70.00 (56.79)	68.00 (55.55)
$V_2L_1R_1$	61.00 (51.35)	60.00 (50.77)	57.00 (49.02)	54.00 (47.29)	50.00 (45.00)	55.00 (47.87)	43.00 (40.98)
$V_2L_1R_2$	45.00 (42.13)	44.00 (41.55)	41.00 (39.82)	39.00 (38.65)	34.00 (35.67)	30.00 (33.21)	26.00 (30.66)
$V_2L_2R_0$	86.00 (68.03)	84.00 (66.42)	81.00 (64.16)	78.00 (62.03)	70.00 (56.79)	69.00 (56.17)	56.00 (48.45)
$V_2L_2R_1$	59.00 (50.18)	47.00 (43.28)	56.00 (48.45)	53.00 (46.72)	49.00 (44.43)	44.00 (41.55)	42.00 (40.40)
$V_2L_2R_2$	48.00 (43.85)	45.00 (42.13)	40.00 (39.23)	38.00 (38.06)	34.00 (35.67)	30.00 (33.21)	26.00 (30.66)
SEm(±))	1.071	2.043	0.806	1.224	1.170	1.322	0.686
CD5%	NS	NS	2.365	NS	NS	NS	2.012

*Figures in parenthesis are arc sin transformed values

Crop: Soybean
Centre: UAS, Dharwad

Experimental details:

Class of seed used: Certified seed

Crop	Varieties	Lots	Storage Period (Months)	Date of harvest	Date of test	Validity up to	Germination (%)
Soybean	JS-335	Fresh lot	1	29-08-2018	5-09-2018	5-05-2019	89.0
		Aged lot	12	28-08-2017	13-09-2017	14-04-2018	75.0
	DSb-21	Fresh lot	1	17-08-2018	25-08-2018	26-05-2019	91.0
		Aged lot	11	4-09-2017	16-09-2017	17-04-2018	73.0

Results:

Experiment to test the validity period of soybean seed lots was conducted using aged seed lots (12 months old) of cultivar JS-335 and DSb-21 against two freshly harvested seed lots (one month old) of same varieties. From the results, it was observed that there was a gradual reduction in seed quality parameters in both seed lots, performance of fresh seed lots were significantly higher compare to the aged seeds lots. Among the varieties DSB-21 was significantly superior since it recorded significantly higher first count, germination percentage, seedling vigour index – I, II and final plant stand as compare to the JS-335 at the end of storage period.

Table 1.117: Effect of variety, lot and storage period on seed moisture content in soybean

Treatment	Seed moisture content (%) of fresh and aged seed lots in soybean					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: JS-335	14.42	13.84	13.24	10.61	11.40	10.93
V2: DSb-21	14.00	13.44	13.18	11.88	11.82	10.79
SE.m±	**0.02**	**0.01**	**0.03**	**0.04**	**0.02**	**0.02**
CD(p=0.05)	**0.06**	**0.02**	**0.09**	**NS**	**NS**	**NS**
Seed lots						
L1: Fresh seed lot	13.95	13.39	12.89	11.26	11.59	10.83
L2: Aged seed lot	14.47	13.89	13.52	11.22	11.63	10.89
SE.m±	**0.02**	**0.01**	**0.03**	**0.04**	**0.02**	**0.02**
CD(p=0.05)	**0.06**	**0.02**	**NS**	**0.12**	**0.07**	**NS**
Interaction						
V1L1	14.33	13.74	12.94	10.92	11.17	10.89
V1L2	14.51	13.93	13.53	10.29	11.63	10.97
V2L1	13.58	13.03	12.84	11.60	12.00	10.76
V2L2	14.42	13.84	13.51	12.15	11.63	10.81

SE.m±	**0.04**	**0.01**	**0.06**	**0.08**	**0.05**	**0.03**
CD(p=0.05)	**0.13**	**0.04**	**NS**	**0.24**	**0.15**	**0.09**
CV	**1.43**	**0.49**	**2.18**	**3.41**	**2.07**	**1.39**

Table 1.118: Effect of variety, lot and storage period on first count in soybean

Treatment	First count (%) of fresh and aged seed lots in soybean					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: JS-335	41.31	34.01	31.08	30.78	27.89	22.34
V2: DSb-21	42.34	31.58	31.60	31.10	25.01	20.16
SE.m±	**1.35**	**0.10**	**0.10**	**0.03**	**0.08**	**0.07**
CD(p=0.05)	**NS**	**0.30**	**0.31**	**0.08**	**0.25**	**0.22**
Seed lots						
L1: Fresh seed lot	43.65	38.95	34.88	30.56	29.59	27.61
L2: Aged seed lot	39.99	36.64	32.79	29.31	26.32	24.89
SE.m±	**1.35**	**0.10**	**0.10**	**0.03**	**0.08**	**0.07**
CD(p=0.05)	**NS**	**0.30**	**NS**	**0.08**	**0.25**	**NS**
Interaction						
V1L1	38.41	34.17	32.59	30.41	29.35	27.45
V1L2	35.04	33.85	31.56	28.14	26.43	23.24
V2L1	36.35	33.43	34.03	33.48	25.21	22.55
V2L2	32.52	29.72	29.17	28.72	26.82	25.77
SE.m±	**2.69**	**0.20**	**0.20**	**0.05**	**0.16**	**0.14**
CD(p=0.05)	**8.29**	**0.61**	**0.63**	**0.16**	**0.51**	**NS**
CV	**3.24**	**3.01**	**3.25**	**4.85**	**6.12**	**5.76**

Table 1.119: Effect of variety, lot and storage period on seed germination (%) in soybean

Treatment	Seed germination (%) of fresh and aged seed lots in soybean					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: JS-335	83.33	79.16	75.20	71.44	67.87	64.48
V2: DSb-21	77.49	73.62	69.94	66.44	63.12	59.96
SE.m±	**0.21**	**0.20**	**0.19**	**0.18**	**0.17**	**0.17**
CD(p=0.05)	**0.66**	**0.63**	**0.60**	**0.57**	**0.54**	**0.51**
Seed lots						
L1: Fresh seed lot	81.49	77.42	73.55	69.87	66.38	63.06
L2: Aged seed lot	79.32	75.36	71.59	68.01	64.61	61.38
SE.m±	**0.21**	**0.20**	**0.19**	**0.18**	**0.17**	**0.17**
CD(p=0.05)	**0.66**	**0.63**	**0.60**	**0.57**	**0.54**	**0.51**

Interaction						
V1L1	84.45	80.23	76.22	72.41	68.79	65.35
V1L2	82.20	78.09	74.19	70.48	66.95	63.60
V2L1	78.54	74.61	70.88	67.34	63.97	60.77
V2L2	76.45	72.62	68.99	65.54	62.27	59.15
SE.m±	**0.43**	**0.41**	**0.39**	**0.37**	**0.35**	**0.33**
CD(p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
CV	**3.64**	**2.01**	**1.13**	**2.64**	**2.39**	**4.64**

Table 1.120: Effect of variety, lot and storage period on seedling vigour index-I in soybean

Treatment	Seedling vigour index-1 (%) of fresh and aged seed lots in soybean					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: JS-335	3282	1907	2118	1979	1810	972
V2: DSb-21	3307	2004	1991	1866	1750	800
SE.m±	**115**	**6**	**13**	**8**	**3**	**7**
CD(p=0.05)	**NS**	**18**	**NS**	**NS**	**9**	**22**
Seed lots						
L1: Fresh seed lot	3178	2039	2057	1955	1807	1005
L2: Aged seed lot	3411	1871	2052	1891	1753	767
SE.m±	**115**	**6**	**13**	**8**	**3**	**7**
CD(p=0.05)	**NS**	**18**	**NS**	**24**	**9**	**22**
Interaction						
V1L1	2972	2008	2092	1969	1802	1168
V1L2	2930	1806	2144	1989	1818	777
V2L1	2765	2071	2023	1941	1812	842
V2L2	2617	1937	1960	1792	1688	758
SE.m±	**211**	**19**	**17**	**15**	**10**	**10**
CD(p=0.05)	**NS**	**NS**	**53**	**45**	**NS**	**31**
CV	**3.64**	**5.30**	**4.40**	**3.85**	**5.06**	**4.49**

Table 1.121: Effect of variety, lot and storage period on seedling dry weight in soybean

Treatment	Seedling dry weight (mg) of fresh and aged seed lots in soybean					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: JS-335	1.45	1.28	1.23	1.20	1.17	1.09
V2: DSb-21	1.46	1.16	1.11	1.09	1.05	0.98
SE.m±	**0.05**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**
CD(p=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**0.01**

Seed lots						
L1: Fresh seed lot	1.52	1.39	1.29	1.26	1.20	1.19
L2: Aged seed lot	1.48	1.41	1.27	1.24	1.16	1.13
SE.m±	**0.05**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**
CD(p=0.05)	**NS**	**0.02**	**0.01**	**0.01**	**NS**	**0.01**
Interaction						
V1L1	1.34	1.32	1.27	1.24	1.20	1.12
V1L2	1.26	1.24	1.19	1.17	1.13	1.05
V2L1	1.21	1.17	1.13	1.10	1.07	1.03
V2L2	1.13	1.14	1.09	1.07	1.04	0.96
SE.m±	**0.10**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**
CD(p=0.05)	**0.32**	**0.03**	**NS**	**NS**	**NS**	**NS**
CV	**4.16**	**4.45**	**2.88**	**4.66**	**4.17**	**2.43**

Table 1.122: Effect of variety, lot and storage period on seedling vigour index-II in soybean

Treatment	Seedling vigour index-II of fresh and aged seed lots in soybean					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: JS-335	121.59	101.28	92.37	85.99	79.24	70.01
V2: DSb-21	112.98	85.01	77.53	72.18	66.52	58.77
SE.m±	**4.23**	**0.40**	**0.36**	**0.34**	**0.31**	**0.28**
CD(p=0.05)	**NS**	**1.23**	**1.12**	**1.05**	**0.96**	**0.85**
Seed lots						
L1: Fresh seed lot	113.60	95.27	86.89	80.89	74.54	65.86
L2: Aged seed lot	120.97	91.02	83.01	77.29	71.22	62.92
SE.m±	**4.23**	**0.40**	**0.36**	**0.34**	**0.31**	**0.28**
CD(p=0.05)	**NS**	**1.23**	**1.12**	**1.05**	**0.96**	**0.85**
Interaction						
V1L1	114.57	105.79	96.48	89.82	82.77	73.13
V1L2	104.27	96.77	88.26	82.17	75.72	66.89
V2L1	93.48	85.28	77.77	72.41	66.72	58.95
V2L2	89.75	84.75	77.29	71.96	66.31	58.58
SE.m±	**7.79**	**0.56**	**0.41**	**0.50**	**0.45**	**0.32**
CD(p=0.05)	**NS**	**NS**	**1.27**	**1.54**	**NS**	**NS**
CV	**3.19**	**3.21**	**3.33**	**3.90**	**3.13**	**2.39**

Table 1.123: Effect of variety, lot and storage period on speed of germination in soybean

Treatment	Speed of germination of fresh and aged seed lots in soybean					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: JS-335	22.55	20.56	19.96	18.80	15.68	14.10
V2: DSb-21	23.11	21.24	19.25	17.98	14.01	13.00
SE.m±	**0.73**	**0.05**	**0.06**	**0.01**	**0.04**	**0.04**

CD(p=0.05)	**NS**	**0.17**	**0.17**	**0.04**	**0.14**	**0.12**
Seed lots						
L1: Fresh seed lot	23.83	18.36	17.90	17.64	15.00	12.04
L2: Aged seed lot	21.83	17.44	16.31	16.14	14.69	11.06
SE.m±	**0.73**	**0.05**	**0.06**	**0.01**	**0.04**	**0.04**
CD(p=0.05)	**NS**	**0.17**	**NS**	**0.04**	**0.14**	**NS**
Interaction						
V1L1	21.13	18.48	17.23	17.00	16.70	15.23
V1L2	20.97	18.65	16.70	16.60	15.65	12.98
V2L1	19.84	18.25	18.58	18.10	17.51	16.85
V2L2	17.75	16.23	15.93	15.68	14.73	13.15
SE.m±	**1.47**	**0.11**	**0.11**	**0.03**	**0.09**	**0.08**
CD(p=0.05)	**NS**	**0.33**	**0.34**	**0.09**	**0.28**	**NS**
CV	**5.24**	**3.01**	**3.25**	**3.85**	**2.16**	**3.76**

Table 1.124: Effect of variety, lot and storage period on final plant stand in soybean

Treatment Combination	Bimonthly final plant stand of fresh and aged seed lots in sorghum		
	July -18	Sept-18	Nov-18
Varieties			
V1: JS-335	65.44	54.00	48.05
V2: DSb-21	70.06	56.35	55.90
SE.m±	**2.60**	**0.88**	**0.81**
CD(p=0.05)	**NS**	**2.71**	**2.51**
Seed lots			
L1: Fresh seed lot	72.31	60.05	56.05
L2: Aged seed lot	63.19	50.30	47.90
SE.m±	**2.60**	**0.88**	**0.81**
CD(p=0.05)	**7.81**	**2.71**	**2.51**
Interaction			
V1L1	58.25	55.20	53.50
V1L2	57.13	52.80	48.60
V2L1	68.88	64.90	58.60
V2L2	43.75	47.80	53.20
SE.m±	**5.20**	**1.76**	**1.63**
CD(p=0.05)	**16.02**	**NS**	**NS**
CV	**9.06**	**12.92**	**10.65**

Centre (Volunteer): PDKV, Akola

Experimental details:

Three seed lots (L1, L2, L3) of two soybean varieties; V1- JS-335 and V2- JS 20-34 were collected for study. After seed quality testing, all lots were sown to study field performance. Lot 1 of both the varieties showed significantly superior in yield and seed quality parameters (Table 50).

Table 1.125: Laboratory observations of seed quality parameters in soybean before sowing

Treatments	Seed Germination (%)	Moisture content (%)	Radicle emergence (Days)	First count (%)	Seedling dry weight (g)	VI-II
V_1L_1	76 (60.66)	8.9 (17.42)	2.0	74	0.44	33.69
V_1L_2	73 (58.69)	8.7 (17.15)	1.8	72	0.42	30.66
V_1L_3	72 (58.05)	8.5 (16.98)	1.8	69	0.40	28.80
V_2L_1	73 (58.69)	8.9 (17.35)	2.0	70	0.41	29.93
V_2L_2	71 (57.41)	8.8 (17.25)	1.8	68	0.39	27.69
V_2L_3	71 (57.41)	8.5 (16.95)	2.0	69	0.37	26.27
SEm(±)	**0.40**	**0.05**	**0.12**	**0.62**	**0.01**	**1.31**
CD (p=0.05)	**N/S**	**0.18**	**N/S**	**1.99**	**N/S**	**4.14**

Figures in parenthesis are arc sin values



Fig. 1.7: Field view of different seed lots of two soybean varieties at PDKV, Akola

Table 1.126: Effect of different seed lots on field performance in soybean.

Treatments	Field emergence /m²	Days to emergence	Days to flowering	Days to maturity	Number of pods/plant	Grain Yield (g/plant)	Grain yield (q/ha)	100 seed weight (g)
V_1L_1	20.83	7.3	40.00	98.00	24	9.46	18.09	10.62
V_1L_2	20.33	6.6	41.33	99.66	23	9.08	16.85	10.22
V_1L_3	20.00	7.6	42.66	100.00	22	8.8	14.70	10.08
V_2L_1	18.66	8.6	35.33	87.33	27	10.61	18.25	11.36
V_2L_2	18.33	8.3	36.33	88.33	25	10.14	17.61	11.12
V_2L_3	18.00	8.0	37.66	88.66	24	9.9	15.40	11.02
SEm(±)	0.19	0.32	0.41	0.52	0.51	0.03	0.01	0.31
CD (p=0.05)	0.62	1.03	1.31	1.66	1.62	0.11	0.04	N/S

L_1-Lot one, L_2- Lot two, L_3- Lot three Figures in parenthesis are arc sin values.

Crop: Chickpea

Centre: ICAR-IARI, New Delhi (Not reported)

JNKVV, Jabalpur
Experimental details:
Chickpea varieties : Certified seed of JG16 and JG63

Results:

Certified seeds of two varieties of chickpea JG16 and JG63 with three seed lots *viz.,* fresh seed lot , revalidated seed lot-1 and revalidated seed lot-2 were collected from government seed agency in the *rabi* season 2017 with three replication and observation were recorded as per the approved technical programme.

The fresh seed lot of JG 16 seed lot recorded maximum seed yield (18.65 q/ha) followed by revalidated certified seed lots-1 of JG16 (16.23 q/ha) whereas lowest seed yield was registered under revalidated seed lot-2 (14.50 q/ha). Highest germination percentage (94.60%) was observed for fresh seed lot of JG16 followed by revalidated seed lot-1 (88.85%) and lowest was observed in case of revalidated seed lot-2 (88.60%) of JG16. In Case of JG63, highest germination percentage 97.10% was observed for fresh certified seed lot followed by revalidated seed lot-1 (91.82%)and lowest Germination percentage (87.55%) were observed for revalidated seed lot-2. 10% & 22% yield reduction over fresh lot seed yield were observed for revalidated seed lot-1 and revalidated seed lot-2, respectively. It is found from the investigation that there is a possibility to use revalidated seed lot for sowing purpose as it complied with the IMSCS *w.r.t* germination percentage.

Table 1.127: Studies on seed moisture content (%) recorded in the fresh and revalidated seed lots of two chick pea varieties JG16 and JG63

Seed lot Categories	JG 16	JG63	Mean
Fresh seed lot	11.20	10.80	11.00
Revalidated seed lot-I	10.87	10.20	10.53
Revalidated seed lot-II	10.36	10.00	10.18
Mean	10.81	10.33	
CD(p=0.05)	V=0.076	Lot=0.067	V x Lot=0.089

Table 1.128: Studies on first count recorded in the fresh and revalidated seed lots of two chick pea varieties JG16 and JG63

Seed lot Categories	JG 16	JG63	Mean
Fresh seed lot	74.00	79.00	76.50

Revalidated seed lot-I	68.00	72.00	70.00
Revalidated seed lot-II	65.00	70.00	67.50
Mean	69.00	73.66	
CD(p=0.05)	V=2.438	Lot=2.08	V x Lot=3.86

Table 1.129: Studies on Germination Percentage recorded in the fresh and revalidated seed lots of two chick pea varieties JG16 and JG63

Seed lot Categories	JG 16	JG63	Mean
Fresh seed lot	94.60	97.10	95.85
Revalidated seed lot-I	88.85	91.82	90.33
Revalidated seed lot-II	88.60	87.55	88.07
Mean	90.68	92.15	
CD(p=0.05)	V=3.12	Lot=1.45	V x Lot=2.78

Table 1.130: Studies on Seed Vigour index I recorded in the fresh and revalidated seed lots of two chick pea varieties JG16 and JG63

Seed lot Categories	JG 16	JG63	Mean
Fresh seed lot	2680.00	2870.02	2775.01
Revalidated seed lot-I	2239.02	2512.17	2375.595
Revalidated seed lot-II	1736.93	2146.72	1941.825
Mean	2218.65	2509.637	
CD(p=0.05)	V=250.15	Lot=276.63	V x Lot=308.00

Table 1.31: Studies on Seed Vigour index II recorded in the fresh and revalidated seed lots of two chick pea varieties JG16 and JG63

Seed lot Categories	JG 16	JG63	Mean
Fresh seed lot	22.73	27.04	24.88
Revalidated seed lot-I	18.67	24.59	21.63
Revalidated seed lot-II	16.24	22.79	19.51

Mean	19.21	24.80	
CD(p=0.05)	V=2.05	Lot=2.50	V x Lot=2.78

Table 1.132: Studies on field emergence recorded in the fresh and revalidated seed lots of two chick pea varieties JG16 and JG63

Seed lot Categories	JG 16	JG63	Mean
Fresh seed lot	91.20	96.24	93.72
Revalidated seed lot-I	84.54	90.66	87.6
Revalidated seed lot-II	78.52	82.45	80.485
Mean	84.75	89.78	
CD(p=0.05)	V=3.12	Lot=4.12	V x Lot=5.21

Table 1.133: Studies on seed yield(q/ha) recorded in the fresh and revalidated seed lots of two chick pea varieties JG16 and JG63.

Seed lot Categories	JG 16		JG63	Mean
Fresh seed lot	18.65		20.10	19.375
Revalidated seed lot-I	16.23		18.66	17.445
Revalidated seed lot-II	14.50		15.89	15.195
Mean	84.75		89.78	
CD(p0.05)	V=2.10	Lot=1.90	V x Lot=2.89	

Centre: VNMKV, Parbhani (Not reported)

Centre: SKNAU, Jobner (Not reported)

Crop: Chickpea
Centre: CSAUAT, Kanpur

Results (2018-19):-

The experiment has started on four variations of chickpea KGD-1168, Awrodhi, KPG-59 and KWR-108 from old seed lots.

Observations of effect of storage period on seed quality parameters are given in Table 1.134 and 1.135.

Table 1.134: Effect of storage period on seed quality in chickpea varieties

Crop/ Variety	Initial Moisture (%)	Seed Vigour Index-I				Seed Vigour Index-II				Final Plant Stand				Days of (50%) Emergence			
		June-2018	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18
GRAM																	
KGD-1168	9.34	1338	1214	1169	1147	23.63	22.83	17.40	15.67	83.25	79.75	76.75	71.50	46.00	41.25	35.75	30.50
Abrodhi	9.47	1317	1302	1168	1164	22.14	21.84	16.67	16.73	81.75	79.00	77.25	71.75	43.75	40.25	37.50	33.00
KPG-59	9.75	1241	1248	1174	1174	21.60	20.54	17.48	16.77	78.50	74.75	72.75	71.80	43.75	42.00	38.50	34.25
KWR-108	9.5	1237	1238	1165	1102	24.00	22.84	20.73	18.83	81.50	78.50	75.75	71.80	41.00	37.50	33.75	32.00

Table 1.135: Effect of storage period on seed quality in chickpea varieties

Crop/ Variety		First Count %				Germination (%)				10- Seedling length (cm)				10- Seedling Dry wt. (g)			
		June-2018	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18	June-2018	Aug.-18	Oct.-18	Dec.-18
GRAM																	
KGD-1168		64.00	62.00	61.00	61.00	81.50	78.70	72.50	71.25	16.42	16.70	16.13	16.10	0.29	0.27	0.24	0.22
Abrodhi		59.00	59.00	58.00	57.00	82.00	78.00	72.50	72.75	16.07	16.40	16.12	16.00	0.27	0.28	0.23	0.23
KPG-59		69.00	67.00	66.00	64.00	80.00	79.00	76.00	76.25	15.52	15.80	15.45	15.40	0.27	0.26	0.23	0.22
KWR-108		63.00	62.00	63.00	62.00	75.00	73.70	71.50	69.75	16.50	16.80	16.30	15.80	0.32	0.31	0.29	0.27

Centre: RARI, Durgapura, Jaipur (SKNAU, Durgapura)

Experimental details:
Certified fresh and stored seeds of two popular varieties of chickpea i.e. RSG 963 and CSJ 884 were taken for study.

Results:
Results showed that seed moisture content was higher in CSJ 884 in both the lots which declined continuously with advancement of the time. Varietal differences were statistically significant. The first count and germination percentage were also higher in CSJ 884. It was noticed that the germination percentage was reduced by 5-6% in laboratory condition in old seed lots as compared to fresh seed lots. However, it was above the IMSCS standard in both the cultivars Morphological characters like root length, shoot length, seedling length and seedling dry weight were also measured. Significant decline in these characters were observed in old seed lots. Genotypic variations were significant but both the varieties followed almost similar trend. Seed vigour indexes of both the varieties indicated that CSJ 884 sustained better than RSH 963 on account of better seedling length and seedling dry weight (Table 1.136 to 1.138).

Table 1.136: Effect of various storage periods on mean moisture content, first count and germination percentage in two varieties of chickpea

	Moisture content (%)			First count (%)			Germination (%)		
Storage period	**RSG 963**	**CSJ 884**	**Mean**	**RSG 963**	**CSJ 884**	**Mean**	**RSG 963**	**CSJ 884**	**Mean**
6 months	10.33 (18.74)	10.50 (18.91)	10.41 (18.83)	73.00 (58.71)	70.50 (57.12)	71.75 (57.91)	93.00 (74.68)	95.00 (77.11)	94.00 (75.89)
7 months	9.95 (18.39)	10.15 (18.58)	10.05 (18.48)	71.75 (57.91)	69.75 (56.64)	70.75 (57.28)	92.75 (74.47)	94.00 (75.89)	93.38 (75.18)
8 months	9.40 (17.85)	9.53 (17.98)	9.46 (17.92)	70.50 (57.13)	68.50 (55.87)	69.50 (56.50)	92.25 (73.90)	93.00 (74.78)	92.63 (74.34)
9 months	8.78 (17.23)	8.90 (17.36)	8.84 (17.29)	69.25 (56.34)	67.75 (55.40)	68.50 (55.87)	91.00 (72.82)	92.50 (74.15)	91.75 (73.48)
10 months	8.73 (17.18)	8.75 (17.21)	8.74 (17.19)	68.00 (55.57)	66.50 (54.64)	67.25 (55.10)	90.25 (71.99)	91.00 (72.63)	90.63 (72.31)
18 months	8.70 (17.15)	8.73 (17.18)	8.71 (17.17)	67.50 (55.25)	65.25 (53.88)	66.38 (54.57)	89.00 (70.68)	90.25 (71.89)	89.63 (71.28)
19 months	8.68 (17.13)	8.98 (17.43)	8.83 (17.28)	66.25 (54.49)	64.50 (53.43)	65.38 (53.96)	88.00 (69.77)	89.50 (71.12)	88.75 (70.44)
20 months	8.63 (17.08)	8.68 (17.13)	8.65 (17.10)	65.00 (53.73)	64.25 (53.28)	64.63 (53.51)	87.50 (69.34)	88.75 (70.46)	88.13 (69.90)
21 months	8.43 (16.87)	8.60 (17.05)	8.51 (16.96)	64.50 (53.44)	64.00 (53.13)	64.25 (53.29)	86.25 (68.29)	88.00 (69.85)	87.13 (69.07)
22 months	8.23 (16.67)	8.43 (16.87)	8.33 (16.77)	64.00 (53.13)	63.25 (52.69)	63.63 (52.91)	85.50 (67.66)	87.00 (68.91)	86.25 (68.28)
Mean	8.77	9.12		67.98	66.43		89.55	90.90	

	(17.43)	(17.57)		(55.57)	(54.61)		(71.36)	(72.68)	
	V	SP	Vx SP	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	0.02	0.04	0.05	0.22	0.48	0.68	0.33	0.73	1.03
CD(p=0.05)	0.05	0.10	NS	1.61	1.36	NS	0.92	2.06	NS

Table 1.137: Effect of various storage periods on mean root length, shoot length and seedling length in two varieties of chickpea

	Root length (cm)			Shoot length (cm)			Seedling length (cm)		
Storage period	**RSG 963**	**CSJ 884**	**Mean**	**RSG 963**	**CSJ 884**	**Mean**	**RSG 963**	**CSJ 884**	**Mean**
6 months	18.70	18.93	18.81	12.63	12.90	12.76	31.33	31.83	31.58
7 months	18.23	18.25	18.24	12.23	12.40	12.31	30.45	30.65	30.55
8 months	17.75	17.83	17.79	11.70	12.03	11.86	29.45	29.85	29.65
9 months	16.28	16.50	16.39	11.40	11.73	11.56	27.68	28.23	27.95
10 months	15.90	16.13	16.01	10.60	11.20	10.90	26.50	27.33	26.91
18 months	14.53	15.48	15.00	9.98	10.53	10.25	24.50	26.00	25.25
19 months	13.83	14.60	14.21	9.65	10.08	9.86	23.48	24.68	24.08
20 months	13.30	14.13	13.71	9.13	9.55	9.34	22.43	23.68	23.05
21 months	12.15	13.58	12.86	8.58	9.15	8.86	20.73	22.73	21.73
22 months	10.25	11.70	10.98	7.73	8.58	8.15	17.98	20.28	19.13
Mean	15.09	15.71		10.36	10.81		25.45	26.52	
	V	SP	Vx SP	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	0.06	0.13	0.18	0.07	0.15	0.21	0.08	0.19	0.26
CD(p=0.05)	0.16	0.36	0.51	0.19	0.42	NS	0.23	0.53	0.74

Table 1.138: Effect of various storage periods on mean seedling dry weight, seedling index I and seedling index II in two varieties of chickpea

	Seedling dry weight (mg)			Seedling Index-I			Seedling Index-II		
Storage period	**RSG 963**	**CSJ 884**	**Mean**	**RSG 963**	**CSJ 884**	**Mean**	**RSG 963**	**CSJ 884**	**Mean**
6 months	190.00	192.25	191.13	2913	3023	2968	176.70	182.64	179.67
7 months	184.75	188.75	186.75	2824	2881	2853	171.40	177.40	174.40
8 months	178.25	184.25	181.25	2716	2777	2746	164.47	171.38	167.92
9 months	175.00	180.50	177.75	2519	2611	2565	159.35	166.95	163.15
10 months	165.25	177.75	171.50	2392	2486	2439	149.17	161.73	155.45
18 months	162.00	175.00	168.50	2180	2347	2263	144.14	157.94	151.04
19 months	158.25	171.50	164.88	2066	2208	2137	139.28	153.52	146.40
20 months	155.75	168.00	161.88	1963	2102	2032	136.32	149.11	142.71

21 months	153.25	165.50	159.38	1787	2000	1893	132.14	145.67	138.91
22 months	152.25	162.75	157.50	1536	1764	1650	130.14	141.63	135.89
Mean	167.48	176.63		2290	2420		150.31	160.80	
	V	SP	Vx SP	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	0.54	1.21	1.71	11.82	26.42	37.37	0.83	1.85	2.62
CD(p=0.05)	1.53	3.43	4.84	33.43	74.74	NS	2.34	5.24	NS

Field Experiment:

Same varieties (RSG 963 & CSJ 884) were grown in the field on Nov 11, 2018 in randomized block design with four replications under irrigated conditions. It was observed that the seedling emergence and final plant stand in field were higher in fresh seeds as compared to one year old seeds. Both the parameters were again reduced significantly at two month intervals. The trend was almost same in two varieties taken for study (Table 1.139).

Table 1.139: Effect of various storage periods on mean seedling emergence and final plant stand establishment in two varieties of chickpea

	Seedling emergence (%)			**Final plant stand (per m^2)**		
Storage period	**RSG 963**	**CSJ 884**	**Mean**	**RSG 963**	**CSJ 884**	**Mean**
6 months	88.75 (70.47)	91.00 (72.70)	89.88 (71.58)	42.25	44.00	43.13
8 months	87.50 (69.37)	88.50 (70.23)	88.00 (69.80)	38.75	39.75	39.25
18 months	85.50 (67.68)	86.00 (68.03)	85.75 (67.86)	36.25	37.50	36.88
20 months	83.25 (65.92)	84.75 (67.05)	84.00 (66.48)	34.00	35.25	34.63
Mean	86.25 (68.36)	87.56 (69.50)		37.81	39.13	
	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	0.53	0.75	1.06	0.78	1.10	1.55
CD(p=0.05)	NS	2.57	NS	NS	3.20	NS

Centre: ICAR-IARI, New Delhi
Experimental details:

Results:
Experimental Details: One seed lot each of foundation or certified class of two varieties of chickpea were procured from NSC H.O., New Delhi during May, 2017 and stored under ambient conditions at DSST, ICAR-IARI, New Delhi. Details of the experimental material used are mentioned below. The test report in respect of these samples was also obtained from the respective state seed certification agency to know the initial seed quality of the seed lots.

Variety	Class of Seed	Year of harvest	RO/Farm Units
JAKI-9218	Certified Seed	*Rabi* 2016-17	CSF, Raichur
JG-11	Certified Seed	*Rabi* 2016-17	CSF, Raichur

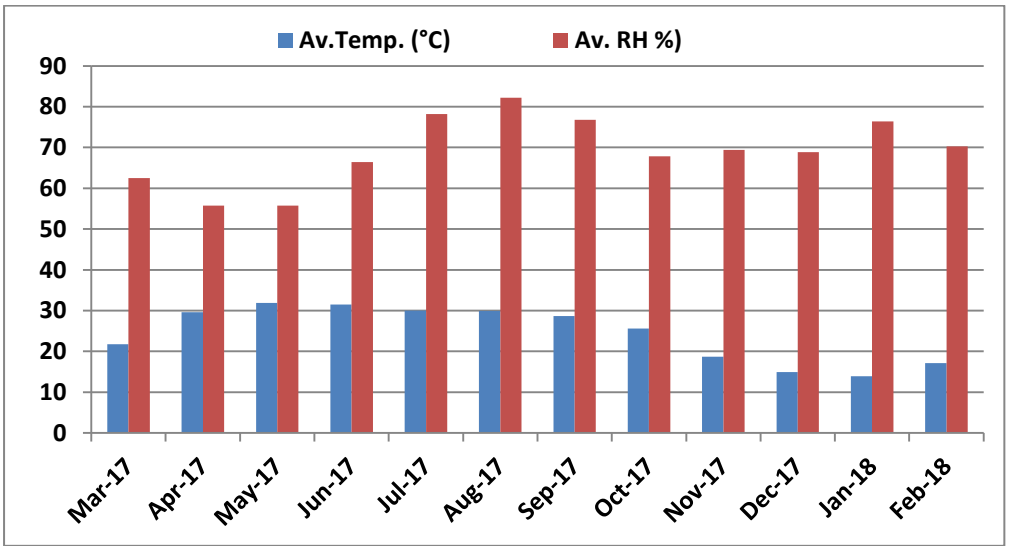


Figure 1.8: Monthly average temperature and relative humidity (RH) under Delhi conditions

Results:

The germination percentage of different seed samples as recoded under the laboratory conditions is presented in the Table 1.140. The seed deterioration and reduction in germination was gradual. Seed moisture content was regulated by the climatic variables, temperature and relative humidity (RH), which ultimately influenced the pattern of seed deterioration during storage. The field emergence studies also indicated similar trends as in germination per cent and there was a progressive decline in the seedling emergence as the storage period increased. The initial germination of chickpea varieties, JAKI 9218 and JG-11 was 91 and 89 per cent, respectively. Both the varieties were able to meet the IMSCS for a period of nine months of storage. It is found that high quality seed lots of chickpea seeds can be stored safely for a period of one year and qualify for revalidation (after nine months).

Table 1.140: Effect of storage period on the germination per cent of different crops

Crop	Variety	Storage period					C.D. (p=0.05)
		Initial germination (date of test by S.C.A.)	0 months	3 months	6 months	9 months	
Chickpea	JAKI-9218	91 (21.09.2017)	94.50 (76.64)	92.75 (74.47)	89.25 (70.86)	88.00 (69.80)	3.82
	JG-11	89** (06.09.2017)	91.25 (72.81)	89.50 (71.14)	86.50 (68.43)	85.25 (67.41)	2.51

**Seeds were procured before the conduct of seed germination test

Crop: Castor
Centre: PJTSAU, Hyderabad

Experimental details:

Castor varities: PCH 111; DCH 519
Results:

In castor, germination percentage varied from 94 to 98 percentage. Germination percentage was higher in DCH 519 and low in PCH 111. Root and shoot length was more in DCH 519. In field, plant stand was comparatively lower than the germination percentage, but it is higher in DCH 519 and low in PCH 111

Table 1.141: Germination (%), shoot and root length, plant stand in two castor varieties

Crop/Variety	Germination (%)	Root length (cm)	Shoot length (cm)	Plant stand In field (%)
PCH-111	94	9.5	8.5	80
DCH 519	98	9.5	9.5	84



Fig 1.9:Castor Plant stand in field

Centre: JAU, Jamnagar

Castor, Variety: GCH-7

Experimental details:

Sr. No.	Particular	Fresh seed (Lot-1) (3 Month of storage) (May-18 to July-18)	Re-validated seed (Lot-2) (15 Month of storage) (May-17 to July-18)
1	Name of variety/ hybrid	GCH-7	GCH-7
2	Class of seeds used	Certified	Certified
3	Storage container	Cloth bags	Cloth bags
4	Date of harvesting	28-3-2018	14-3-2017
5	Date of test (1st Time)	21-5-2018	27-4-2017
6	Valid up to	20-2-2019 (9 months)	26-01-2018 (9 months)
7	Date of test (2nd Time)	--	18-06-2018
8	Valid up to	--	17-12-2018
9	Revalidated period	--	6 months
10	Date of installing Expt.	01-08-2018	01-08-2018

Results:

Table-1.142: **Effect of storage periods and seed lots on different characters of castor.**

Sr. No.	Treatment	**Laboratory Observations**				
		Seed moisture content (%)	First count (%)	Germination (%)	Seed Vigour Index-I (%)	Seed Vigour Index-II (%)
1	L1S1	6.08	69.00	93.75	1916.6	3455.7

2	L1S2	6.10	74.00	88.00	1585.6	2841.4
3	L1S3	6.00	76.25	91.50	1850.9	2953.6
4	L1S4	6.85	77.75	90.50	1731.7	2883.6
5	L1S5	6.90	80.25	90.25	1733.8	2696.2
6	L1S6	5.28	83.00	88.25	1469.9	2334.3
Mean of fresh seed lot		6.20	76.71	90.38	1714.75	2860.80
7	L2S1	6.53	67.75	92.25	1557.8	3149.6
8	L2S2	6.23	67.00	85.00	1403.2	2600.1
9	L2S3	5.93	73.25	86.75	1608.3	2583.1
10	L2S4	6.85	75.75	85.00	1593.4	2500.8
11	L2S5	6.80	77.50	85.50	1543.3	2544.2
12	L2S6	5.23	84.25	87.25	1406.5	2458.5
Mean of re-validate seed lot		6.26	74.25	86.96	1518.75	2639.38
Overall Mean		6.23	75.48	88.67	1616.7	2750.1
SEm(±) for "L"		0.08	0.61	0.65	23.33	41.39
SEm(±) for "S"		0.14	1.06	1.13	40.42	71.69
SEm(±) for "L x S"		0.19	1.50	1.60	57.16	101.39
CD (p=0.05) for "L"		NS	1.75	1.87	66.98	118.82
CD (p=0.05) for "S"		0.39	3.04	3.24	116.01	205.80
CD (p=0.05) for "L x S"		NS	NS	NS	NS	NS

L= Seed lot, S= Month of storage, L1= Fresh seed lot, L2= Re-validated seed lot (Once), S1=0 month of storage, S2=1 month of storage, S3=2 month of storage, S4=3 month of storage, S5=4 month of storage and S6= 5 month of storage.

Table 1.143: **Effect of storage periods and seed lots on different characters of castor.**

Sr. No.	Treatment	Field Observations	
		Speed of Emergence (%)	Final plant stand establishment (%)
1	L1S1	10.34	82.50
2	L1S3	10.11	81.75
3	L1S5	9.11	87.50
Mean of fresh seed lot		9.85	83.92
4	L2S1	8.82	74.75
5	L2S3	8.08	77.50
6	L2S5	8.27	82.50
Mean of re-validate seed lot		8.39	78.25
Overall Mean		9.12	81.08
SEm (±) for "L"		0.10	0.59
SEm(±) for "S"		0.12	0.72
SEm(±) for "L x S"		0.18	1.02
CD (p=0.05) for "L"		0.30	1.78
CD (p=0.05) for "S"		NS	NS
CD (p=0.05) for "L x S"		NS	NS

L= Seed lot, S= Month of storage; L1= Fresh seed lot, L2= Re-validated seed lot (Once); S1=0 month of storage, S3=2 month of storage, S5=4 month of storage.

As per technical programme, the experiment on "to validate the validity periods of certified seeds of castor was installed on 1st August, 2018 to examine the prescribed periods of validity of fresh and revalidated certified seed lots of castor (GCH-7). The fresh and revalidated seeds of GCH-7 were purchased from Gujarat State Seed Corporation Ltd. The results from 01-08-2018 to 20-01-2019 are as under

Seed Lots (L): Effect of seed lots on all the characters under studied was reflected significant except seed moisture content per cent. The fresh and 9 months old (RVD I) seed lots maintained germination in the range of 88.0 % to 93.7 % and 85.0% to 92.2% (above IMSCS) respectively. Similarly significant reduction in field emergence was observed in RVD I seed lot in comparison to fresh seed lot.

Storage periods (S): Effect of storage periods was found significant for all the characters under study except speed of emergence and field emergence. In both seed lots, increase the storage period with decrease the germination, seed vigour index I & II and speed of emergence.

Interaction: Interaction L x S was found non-significant for all the traits under studied.

The results revealed that the fresh and RVD I seed lots successfully maintained germination above IMSCS (mean germination of fresh-90.38% & RVD I-86.96%). Similarly, field emergence in fresh & RVD I seed lots were well above IMSCS (Mean field emergence of fresh-83.92% & RVD I-78.25%).

Centre: AAU, Anand (Not reported)

Centre: ICAR-IIOR, Hyderabad (Not reported)

Centre: SKNAU, Durgapura (Not reported)

Centre: RARI, Durgapura, Jaipur (SKNAU, Durgapura) **(Not reported)**

Crop: Groundnut

Centre: AAU, Anand (Not reported)

Centre: OUAT, Bhubaneswar (Not reported)

Experimental details:

Fresh and 7-month old seeds of two groundnut varieties ICGV-91114 (Devi) and Smruti (OG 52-1) were procured from AICRP on Groundnut, OUAT and Bhubaneswar. The 7-month old seeds were of Kharif 2017 harvest (L_1) and had been tested in December 2017 prior to packing and labelling, while the fresh seeds were of Rabi 2017-18 harvest (L_2) and

had been tested in May 2018 prior to packing and labelling. The storage experiment was initiated in first week of July 2018 and set up in CRD with four replications. Three kilogram seed per replication of each seed lot were stored in inter-woven HDPE bags. The seed lots were tested for moisture content (%), first count (%), germination (%) and vigour indices at monthly interval. The seed lots were also tested in the field at 2 months interval for seedling emergence, speed of emergence and final plant stand establishment at 4 weeks stage. The results up to 6 months storage are presented in Tables 1.144 to 1.150.

Result:

The fresh and 7-month old seeds of the two groundnut varieties had moisture content in the range of 8.08% to 8.13% at the start of storage experiment. Subsequently, there was only slight increase in moisture content over the period of storage. Moisture content of the seeds ranged from 8.75% to 8.83% after 6 months. The mean initial germination of fresh and old seeds was 86.38% and 72.88%, respectively. The germination of *Kharif* 2017 seeds (L_1) declined below MSCS (70%) after two months of storage. However, the Rabi 2017-18 seeds (L_2) still continue to maintain germination above MSCS after 6 months of storage (81.38%). Similar trend of decline in seed vigour parameters was observed over the period of storage, with the *Rabi* 2017-18 seeds (L_2) showing a slower decline in these parameters than the *Kharif* 2017 seeds (L_1). Seedling emergence and final plant stand at 4 weeks stage of Rabi 2017-18 seeds (L_2) were 77.25% and 73.25%, respectively, after 6 months of storage.

Table 1.144: Seed quality parameters of two seed lots of two groundnut varieties at the start of storage experiment

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II
V_1 (ICGV-91114)	8.10	34.50 (35.84)	80.25 (8.95)	25.10	0.072	2039.0	5.83
V_2 (Smruti)	8.09	33.75 (35.38)	79.00 (8.88)	24.73	0.071	1970.7	5.62
SEm(±)	0.045	0.327	0.040	0.228	0.0007	36.81	0.106
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	8.08	26.38 (30.89)	72.88 (8.54)	22.05	0.063	1607.9	4.58
L_2 (Rabi 2017-18 harvest)	8.11	41.88 (40.32)	86.38 (9.29)	27.79	0.079	2401.7	6.86
SEm(±)	0.045	0.327	0.040	0.228	0.0007	36.81	0.106
CD(p=0.05)	NS	1.009	0.124	0.701	0.0020	113.42	0.326
V_1L_1	8.08	26.75 (31.14)	72.75 (8.53)	22.02	0.063	1602.9	4.57
V_1L_2	8.13	42.25 (40.54)	87.75 (9.37)	28.19	0.081	2475.0	7.09
V_2L_1	8.08	26.00 (30.65)	73.00 (8.54)	22.09	0.063	1612.9	4.60
V_2L_2	8.10	41.50 (40.10)	85.00 (9.22)	27.38	0.078	2328.5	6.63
SEm(±)	0.079	0.567	0.070	0.394	0.0011	63.76	0.183
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine / square root transformed values

Table 1.145: Seed quality parameters of two seed lots of two groundnut varieties after one month storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II
V_1 (ICGV-91114)	8.29	33.88 (35.45)	78.63 (62.92)	24.63	0.070	1964.4	5.55
V_2 (Smruti)	8.28	33.25 (35.07)	77.63 (62.06)	24.26	0.069	1903.9	5.39
SEm(±)	0.046	0.328	0.541	0.224	0.0007	36.17	0.106
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	8.25	25.75 (30.48)	70.63 (57.19)	21.39	0.061	1511.2	4.27
L_2 (Rabi 2017-18	8.31	41.38 (40.03)	85.63 (67.79)	27.51	0.078	2357.1	6.66

harvest)							
SEm(±)	0.046	0.328	0.541	0.224	0.0007	36.17	0.106
CD(p=0.05)	NS	1.010	1.668	0.690	0.0021	111.45	0.326
V_1L_1	8.25	26.00 (30.65)	70.50 (57.11)	21.36	0.061	1506.4	4.27
V_1L_2	8.33	41.75 (40.25)	86.75 (68.72)	27.91	0.079	2422.3	6.84
V_2L_1	8.25	25.50 (30.32)	70.75 (57.26)	21.42	0.061	1516.0	4.28
V_2L_2	8.30	41.00 (39.81)	84.50 (66.86)	27.11	0.077	2291.8	6.49
SEm(±)	0.079	0.568	0.937	0.388	0.0012	62.65	0.183
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Table 1.146: Seed quality parameters of two seed lots of two groundnut varieties after two months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II	Seedling emergence (%)	Speed of emergence	Final plant stand (%) at 4 weeks
V_1 (ICGV-91114)	8.43	33.13 (34.98)	77.13 (61.87)	23.92	0.068	1875.8	5.31	72.63 (58.79)	13.45	68.38 (56.02)
V_2 (Smruti)	8.41	32.63 (34.67)	76.00 (60.97)	23.57	0.067	1814.3	5.13	71.50 (57.95)	13.23	67.25 (55.24)
SEm(±)	0.047	0.331	0.521	0.218	0.0006	34.78	0.095	0.464	0.125	0.384
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	8.40	24.88 (29.91)	68.50 (55.86)	20.53	0.058	1407.1	3.98	63.63 (52.91)	10.25	59.38 (50.41)
L_2 (Rabi 2017-18 harvest)	8.44	40.88 (39.74)	84.63 (66.98)	26.96	0.076	2283.0	6.46	80.50 (63.83)	16.42	76.25 (60.86)
SEm(±)	0.047	0.331	0.521	0.218	0.0006	34.78	0.095	0.464	0.125	0.384
CD(p=0.05)	NS	1.019	1.605	0.671	0.0018	107.16	0.292	1.428	0.385	1.182
V_1L_1	8.40	25.00 (29.99)	68.50 (55.87)	20.50	0.058	1404.9	3.98	63.50 (52.84)	10.24	59.25 (50.33)
V_1L_2	8.45	41.25	85.75	27.35	0.078	2346.6	6.65	81.75	16.66	77.50

		(39.96)	(67.88)					(64.75)		(61.70)
V_2L_1	8.40	24.75 (29.82)	68.50 (55.86)	20.57	0.058	1409.2	3.99	63.75 (52.98)	10.27	59.50 (50.48)
V_2L_2	8.43	40.50 (39.52)	83.50 (66.07)	26.57	0.075	2219.4	6.27	79.25 (62.92)	16.18	75.00 (60.01)
SEm(±)	0.081	0.573	0.902	0.377	0.0010	60.24	0.164	0.803	0.216	0.665
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Table 1.147: Seed quality parameters of two seed lots of two groundnut varieties after three months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II
V_1 (ICGV-91114)	8.60	32.75 (34.74)	75.63 (60.85)	23.24	0.066	1791.1	5.06
V_2 (Smruti)	8.59	32.00 (34.27)	74.63 (60.06)	22.89	0.065	1734.3	4.92
SEm(±)	0.045	0.331	0.496	0.212	0.0007	33.26	0.098
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	8.58	24.13 (29.41)	66.50 (54.64)	19.71	0.056	1311.4	3.70
L_2 (Rabi 2017-18 harvest)	8.61	40.63 (39.59)	83.75 (66.28)	26.42	0.075	2214.0	6.28
SEm(±)	0.045	0.331	0.496	0.212	0.0007	33.26	0.098
CD(p=0.05)	NS	1.020	1.529	0.654	0.0020	102.48	0.302
V_1L_1	8.58	24.50 (29.66)	66.50 (54.64)	19.68	0.056	1309.6	3.69
V_1L_2	8.63	41.00 (39.81)	84.75 (67.07)	26.80	0.076	2272.6	6.42
V_2L_1	8.58	23.75 (29.16)	66.50 (54.64)	19.74	0.056	1313.2	3.71
V_2L_2	8.60	40.25 (39.38)	82.75 (65.49)	26.04	0.074	2155.5	6.13
SEm(±)	0.079	0.573	0.859	0.368	0.0011	57.60	0.170
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Table 1.148: Seed quality parameters of two seed lots of two groundnut varieties after four months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II	Seedling emergence (%)	Speed of emergence	Final plant stand (%) at 4 weeks
V_1 (ICGV-91114)	8.70	32.00 (34.26)	74.25 (59.95)	22.58	0.064	1713.5	4.86	69.75 (56.96)	12.98	65.75 (54.42)
V_2 (Smruti)	8.69	31.38 (33.88)	73.13 (59.09)	22.23	0.063	1654.7	4.67	68.88 (56.32)	12.76	64.88 (53.83)
SEm(±)	0.045	0.307	0.492	0.206	0.0006	32.35	0.092	0.462	0.121	0.392
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	8.68	23.38 (28.91)	64.50 (53.43)	18.92	0.054	1221.0	3.45	59.88 (50.70)	9.65	55.63 (48.23)
L_2 (Rabi 2017-18 harvest)	8.71	40.00 (39.23)	82.88 (65.61)	25.89	0.073	2147.1	6.08	78.75 (62.58)	16.09	75.00 (60.02)
SEm(±)	0.045	0.307	0.492	0.206	0.0006	32.35	0.092	0.462	0.121	0.392
CD(P=0.05)	NS	0.945	1.515	0.636	0.0019	99.67	0.283	1.424	0.373	1.209
V_1L_1	8.68	23.50 (28.99)	64.50 (53.43)	18.89	0.054	1219.4	3.45	59.75 (50.63)	9.63	55.50 (48.16)
V_1L_2	8.73	40.50 (39.52)	84.00 (66.47)	26.26	0.075	2207.5	6.26	79.75 (63.29)	16.33	76.00 (60.68)
V_2L_1	8.68	23.25 (28.82)	64.50 (53.43)	18.95	0.054	1222.7	3.45	60.00 (50.77)	9.66	55.75 (48.30)
V_2L_2	8.70	39.50 (38.94)	81.75 (64.74)	25.51	0.072	2086.7	5.89	77.75 (61.88)	15.86	74.00 (59.35)
SEm(±)	0.079	0.531	0.852	0.358	0.0010	56.03	0.159	0.801	0.210	0.679
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Table 1.149: Seed quality parameters of two seed lots of two groundnut varieties after five months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II
V_1 (ICGV-91114)	8.74	31.63 (34.01)	73.13 (59.26)	21.94	0.062	1645.8	4.64
V_2 (Smruti)	8.73	30.75 (33.46)	71.75 (58.21)	21.60	0.061	1581.8	4.49
SEm(±)	0.057	0.314	0.457	0.200	0.0006	30.33	0.089
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS
L_1 (Kharif 2017 harvest)	8.73	22.63 (28.39)	62.50 (52.24)	18.17	0.051	1136.0	3.20
L_2 (Rabi 2017-18 harvest)	8.74	39.75 (39.08)	82.38 (65.23)	25.37	0.072	2091.6	5.93
SEm(±)	0.057	0.314	0.457	0.200	0.0006	30.33	0.089
CD(p=0.05)	NS	0.966	1.409	0.617	0.0019	93.46	0.276
V_1L_1	8.73	23.00 (28.65)	62.50 (52.24)	18.14	0.051	1134.4	3.19
V_1L_2	8.75	40.25 (39.37)	83.75 (66.27)	25.74	0.073	2157.2	6.10
V_2L_1	8.73	22.25 (28.14)	62.50 (52.24)	18.20	0.052	1137.6	3.22
V_2L_2	8.73	39.25 (38.79)	81.00 (64.18)	25.00	0.071	2026.1	5.75
SEm(±)	0.099	0.543	0.792	0.347	0.0011	52.54	0.155
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Table 1.150: Seed quality parameters of two seed lots of two groundnut varieties after six months storage

Treatments	Moisture content (%)	First count (%)	Germination (%)	Seedling length (cm)	Seedling dry weight (g)	SVI-I	SVI-II	Seedling emergence (%)	Speed of emergence	Final plant stand (%) at 4 weeks
V_1 (ICGV-91114)	8.79	31.00 (33.61)	71.63 (58.28)	21.32	0.060	1571.4	4.44	67.38 (55.49)	12.53	63.38 (52.99)
V_2 (Smruti)	8.78	30.38 (33.22)	70.25 (57.26)	20.98	0.059	1509.0	4.26	66.25 (54.71)	12.32	62.25 (52.25)
SEm(±)	0.046	0.302	0.448	0.195	0.0006	29.33	0.083	0.386	0.118	0.354
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
L_1(Kharif 2017 harvest)	8.75	22.00 (27.96)	60.50 (51.06)	17.44	0.049	1055.7	2.98	56.38 (48.66)	9.08	52.38 (46.36)
L_2 (Rabi 2017-18 harvest)	8.81	39.38 (38.86)	81.38 (64.48)	24.86	0.070	2024.7	5.72	77.25 (61.54)	15.77	73.25 (58.87)
SEm(±)	0.046	0.302	0.448	0.195	0.0006	29.33	0.083	0.386	0.118	0.354
CD(p=0.05)	NS	0.931	1.381	0.600	0.0017	90.37	0.257	1.190	0.362	1.092
V_1L_1	8.75	22.25 (28.14)	60.50 (51.06)	17.41	0.049	1054.2	2.97	56.25 (48.59)	9.06	52.25 (46.29)
V_1L_2	8.83	39.75 (39.08)	82.75 (65.50)	25.22	0.072	2088.6	5.92	78.50 (62.39)	16.00	74.50 (59.68)
V_2L_1	8.75	21.75 (27.79)	60.50 (51.06)	17.47	0.050	1057.2	3.00	56.50 (48.74)	9.09	52.50 (46.43)

V_2L_2	8.80	39.00 (38.64)	80.00 (63.45)	24.50	0.069	1960.9	5.52	76.00 (60.68)	15.55	72.00 (58.06)
SEm(±)	0.079	0.524	0.776	0.337	0.0010	50.80	0.144	0.669	0.204	0.614
CD(p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*Figures in the parenthesis are arc sine transformed values

Centre: JAU, Jamnagar
Experimental details:

Results:

Groundnut, variety: GG-5

Experimental details:

Sr. No.	Particular	**Fresh seed (Lot-1)** (1 Month of storage) (Dec.-18)	**Re-validated seed (Lot-2)** (12 Month of storage) (Dec-17 to Dec.-18)
1	Name of variety/ hybrid	GG-5	GG-5
2	Class of seeds used	Breeder	Breeder
3	Seed produced during	*Kharif*-2017	*Kharif*-2018
4	Storage container	Gunny bags	Gunny bags
5	Date of harvesting	20-11-2018	12-11-2017
6	Date of installing Expt.	01-01-2019	01-01-2019

Results:

As per technical programme, the experiment on "to validate the validity periods of certified seeds of groundnut is installed on 1st January, 2019. Any classes of revalidate or stored seeds of groundnut were not available during July-August, 2018; hence, the experiment on groundnut installed during January, 2019. The breeder seed of GG-5 was produced at our centre during *kharif*-2017, which is stored in gunny bags in our storage godown and used as re-validate seed lot in this experiment. The fresh breeder seeds GG-5 which is produced at our centre during *kharif*-2018, used as fresh seed lot. The experiment on groundnut is in continuing at our centre.

Centre: MPKV, Rahuri (Not reported)

Centre: UAS, Bengaluru
Experimental details:

Class of seed used: Certified seed

Technical details:

Design: FRBD, Factor (1): Varieties; Factor (2) : Seed lots, Replication: Five

Crop	**Varieties**	**Lots**	**Storage Period (Months)**	**Date of harvest**	**Date of test**	**Validity up to**	**Germination (%)**
Groundnut	TAG-24	Fresh	5	9-02-2018	5-03-2018	6-12-2018	98.0

		lot					
		Aged lot	16	10- 03-2017	13-05-2017	14-02-2017	73.0
	G2-52	Fresh lot	5	03-02-2018	19-02-2018	20-11-2018	93.0
		Aged lot	13	3-04-2017	15-05-2017	15-01-2018	70.0

Results:

The experiment on revalidation of Groundnut seed lots were conducted using aged seed lots (13-16 months old) of cultivar TAG-24 and G2-52 against two freshly harvested seed lots (5 month old) of similar varieties. From the results, it was observed that overall performance of fresh seed lots were significantly higher compare to the aged seeds lots. Among the varieties G2-52 was significantly superior since it recorded significantly higher first count, germination percentage, seedling vigour index –I & II and final plant stand as compared to the TAG-24 during entire period of testing.

Table 1.151: Seed moisture content (%) of fresh and aged seed lots in Groundnut

Treatment	Seed moisture content (%) of fresh and aged seed lots in Groundnut					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: TAG-24	16.43	12.24	12.21	12.10	12.16	11.72
V2: G2-52	15.82	11.84	11.61	11.38	11.34	10.62
SEm(±)	0.03	0.04	0.06	0.08	0.09	0.08
CD(p=0.05)	0.10	0.13	0.20	0.24	0.28	0.26
Seed lots						
L1: Fresh seed lot	14.90	10.94	10.95	10.52	10.55	9.88
L2: Aged seed lot	17.35	13.14	12.86	12.97	12.95	12.46
SEm(±)	0.03	0.04	NS	NS	NS	0.08
CD(p=0.05)	0.10	0.13	0.20	0.24	0.28	0.26
Interaction						
V1L1	12.04	11.06	11.46	10.91	11.01	10.31
V1L2	14.10	13.43	12.95	13.29	13.31	13.13
V2L1	11.71	10.83	10.44	10.12	10.09	9.45
V2L2	13.55	12.85	12.77	12.64	12.60	11.80
SEm(±)	0.07	0.08	0.13	0.16	0.18	0.17
CD(p=0.05)	NS	NS	NS	NS	NS	NS
CV	2.58	3.41	5.38	6.66	7.78	7.55

Table 1.152: First count (%) of fresh and aged seed lots in Groundnut

Treatment Combination	First count (%) of fresh and aged seed lots in Groundnut					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18

Varieties						
V1: TAG-24	61.55	45.83	44.63	44.34	43.17	20.04
V2: G2-52	54.36	46.53	43.17	43.55	43.21	17.04
SEm(±)	0.12	0.15	0.17	0.08	0.10	0.18
CD(p=0.05)	0.36	0.46	0.51	0.25	0.32	0.56
Seed lots						
L1: Fresh seed lot	61.24	48.74	46.90	47.73	46.43	23.29
L2: Aged seed lot	54.68	43.62	40.90	40.17	39.95	13.78
SEm(±)	0.12	0.15	0.17	0.08	0.10	0.18
CD(p=0.05)	0.36	NS	NS	0.25	NS	0.56
Interaction						
V1L1	53.42	46.90	47.66	48.42	46.40	23.89
V1L2	45.67	44.76	41.59	40.27	39.95	16.18
V2L1	44.72	50.57	46.15	47.03	46.46	22.69
V2L2	42.19	42.48	40.20	40.08	39.95	11.38
SEm(±)	0.23	0.30	0.33	0.16	0.21	0.36
CD(p=0.05)	0.71	0.93	NS	NS	NS	1.11
CV	2.50	3.26	3.76	1.84	2.39	6.72

Table 1.153: Seed germination (%) of fresh and aged seed lots in Groundnut

Treatment Combination	Seed germination (%) of fresh and aged seed lots in Groundnut					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: TAG-24	77.90	72.50	70.60	70.15	68.30	31.70
V2: G2-52	68.80	73.60	68.30	68.90	68.35	26.95
SEm(±)	0.18	0.24	0.26	0.13	0.16	0.29
CD(p=0.05)	0.56	0.73	0.81	0.39	0.50	0.88
Seed lots						
L1: Fresh seed lot	77.50	77.10	74.20	75.50	73.45	36.85
L2: Aged seed lot	69.20	69.00	64.70	63.55	63.20	21.80
SEm(±)	0.18	0.24	0.26	0.13	0.16	0.29
CD(p=0.05)	0.56	NS	NS	0.39	NS	0.88
Interaction						
V1L1	83.60	74.20	75.40	76.60	73.40	37.80
V1L2	72.20	70.80	65.80	63.70	63.20	25.60
V2L1	71.40	80.00	73.00	74.40	73.50	35.90
V2L2	66.20	67.20	63.60	63.40	63.20	18.00
SEm(±)	0.37	0.48	0.52	0.26	0.33	0.57
CD(p=0.05)	1.13	1.47	NS	NS	NS	1.76
CV	2.50	3.26	3.76	1.84	2.39	4.72

Table 1.154: Seedling vigour index-I of fresh and aged seed lots in Groundnut

Treatment Combination	Seedling vigour index-I of fresh and aged seed lots in Groundnut					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: TAG-24	2405	1512	1547	1495	1447	547
V2: G2-52	2305	1871	1488	1484	1459	455
SEm(±)	9	13	9	6	6	7
CD(p=0.05)	27	NS	26	20	18	21
Seed lots						
L1: Fresh seed lot	2487	1728	1659	1669	1574	679
L2: Aged seed lot	2223	1655	1376	1311	1332	324
SEm(±)	9	13	9	6	6	7
CD(p=0.05)	NS	39	NS	NS	NS	21
Interaction						
V1L1	2126	1437	1646	1642	1511	703
V1L2	1781	1587	1448	1349	1384	392
V2L1	1880	2018	1672	1695	1638	655
V2L2	1774	1723	1303	1274	1281	256
SEm(±)	18	25	17	13	12	14
CD(p=0.05)	54	78	53	39	36	NS
CV	4.65	7.47	5.65	4.26	3.97	3.69

Table 1.155: Seedling dry weight (mg) of fresh and aged seed lots in Groundnut

Treatment Combination	Seedling dry weight (mg) of fresh and aged seed lots in Groundnut					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: TAG-24	4.75	3.78	3.69	3.67	3.51	3.49
V2: G2-52	4.85	4.00	3.68	3.75	3.81	3.67
SEm(±)	0.02	0.03	0.01	0.01	0.01	0.02
CD(p=0.05)	0.06	NS	NS	0.04	0.04	0.06
Seed lots						
L1: Fresh seed lot	4.95	3.87	3.72	3.83	3.78	3.73
L2: Aged seed lot	4.65	3.90	3.65	3.60	3.55	3.43
SEm(±)	0.02	0.03	0.01	0.01	0.01	0.02
CD(p=0.05)	NS	NS	NS	NS	0.04	NS
Interaction						
V1L1	4.02	3.69	3.62	3.75	3.65	3.59
V1L2	3.54	3.87	3.76	3.59	3.37	3.40
V2L1	3.85	4.06	3.82	3.90	3.91	3.88
V2L2	3.96	3.94	3.54	3.60	3.72	3.46
SEm(±)	0.04	0.06	0.02	0.03	0.03	0.04
CD(p=0.05)	0.11	NS	0.08	NS	NS	NS
CV	4.85	7.57	3.32	3.86	3.54	5.42

Table 1.156: Seedling vigour index-II of fresh and aged seed lots in Groundnut

Treatment Combination	Seedling vigour index-II of fresh and aged seed lots in Groundnut					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: TAG-24	371.81	273.67	260.21	258.14	240.45	119.38
V2: G2-52	333.80	294.62	251.93	259.29	261.12	102.91
SEm(±)	1.71	2.12	1.29	1.17	1.37	1.08
CD(p=0.05)	5.26	6.55	3.96	3.60	4.22	3.34
Seed lots						
L1: Fresh seed lot	384.21	299.36	275.83	288.80	277.41	138.75
L2: Aged seed lot	321.41	268.94	236.31	228.63	224.16	83.55
SEm(±)	1.71	2.12	1.29	1.17	1.37	1.08
CD(p=0.05)	5.26	6.55	NS	NS	4.22	3.34
Interaction						
V1L1	339.99	273.59	272.85	287.20	267.74	138.28
V1L2	255.53	273.75	247.57	229.08	213.17	100.49
V2L1	271.97	325.12	278.81	290.40	287.08	139.23
V2L2	264.58	264.13	225.05	228.18	235.16	66.60
SEm(±)	3.42	4.25	2.57	2.34	2.74	2.17
CD(p=0.05)	10.53	13.09	7.92	NS	NS	6.67
CV	6.05	7.48	5.02	4.52	5.46	4.74

Table 1.157: Speed of germination (%) of fresh and aged seed lots in Groundnut

Treatment Combination	Speed of germination (%) of fresh and aged seed lots in Groundnut					
	July -18	Aug-18	Sept-18	Oct-18	Nov-18	Dec-18
Varieties						
V1: TAG-24	44.43	33.08	32.22	32.01	31.17	14.47
V2: G2-52	39.24	33.59	31.17	31.44	31.19	12.30
SEm(±)	0.08	0.11	0.12	0.06	0.07	0.13
CD(p=0.05)	0.26	0.34	0.37	0.18	0.23	0.40
Seed lots						
L1: Fresh seed lot	44.21	35.18	33.86	34.45	33.52	16.82
L2: Aged seed lot	39.47	31.49	29.52	29.00	28.84	9.95
SEm(±)	0.08	0.11	0.12	0.06	0.07	0.13
CD(p=0.05)	0.26	NS	NS	0.18	NS	0.40
Interaction						
V1L1	38.56	33.86	34.41	34.95	33.49	17.25
V1L2	32.97	32.31	30.03	29.07	28.84	11.68
V2L1	32.28	36.51	33.31	33.95	33.54	16.38
V2L2	30.46	30.66	29.02	28.93	28.84	8.21
SEm(±)	0.17	0.22	0.24	0.12	0.15	0.26
CD(p=0.05)	0.51	0.67	NS	NS	NS	0.80
CV	2.50	3.26	3.76	1.84	2.39	5.72

Table 1.158: Bimonthly final plant stand of fresh and aged seed lots in Groundnut

Treatment Combination	Bimonthly final plant stand of fresh and aged seed lots in Groundnut		
	July -18	Sept-18	Nov-18
Varieties			
V1: TAG-24	83.19	62.20	54.90
V2: G2-52	70.13	44.90	52.70
SEm(±)	0.50	0.52	0.51
CD(p=0.05)	1.55	1.60	1.58
Seed lots			
L1: Fresh seed lot	93.75	67.10	64.60
L2: Aged seed lot	59.56	40.00	43.00
SEm(±)	0.50	0.52	0.51
CD(p=0.05)	1.55	1.60	NS
Interaction			
V1L1	70.75	66.80	60.40
V1L2	64.13	57.60	49.40
V2L1	78.75	67.40	68.80
V2L2	31.50	22.40	36.60
SEm(±)	1.01	1.04	1.02
CD(p=0.05)	3.10	3.20	3.15
CV	8.19	9.71	9.51

Centre: RARI, Durgapura, Jaipur (SKNAU, Durgapura)

Experimental details:

The experiment was conducted with an objective to study the vigour status of seeds for consideration to revalidate seed lots for sowing purpose. Fresh and one year old certified seeds of two popular Groundnut varieties namely RG 425 and RG 510 were collected and grown in laboratory as well as field conditions.

Results:

Results showed that the moisture content was in general higher in fresh seeds as compared to the older seeds. The values were decreased with the advancement of storage period. These seeds were grown in germination papers under controlled conditions for seven days and various parameters were recorded. It was noticed that the first count and germination percentage were maximum in 6 months old seeds (fresh lots) and 18 months old seeds (old lot). The magnitude of decline was higher in fresh as compared to old seed lots. Statistical variations were significant only for genotype and storage period. The root length and shoot length were measured in seven days old seedlings and significant variations were observed for genotype, storage period and their interaction (Table 3). Shoot dry weight was also observed and seedling indexes were calculated (Table 4). Overall, it was found that in fresh lot 6 months old seeds were found better and in old seed lot 18 months

old seeds were found better as compared to other lots. Among varieties RG 510 performed better over RG 425 in most of the conditions.

Field Experiments:

Same groundnut varieties (RG 425 & RG 510) were grown in the field on July 13, 2018 in plots with size 2x3 m^2. The experiment was laid down in a randomized block design with four replications under irrigated conditions. Results showed that the field emergence was higher in fresh seeds as compared to one year old seeds. The seedling emergence and plant stand were found to vary significantly among fresh and one year old seeds grown at two months intervals. The trend was almost similar in both the varieties; however, the variety RG 510 was better over RG 425 for both the parameters (Table 5).

Table 1.159: Effect of storage periods on mean moisture content, first count and germination percentage in two varieties of groundnut

	Moisture content (%)			First count (%)			Germination (%)		
Storage period	**RG 425**	**RG 510**	**Mean**	**RG 425**	**RG 510**	**Mean**	**RG 425**	**RG 510**	**Mean**
6 months	10.63 (19.02)	10.53 (18.93)	10.58 (18.98)	72.25 (58.22)	70.25 (56.95)	71.25 (57.58)	89.50 (71.16)	87.50 (69.31)	88.50 (70.24)
7 months	10.48 (18.88)	10.30 (18.72)	10.39 (18.80)	69.75 (55.71)	68.25 (55.71)	69.00 (56.17)	88.00 (69.77)	86.75 (68.68)	87.38 (69.23)
8 months	10.33 (18.74)	10.08 (18.51)	10.20 (18.62)	69.75 (56.64)	66.75 (54.79)	68.25 (55.71)	86.50 (68.46)	85.25 (67.49)	85.88 (67.98)
9 months	10.25 (18.67)	10.05 (18.48)	10.15 (18.58)	68.50 (55.86)	66.50 (54.64)	67.50 (55.25)	85.25 (67.46)	84.00 (66.49)	84.63 (66.97)
10 months	10.00 (18.43)	9.93 (18.36)	9.96 (18.40)	67.25 (55.10)	64.50 (53.43)	65.88 (54.27)	83.75 (66.25)	83.00 (65.68)	83.38 (65.97)
18 months	9.88 (18.32)	9.88 (18.31)	9.88 (18.32)	65.75 (54.18)	63.25 (52.69)	64.50 (53.43)	82.00 (64.91)	81.00 (64.16)	81.50 (64.54)
19 months	9.73 (18.17)	9.58 (18.03)	9.65 (18.10)	64.00 (53.13)	62.25 (52.10)	63.13 (52.62)	80.50 (63.81)	78.75 (62.56)	79.63 (63.19)
20 months	9.35 (17.80)	9.33 (17.78)	9.34 (17.79)	63.50 (52.83)	61.50 (51.65)	62.50 (52.24)	78.50 (62.38)	76.25 (60.84)	77.38 (61.61)
21	8.98	8.85	8.91	62.00	61.25	61.63	77.75	75.75	76.75

months	(17.43)	(17.31)	(17.37)	(51.95)	(51.50)	(51.73)	(61.90)	(60.52)	(61.21)
22 months	8.85 (17.31)	8.75 (17.21)	8.80 (17.26)	60.50 (51.06)	58.50 (49.90)	59.50 (50.48)	76.75 (61.18)	75.25 (60.17)	76.00 (60.67)
Mean	9.85 (18.28)	9.73 (18.16)		66.33 (54.56)	64.30 (53.33)		82.85	81.35	
	V	SP	Vx SP	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	0.02	0.04	0.05	0.14	0.31	0.44	0.24	0.53	0.75
CD(p=0.05)	0.05	0.10	NS	0.39	0.88	NS	0.67	1.51	NS

Table 1.160: Effect of storage periods on mean root length, shoot length and seedling length in two varieties of groundnut

	Root length (cm)			Shoot length (cm)			Seedling length (cm)		
Storage period	**RG 425**	**RG 510**	**Mean**	**RG 425**	**RG 510**	**Mean**	**RG 425**	**RG 510**	**Mean**
6 months	7.70	7.85	7.78	14.63	14.88	14.75	22.33	22.73	22.53
7 months	7.45	7.53	7.49	14.50	14.75	14.63	21.95	22.28	22.11
8 months	7.30	7.35	7.33	14.28	14.53	14.40	21.58	21.88	21.73
9 months	7.25	7.30	7.28	13.78	14.30	14.04	21.03	21.60	21.31
10 months	7.10	7.15	7.13	13.50	14.08	13.79	20.60	21.23	20.91
18 months	6.55	6.78	6.66	12.88	13.40	13.14	19.43	20.18	19.80
19 months	6.23	6.65	6.44	12.58	13.08	12.83	18.80	19.73	19.26
20 months	6.08	6.40	6.24	12.35	12.90	12.63	18.43	19.30	18.86
21 months	5.78	6.05	5.91	12.10	12.53	12.31	17.88	18.58	18.23
22 months	5.25	5.73	5.49	11.80	12.20	12.00	17.05	17.93	17.49
Mean	6.67	6.88		13.24	13.66		19.91	20.54	
	V	SP	Vx SP	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	0.02	0.05	0.07	0.02	0.04	0.06	0.03	0.06	0.08
CD(p=0.05)	0.06	0.13	0.19	0.05	0.11	0.16	0.08	0.17	0.24

Table 1.161: Effect of various storage periods on mean seedling dry weight, seedling index I and seedling index II in two varieties of groundnut

	Seedling dry weight (mg)			Seedling index-I			Seedling Index-II		
Storage period	**RG 425**	**RG 510**	**Mean**	**RG 425**	**RG 510**	**Mean**	**RG 425**	**RG 510**	**Mean**
6 months	290.25	295.50	292.88	1998	1988	1993	259.78	258.56	259.17
7 months	285.75	289.50	287.63	1931	1932	1931	251.46	251.15	251.31
8 months	282.50	284.25	283.38	1866	1864	1865	244.39	242.38	243.38

9 months	274.25	278.50	276.38	1792	1814	1803	233.82	233.99	233.91
10 months	271.25	276.75	274.00	1725	1761	1743	227.16	229.68	228.42
18 months	259.50	267.00	263.25	1592	1634	1613	212.80	216.30	214.55
19 months	250.50	261.25	255.88	1513	1553	1533	201.65	205.77	203.71
20 months	247.50	258.50	253.00	1446	1471	1459	194.38	197.09	195.73
21 months	240.50	251.75	246.13	1389	1407	1398	186.90	190.65	188.78
22 months	229.00	236.00	232.50	1308	1348	1328	175.77	177.59	176.68
Mean	263.10	269.90		1656	1677		218.81	220.31	
	V	SP	Vx SP	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	0.70	1.56	2.21	6.83	15.28	21.60	1.05	2.35	3.32
CD(p=0.05)	1.98	4.42	NS	19.33	43.21	NS	NS	6.64	NS

Table 1.162: Effect various storage periods on mean seedling emergence and final plant stand establishment of in two varieties of groundnut

	Seedling emergence (%)			**Final plant stand (per m^2)**		
Storage period	**RG 425**	**RG 510**	**Mean**	**RG 425**	**RG 510**	**Mean**
6 months	91.25 (73.16)	92.50 (74.32)	91.88 (73.64)	40.25	42.00	41.13
8 months	86.75 (69.13)	88.00 (69.98)	87.38 (69.55)	36.75	38.00	37.38
18 months	84.50 (67.10)	86.25 (68.48)	85.38 (67.79)	33.50	35.75	34.63
20 months	81.75 (65.03)	83.25 (66.03)	82.50 (65.53)	31.50	33.00	32.25
Mean	86.06	87.50		35.50	37.19	
	V	SP	Vx SP	V	SP	Vx SP
SEm(±)	1.15	1.62	2.29	1.24	1.76	2.49
CD(p=0.05)	NS	4.73	NS	NS	5.13	NS

Centre: KKV, Dapoli

Experimental details:

Two seed lots of truthful seeds (pods) of two University released ground nut varieties viz., TKG-Bold (V_1) and Konkan Bhuratn (V_2) from the harvest of Rabi-2018 were procured from Agriculture Research Stations of the University. Date of harvesting, date of test, and validity period for TKG-Bold (V_1) was 12/04/2018, 10/05/2018, 3 months, respectively while date of harvesting, date of test and validity period for Konkan Bhuratn

(V_2) was 03/04/2018, 2/05/2018, 3 months, respectively. Seed lots were stored in recommended HDPE bags under ambient seed storage conditions. Seed lots were tested July onwards (2 months of storages) for the observations in consideration periodically under lab at 1 month interval and under field at 2 months interval.

Results:

Effect of varieties *viz.,* TKG Bold (V_1) and Konkan Bhuratn (V_2); storage periods *viz.,* SP_1 (2 months), SP_2 (3 months), SP_3 (4 months), SP_4 (5 months), SP_5 (6 months), SP_6 (7 months) and their interactions in groundnut on different seed quality parameters tested under lab & field conditions are given in Table 1.164 to 1.170. Varieties (V), storage periods (SP) and their interactions revealed significant variation for all the traits under study viz., first count (%), germination (%), vigour index-I, vigour index-II, speed of field emergence and final plant stand (%).

In case of varieties, V_2 recorded higher moisture content (9.69 %) than V_1 (8.61 %). In case of storage periods, moisture content increased gradually with storage periods from SP_1 to SP_3 (2^{nd} to 4^{th} month of storage) in rainy season i.e. from July to September and decreased successively afterwards till SP_7 (8^{th} month of storage) in winter season i.e. from October to January. Mean moisture content was highest (9.88 %) at SP_3 (4 months after storage). Interaction V_1SP_1 recorded lowest moisture content (7.56 %) while V_2SP_3 recorded highest moisture (10.34 %).

TKG Bold (V_1), 2 months of storage (SP_1) and their interaction (V_1SP_1) recorded highest significant first count of 21.25 %, 42.50 % and 51.25 %, respectively and germination of 38.82 %, 79.38 % and 90.50 %, respectively. First count and germination percentage were found to decline successively over the storage periods. Mean germination percentage was found to be lower than seed standards after SP_2 (3 months of storage). However, V_1 maintained minimum germination till SP_3 (4 months of storage).

TKG Bold (V_1), 2 months storage period (SP_1) and their interaction (V_1SP_1) revealed highest significant vigour index-I of 561.99, 1273.33 and 1462.63, respectively and vigour index-II of 18.27, 39.06 and 46.58, respectively. Both vigour indices were found to decline successively over the storage periods.

Under field tests, TKG Bold (V_1), 2 months storage period (SP_1) and their interaction (V_1SP_1) revealed highest significant speed of emergence of 2.12, 4.17 and 4.92, respectively and final plant stand of 29.69 %, 53.13 % and 73 %, respectively. Both, the speed of emergence and final plant stand declined successively over the storage periods.

Thus, in case of *rabi* seed lots of groundnut, all the seed quality parameters viz., germination (%), vigour index-I, vigour index-II, speed of emergence were found to decline rapidly under ambient storage conditions which ultimately affected the final plant stand establishment of the crop. Hence, in case of *rabi* groundnut seed lots, maximum validity

period of 2-3 months under ambient seed storage conditions will be better to assure good plant stand at farmers' field.

Table 1.163 Effect of storage period(s) and varieties on seed moisture content in groundnut.

Storage Periods (SP)	Varieties (V)		Mean
	TKG-Bold (V_1)	Konkan Bhuratn (V_2)	
SP_1 :2 month	7.56	8.68	8.12
SP_2 :3 month	8.92	10.16	9.54
SP_3 :4 month	9.42	10.34	9.88
SP_4 :5 month	8.83	9.86	9.35
SP_5 :6 month	8.60	9.70	9.15
SP_6 : month	8.52	9.65	9.09
SP_7 :8 month	8.41	9.45	8.93
Mean	8.61	9.69	9.15

Table 1.164: Effect of storage period(s) and varieties on first count in Groundnut.

Storage Periods (SP)	Varieties (V)		Mean
	TKG-Bold	Konkan Bhuratn	
SP_1 :2 month	51.25 (45.72)	33.75 (35.48)	42.50 (40.60)
SP_2 :3 month	48.25 (44.00)	21.50 (27.47)	34.88 (35.73)
SP_3 :4 month	36.75 (37.31)	14.00 (21.84)	25.38 (29.57)
SP_4 :5 month	12.50 (20.48)	5.00 (12.79)	8.75 (16.64)
SP_5 :6 month	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
SP_6 : month	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
SP_7 :8 month	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Mean	21.25 (21.07)	10.61 (13.94)	15.93 (17.51)
SEm (±)	0.38	0.71	1.01
CD (p=0.05)	V=1.10	SP=2.05	V x SP=2.90

(Figures in parentheses are arc sine values)

Table 1.165: Effect of storage period(s) and varieties on mean germination (%) in Groundnut.

Storage Periods (SP)	Varieties (V)		Mean
	TKG-Bold	Konkan Bhuratn	
SP_1 :2 month	90.50 (72.11)	68.25 (55.71)	79.38 (63.91)
SP_2 :3 month	82.75 (65.55)	36.50 (37.13)	59.63 (51.34)
SP_3 :4 month	64.50 (53.46)	29.00 (32.56)	46.75 (43.01)
SP_4 :5 month	30.00 (33.14)	10.75 (19.01)	20.38 (26.08)
SP_5 :6 month	4.00 (11.38)	0.00	2.00 (5.69)

SP_6 : month	0.00	0.00	0.00
SP_7 :8 month	0.00	0.00	0.00
Mean	38.82 (33.66)	20.64 (20.63)	29.73 (27.15)
SEm (±)	0.39	0.72	1.02
CD (p=0.05)	V=1.11	SP=2.07	V x SP=2.93

(Figures in parentheses are arc sine values)

Table 1.166. Effect of storage period(s) and varieties on vigour index-I in Groundnut.

Storage Periods (SP)	Varieties (V)		Mean
	TKG-Bold	Konkan Bhuratn	
SP_1 :2 month	1462.63	1084.05	1273.33
SP_2 :3 month	1110.37	496.99	803.68
SP_3 :4 month	1007.56	266.51	637.04
SP_4 :5 month	319.24	99.21	209.22
SP_5 :6 month	34.13	0.00	17.06
SP_6 : month	0.00	0.00	0.00
SP_7 :8 month	0.00	0.00	0.00
Mean	561.99	278.11	420.05
SEm (±)	15.26	28.56	40.39
CD (p=0.05)	V=43.83	SP=82.00	V x SP=115.96

Table 1.167: Effect of storage period(s) and varieties on vigour index-II in Groundnut.

Storage Periods (SP)	Varieties (V)		Mean
	TKG-Bold	Konkan Bhuratn	
SP_1 :2 month	46.58	31.55	39.06
SP_2 :3 month	36.48	15.11	25.79
SP_3 :4 month	32.95	8.54	20.74
SP_4 :5 month	10.55	3.19	6.87
SP_5 :6 month	1.37	0.00	0.69
SP_6 : month	0.00	0.00	0.00
SP_7 :8 month	0.00	0.00	0.00
Mean	18.27	8.34	13.31
SEm (±)	0.49	0.91	1.29
CD (p=0.05)	V=1.40	SP=2.61	V x SP=3.69

Table 1.168: Effect of storage period(s) and varieties on speed of emergence in Groundnut.

Storage Periods (SP)	Varieties (V)		Mean
	TKG-Bold	Konkan Bhuratn	
SP_1 :2 month	4.92	3.42	4.17
SP_3 :4 month	3.49	1.77	2.63
SP_5 :6 month	0.06	0.00	0.03

SP_7 :8 month	0.00	0.00	0.00
Mean	2.12	1.30	1.71
SEm (±)	0.08	0.11	0.15
CD (p=0.05)	V=0.23	SP=0.32	V x SP=0.45

Table 1.169: Effect of storage period(s) and varieties on final plant stand establishment in Groundnut.

Storage Periods (SP)	Varieties (V)		Mean
	TKG-Bold	Konkan Bhuratn	
SP_1 :2 month	73.00 (58.87)	33.25 (35.17)	53.13 (47.02)
SP_3 :4 month	44.75 (41.98)	11.50 (19.77)	28.13 (30.88)
SP_5 :6 month	1.00 (4.90)	0.00 (0.00)	0.50 (2.45)
SP_7 :8 month	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Mean	29.69 (26.44)	11.19 (13.74)	20.44 (20.09)
SEm (±)	0.69	0.97	1.38
CD (p=0.05)	V=2.04	SP=2.88	V x SP= 4.07

(Figures in parentheses are arc sine values)

Experiment 2: Hybrid purity testing using molecular markers in public sector hybrids of field crops

Year of Start: 2011- 2012

Objective:

1. To assess the efficiency of molecular markers in hybrid purity testing in comparison to the grow-out test (GOT) in various field crops.

Crops		**Centres**
Rice	:	PJTSAU, Hyderabad; TNAU, Coimbatore; ICAR-IISS, Mau; JNKVV, Jabalpur; AAU, Jorhat; ICARRC NEH Region - Manipur Centre; SKUAST, Kashmir, Srinagar and KAU, RARS, Pattambi
Maize*	:	UAS, Bengaluru; CSKHPKV Palampur and PAU, Ludhiana
Pearl millet	:	SKNAU, Durgapura; MPKV, Rahuri; CCS HAU Hisar and VNMKV, Parbhani
Sunflower	:	UAS, Bengaluru; JAU, Jamnagar; ICAR-IIOR, Hyderabad and RAU, TCA, Dholi
Cotton	:	ICAR-CICR, Nagpur** PDKV, Akola; & AAU, Anand; NAU, Navsari; and UAS, Dharwad

*ISTA recommended method of testing of hybrid purity using isozymes available in maize (Orman *et al.,* 1991) wasfollowed by the maize centres.
**ICAR-CICR, Nagpur investigated the trait specific purity of cotton hybrids (Singh *et al.,* 2016).

Crop-wise and centre-wise research findings during 2018-19

Crop: Rice
Centre: TNAU, Coimbatore
Experimental details:
Name of hybrids: CO 4
Name of parental lines: CMS 23 A;CMS 23 B; CB 174 R(A , B & R lines respectively)
Marker Used: RM551

GOT Plot : A two dimensional DNA sampling strategy suggested by Nas*et al.* (2002) was adopted for molecular characterization of parental lines viz., TNAU CMS 23A, CB174 R and TNAU CMS 23B. Seedlings of these three genotypes were obtained from 20- row x 20-column of grow out matrix planted in GOT field. 2cm leaf bits were collected from 20-day-old seedling on the rows of the matrix and the samples were bulked. Thus a total of 40 DNA bulks representing 20 rows and 20 columns were prepared and used for the extraction of total genomic DNA.

DNA extraction: The genomic DNA was extracted by following the protocol described by Gawel and Jarret (1991).

Loading the DNA samples: Two µl of DNA sample dissolved in TE was pipetted onto a parafilm and mixed well with 3 µl of 10X loading dye. The gel was run at 70V for 1-1.5 hours and bands were visualized and documented using a gel documentation system

DNA quantity and purity check: DNA was quantified by using Nano drop (Figure 2.1 & Table 2.1).

Results: The DNA concentration was brought down to 100 ng/ µl by dilution. PCR was done using the rice marker RM551 but the bands were monomorphic as shown in gel electrophoresis picture fig 2.2.

Table 2.1: Quantity and quality of DNA was estimated

Sample	Concentration of DNA (ng/µl)	OD value at 260/280nm
A line	5162	2.13
B line	5706	1.92
R line	5979	2.14
Hybrid	3340	2.10

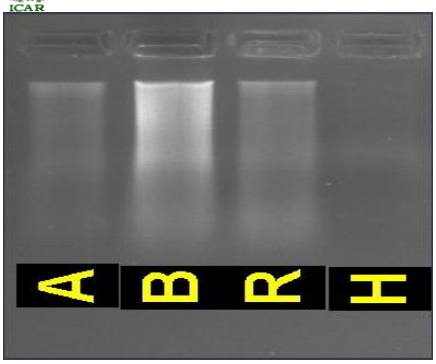


Figure 2.1: DNA Quantification

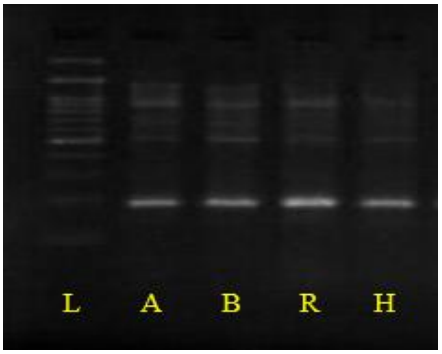


Figure 2.2: Hybrid purity testing using RM551 Marker

The work will be continued and suitable polymorphic SSR markers will be identified to assess the genetic purity in comparison with GOT.

Crop: Rice
Centre: JNKVV, Jabalpur
Experimental details:
Name of hybrids: JRH -5
Name of parental lines: A line & R Line
Marker Identified and Used: RM276

Details of Markers:

Primer name	Forward primer sequence	Reverse primer Sequence
RM276	CTCAACGTTGACACCTCGTG	TCCTCCATCGAGCAGTATCA

Results:

Identification of hybrid specific SSR markers for genetic purity: Determining the genetic purity of hybrid seed is an essential requirement for its commercial use, since there is always a chance of contamination in the hybrid seed production plot because of pollen shedders, out-crossing and physical mixtures during the subsequent handling of the harvested material.

To test the genetic purity of hybrid JRH 5, the SSR markers RM 234, RM 228, RM 84, RM 276 and RM 237 were identified and validated.DNA Profiling of 40 hybrids along with parents was conducted for hybrid purity testing using molecular markers (figure 2.3-2.5). RM 276 was used for testing the genetic purity of Hybrids JRH 5.

Conduct of Grow Out Test: The minimum population sown for taking the observation is 400 plants. The standard sample of JRH 5 was obtained from the origination plant breeder which was used as the standard against which all other samples of the seed of the hybrid to be judged. Standard and recommended cultural practices were followed for both sample in question and its control. Grow out test plot was examined throughout the growing season with emphasis on the period from the flowering to Physiological maturity.

Calculation and interpretation of the result of GOT

Variety	No. of plant Population	No. of Off type	Off type percentage
JRH5	400	4	0.1%

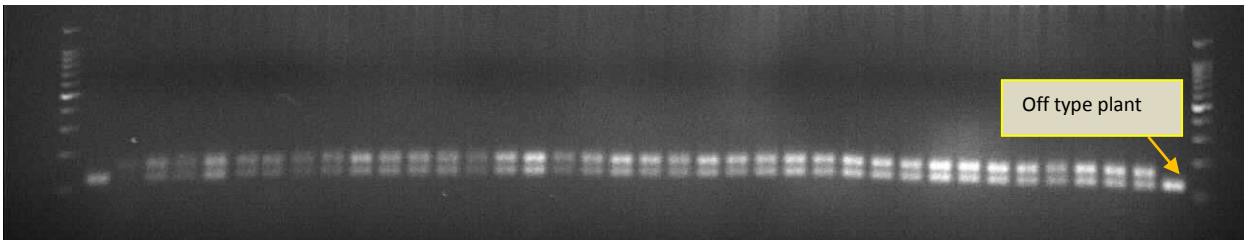


Figure 2.3: Molecular DNA profiling of parents (First well-A Line; second Line- R Line) along with 41-80 hybrid paddy variety JRH5

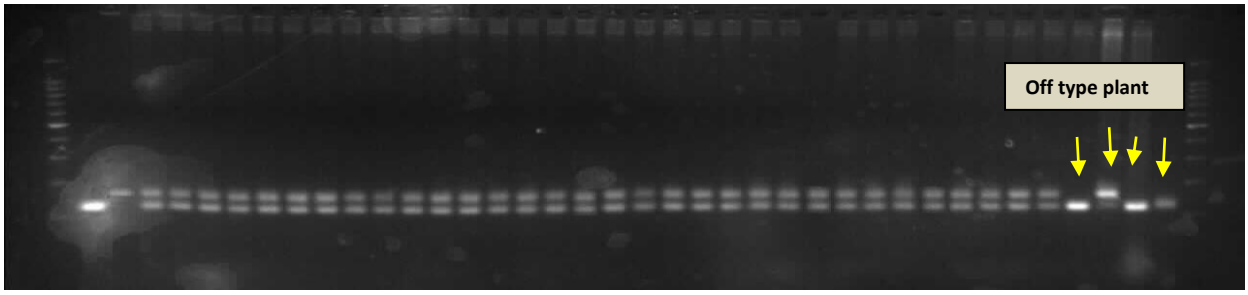


Figure 2.4: Molecular DNA Profiling of parents (First well-A Line; second Line- R Line) along with 153-192 hybrid paddy variety JRH5

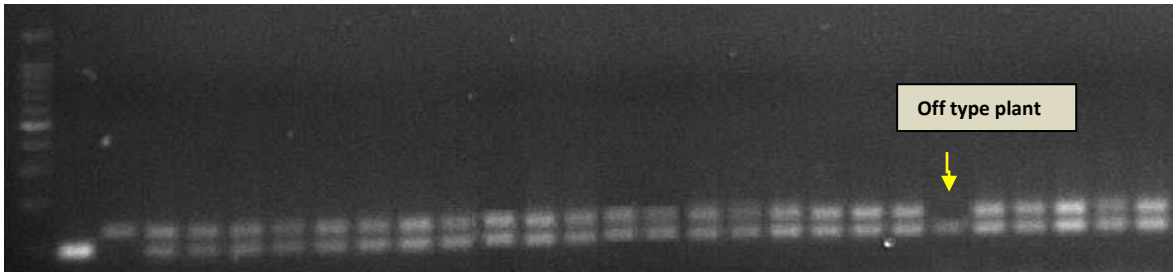


Figure 2.5: Molecular DNA Profiling of parents (First well-A Line; second well- R Line) along with 374-400 hybrid paddy variety JRH5.

Conclusion: Molecular hybrid purity testing results confirm the presence of six off type plants as against four off type identified and tagged during Grow Out Test. Hybrid Purity testing using molecular markers validate the result of Grow Out test conducted for JRH5 hybrid.

Crop: Rice
Centre: AAU, Jorhat
Experimental details:
Name of hybrid:AAU hybrid3
Name of parental lines: A line & R Line

Marker Identified and Used: RM206, RM263, RM216, RM234

Table 2.2: Banding pattern of polymorphic SSR markers with amplicon size

Sl. No.	Primers	Annealing temperature (°C)	Product size of parental lines and rice hybrid IR79156A/Swarna			DNA profile
			IR79156A	IR79156A/Swarna	Swarna	
1	RM263	54	190bp	190bp, 200bp	200bp	Polymorphic
2	RM234	52	150bp	150bp, 170bp	170bp	Polymorphic
3	RM216	59	150bp	140bp, 150bp	140bp	Polymorphic
4	RM206	54	120bp, 180bp	120bp,180bp,110bp, 130bp	110bp, 130bp	Polymorphic

Results: Among the tested SSR primers, 4 primers exhibited a complementary banding pattern between hybrid IR79156A/Swarna and its parental lines with different amplicons andRM206, RM263, RM216, RM234, were found to be polymorphic primers (Figure 2.6).

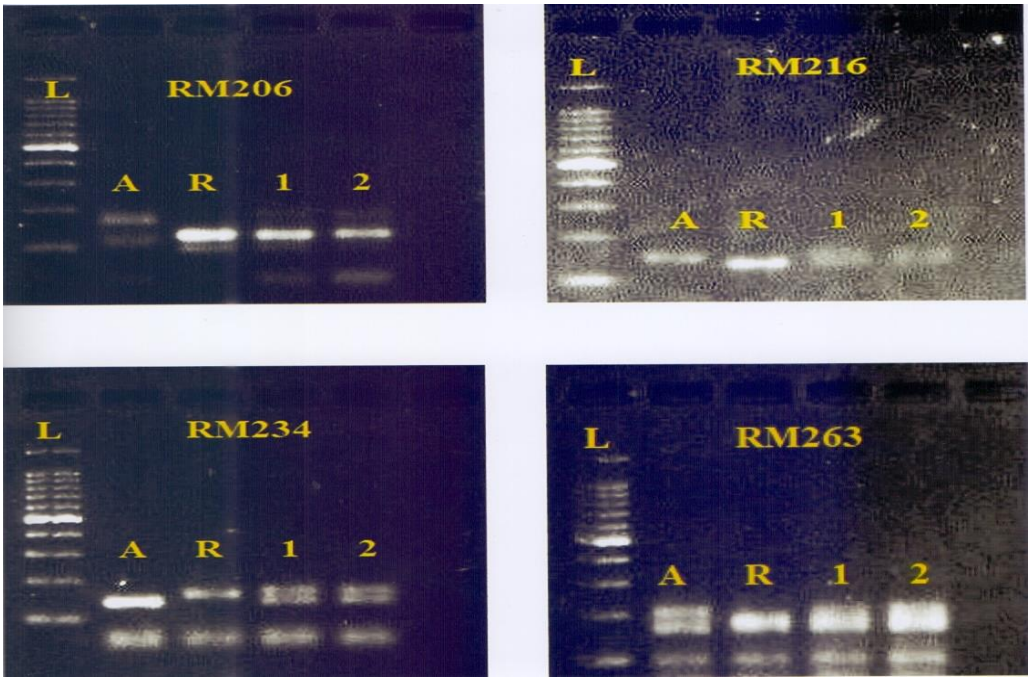


Figure 2.6: Banding pattern of polymorphic SSR markers with amplicon size for AAU hybrid 3

Conclusion: SSR marker RM234 was used for hybrid purity assessment, DNA was isolated from 15 days old seedlings of the 100 individual plants raised in the field. Genotyping of these 100 individual plants was carried out using highly polymorphic marker RM234. As expected two alleles were present in hybrid samples (Figure 2.7).The highly informative SSR marker RM234 effectively differentiated IR79156A and Swarna from its hybrid combination IR79156A/Swarna and thus SSR marker RM234 can be effectively used for hybrid purity assessment of the rice hybrid AAU hybrid 3.

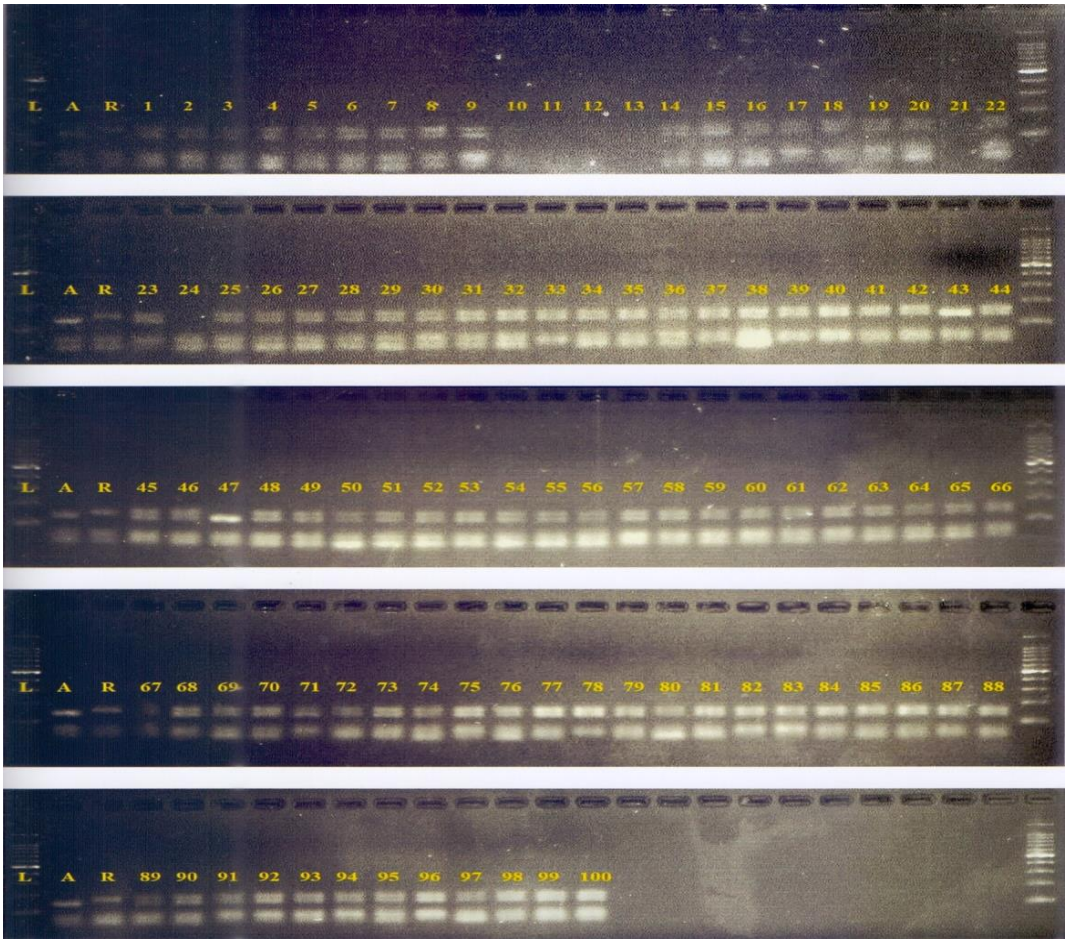


Figure 2.7: **Hybrid purity testing using SSR primer RM234**

Crop: Maize
Centre: UAS, Bengaluru
Experimental details:
Name of hybrid: MAH-14-5
Name of parental lines: CAL-1443 (Female) and CML-451 (Male)
Name of hybrid: Hema
Name of parental lines: NAI-137(Female) and MAI-105(Male).

Marker Identified and Used: phi053, umcl223, bnlg1520, bnlg1185, bnlg1621, umc1288, and bnlg1014.

Selection of hybrids: Among the umpteen genotypes, varieties and hybrids available in maize, opting for MAH-14-5 and Hema hybrids has profound importance behind it. Among these two public sector hybrids; hybrid Hema was released at recent past and performed well at farmer's fields of Karnataka assuring higher yield when compared to MAH-14-5 which

is in the pipeline. MAH-14-5 has the added advantage of possessing resistance to leaf blight, which when affects the crop leads to a loss in yield of 50 - 80%. Unlike other varieties of maize, the leaves of this hybrid stay green even on maturity which can so be used as fodder. Hema hybrid also offers a wide range of resistance against Sorghum Downy Mildew (SDB), *Turcicum*Leaf Blight (TLB) and *Polysora* rust. As these hybrids have good demand among farmers, it is high time to make available genetically pure and quality seeds to assure farmers with promised yield and potential of the hybrids. So, the research is focused on assessing the genetic purity of these hybrids through microsatellite markers and GBS with the following objectives.

Materials and methods: 50 seeds each of hybrid MAH-14-5 and the parental lines CAL-1443 (Female) and CML-451 (Male) and Hema and its parental lines NAI-137(Female) and MAI-105(Male) were sown.Morphological observations of the hybrids and its parental lines for its descriptors to confirm for purity was recorded (Plate 2.1).





Plate 2.1: Field View of GOT Plots

Extraction of DNA: Twenty one days old seedlings were used for DNA extraction. DNA was extracted as per the modified CTAB (CetylTrimethyl Ammonium Bromide) method (Cao and Oard, 1997). The extracted DNA was quantified by electrophoresis in 0.8 % Agarose gel and also by nano photometer.

PCR amplification: The DNA sample obtained was diluted using TE buffer for the concentration of 80 ng/µl. The PCR reactions were performed in 15 µl using a gradient thermocycler (Quantum Bio). The annealing temperature (Tm) was about 58 ^{o}C to 60 ^{o}C and it differed for each primer and the reactions were performed based on the Tm temperature of each primer to get specific amplification.

Scoring of SSR generated bands

The bands generated by SSR primers were scored.

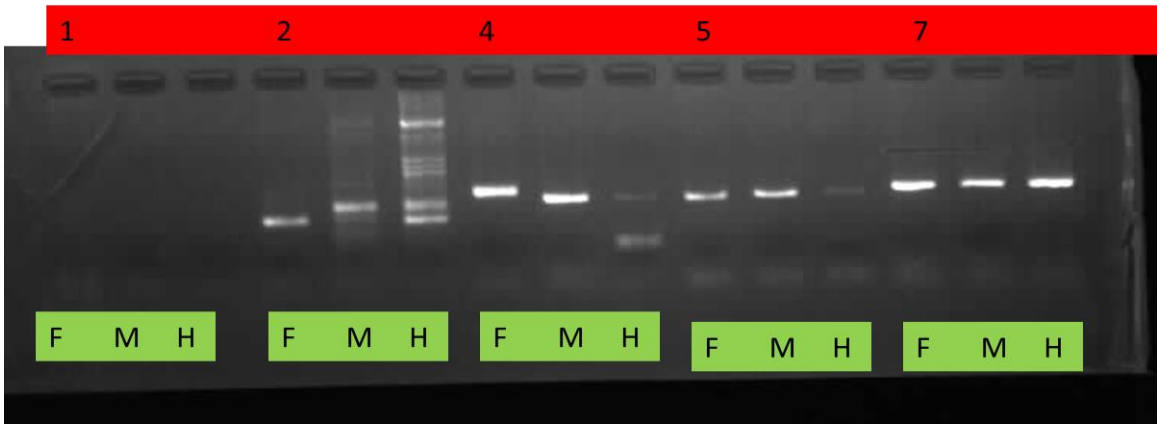


Figure 2.8: **Hybrid purity testing using SSR primer bnlg1520 in MAH-14-5 (F-220;M- 240) and HEMA (F-220;M- 240); it was found to be Monomorphic**

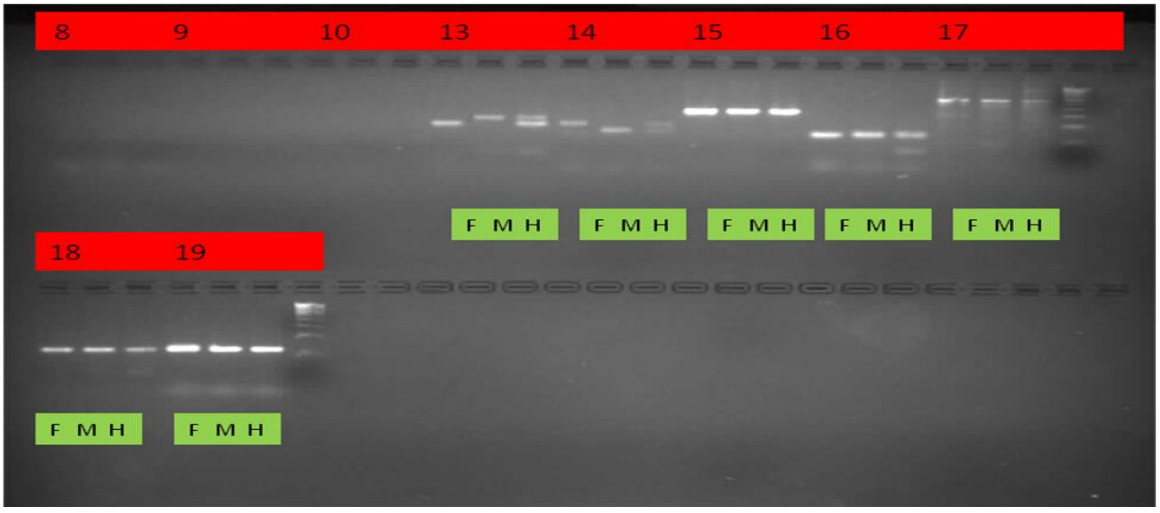


Figure 2.9: **Hybrid purity testing using SSR primer phi053 in MAH-14-5 (F-220;M- 240) – polymorphic and HEMA-Monomorphic**

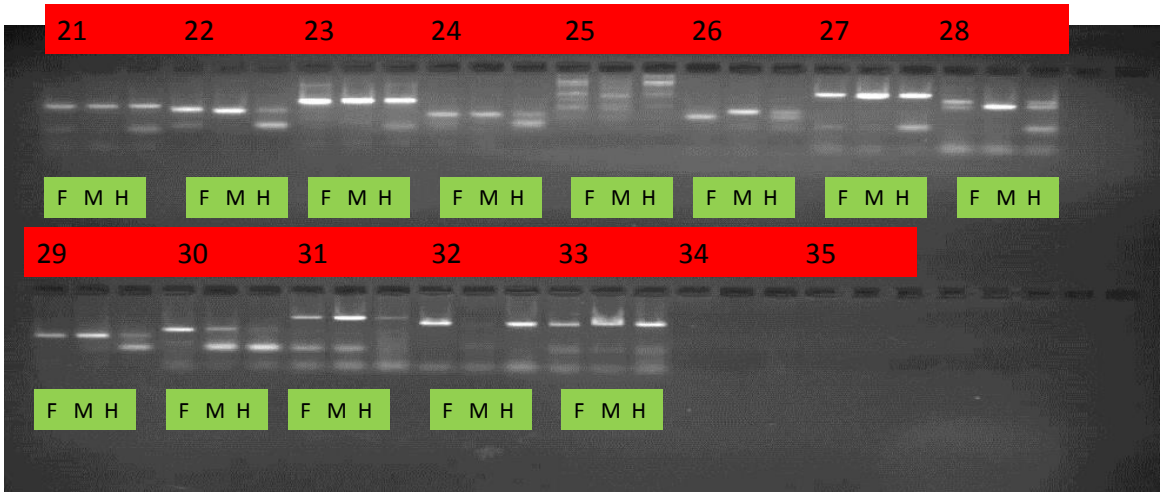


Figure 2.10: **Hybrid purity testing using SSR primer umcl223 in MAH-14-5- Monomorphic and HEMA-(F-220; M- 240) –polymorphic**

Conclusion:A total of seven primers were used and overall result of primers for both hybrids is given below;

Primer	**MAH-14-5**			**HEMA**		
	F	M	H	F	M	H
phi053	MONOMORPHIC			120	140	120,140
umcl223	140	120	140,120	140	120	140,120
bnlg1520	220	240	220,240	MONOMORPHIC		
bnlg1185	120	100	120,100	100	110	100,110
bnlg1621	MONOMORPHIC			220	240	220,240
umc1288	220	200	220,200	MONOMORPHIC		
bnlg1014	MONOMORPHIC			180	160	180,160

Primers umcl223 and bnlg1185 showed polymorphism to both hybrids while primer phi053, bnlg1621 and bnlg1014 showed polymorphism in hybrid Hema and primers bnlg1520 and umc1288showed polymorphism in hybrid MAH-14-5

Crop: Maize
Centre: CSKHPAU, Palampur
Experimental details:
Name of hybrid: PalamSankar Makka-2 (single cross hybrid)
Name of inbreds: Bajim-08-26 (female inbred) and Bajim-08-27 (male inbred)

Testing of hybrid genetic purity through grow-out test

The sowing of PalamSankar Makka-2 was done on June 7, 2018 by hand dibbling at 60 cm x 25 cm spacing. The row length was kept 10 meter and total number of rows were 15. The fertilizer @ 90N:45P:30K per hectare was applied.For taking observations in grow-out test, 400 F_1plants were selected from the plot randomly and were examined critically throughout the growing season from flowering to ripening for distinguishable morphological characters. All selected plants were found uniform with respect to different morphological traits i.e. genetically pure during the grow-out test.

Testing of hybrid genetic purity through molecular markers: Out of 400 plants used for taking observations in grow-out test, 100 plants were selected randomly to test the genetic

purity through molecular markers i.e. SSR marker. Single leaf from individual 100 plants was taken before flowering for DNA extraction.

Genomic DNA extraction and purification: Seeds of parental lines/hybrid plants of maize served as source of genomic DNA. Genomic DNA was extracted from the leaves of Bajim-08-26 (female parental line), Bajim-08-27 (male parental line) andone hundred F1 plants of PalamSankar Makka-2. The genomic DNA was extracted using a protocol described by Murray and Thompson (1980).

DNA quality assessment and quantification: The purity of isolated DNA was ascertained and quantified using nanophotometer (Implen). The samples were diluted to a concentration of 15 ng μl^{-1} before being used in the DNA fingerprinting.

Identification, selection and screening of SSR markers for PCR amplification: The SSR primer pairs were selected based on repeat units and bin locations so as to provide a uniform coverage of the entire maize genome. Forty two pre mapped SSR markers whose sequences are publically available at the Maize Genetics and Genome database (http//:www.maizedb.org/SSR.php) were screened to detect polymorphism among the maize parental lines/hybrid. Finally, the polymorphic SSR loci were used for carrying out polymerase chain reaction (PCR) and developing DNA fingerprinting profiles for parental lines/hybrid. The basic information in respect of these microsatellite markers is tabulated in Table 2.3.

Table 2.3: Basic information of the 42 SSR markers used for detecting polymorphism amongparentallines/hybrid

S. No.	Oligo Nucleotide	Forward sequence	Reverse sequence	T_m (˚C)
1.	phi002	CATGCAATCAATAACGATGGCGAGT	TTAGCGTAACCCTTCTCCAGTCAGC	57.6
2.	phi006	AGGCGGCGTGCTGAACACCT	CGCTTCATCTCCCGTGACAATG	58.3
3.	phi008	CGGCTACGGAGGCGGTG	GATGGGCCCACACATCAGTC	58.3
4.	phi032	CTCCAGCAAGTGATGCGTGAC	GACACCCGGATCAATGATGGAAC	57.2
5.	phi034	TAGCGACAGGATGGCCTCTTCT	GGGGAGCACGCCTTCGTTCT	59.2
6.	phi046	ATCTCGCGAACGTGTGCAGATTCT	TCGATCTTTCCCGGAACTCTGAC	57.2
7.	phi056	ACTTGCTTGCCTGCCGTTAC	CGCACACCACTTCCCAGAA	57.2
8.	phi063	GGCGGCGGTGCTGGTAG	CAGCTAGCCGCTAGATATACGCT	57.6
9.	phi065	AGGGACAAATACGTGGAGACACAG	CGATCTGCACAAAGTGGAGTAGTC	57.2
10.	phi072	ACCGTGCATGATTAATTTCTCCAGCCTT	GACAGCGCGCAAATGGATTGAACT	59.2
11.	phi073	GTGCGAGAGGCTTGACCAA	AAGGGTTGAGGGCGAGGAA	57.6
12.	phi076	TTCTTCCGCGGCTTCAATTTGACC	GCATCAGGACCCGCAGAGTC	59.2
13.	phi078	CAGCACCAGACTACATGACGTGTAA	GGGCCGCGAGTGATGTGAGT	57.6
14.	phi079	TGGTGCTCGTTGCCAAATCTACGA	GCAGTGGTGGTTTCGAACAGACAA	59.2
15.	phi083	CAAACATCAGCCAGAGACAAGGAC	ATTCATCGACGCGTCACAGTCTACT	57.6
16.	phi084	AGAAGGAATCCGATCCATCCAAGC	CACCCGTACTTGAGGAAAACCC	57.2

17.	phi085	AGCAGAACGGCAAGGGCTACT	TTTGGCACACCACGACGA	57.2
18.	phi087	GAGAGGAGGTGTTGTTTGACACAC	ACAACCGGACAAGTCAGCAGATTG	57.6
19.	phi102228	ATTCCGACGCAATCAACA	TTCATCTCCTCCAGGAGCCTT	52.2
20.	phi108411	CGTCCCTTGGATTTCGAC	CGTACGGGACCTGTCAACAA	52.2
21.	phi116	GCATACGGCCATGGATGGGA	TCCCTGCCGGGACTCCTG	59.2
22.	phi121	AGGAAAATGGAGCCGGTGAACCA	TTGGTCTGGACCAAGCACATACAC	58.3
23.	phi127	ATATGCATTGCCTGGAACTGGAAGGA	AATTCAAACACGCCTCCCGAGTGT	59.2
24.	phi308707	GCAACAAGATCCAGCCGAT	GTCGCCCTCATATGACCTTC	54.2
25.	phi420701	GATGTTTCAAAACCACCCAGA	ATGGCACGAATAGCAACAGG	52.2
26.	phi448880	CGATCCGGAGGAGTTCCTTA	CCATGAACATGCCAATGC	52.2
27.	phi452693	CAAGTGCTCCGAGATCTTCCA	CGCGAACATATTCAGAAGTTTG	52.2
28.	umc1161	GGTACCGCTACTGCTTGTTACTGC	GCTCGCTGTTGGTAGCAAGTTTTA	57.2
29.	umc1304	CATGCAGCTCTCCAAATTAAATCC	GCCAACTAGAACTACTGCTGCTCC	54.2
30.	umc1399	GCTCTATGTTATTCTTCAATCGGGC	GGTCGGTCGGTACTCTGCTCTA	54.2
31.	zct118	CTTCCAGCCGCAACCCTC	CCAACAACGCGGACGTGA	57.2
32.	umc 1128	TCAATTTTGAGCTATCACTTTCCG	ATTGGTTCCATTGGTTTTGTTGAT	52.2
33.	bnlg 1017	ATTGGAAGGATCTGCGTGAC	CAGCTGGTGGACTGCATCTA	54.2
34.	bnlg 2077	GACCAGAGGATGGGGAAATT	GTAGGCACATGCACATGAGG	54.2
35.	umc 1088	TCATCCTCCTAGCTCCTCTACTCG	AAAACAGTCAGCAGAACCCACTTT	57.0
36.	phi 112	TGCCCTGCAGGTTCACATTGAGT	AGGAGTACGCTTGGATGCTCTTC	58.3
37.	umc 1066	ATGGAGCACGTCATCTCAATGG	AGCAGCAGCAACGTCTATGACACT	57.0
38.	phi 114	CCGAGACCGTCAAGACCATCAA	AGCTCCAAACGATTCTGAACTCGC	57.0
39.	phi 033	ATCGAAATGCAGGCGATGGTTCTC	ATCGAGATGTTCTACGCCCTGAAGT	58.3
40.	phi 059	AAGCTAATTAAGGCCGGTCATCCC	TCCGTGTACTCGGCGGACTC	58.3
41.	umc1545	GAAAACTGCATCAACAACAAGCTG	ATTGGTTGGTTCTTGCTTCCATTA	54.2
42.	umc 2357	GAGCAAGAAGCAGAGCAGCAAG	AGCTCCCTCAGGTAGTTGTCCTG	57.0

DNA fingerprinting of PalamSankar Makka-2 hybrid plants and their parental lines: Out of 42 SSR markers screened for detecting polymorphism among parental lines/hybrid, only one SSR marker i.e. umc1066 was found to be polymorphic for Bajim-08-26 (female parental line), Bajim-08-27(male parental line) and one hundred F_1plants of PalamSankar Makka-2 (Fig: 2.11).

Conclusion: All the 100 F_1plants of PalamSankar Makka-2 (single cross hybrid) were found genetically pure through grow-out test that was validated through using DNA fingerprinting (SSR markers, umc1066). No off type plant could be established among 100 plants of hybrid selected randomly and tested using SSR marker, umc1066.

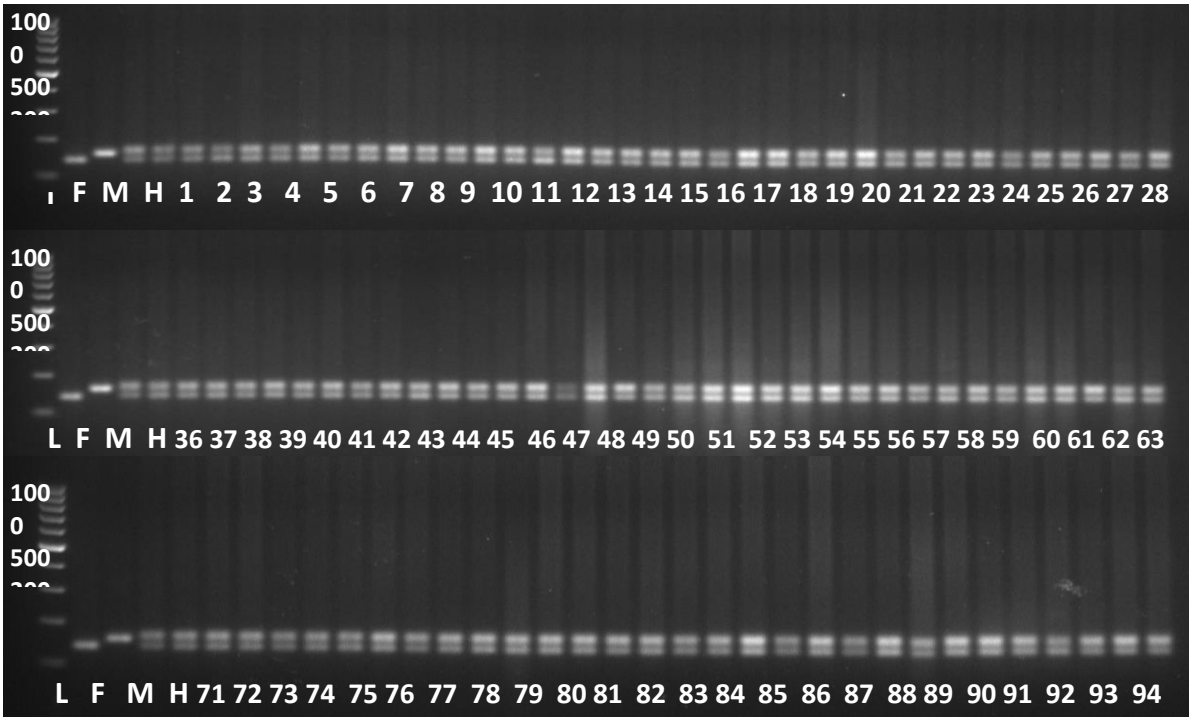


Figure 2.11: **DNA profiles of maize Bajim-08-26 (female parental line), Bajim-08-27(male parental line)and one hundred F_1plants of PalamSankar Makka-2 amplified using SSR marker, umc1066**

L = 100 bp ladder, F = Bajim-08-26 female parental line, M = Bajim-08-27 male parental line, H = PalamSankar Makka-2 (single cross hybrid)and 1-100 = 100 randomly selected F_1 plants.

Crop: Maize
Centre: PAU, Ludhiana
Experimental details:
Name of hybrid: PMH 1
Name of parental lines: LM 13 (Female parent) and LM 14 (Male parent)

Grow out Test: Grow out test was conducted by sowing the standard sample and PMH 1 hybrid population during the month of June. Crop was raised following the recommended agronomic practices. DUS characters as mentioned in the Table 2.4 were recorded for the PMH 1 hybrid population as described for the maize hybrids (Kaul *et. a.l.* 2012, 2018).

Table 2.4: DUS characters of maize

S.No.	Character	States	Note	PMH1
1	Stem: anthocyanin colouration of brace roots	Absent Present	1 9	9
2	Tassel: Time of anthesis (on middle third of main axis, 50 % of plants)	Very early (<45 days) Early (45-50 days) Medium (50-55 days) Late (>55 days)	1 3 5 7	7

3	Tassel: Anthocyanin colouration of anthers (in middle third of main axis on fresh anthers)	Absent Present	1 9	1
4	Ear: Time of silk emergence (50 % plants)	Very early (<48 days) Early (48-53 days) Medium (53-58 days) Late (>58 days)	1 3 5 7	7
5	Ear: Anthocyanin colouration of silks (on day of emergence)	Absent Present	1 9	9
6	Leaf: Anthocyanin colouration of sheath (below the ear)	Absent Present	1 9	1
7	Hybrids and open pollinated varieties only: Plant length (up to flag leaf)	Short (<150 cm) Medium (150-180cm) Long (181-210 cm) Very Long (>210cm)	3 5 7 9	9
8	Plant: Ear placement	Low Medium High	3 5 7	7
9	Leaf: Width of blade (leaf of upper ear)	Narrow(<8 cm) Medium (8-9cm) Broad (>9 cm)	3 5 7	7
10	Ear: Length without husk	Short (<10 cm) Medium (10-15cm) Long (>15 cm)	3 5 7	7
11	Ear: Diameter without husk (in middle)	Small (<4 cm) Medium (4-5cm) Large(>5 cm)	3 5 7	7
12	Ear: Number of rows of grains	Few (<8) Medium (10-12) Many (>14)	3 5 7	7
13	Kernel: Row arrangement (middle of ear)	Straight Spiral Irregular	1 2 3	1
14	Kernel: 1000 kernel weight	Very small (<100 g) Small (100-200g) Medium (200-300g) Large (>300g)	1 3 5 7	5

Molecular markers: Young leaves were collected fromboth parents and PMH 1 hybrid population consisting of 100 plants. Genomic DNA was extracted by CTAB (cetyl trimethyl ammonium bromide) method (Saghai-Maroof *et al.* 1984). Quantification of DNA and

assessment of DNA quality was assessed by electrophoresis in 0.8 % agarose gels with known concentrations of DNA marker. Parental polymorphism and hybrid purity was identified by screening DNA with following SSR primer pairs (Table 2.5).

Table 2.5: Annealing temperature and primer sequence of SSR primer pairs used for testing hybrid purity of maize hybrid PMH1

S.No.	Primer	Annealing Temp.(°C)	Chromosome No.	Primer Sequence
1	bnlg 238	55	6	F 5'- CTTATTGCTTTCGTCATACACACACATTCAT-3' R 5'-GAGCATGAGCTTGCATATTTCTTGTGG-3'
2	umc 1227	58	2	F 5'-GCTCCTGGGTCTTCCTCTCC-3' R 5'-CAAGTTGGTGAGATGGATCTGTTG-3'
3	umc 1798	61	2	F 5'- GATCGACCCTAATCGTCCTCCTAC-3' R- 5'- TATAACAACGTAGCAAAGCACGGG-3'

Results: Three SSR markers namely bnlg 238, umc 1227 and umc 1798 produced polymorphic bands and were capable to distinguish parental lines of maize hybrid (Table 6). There were 4 off type plants identified from a population of 100 plants which showed the presence of only female specific allele for the three SSR markers (Figure: 2.12-2.13). The genetic purity test of PMH 1 population using SSR markers indicated that hybrid PMH 1 had purity level of 96 %.

No off-type plant could be differentiated on the basis of morphological characters (Table 2.4). On the other side, SSR markers identified 4 off type plants. These differences between the results of morphological and molecular markers could be attributed to the fact that female parent LM 13 is as vigorous as that of hybrid PMH 1.

Table 2.6: Multiple allelic expression using SSR markers in PMH 1 hybrid and its parents LM 13 and LM 14

S.No.	Primer	No. of allele	LM 13	LM 14	PMH 1
1	bnlg 238	A1-180 bp ;A2- 200 bp	A1	A2	A1/A2
2	umc 1227	A1-130 bp; A2- 150 bp	A1	A2	A1/A2
3	umc 1798	A1-120 bp; A2- 150 bp	A1	A2	A1/A2

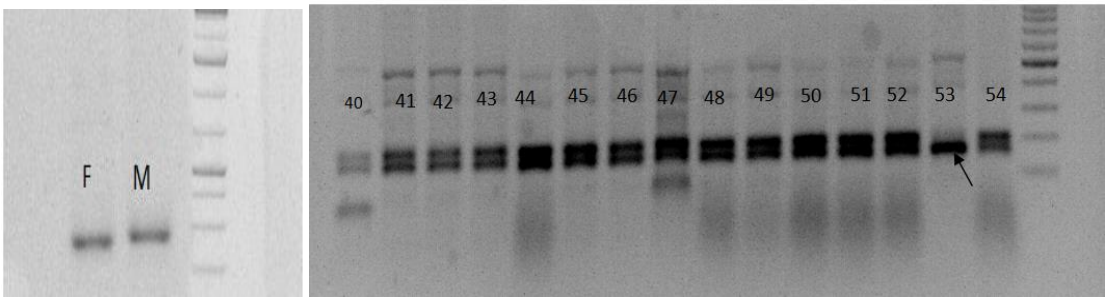


Figure 12: Visualization of DNA banding patern using SSR marker bnlg 238. F-Female parent, M-Male parent, Nos. 40, 41 to 54 Population of PMH 1 hybrid; arrow indicate off type plant.

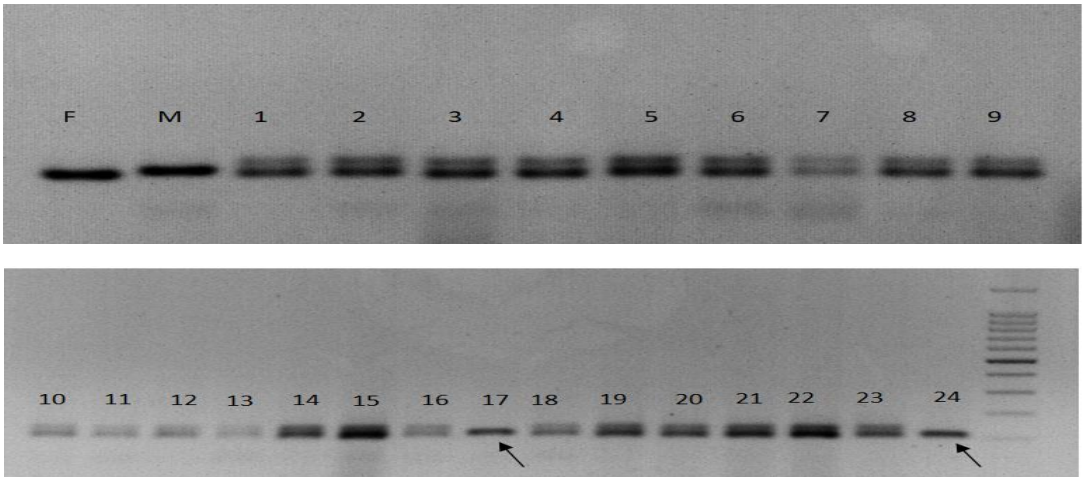


Figure 13: Visualization of DNA banding pattern using SSR marker umc 1227. F-Female parent, M-Male parent, No.1,2 to 24 Population of PMH 1 hybrid; arrows indicate off type plants.

Conclusion: The genetic purity test of PMH 1 population using SSR markers indicated that hybrid PMH 1 had purity level of 96%. No off-type plant could be differentiated on the basis of morphological characters

Crop: Pearl millet
Centre: RARI, Durgapura, Jaipur
Experimental details:

Table 2.7: Bajra hybrids and their parents taken for study of polymorphism at Durgapura, Jaipur

S. No.	Hybrid	Female Parent	Male Parent
1.	RMS6AX98-109	RMS6A	Inbred 98-109
2.	ICMA 843-22 X 58-64	ICMA 843-22	Inbred 58-64
3.	ICMA 843-22X 65-74	ICMA 843-22	Inbred 65-74
4.	ICMA 843-22 X 75-85	ICMA 843-22	Inbred 75/85
5.	ICMA 97111 A X 1-7	ICMA 977111	Inbred 1-7

Five pearl millet hybrids along with their parents were sown in petri plates under control environment to identify unique marker for variety identification and maintenance of genetic

purity in pearl millet. Plant genomic DNA was extracted from leaves of 6 day old seedlings (Sharma *et al* (2011)).

Results:

The DNA was purified and used for DNA fingerprinting through electrophoresis/ PCR analysis for identification of polymorphic markers unique for variety using SSR markers. In total, 15 SSR markers were used in this study to screen pearl millet hybrids (Table 2.8). Among these, few SSR markers showed polymorphism between the varieties used in this study. Study with some more SSR markers is in progress.

Table 2.8: List of SSR markers along with their nucleotide sequences used to study the polymorphism in pearl millet at Durgapura, Jaipur

Sr. No.	SSR marker	F/R	Primer sequence (5'-3')
1	PSMP2069	F	CCCATCTGAAATCTGGCTGAGAA
		R	CCGTGTTCGTACAAGGTTTTGC
2	PSMP2090	F	AGCAGCCCAGTAATACCTCAGCTC
		R	AGCCCTAGCGCACAACACAAACTC
3	PSMP2246	F	CGGATGCTAAATTAACCGAAGC
		R	CCAGCTTGCTTCTGTTGCGTTC
4	PSMP2273	F	AACCCCACCAGTAAGTTGTGCTGC
		R	GATGACGACAAGACCTTCTCTCC
5	PSMP2088	F	AAGAAGCCACCAGCACAAAA
		R	TGCATGAAAGTAGAGGATGGTAAA
6	PSMP2089	F	TTCGCCGCTGCTACATACTT
		R	TGTGCATGTTGCTGGTCATT
7	PSMP2206	F	AGAAGAAGAGGGGGTAAGAAGGAG
		R	AGCAACATCCGTAGAGGTAGAAG
8	PSMP2237	F	TGGCCTTGGCCTTTCCACGCTT
		R	CAATCAGTCCGTAGTCCACACCCCA
9	PSMP2056	F	ACCTGTAGCTTCAAAATTCAAAAA
		R	AATTCAGTGTGATTTCGATGTTGC
10	PSMP2251	F	TCAAACATAGATATGCCGTGCCTCC
		R	CAGCAAGTCGTGAGGTTCGGATA
		R	GGTTAGTTTGTTTGAGGCAAATGC
11	PSMP2086	F	CGCTTGTTTTCCTTTCTTGCTGTT
		R	CCTTCTCAGATCCTGTGCTTTCTT
12	PSMP2001	F	CATGAAGCCAATTAGGTCTC
		R	ACCATCTGACTTGTTCTTATCC
13	PSMP2248	F	TCTGTTTIGTTTGGGTCAGGTCCTTC
		R	CGAATACGTATGGAGAACTGCGCATC
14	PSMP2224	F	GGCGAATTGGAATTCAGATTG

Sr. No.	SSR marker	F/R	Primer sequence (5'-3')
		R	CGTAATCGTAGCGTCTCGTCTAA
15	PSMP2263	F	AAAGTGAATACGATACAGGAGCTGAG
		R	CATTTCAGCCGTTAAGTGAGACAA

Crop: Pearl millet
Centre: MPKV, Rahuri

Experimental details:

Name of hybrid: MH 2114 (DHBH1397)

Name of parental lines: DHLB 16 A (Female line); DHLB I 1035(Male (Restorer)); DHLB 16 B (Maintainer)

The present investigation was conducted during 2018. The experimental material was procured from AICPMIP, Pearl millet Research Scheme, Dhule, (MS).

Genomic DNA isolation: Young (15-20 days old) and healthy leaves were collected for genomic DNA extraction from individual plants. Total genomic DNA was isolated and purified according a modified CTAB protocol and the DNA quality for each sample was assessed on 1.2% agarose gel.

Genetic Purity Data Analysis: Clear and distinct bands amplified by SSR primers were scored for the presence and absence of the corresponding band among the genotypes. A dendrogram was constructed by using the unweighted pair group method with arithmetic average (UPGMA) with the XLSTAT to show a genetic relationship by the similarity coefficient.

SSR analysis

Primers used

1. PSMP-2013
2. PSMP-2056
3. PSMP-2089
4. PSMP-2246
5. PSMP-2263
6. PSMP-2270

Result: Out of six SSR primers three showed polymorphism among the genotypes. However, no unique marker was found for the hybrid purity testing.

Crop: Pearl-millet (Bajra)
Centre: CCS HAU Hisar
Experimental details:
Name of hybrid: HHB272
Name of parental lines: HMS47B x AC 04/13

Name of hybrid: HHB67
Name of parental lines: 843-22B x H77/833-2-202

Name of hybrid: HHB 197
Name of parental lines: 97 111B x HBL-11

Grow-out test was conducted to know the genetic purity of the hybrids along with their parents during kharif 2018 for which 400 plants were taken. For molecular marker analysis genomic DNA was extracted by CTAB/modified CTAB method (Taylor *et al.*, 1995). Quantification of DNA and assessment of DNA quality for each sample was studied on 1.2% agarose gel. PCR analysis was done by using unique markers (Nagawade *et al.,* 2016).

Results: Thirteen primers *viz.,* PSMP 2008, PSMP 2224. XCUMP 0018, ICMP 3018, CTM 10, PGIRD 46, PGIRD 50, PGIRD 54, PSMP 2027, CTM 55, PSMP 20, PSMP 2087 and ICMP 3056 were screened to identify the specific marker associated with hybrid and parental lines, out of these 13 primers, only 3 primers *viz.,* PSMP 2008, ICMP 3018 andPGIRD 46 were found highly polymorphic and reproducible which generated distinct and polymorphic banding patterns. These primers enabled the assessment of genetic diversity and hybrid purity.

Conclusion: Out of 13 SSR primers three showed polymorphism among the genotypes. However, no unique marker was found for the hybrid purity testing.

Crop: Sunflower
Centre: UAS, Bengaluru

Experimental details: Freshly harvested pure seeds were collected from AICRP on Sunflower, GKVK, Bangalore. Same methodology as for Hybrid Maize was followed.

Results: Unique SSR markers for varieties were identified (Table 2.9 and Figure 2.14-2.16).

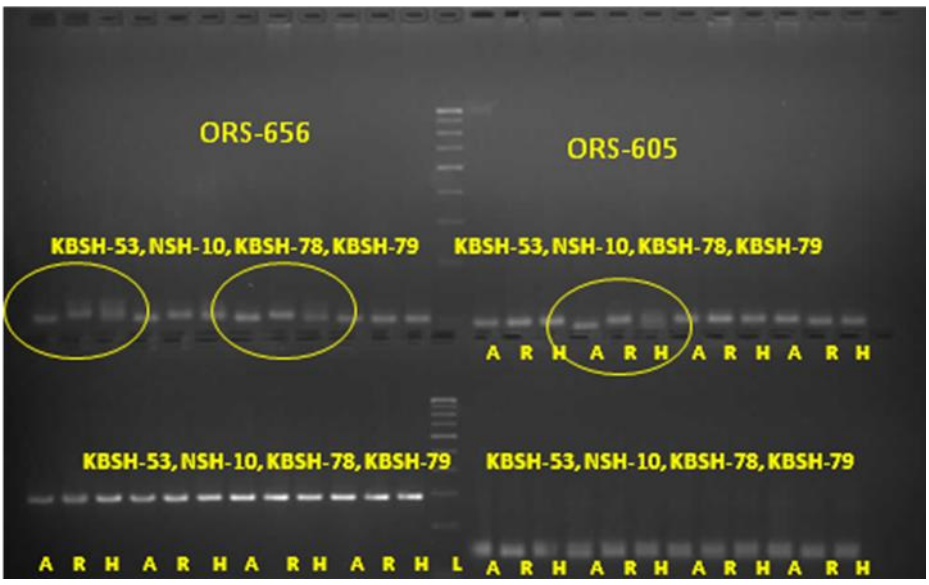


Figure 2.14: Polymorphic banding pattern of parental lines and sunflower hybrids using ORS 656 and ORS 605 SSR primers

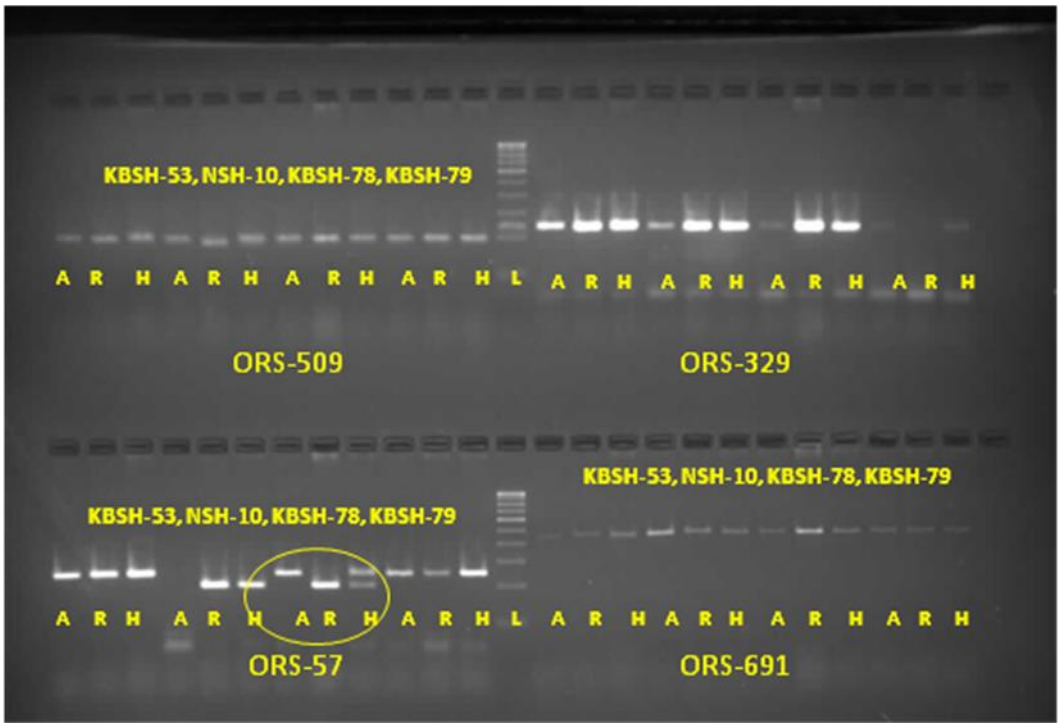


Figure 2.15: Polymorphic banding pattern of parental lines and sunflower hybrids using ORS 509, ORS329, ORS 57 and ORS 691 SSR primers

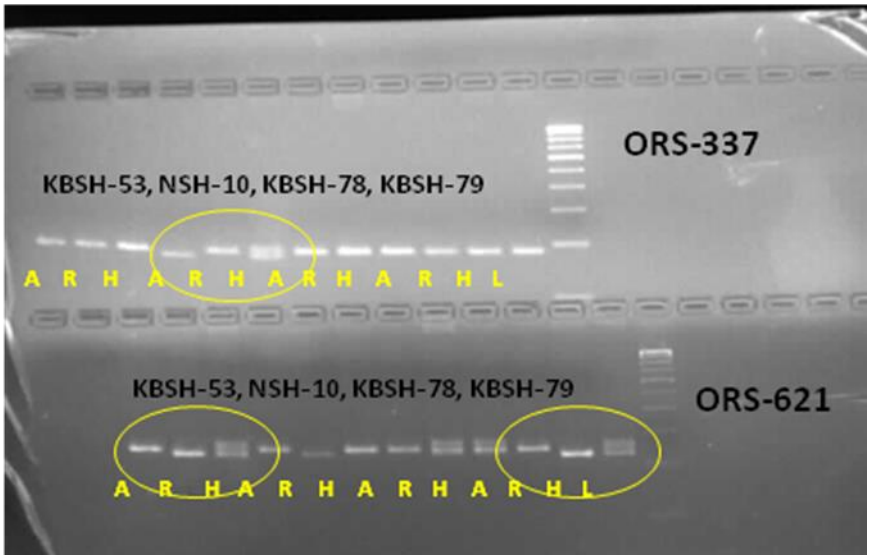


Figure 2.16: Polymorphic banding pattern of parental lines and sunflower hybrids using ORS 337 and ORS 621 SSR primers

Table 2.9: Identified Unique SSR Markers for Varieties

Hybrid	Unique marker	Parental line	Base Pair
1. KBSH-78	ORS-57	A	250 bp
		R	210 bp
	ORS-170	A	120 bp

		R	140 bp
2. KBSH-79	ORS-610	A	150 bp
		R	170 bp
3. KBSH-41	ORS-513	A	220 bp
		R	250 bp
	ORS-613	A	160 bp
		R	180 bp
4. KBSH-44	ORS-716	A	210 bp
		R	220 bp
5. KBSH-53	ORS-621	A	240 bp
		R	250 bp
	ORS-811	A	110 bp
		R	130 bp
6. NSH-10	ORS-513	A	210 bp
		R	180 bp
	ORS-605	A	190 bp
		R	210 bp
	ORS-337	A	180 bp
		R	190 bp

Conclusion: Out of 96 microsatellite primers studied eleven markers amplified a specific allele among the six hybrids studied. The experiment is in progress.

Highlights:

SSR markers that can be used for hybrid purity assessment

Crop	**SSR Marker**	**Hybrid**
Rice	RM276	JRH5 hybrid
Rice	RM234	AAU hybrid 3
Maize	phi053	MAH-14-5
Maize	umcl223	HEMA

Experiment 3: Physiology studies and development of priming technologies for enhancing planting value of seed in field crops under optimal and sub-optimal conditions

Note: The experiment 2 "Seed quality, health, yield, storability as affected by pre-sowing seed priming treatments in kabuli chickpea, field pea and lentil" (Year of start: 2014-15) of

the Seed Production and Certification/ Seed Processing project was merged with experiment 3 "Basic studies for developing priming technology in crop plants" (Year of start: 2016-17) of Seed Physiology, Storage and Testing project. One more objective "Development of seed enhancement techniques for low temperature stress during seedling establishment in maize and rice" was added.

Year of start: 2018-19

Objective:

1. Development of priming technologies for enhanced planting value of seed under sub-optimal conditions in field crops
2. Validation of standardized priming technologies in pigeon pea for sub-optimal conditions
3. Development of seed enhancement techniques for low temperature stress during seedling establishment in maize and rice

Crops		**Centres**
Chickpea	:	ICAR-IISS, Mau and CCS HAU, Hisar
Kabuli Chickpea	:	PAU, Ludhiana; JNKVV, Jabalpur; UAS, Raichur; MPKV, Rahuri; SKNAU, Durgapura and PDKV, Akola
Rice	:	UAS, Bengaluru; GBPUAT, Pantnagar; OUAT, Bhubaneswar and SKUAST, Kashmir, Srinagar
Field pea	:	CSAUAT, Kanpur; JNKVV, Jabalpur and NDUAT, Faizabad
Lentil	:	JNKVV, Jabalpur; NDUAT, Faizabad and CSAUAT, Kanpur
Mustard	:	ICAR-IARI, New Delhi; ICAR-CAZRI, Jodhpur and AAU, Anand;
Cotton	:	ICAR-CICR, Nagpur;
Speciality Maize	:	ICAR-IARI, New Delhi; RAU, TCA, Dholi and ICAR-VPKAS, Almora
For testing and validation		
Pigeonpea	:	ICAR-IARI, New Delhi; ICAR-IISS, Mau; AAU, Jorhat; PAU, Ludhiana; BSKKV, Dapoli and PAJANCOA&RI, Karaikal
For low temperature stress		
Maize	:	ICAR-VPKAS, Almora and RAU, TCA, Dholi
Rice	:	AAU, Jorhat; ICAR Research Complex for NEH Region, Shillong and ICARRC NEH Region - Manipur Centre

Sub. Experiment I (As per Objective 1): Development of priming technologies for enhanced planting value of seed under sub-optimal conditions in field crops

Materials: Each centre will use the seeds of location specific two most popular varieties (preferably one tolerant and other susceptible to sub-optimal condition of their locality). Two lots; fresh and one year old seeds of each variety will be taken for study for comparison, as germinability and other vigour parameters of high quality (Fresh) seeds may not significantly be improved by seed priming technologies. In case of non-availability of

aged seeds of same variety, the fresh seeds will be aged by giving recommended accelerated ageing treatments for creating the other (old) lot(s).

Treatment Details: For development of priming technologies for enhanced planting value of seed under sub-optimal conditions in field crops, following treatments will be given;

1. Control (Untreated)
2. Control (Crop and location specific recommended seed treatment(s) as per package of practices)
3. Hydropriming – Soaking in water for4h (at 20°C for Kabuli Chickpea), 6h (at 20°C for Chickpea), 30h (at 25°C for Paddy), 10h (at 20°C for Field pea), and 8h (at 25°C for Lentil) and air-drying at 25°C for 48h. The period, temperature and drying specified above may be the same for all other priming treatments. It is suggested to see if there are any instances of radicle *emergence during soaking period or the seeds are still absorbing water. If noticed, the duration has to be standardised first in each crop by respective centre. While standardization, please take into due consideration the temperature at which seeds are being primed and amount of solution or water (Wt. of seed = (1.5 Max.)Volume or water/solution is suggested)*
4. Halopriming- Soaking in 800ppm solution of Salicylic acid and drying
5. Halopriming- Soaking in KNO_3(@0.3%) solution and drying
6. Halopriming- Soaking in $MgNO_3$ (@2%) solution and drying
7. Halopriming- Soaking in KH_2PO_4(@0.5%) solution and drying
8. Halopriming- Soaking in $ZnSO_4$ (@0.3%) solution and drying
9. Halopriming- Soaking in $MnSO_4$ (@0.5%) solution and drying
10. Halopriming- Soaking in $ZnSO_4$ (@0.3%) + $MnSO_4$ (@0.5%) solution for and drying
11. Halopriming- Soaking in Nitric oxide (@0.25 mM) solution prepared by mixing 6.548g Sodium Nitroprusside (SNP) in 100ml water and drying
12. Seed coating (on dry seeds) with *T. harzianum* (**CFU –** 2 X 10^6per gm) @ 15 g / kg seed (Mix 15g in 50 ml of water and applied on 1 kg of seed uniformly. Shade drying the seeds for 20 – 30 minutes before sowing). CFUs are required to be counted before treatment.
13. Seed coating (on hydroprimed seeds) with *T. harzianum* (**CFU –** 2 X 10^6per gm) @ 15 g / kg seed (Mix 15g in 50 ml of water and applied on 1 kg of seed uniformly. Shade drying the seeds for 20 – 30 minutes before sowing). CFUs are required to be counted before treatment.
14. Seed coating (on dry seeds) with *T. viride* (**CFU –** 2 X 10^9per gm) @ 10 g / kg seed (Mix 10g in 50 ml of water and applied on 1 kg of seed uniformly. Shade drying the seeds for 20 – 30 minutes before sowing). CFUs in the consortium must be confirmed before treatment.
15. Seed coating (on hydroprimed seeds) with *T. viride* (**CFU –** 2 X 10^9per gm) @ 10 g / kg seed (Mix 10g in 50 ml of water and applied on 1 kg of seed uniformly. Shade drying the seeds for 20 – 30 minutes before sowing). CFUs in the consortium must be confirmed before treatment.

16. Microbial consortia for priming and abiotic stress mitigation (As supplied (Bio NPK, BIOGROW, Biophos, **Bio Pulse)** and treatment method suggested by the ICAR-NBAIM, Mau- Contact Person: **Dr. Hillol Chakdar,** hillol.chakdar@gmail.com (+91-8765107799).

Laboratory observations:

- Moisture content (ISTA) before and after treatment i.e. before sowing
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)
- Incidence of seed borne pathogens (%)

Field observations:

- Speed of emergence (Maguire, 1962)
- Final plant stand establishment (%) after 3 weeks in pulses and 6 weeks in cereals

NB: Observations to be recorded on minimum four replications of 100 seeds each, except SMC, which will to be estimated on dry weight basis as per ISTA recommendations.

Crop-wise and centre-wise research findings during 2018-19 (Experiment 3.I)

Chickpea

CCS HAU, Hisar

Experimental details:

Varieties: Two (HC 1 and HC 5)

Lots: Two L1 (Fresh); L2 (One year old)

Seed treatment details: In addition to above 18 treatments another treatment of Control (Seed treatment rhizobium@25g/kg) was taken as T2

Results: All the priming treatments showed significant enhancement in the seed quality parameters over control (Table 3.1 to 3.6). Maximum germination was observed in seeds treated with T_{14} -seeds coating (on hydro primed seeds) with BioNPK in variety HC 5 (92.67%) in fresh seed lot but overall germination was recorded maximum in seeds treated with T_{17} - Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + BioNPK).

Table 3.1: Effect of priming on seed germination (%)

Treatment	Variety 1 (V)			Variety 2 (V)			Mean (L×T)		Mean (Treat)
	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	L1	L2	
T1 (Control)	74.67 (59.77)	66.67 (54.73)	70.67 (57.25)	82.00 (64.89)	73.33 (58.93)	77.67 (61.91)	78.33 (62.33)	70.00 (56.83)	74.17 (59.58)
T2	84.67	80.67	82.67	87.33	86.00	86.67	86.00	83.33	84.67

	(67.27)	(63.91)	(65.59)	(69.31)	(68.11)	(68.71)	(68.29)	(66.01)	(67.15)
T3	80.67 (64.00)	77.33 (61.56)	79.00 (62.78)	86.00 (68.03)	82.67 (65.43)	84.33 (66.73)	83.33 (66.02)	80.00 (63.50)	81.67 (64.76)
T4	76.00 (60.69)	71.33 (57.61)	73.67 (59.15)	82.67 (65.40)	77.33 (61.58)	80.00 (63.49)	79.33 (63.05)	74.33 (59.59)	76.83 (61.32)
T5	75.33 (60.22)	70.67 (57.24)	73.00 (58.73)	88.67 (70.42)	86.67 (68.57)	87.67 (69.49)	82.00 (65.32)	78.67 (62.90)	80.33 (64.11)
T6	76.00 (60.65)	70.00 (56.80)	73.00 (58.73)	89.33 (71.17)	84.00 (66.42)	86.67 (68.79)	82.67 (65.91)	77.00 (61.61)	79.83 (63.76)
T7	78.00 (62.00)	73.33 (58.99)	75.67 (60.49)	88.00 (69.88)	89.33 (71.16)	88.67 (70.52)	83.00 (65.94)	81.33 (65.07)	82.17 (65.51)
T8	76.00 (60.69)	70.67 (57.20)	73.33 (58.95)	85.33 (67.47)	83.33 (65.94)	84.33 (66.70)	80.67 (64.08)	77.00 (61.57)	78.83 (62.82)
T9	83.33 (66.03)	81.33 (64.38)	82.33 (65.21)	88.67 (70.42)	86.00 (68.14)	87.33 (69.28)	86.00 (68.22)	83.67 (66.26)	84.83 (67.24)
T10	76.67 (61.20)	72.00 (58.09)	74.33 (59.64)	84.67 (66.99)	83.33 (65.94)	84.00 (66.46)	80.67 (64.09)	77.67 (62.01)	79.17 (63.05)
T11	89.33 (71.79)	85.33 (67.75)	87.33 (69.77)	86.67 (68.57)	84.00 (66.42)	85.33 (67.50)	88.00 (70.18)	84.67 (67.09)	86.33 (68.63)
T12	81.33 (64.41)	78.67 (62.53)	80.00 (63.47)	81.33 (64.38)	78.67 (62.47)	80.00 (63.43)	81.33 (64.39)	78.67 (62.50)	80.00 (63.45)
T13	81.33 (64.41)	79.33 (62.97)	80.33 (63.69)	83.33 (65.94)	79.33 (62.96)	81.33 (64.45)	82.33 (65.17)	79.33 (62.97)	80.83 (64.07)
T14	**86.67 (68.80)**	**80.67 (64.06)**	**83.67 (66.43)**	**92.67 (74.64)**	**86.00 (68.03)**	**89.33 (71.34)**	**89.67 (71.72)**	**83.33 (66.05)**	**86.50 (68.89)**
T15	84.67 (66.93)	80.00 (63.47)	82.33 (65.20)	92.00 (73.62)	87.33 (69.14)	89.67 (71.38)	88.33 (70.28)	83.67 (66.30)	86.00 (68.29)
T16	84.00 (66.48)	79.33 (63.04)	81.67 (64.76)	89.33 (70.93)	86.67 (68.64)	88.00 (69.79)	86.67 (68.70)	83.00 (65.84)	84.83 (67.27)
T17	92.00 (73.62)	88.67 (70.60)	90.33 (72.11)	88.67 (70.60)	84.67 (66.96)	86.67 (68.78)	90.33 (72.11)	86.67 (68.78)	88.50 (70.44)
T18	88.67 (70.36)	84.67 (66.99)	86.67 (68.67)	86.67 (68.57)	83.33 (65.99)	85.00 (67.28)	87.67 (69.46)	84.00 (66.49)	85.83 (67.98)
T19	86.00 (68.14)	82.67 (65.43)	84.33 (66.78)	89.33 (71.03)	86.00 (68.14)	87.67 (69.58)	87.67 (69.58)	84.33 (66.78)	86.00 (68.18)
Mean	81.86 (65.13)	77.54 (61.97)	79.70 (63.55)	86.98 (69.06)	83.58 (66.26)	85.28 (67.66)	84.42 (67.10)	80.56 (64.11)	82.49 (65.61)
SEd(±)	0.378	0.378	1.166	0.535	1.649	1.649	2.333		
CD (p=0.05)	V= 0.748	L= 0.748	T= 2.305	V×L= NS	V×T= 3.259	L×T= NS	V×L×T=NS		

#Values in the parenthesis are arc-sine transformed of the original

Table 2: Effect of priming on seedling length (cm)

Treatment	Variety 1 (V)			Variety 2 (V)			Mean (L×T)		Mean (Treat)
	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	L1	L2	
T1 (Control)	23.63	22.73	23.18	22.47	17.93	20.20	23.05	20.33	21.69
T2	28.87	27.67	28.27	25.53	18.73	22.13	27.20	23.20	25.20
T3	32.27	29.93	31.10	23.67	19.87	21.77	27.97	24.90	26.43
T4	28.50	27.43	27.97	24.47	21.07	22.77	26.48	24.25	25.37
T5	29.60	28.47	29.03	29.00	22.47	25.73	29.30	25.47	27.38
T6	33.60	29.07	31.33	25.33	20.53	22.93	29.47	24.80	27.13

T7	37.00	31.20	34.10	24.67	19.53	22.10	30.83	25.37	28.10
T8	33.60	31.33	32.47	28.80	23.33	26.07	31.20	27.33	29.27
T9	33.13	31.43	32.28	29.87	22.67	26.27	31.50	27.05	29.28
T10	31.60	28.00	29.80	26.33	19.87	23.10	28.97	23.93	26.45
T11	26.57	25.43	26.00	23.40	18.87	21.13	24.98	22.15	23.57
T12	27.67	26.03	26.85	24.13	20.00	22.07	25.90	23.02	24.46
T13	26.50	25.60	26.05	23.60	18.47	21.03	25.05	22.03	23.54
T14	**29.80**	**28.23**	**29.02**	**26.33**	**22.33**	**24.33**	**28.07**	**25.28**	**26.67**
T15	28.13	27.80	27.97	28.07	23.07	25.57	28.10	25.43	26.77
T16	32.70	30.87	31.78	28.00	21.80	24.90	30.35	26.33	28.34
T17	32.00	30.33	31.17	32.20	24.20	28.20	32.10	27.27	29.68
T18	30.37	28.60	29.48	29.40	21.33	25.37	29.88	24.97	27.43
T19	29.80	28.33	29.07	26.13	22.13	24.13	27.97	25.23	26.60
Mean	30.28	28.34	29.31	26.39	20.96	23.67	28.34	24.65	26.49
SEd(±)	0.537	0.537	1.656	0.760	2.342	2.342	3.312		
CD (p=0.05)	V= 1.062	L= 1.062	T= 3.272	V×L= 1.501	V×T= NS	L×T= NS	V×L×T=NS		

Table 3: Effect of priming on seedling dry weight (mg)

Treatment	Variety 1 (V)			Variety 2 (V)			Mean (L×T)		Mean (Treat)
	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	L1	L2	
T1 (Control)	0.101	0.077	0.089	0.137	0.115	0.126	0.119	0.096	0.108
T2	0.120	0.081	0.101	0.150	0.131	0.141	0.135	0.106	0.121
T3	0.132	0.104	0.118	0.145	0.122	0.134	0.139	0.113	0.126
T4	0.133	0.097	0.115	0.183	0.128	0.156	0.158	0.113	0.135
T5	0.123	0.099	0.111	0.185	0.136	0.161	0.154	0.118	0.136
T6	0.123	0.102	0.113	0.156	0.140	0.148	0.140	0.121	0.130
T7	0.126	0.107	0.117	0.152	0.122	0.137	0.139	0.115	0.127
T8	0.112	0.086	0.099	0.164	0.131	0.148	0.138	0.109	0.123
T9	0.122	0.093	0.108	0.154	0.131	0.143	0.138	0.112	0.125
T10	0.108	0.081	0.095	0.154	0.121	0.138	0.131	0.101	0.116
T11	0.111	0.106	0.109	0.145	0.120	0.133	0.128	0.113	0.121
T12	0.121	0.091	0.106	0.171	0.135	0.153	0.146	0.113	0.130
T13	0.128	0.088	0.108	0.159	0.132	0.146	0.144	0.110	0.127
T14	**0.132**	**0.097**	**0.115**	**0.178**	**0.136**	**0.157**	**0.155**	**0.117**	**0.136**
T15	0.122	0.093	0.108	0.199	0.147	0.173	0.161	0.120	0.140
T16	0.126	0.096	0.111	0.195	0.145	0.170	0.161	0.121	0.141
T17	0.118	0.095	0.107	0.200	0.144	0.172	0.159	0.120	0.139
T18	0.116	0.092	0.104	0.165	0.141	0.153	0.141	0.117	0.129
T19	0.118	0.090	0.104	0.182	0.137	0.160	0.150	0.114	0.132
Mean	0.121	0.093	0.107	0.167	0.132	0.150	0.144	0.113	0.128
SEd(±)	0.01	0.01	0.04	0.02	0.06	0.06	0.08		
CD (p=0.05)	V= 0.03	L= 0.03	T= 0.08	V×L= 0.04	V×T= 0.012	L×T= 0.012	V×L×T=NS		

Table 4: Effect of priming on seed vigour index I

Treatment	Variety 1 (V)			Variety 2 (V)			Mean (L×T)		Mean (Treat)
	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	L1	L2	
T1 (Control)	1765	1519	1642	1847	1315	1581	1806	1417	1612

T2	2444	2236	2340	2214	1602	1908	2329	1919	2124
T3	2596	2318	2457	2034	1649	1841	2315	1983	2149
T4	2166	1955	2061	2019	1630	1824	2093	1793	1943
T5	2230	2008	2119	2561	1944	2253	2396	1976	2186
T6	2549	2031	2290	2273	1733	2003	2411	1882	2147
T7	2886	2287	2587	2174	1759	1967	2530	2023	2277
T8	2549	2217	2383	2461	1940	2201	2505	2079	2292
T9	2759	2555	2657	2650	1951	2300	2705	2253	2479
T10	2433	2021	2227	2240	1666	1953	2336	1843	2090
T11	2372	2170	2271	2025	1580	1802	2199	1875	2037
T12	2250	2045	2148	1961	1570	1765	2106	1807	1956
T13	2156	2031	2093	1957	1468	1713	2057	1749	1903
T14	**2587**	**2281**	**2434**	**2458**	**1924**	**2191**	**2522**	**2103**	**2312**
T15	2381	2226	2304	2572	2013	2292	2477	2119	2298
T16	2751	2448	2599	2499	1884	2192	2625	2166	2396
T17	2944	2685	2815	2840	2038	2439	2892	2361	2627
T18	2692	2425	2558	2545	1784	2164	2619	2104	2361
T19	2566	2337	2452	2333	1919	2126	2450	2128	2289
Mean	2478	2200	2339	2298	1756	2027	2388	1978	2183
SEd(±)	47.28	47.28	145.72	66.86	206.07	206.07	291.43		
CD (p=0.05)	V= 93.41	L= 93.41	T= 287.92	V×L= 132.11	V×T= NS	L×T= NS	V×L×T=NS		

Table 5: Effect of priming on vigour index II

Treatment	Variety 1 (V)			Variety 2 (V)			Mean (L×T)		Mean (Treat)
	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	L1	L2	
T1 (Control)	7.56	5.14	6.35	11.27	8.39	9.83	9.41	6.76	8.09
T2	10.17	6.51	8.34	13.10	11.23	12.17	11.64	8.87	10.25
T3	10.65	8.02	9.33	12.45	10.13	11.29	11.55	9.08	10.31
T4	10.09	6.90	8.49	15.15	9.90	12.53	12.62	8.40	10.51
T5	9.29	7.00	8.15	16.35	11.76	14.05	12.82	9.38	11.10
T6	9.37	7.16	8.26	13.98	11.80	12.89	11.67	9.48	10.57
T7	9.83	7.82	8.82	13.36	10.89	12.12	11.59	9.35	10.47
T8	8.48	6.11	7.29	13.97	10.94	12.46	11.23	8.52	9.87
T9	10.17	7.54	8.86	13.64	11.28	12.46	11.91	9.41	10.66
T10	8.32	5.81	7.06	13.04	10.10	11.57	10.68	7.96	9.32
T11	9.92	9.04	9.48	12.60	10.05	11.32	11.26	9.55	10.40
T12	9.87	7.15	8.51	13.94	10.65	12.29	11.90	8.90	10.40
T13	10.41	6.99	8.70	13.26	10.47	11.86	11.83	8.73	10.28
T14	**11.46**	**7.79**	**9.63**	**16.59**	**11.72**	**14.15**	**14.03**	**9.75**	**11.89**
T15	10.37	7.46	8.91	18.34	12.86	15.60	14.36	10.16	12.26
T16	10.62	7.65	9.13	17.40	12.57	14.98	14.01	10.11	12.06
T17	10.85	8.47	9.66	17.68	12.19	14.94	14.27	10.33	12.30
T18	10.29	7.76	9.02	14.29	11.74	13.02	12.29	9.75	11.02
T19	10.13	7.45	8.79	16.30	11.77	14.04	13.22	9.61	11.41
Mean	9.89	7.25	8.57	14.56	11.08	12.82	12.22	9.16	10.69
SEd(±)	0.129	0.129	0.397	0.182	0.561	0.561	0.793		
CD (p=0.05)	V= 0.254	L= 0.254	T= 0.784	V×L= 0.360	V×T= 1.108	L×T= 1.108	V×L×T=NS		

Table 6: Effect of priming on field emergence (%)

Treatment	Variety 1 (V)			Variety 2 (V)			Mean (L×T)		Mean (Treat)
	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	Lot 1 (L)	Lot 2 (L)	Mean (V×T)	L1	L2	
T1 (Control)	64 (53)	55(48)	60(51)	71(57)	63(53)	67(55)	68(55)	59(50)	63(53)
T2	76(60)	70(57)	73(59)	75(60)	75(60)	75(60)	76(60)	73(59)	74(59)
T3	70(57)	67(55)	69(56)	76(61)	73(59)	75(60)	73(59)	70(57)	72(58)
T4	66(54)	61(51)	63(53)	72(58)	66(55)	69(56)	69(56)	64(53)	66(55)
T5	66(55)	60(51)	63(53)	79(62)	76(61)	78(62)	73(58)	68(56)	70(57)
T6	67(55)	60(51)	64(53)	80(63)	74(59)	77(61)	74(59)	67(55)	70(57)
T7	68(56)	63(53)	66(54)	79(63)	79(63)	79(63)	74(59)	71(57)	72(58)
T8	66(54)	60(51)	63(53)	76(61)	73(59)	75(60)	71(57)	67(55)	69(56)
T9	74(59)	72(58)	73(58)	79(62)	75(60)	77(61)	76(61)	74(59)	75(59)
T10	66(55)	61(52)	64(53)	74(59)	73(59)	74(59)	70(57)	67(55)	69(56)
T11	80(63)	76(60)	78(62)	77(61)	74(59)	75(60)	78(62)	75(60)	77(61)
T12	71(57)	67(55)	69(56)	71(57)	66(55)	69(56)	71(57)	67(55)	69(56)
T13	71(57)	69(56)	70(57)	73(59)	69(56)	71(57)	72(58)	69(56)	71(57)
T14	**77(61)**	**71(57)**	**74(59)**	**83(66)**	**76(61)**	**80(63)**	**80(63)**	**74(59)**	**77(61)**
T15	73(59)	71(57)	72(58)	84(66)	77(61)	80(64)	79(62)	74(59)	76(61)
T16	74(59)	69(56)	72(58)	78(62)	75(60)	77(61)	76(61)	72(58)	74(59)
T17	82(65)	80(63)	81(64)	79(62)	73(59)	76(61)	80(64)	77(61)	78(62)
T18	78(62)	75(60)	76(61)	77(61)	72(58)	74(59)	77(62)	73(59)	75(60)
T19	77(61)	72(58)	75(60)	79(63)	76(60)	77(62)	78(62)	74(59)	76(61)
Mean	(58)	(55)	(57)	(61)	(59)	(60)	(60)	(57)	(58)
SEd(±)	0.114	0.114	0.286	0.197	0.495	0.495	0.857		
CD (p=0.05)	V= 0.223	L= 0.223	T= 0.562	V×L= NS	V×T= 0.974	L×T= 0.974	V×L×T=NS		

#Values in the parenthesis are arc-sine transformed of the original

Conclusion or Salient Finding(s): Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + BioNPK in chickpea enhances the germination percentage in both old as well as fresh seed lots and in both the varieties.

Kabuli Chickpea

UAS, Raichur

The seed material of kabuli chickpea variety MNK-1 with two vigour levels (Fresh seeds: Lot 1, One year old seeds: Lot 2) was collected from Seed Unit, UAS, Raichur and used for the experiment. Only one variety was selected for the study as there is no availability of other variety in the region. These low and high vigour seeds were subjected to priming with different treatments as detailed below.

Details of Treatments:

T_1 - Control (Untreated)

T_2 – Thiram seed treatment @ 2g/Kg

T_3 - Hydropriming – Soaking in water for 4h (at 20°C) and air-drying at 25°C for 48h

T_4 - Halopriming- Soaking in KNO_3 (@0.3%) solution and drying

T_5 - Halopriming- Soaking in $MgNO_3$ (@2%) solution and drying

T_6- Halopriming- Soaking in KH_2PO_4 (@0.5%) solution and drying

T_7 - Halopriming- Soaking in $ZnSO_4$ (@0.3%) solution and drying

T_8 - Halopriming- Soaking in $MnSO_4$ (@0.5%) solution and drying

T_9- Halopriming- Soaking in $ZnSO_4$ (@0.3%) + MnSO4 (@0.5%) solution for and drying

T_{10} - Seed coating (on hydro primed seeds) with *T. harzianum* (CFU – 2 X 10^6per gm) @ 15 g / kg seed (15g in 50 ml of water and applied on 1 kg of seed uniformly. Later seeds were shade dried for 20 – 30 minutes before sowing).

T_{11} - Seed coating (on hydro primed seeds) with *T. viride* (CFU – 2 X 10^9per gm) @ 10 g / kg seed (10 g in 50 ml of water and applied on 1 kg of seed uniformly. Later seeds were shade dried for 30 minutes before sowing.

T_{12} - Seed coating (on hydro primed seeds) with BioNPK (containing 1 x 10^9 cfu)

T_{13}- Seed coating (on hydro primed seeds) with Biogrow (containing 1 x 10^9 cfu)

T_{14} - Seed coating (on hydro primed seeds) with Biophos (containing 1 x 10^9 cfu)

T_{15} - Seed coating (on hydro primed seeds)) with Drought Alleviating Bacteria + BioNPK

T_{16} - Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biogrow

T_{17} - Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biophos

Results: The results revealed that various priming treatments enhanced the germination and other seed quality parameters of fresh and aged seeds (Tables 3.7 to 3.9). The fresh seeds hydroprimed exhibited significantly higher percentage of normal seedlings in first count (65.33), germination percentage (92.00%) followed by Halopriming- Soaking in $ZnSO_4$ (@0.3%) + MnSO4 (@0.5%) solution (61.25, 89.0 respectively) as compared to un-primed seeds (55.25, 85.50 respectively). There was significant increase in normal seedlings at first count, percent germination in case of aged seed lot which undergone priming with water (61.50, 71.00% respectively) followed by Halopriming- Soaking in $ZnSO_4$ (@0.3%) solution (51.25, 70.0 respectively) as compared to un-primed seeds. The aged seeds showed better improvement in germination as compared to fresh seeds because in seeds of good quality, close to optimum performance, naturally the possibility of improving seed quality is limited as compared to seeds of lower quality with physiological deficiencies.

Among the various priming treatments, hydroprimed seeds and seeds treated with thiram @ 2g/Kg recorded less infection in both fresh seeds (2 %) compared to unprimed seeds (6.75%) and other treatments. In case of old seeds, seeds treated with thiram @ 2g/Kg and hydroprimed seeds recorded less infection (3.00, 2.75 % respectively) as compared to un-primed seeds.

Conclusion: Seed priming improved all the seed quality attributes in fresh and aged seeds. The aged seeds have recorded 26.05 per cent increase in germination percentage in contrast to 7.38 increases in fresh seeds. Among the various priming treatments imposed, hydro priming showed better results compared to rest of the treatments both in fresh and old seeds.

Suggestion(s), if any: Preliminary studies are required to include the priming treatments in the experiment as germination was not observed in few treatments (Halopriming- Soaking in 800ppm solution of Salicylic acid and Halopriming- Soaking in Nitric oxide (@0.25 mM) solution)

Table 3.7: Effect of seed priming treatments on moisture before and after seed priming and first count (%) in two lots of kabuli chickpea variety MNK-1

	Moisture (%) before seed priming			Moisture (%) after seed priming			First count (%)		
Treatments (T)	**Lot 1**	**Lot 2**	**Mean**	**Lot 1**	**Lot 2**	**Mean**	**Lot 1**	**Lot 2**	**Mean**
T_1	9.03	8.68	8.85	9.15	9.58	9.37	55.25	41.50	48.38
T_2	9.10	9.05	9.08	13.03	11.78	12.40	60.75	48.50	54.63
T_3	**9.13**	**9.10**	**9.11**	**18.23**	**17.13**	**17.68**	**65.50**	**61.50**	**63.50**
T_4	9.18	9.00	9.09	19.58	19.70	19.64	61.00	51.50	56.25
T_5	8.93	9.00	8.96	19.40	19.65	19.53	62.25	34.25	48.25
T_6	9.23	9.15	9.19	19.03	19.60	19.31	63.25	47.00	55.13
T_7	9.28	9.03	9.15	18.38	19.50	18.94	59.00	51.25	55.13
T_8	9.28	9.03	9.15	18.73	20.20	19.46	59.50	48.50	54.00
T_9	9.10	8.93	9.01	19.53	18.50	19.01	61.25	48.75	55.00
T_{10}	9.15	9.10	9.13	18.60	18.40	18.50	54.50	47.50	51.00
T_{11}	9.13	9.00	9.06	17.33	18.13	17.73	58.00	48.25	53.13
T_{12}	9.05	9.03	9.04	19.83	19.80	19.81	55.00	49.25	52.13
T_{13}	8.95	9.03	8.99	19.68	19.68	19.68	56.50	45.50	51.00
T_{14}	8.98	8.95	8.96	19.73	19.78	19.75	59.00	49.00	54.00
T_{15}	9.08	8.98	9.03	19.53	20.30	19.91	48.25	47.25	47.75
T_{16}	9.13	9.10	9.11	19.23	20.50	19.86	49.00	46.75	47.88
T_{17}	9.03	9.05	9.04	19.68	20.60	20.14	46.25	47.25	46.75
SEd (**±**)	0.10			0.22			2.12		
CD (p=0.05)	0.28			0.62			5.96		
CD (p=0.01)	0.37			0.81			7.88		

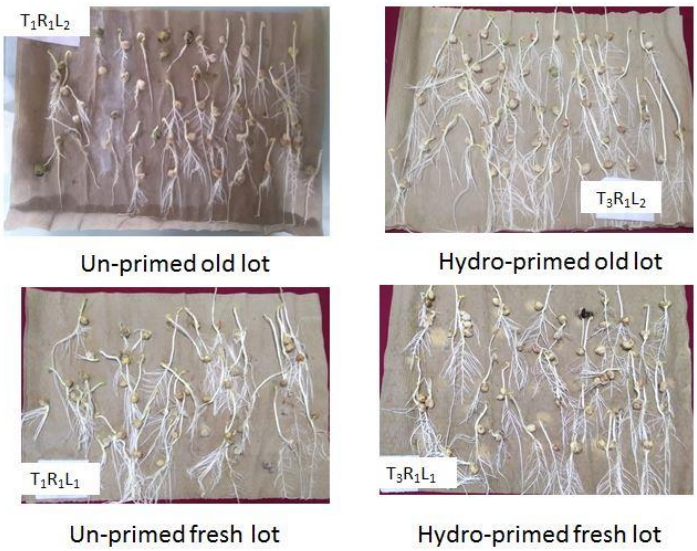
Table 3.8: Effect of seed priming treatments on mean germination, seedling vigour index-I and Seedling vigour index-II in in two lots of kabuli chickpea variety MNK-1

	Germination (%)			Seedling vigour index-I			Seedling vigour index-II		
Treatments (T)	**Lot 1**	**Lot 2**	**Mean**	**Lot 1**	**Lot 2**	**Mean**	**Lot 1**	**Lot 2**	**Mean**
T_1	85.50	56.25	70.88	1156	497	826	49823	27680	38752
T_2	88.00	59.75	73.88	1230	605	918	54742	31184	42963
T_3	**92.00**	**71.00**	**81.50**	**1608**	**972**	**1290**	**63287**	**42247**	**52767**
T_4	86.50	62.00	74.25	1375	625	1000	55669	34603	45136
T_5	85.25	64.25	74.75	1161	686	924	53964	38840	46402
T_6	89.75	64.00	76.88	996	833	914	55543	38332	46937

T_7	85.00	70.00	77.50	1388	947	1168	54769	40764	47767
T_8	85.50	69.25	77.38	1283	908	1096	51183	38061	44622
T_9	89.00	64.75	76.88	1492	658	1075	58375	34918	46647
T_{10}	87.25	61.25	74.25	1221	679	950	53223	32798	43011
T_{11}	86.75	64.75	75.75	1257	778	1018	52850	34923	43887
T_{12}	86.00	65.75	75.88	1335	676	1005	51096	34728	42912
T_{13}	87.50	62.25	74.88	1282	646	964	51581	30620	41100
T_{14}	86.50	65.25	75.88	1329	741	1035	52045	33425	42735
T_{15}	85.25	64.50	74.88	1254	665	959	55644	34503	45074
T_{16}	86.25	65.25	75.75	1306	794	1050	52837	33144	42991
T_{17}	87.00	63.00	75.00	1331	785	1058	50520	33631	42076
SEd (**±**)	1.02			88			2119		
CD (p=0.05)	2.86			250			5945		

Table 3.9: Effect of seed priming treatments on seed infection (%) and speed of emergence in in two lots of kabuli chickpea variety MNK-1

Treatments (T)	Seed infection (%)			Speed of emergence		
	Lot 1	Lot 2	Mean	Lot 1	Lot 2	Mean
T_1	6.75	5.25	6.00	0.326	0.276	0.301
T_2	2.00	3.00	2.50	0.339	0.292	0.315
T_3	**2.00**	**2.75**	**2.38**	**0.394**	**0.379**	**0.387**
T_4	3.00	4.00	3.50	0.259	0.303	0.281
T_5	3.75	5.00	4.38	0.328	0.327	0.328
T_6	4.25	5.25	4.75	0.335	0.328	0.332
T_7	3.50	2.75	3.13	0.317	0.353	0.335
T_8	2.75	3.50	3.13	0.299	0.298	0.299
T_9	2.75	4.75	3.75	0.359	0.307	0.333
T_{10}	3.25	4.25	3.75	0.346	0.286	0.316
T_{11}	3.75	4.50	4.13	0.338	0.333	0.336
T_{12}	5.25	5.50	5.38	0.334	0.292	0.313
T_{13}	5.25	5.50	5.38	0.353	0.346	0.349
T_{14}	6.00	7.25	6.63	0.358	0.344	0.351
T_{15}	5.25	5.00	5.13	0.320	0.320	0.320
T_{16}	4.00	6.50	5.25	0.333	0.308	0.321
T_{17}	6.25	7.00	6.63	0.324	0.325	0.324
SEd (**±**)	1.10			0.011		
CD (p=0.05)	3.30			0.031		



Effect of seed priming on seed germination in kabuli chickpea MNK-1

MPKV, Rahuri

Variety: **V_1:** BDNGK798 **V_2:** Virat **Seed type: F**: Fresh **R:** Old

Results: The data on effect of variety, seed type and seed treatment on seed quality of Kabuli chickpea are presented in table 3.10 to 3.13.

Effect of seed treatment: The germination percentage due to the treatment, seed coating with drought alleviating bacteria + Biogrow (T_{18}) was significantly higher (95.50 %) followed by soaking in $ZnSO_4$ @ 0.3 % + $MnSO_4$ @ 0.5 % (T_{10}) (94.08 %). The seed moisture content was significantly lowest (9.05 %) in the treatment seed coating with T. harzianum (T_{12}). Seed quality parameters *viz.,* root shoot length (37.51 cm), seedling dry weight (2.14 g), field emergence (84.75 %) vigour index I (3582) and vigour index II (204.79) have recorded significantly higher values due to the treatment seed coating with drought alleviating bacteria + Biogrow (T_{18}).

Effect of variety: The germination percentage of the variety Virat was significantly higher (93.50 %) which also recorded significantly higher root shoot length (32.50 cm) seedling dry weight (1.86 g), field emergence (81.72 %), vigour index I (3043) & vigour index II (174.71).

Effect of seed type: The fresh seed recorded significantly higher germination percentage (93.87 %). Root shoot length (32.65 cm), seedling dry weight (1.84 g), field emergence (83.61 %), vigour index I (3067) and vigour index II (173.16).

Interaction effect of variety, seed type and seed treatment: The germination percentage (97.00 %) was significantly higher in the treatment combination of fresh seed of Virat variety coated with drought alleviating bacteria + Biogrow (V_2FT_{18}). Other quality parameters viz; moisture content before treatment, root shoot length seedling dry weight, field emergence, vigour index I & II were not influenced significantly.

Table 3.10: Effect of variety seed types and treatments on seed quality of kabuli chickpea

Treatments	Germination (%)	MC	MC

		(Before Treatment)	(After Treatment)
T_1	90.75 (72.55)	8.96	9.40
T_2	91.25 (72.95)	8.99	9.43
T_3	92.75 (74.67)	8.70	9.24
T_4	91.25 (72.95)	9.00	9.24
T_5	92.25 (74.11)	8.99	9.27
T_6	92.25 (74.08)	8.71	9.11
T_7	92.25 (74.04)	8.95	9.18
T_8	94.00 (76.04)	8.99	9.42
T_9	92.25 (74.03)	8.97	9.38
T_{10}	94.08 (76.08)	8.72	9.18
T_{11}	91.25 (72.98)	9.00	9.47
T_{12}	92.25 (74.10)	8.95	9.05
T_{13}	92.00 (73.89)	8.98	9.15
T_{14}	93.00 (74.93)	8.71	9.17
T_{15}	93.00 (74.92)	9.02	9.25
T_{16}	92.50 (74.41)	8.98	9.24
T_{17}	93.50 (75.52)	8.98	9.21
T_{18}	95.50 (78.05)	8.95	9.21
T_{19}	93.50 (75.32)	8.97	9.16
SEM(±)	0.88	0.200	0.07
CD(p=0.05)	2.46	NS	0.20
Variety			
V_1: BDNGK 798	91.54 (73.35)	8.85	9.14
V_2: Virat	93.50 (75.53)	8.99	9.36
SEM(±)	0.29	0.065	0.023
CD(p=0.05)	0.80	NS	0.065
Seed type			
F: Fresh	93.87 (75.88)	8.97	9.35
R: Old seed	91.17 (73.00)	8.87	9.15
SEM(±)	0.29	0.065	0.023
CD(p=0.05)	0.80	NS	0.065

*Figures in parenthesis are arc sin transformed values

Table 3.11: Effect of variety, seed types and treatments on seed quality of kabuli chickpea

Treatments	R/S length(cm)	Seedling dry wt (g)	Field emergence (%)
T_1	25.27	1.31	77.50 (61.81)
T_2	26.77	1.51	78.50 (62.53)
T_3	27.90	1.60	80.50 (63.95)
T_4	30.35	1.65	79.83 (63.44)
T_5	30.92	1.71	80.00 (63.52)
T_6	30.87	1.82	79.75 (63.36)
T_7	31.45	1.68	80.00 (63.52)
T_8	32.15	1.82	80.25 (63.80)
T_9	32.96	1.85	80.33 (63.85)
T_{10}	33.10	1.81	81.00 (64.26)

T_{11}	34.13	1.90	78.75 (62.67)
T_{12}	32.02	1.93	79.75 (63.35)
T_{13}	34.05	1.89	79.42 (63.12)
T_{14}	33.65	1.88	80.75 (64.14)
T_{15}	34.51	1.94	80.50 (63.93)
T_{16}	34.52	2.02	80.25 (63.76)
T_{17}	35.00	2.033	81.75 (64.79)
T_{18}	37.51	2.14	84.75 (67.20)
T_{19}	36.28	2.01	82.50 (65.38)
SEM(±)	0.18	0.030	0.44
CD(p=0.05)	0.50	0.083	1.22
Variety			
V_1: BDNGK 798	32.07	1.77	78.92 (62.80)
V_2: Virat	32.50	1.86	81.72 (64.82)
SEM(±)	**0.06**	**0.010**	**0.14**
CD(p=0.05)	**0.16**	**0.027**	**0.39**
Seed type			
F: Fresh	32.65	1.84	83.61 (66.19)
R: Old seed	31.92	1.79	77.04 (61.43)
SEM(±)	0.06	**0.010**	**0.14**
CD(p=0.05)	**0.16**	**0.027**	**0.40**

*Figures in parenthesis are arc sin transformed values

Table 3.12: Effect of variety, seed types and treatments on seed quality of kabuli Chickpea

Treatments	Vigour index (I)	Vigour index (II)
T_1	2295	118.78
T_2	2405	135.56
T_3	2588	148.54
T_4	2770	150.63
T_5	2854	157.82
T_6	2849	167.58
T_7	2902	154.78
T_8	3023	170.90
T_9	3042	170.74
T_{10}	3114	170.74
T_{11}	3116	173.19
T_{12}	2955	178.55
T_{13}	3133	173.99
T_{14}	3130	175.20
T_{15}	3210	181.25
T_{16}	3194	187.76
T_{17}	3274	190.11
T_{18}	3582	204.79
T_{19}	3383	187.68
SEM(±)	31.79	3.38
CD(p=0.05)	88.82	9.45
Variety		
V_1: BDNGK 798	2939	161.98

V_2: Virat	3043	174.71
SEM(±)	10.31	1.097
CD(p=0.05)	28.82	3.066
Seed type		
F: Fresh	3067	173.16
R: Old seed	2914	163.54
SEM(±)	10.31	1.097
CD(p=0.05)	3067	173.16

Table 3.13: Interaction effect of variety, seed types and treatments on seed quality of kabuli Chickpea

Treatments	Germination (%)	M.C. (Before Trt.)	M.C. (After Trt.)	R/S length (cm)	Seedling dry wt (g)	Field emergence (%)	Vigour index (I)	Vigour index (II)
V1FT1	92.00 (73.57)	8.92	9.78	25.00	1.30	81.00 (64.16)	2326	121.00
V1FT2	93.00 (74.66)	8.96	9.75	26.80	1.50	82.00 (64.90)	2467	138.36
V1FT3	94.00 (75.82)	8.8	9.98	28.00	1.60	83.00 (65.65)	2632	150.62
V1FT4	92.00 (73.57)	8.97	9.62	30.20	1.65	84.33 (66.68)	2780	151.91
V1FT5	93.00 (74.66)	8.98	9.69	31.10	1.47	82.00 (64.90)	2892	136.79
V1FT6	93.00 (74.66)	8.9	9.5	30.60	1.81	82.00 (64.90)	2846	168.35
V1FT7	93.00 (74.66)	8.93	8.98	31.70	1.60	82.00 (64.90)	2949	148.69
V1FT8	94.00 (75.82)	8.98	8.98	32.40	1.80	83.00 (65.65)	3046	169.15
V1FT9	93.00 (74.66)	8.95	9.1	33.00	1.85	82.00 (64.90)	3069	172.11
V1FT10	94.00 (75.82)	8.97	8.99	33.60	1.82	83.00 (65.65)	3158	170.80
V1FT11	92.00 (73.57)	8.92	8.98	34.00	1.90	81.00 (64.16)	3129	174.88
V1FT12	93.00 (74.66)	8.91	9.05	32.00	1.93	82.00 (64.90)	2976	179.54
V1FT13	93.00 (74.66)	8.96	9.1	34.40	1.90	81.67 (64.65)	3201	176.71
V1FT14	94.00 (75.82)	8.95	8.98	33.80	1.83	84.00 (66.42)	3178	172.08
V1FT15	94.00 (75.82)	8.97	9.03	34.70	1.93	83.00 (65.65)	3262	181.47
V1FT16	93.00 (74.66)	8.92	8.98	34.80	1.96	83.00 (65.65)	3237	182.39
V1FT17	94.00 (75.82)	8.98	9.15	35.00	2.00	83.00 (65.65)	3292	188.06
V1FT18	96.00 (78.46)	8.92	9.07	37.50	2.10	86.00 (68.03)	3600	201.67

V1FT19	94.00 (75.82)	8.9	8.96	36.00	1.95	84.00 (66.42)	3384	183.35
SEM(±)	**1.76**	**0.400**	**0.142**	**0.35**	**0.06**	**0.87**	**63.56**	**6.76**
CD(p=0.05)	**2.49**	**NS**	**0.398**	**NS**	**NS**	**NS**	**NS**	**NS**

*Figures in parenthesis are arc sin transformed values

Table 3.13 contd…

Treatments	Germination (%)	M.C. (Before Trt.)	M.C. (After Trt.)	R/S length (cm)	Seedling dry wt (g)	Field emergence (%)	Vigour index (I)	Vigour index (II)
V1RT1	86.00 (68.08)	8.95	8.98	24.80	1.25	72.00	2157	108.55
V1RT2	87.00 (68.87)	8.97	9.15	25.70	1.46	73.00	2209	125.64
V1RT3	90.00 (71.57)	7.98	8.81	27.50	1.54	76.00	2473	138.48
V1RT4	89.00 (70.63)	8.96	9.11	29.70	1.60	75.00	2642	142.32
V1RT5	89.00 (70.63)	8.95	9.15	30.10	1.70	75.00	2677	151.06
V1RT6	89.00 (70.63)	7.95	8.25	30.40	1.79	74.00	2704	159.37
V1RT7	89.00 (70.63)	8.92	9.1	30.90	1.65	75.00	2751	146.75
V1RT8	93.00 (74.66)	9.1	9.15	31.80	1.77	73.00	2958	164.69
V1RT9	89.00 (70.63)	8.98	9.06	32.50	1.80	73.00	2892	160.10
V1RT10	93.33 (75.03)	7.99	8.97	32.90	1.80	76.00	3071	167.97
V1RT11	88.00 (69.73)	9.05	9.5	33.80	1.87	74.00	2974	164.50
V1RT12	89.00 (70.63)	8.95	9.01	31.80	1.90	75.00	2829	168.98
V1RT13	89.00 (70.63)	8.97	9.11	33.40	1.81	75.00	2970	160.99
V1RT14	90.00 (71.57)	7.98	8.96	32.90	1.77	76.00	2960	159.24
V1RT15	90.00 (71.57)	9.03	9.15	34.10	1.85	75.00	3067	166.38
V1RT16	90.00 (71.57)	9.02	9.1	34.20	1.90	76.00	3077	170.88
V1RT17	91.00 (72.54)	8.97	9.11	34.90	1.95	77.00	3177	177.36
V1RT18	93.00 (74.66)	8.92	8.92	36.90	2.00	80.00	3431	185.90
V1RT19	90.00 (71.57)	8.97	8.99	35.80	1.87	77.00	3222	168.22
SEM(±)	**1.76**	**0.400**	**0.142**	**0.35**	**0.06**	**0.87**	**63.56**	**6.76**
CD(p=0.05)	**2.49**	**NS**	**0.398**	**NS**	**NS**	**NS**	**NS**	**NS**

Table 3.13 contd…

Treatments	Germination (%)	M.C. (Before Trt.)	M.C. (After Trt.)	R/S length (cm)	Seedling dry wt (g)	Field emergence (%)	Vigour index (I)	Vigour index (II)
V2FT1	93.00 (74.66)	8.97	9.18	26.00	1.38	83.00 (65.65)	2444	129.80
V2FT2	94.00 (75.82)	9.01	9.15	27.70	1.57	84.00 (66.42)	2577	146.09
V2FT3	95.00 (77.08)	8.99	9.15	28.80	1.66	85.00 (67.21)	2736	157.75
V2FT4	93.00 (74.66)	9.05	9.16	31.00	1.70	83.00 (65.65)	2883	158.04
V2FT5	94.00 (75.82)	8.98	9.18	31.60	1.87	84.00 (66.42)	2971	175.93
V2FT6	94.00 (75.82)	9.02	9.52	31.50	1.88	84.00 (66.42)	2962	176.86
V2FT7	94.00 (75.82)	8.98	9.11	32.00	1.76	84.00	3008	165.50

						(66.42)		
V2FT8	95.00 (77.08)	8.93	9.97	32.90	1.89	85.00 (67.21)	3126	179.59
V2FT9	94.00 (75.82)	9.03	9.69	33.70	1.90	84.00 (66.42)	3168	178.65
V2FT10	95.00 (77.08)	8.95	9.25	33.90	1.87	85.00 (67.21)	3221	177.75
V2FT11	93.00 (74.66)	9.03	9.66	34.85	1.92	83.00 (65.65)	3241	178.60
V2FT12	94.00 (75.82)	8.98	9.16	32.80	1.98	84.00 (66.42)	3084	186.13
V2FT13	94.00 (75.82)	9.04	9.3	34.60	1.95	84.00 (66.42)	3253	183.35
V2FT14	95.00 (77.08)	8.98	9.75	34.15	1.98	85.00 (67.21)	3244	188.07
V2FT15	95.00 (77.08)	9.05	9.78	35.15	2.01	85.00 (67.21)	3339	191.04
V2FT16	94.00 (75.82)	8.98	9.92	34.90	2.15	84.00 (66.42)	3282	202.27
V2FT17	95.00 (77.08)	9.06	9.6	35.60	2.18	85.00 (67.21)	3383	207.14
V2FT18	97.00 (80.03)	8.97	9.68	37.80	2.27	88.00 (69.73)	3667	220.32
V2FT19	95.00 (77.08)	8.98	9.52	37.20	2.20	86.00 (68.03)	3534	209.11
SEM(±)	**1.76**	**0.400**	**0.142**	**0.35**	**0.06**	**0.87**	**63.56**	**6.76**
CD(p=0.05)	**2.49**	**NS**	**0.398**	**NS**	**NS**	**NS**	**NS**	**NS**

*Figures in parenthesis are arc sin transformed values)

Table 3.13 contd…

Treatments	Germination (%)	M.C. (Before Trt.)	M.C. (After Trt.)	R/S length (cm)	Seedling dry wt (g)	Field emergence (%)	Vigour index (I)	Vigour index (II)
V2RT1	88.00 (69.73)	8.99	9.68	25.30	1.30	74.00 (59.34)	2252	115.78
V2RT2	89.00 (70.63)	9.01	9.67	26.90	1.50	75.00 (60.00)	2369	132.15
V2RT3	92.00 (73.57)	9.02	9.03	27.30	1.60	78.00 (62.03)	2512	147.32
V2RT4	91.00 (72.54)	9.03	9.07	30.50	1.65	77.00 (61.34)	2776	150.23
V2RT5	93.00 (74.66)	9.04	9.05	30.90	1.80	79.00 (62.73)	2875	167.49
V2RT6	93.00 (74.66)	8.98	9.17	31.00	1.78	79.00 (62.73)	2883	165.72
V2RT7	93.00 (74.66)	8.97	9.52	31.20	1.70	79.00 (62.73)	2902	158.19
V2RT8	94.00 (75.82)	8.96	9.58	31.50	1.81	80.00 (63.44)	2961	170.16
V2RT9	93.00 (74.66)	8.92	9.69	32.65	1.85	82.33	3037	172.11

						(65.14)		
V2RT10	94.00 (75.82)	8.95	9.52	32.00	1.77	80.00 (63.44)	3008	166.44
V2RT11	92.00 (73.57)	9.01	9.75	33.90	1.90	77.00 (61.34)	3119	174.79
V2RT12	93.00 (74.66)	8.97	8.99	31.50	1.93	78.00 (62.03)	2930	179.56
V2RT13	92.00 (73.57)	8.94	9.12	33.80	1.90	77.00 (61.34)	3110	174.91
V2RT14	93.00 (74.66)	8.92	8.98	33.75	1.95	78.00 (62.03)	3139	181.40
V2RT15	93.00 (74.66)	9.01	9.06	34.10	2.00	79.00 (62.73)	3172	186.10
V2RT16	93.00 (74.66)	8.98	8.99	34.20	2.10	78.00 (62.03)	3181	195.49
V2RT17	94.00 (75.82)	8.92	8.98	34.50	2.00	82.00 (64.90)	3244	187.87
V2RT18	96.00 (78.46)	8.97	9.16	37.83	2.20	85.00 (67.21)	3631	211.26
V2RT19	94.00 (75.82)	9.01	9.15	36.10	2.02	83.00 (65.65)	3393	190.04
SEM(±)	**1.76**	**0.400**	**0.142**	**0.35**	**0.06**	**0.87**	**63.56**	**6.76**
CD(p=0.05)	**2.49**	**NS**	**0.398**	**NS**	**NS**	**NS**	**NS**	**NS**

*Figures in parenthesis are arc sin transformed values

RARI, Durgapura, Jaipur (SKNAU, Durgapura)

Experimental details: The certified seeds of kabuli chickpea varieties (CSJK 6 and CSJK 21) were taken and treated as per the following details.

Results: Hydropriming enhanced all the characters significantly. The percent increase with halopriming was significant only for few characters. Seed coating further enhanced the effects. Overall, it was observed that Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biogrow performed the best among all the treatments which was followed by hydropriming (Table 3.14- 3.20).

Table 3.14: Effect of seed priming treatments, lots and varieties on seed moisture content in kabuli chickpea (angular transformed values are mentioned here)

Treatments (T)	CSJK 6		Mean	CSJK 21		Mean	Mean (LxT)		Mean
	Lot 1 (L)	Lot 2 (L)	(VXT)	(VXT)	Lot 2	(VxT)	** L1	** L2	(Treat)
T1	18.56	17.75	18.15	18.74	17.56	18.15	18.65	17.65	18.15
T2	18.94	18.22	18.58	18.44	17.90	18.17	18.69	18.06	18.38
T3	22.38	23.04	22.71	23.32	22.23	22.78	22.85	22.64	22.74
T4	22.95	23.32	23.13	23.40	22.42	22.91	23.17	22.87	23.02
T5	23.11	22.85	22.98	22.34	22.61	22.47	22.72	22.73	22.73

T6	22.54	22.71	22.63	22.26	21.51	21.89	22.40	22.11	22.26
T7	23.09	23.26	23.18	22.05	21.79	21.92	22.57	22.53	22.55
T8	23.32	22.45	22.89	22.70	22.52	22.61	23.01	22.48	22.75
T9	22.76	22.40	22.58	22.62	23.26	22.94	22.69	22.83	22.76
T10	22.24	22.24	22.24	22.85	22.52	22.68	22.54	22.38	22.46
T11	22.61	22.84	22.73	22.43	23.40	22.92	22.52	23.12	22.82
T12	22.97	22.43	22.70	22.54	22.70	22.62	22.75	22.56	22.66
T13	22.14	21.51	21.83	23.30	23.21	23.26	22.72	22.36	22.54
T14	22.14	21.88	22.01	22.69	23.25	22.97	22.41	22.56	22.49
T15	22.05	22.16	22.10	22.46	23.34	22.90	22.25	22.75	22.50
T16	22.06	22.05	22.06	22.70	22.69	22.70	22.38	22.37	22.38
T17	21.51	21.61	21.56	22.67	23.39	23.03	22.09	22.50	22.29
T18	**21.40**	**21.53**	**21.47**	**22.38**	**23.21**	**22.79**	**21.89**	**22.37**	**22.13**
T19	21.46	21.38	21.42	21.51	22.87	22.19	21.49	22.12	21.81
SEm(±)	V= 0.12	L= 0.07	T=0.14	VxL= 0.10	VxT=0. 20	LxT=0. 29	VxLxT=0.28		
CD (P=0.05)	V= 0.34	L= 0.20	T= 0.39	VxL= 0.27	VxT=0. 55	LxT=0. 81	VxLxT=0.78		

Table 3.15: Effect of seed priming treatments, lots and varieties on first count (%) in kabuli chickpea (angular transformed values are mentioned here)

Treatments (T)	CSJK 6		Mean	CSJK 21		Mean	Mean (LxT)		Mean
	Lot 1 (L)	Lot 2 (L)	(VXT)	(VXT)	Lot 2	(VxT)	** L1	** L2	(Treat)
T1	54.54	51.49	53.02	56.10	52.46	54.28	55.32	51.98	53.65
T2	57.07	53.94	55.50	58.35	55.43	56.89	57.71	54.68	56.20
T3	57.07	54.45	55.76	58.69	56.14	57.42	57.88	55.30	56.59
T4	57.73	53.92	55.83	58.54	55.83	57.18	58.14	54.87	56.50
T5	57.60	54.40	56.00	58.85	56.68	57.77	58.23	55.54	56.88
T6	58.39	55.26	56.82	58.88	57.08	57.98	58.64	56.17	57.40
T7	57.60	55.03	56.31	58.61	56.64	57.63	58.11	55.83	56.97
T8	58.13	55.64	56.88	58.55	55.85	57.20	58.34	55.74	57.04
T9	57.99	54.81	56.40	58.24	57.14	57.69	58.12	55.97	57.05
T10	57.97	54.42	56.20	57.57	57.64	57.60	57.77	56.03	56.90
T11	58.17	55.48	56.83	58.54	57.71	58.12	58.36	56.60	57.48
T12	56.38	54.66	55.52	58.97	58.12	58.55	57.67	56.39	57.03
T13	55.66	55.03	55.34	57.72	57.01	57.36	56.69	56.02	56.35
T14	56.25	55.36	55.81	57.97	57.34	57.65	57.11	56.35	56.73
T15	55.62	55.25	55.43	57.63	57.30	57.47	56.62	56.28	56.45
T16	56.13	54.63	55.38	57.27	56.85	57.06	56.70	55.74	56.22
T17	56.96	53.94	55.45	56.95	57.58	57.26	56.96	55.76	56.36

T18	**58.92**	**54.27**	**56.59**	**58.04**	**57.71**	**57.87**	**58.48**	**55.99**	**57.23**
T19	57.39	53.79	55.59	57.27	57.97	57.62	57.33	55.88	56.60
SEm(±)	V=0.09	L=0.15	T=0.24	VxL=0.18	VxT=0.34	LxT=2.07	VxLxT=0.48		
CD (P=0.05)	V=0.24	L=0.41	T=0.67	VxL=0.50	VxT=0.94	LxT=5.77	VxLxT=1.33		

Table 3.16: Effect of seed priming treatments, lots and varieties on germination percentages in kabuli chickpea (angular transformed values are mentioned here)

Treatments (T)	CSJK 6		Mean	CSJK 21		Mean	Mean (LxT)		Mean
	Lot 1	Lot 2	(VXT)	(VXT)	Lot 2	(VxT)	** L1	** L2	(Treat)
	(L)	(L)							
T1	68.69	62.64	65.66	65.92	61.74	63.83	67.30	62.19	64.75
T2	68.71	62.20	65.46	69.26	66.02	67.64	68.99	64.11	66.55
T3	72.84	64.42	68.63	69.44	65.75	67.59	71.14	65.08	68.11
T4	72.94	65.25	69.10	70.05	65.56	67.80	71.50	65.41	68.45
T5	74.52	67.83	71.18	70.50	66.94	68.72	72.51	67.38	69.95
T6	75.15	66.96	71.05	69.46	66.89	68.18	72.30	66.93	69.61
T7	72.87	66.51	69.69	68.37	67.76	68.06	70.62	67.14	68.88
T8	73.23	67.73	70.48	68.56	67.13	67.85	70.89	67.43	69.16
T9	72.58	66.84	69.71	68.14	66.87	67.50	70.36	66.85	68.61
T10	73.14	67.25	70.19	68.99	67.21	68.10	71.06	67.23	69.15
T11	73.96	67.77	70.87	69.41	66.53	67.97	71.69	67.15	69.42
T12	75.19	66.89	71.04	71.76	67.51	69.64	73.47	67.20	70.34
T13	73.77	67.65	70.71	70.76	67.18	68.97	72.27	67.42	69.84
T14	71.92	68.06	69.99	70.80	67.59	69.20	71.36	67.83	69.59
T15	73.35	67.82	70.58	71.38	67.80	69.59	72.36	67.81	70.09
T16	73.49	66.71	70.10	71.25	67.45	69.35	72.37	67.08	69.73
T17	75.07	68.47	71.77	71.88	68.16	70.02	73.48	68.32	70.90
T18	**78.04**	**70.04**	**74.04**	**73.39**	**68.61**	**71.00**	**75.71**	**69.32**	**72.52**
T19	75.77	69.25	72.51	72.11	67.74	69.93	73.94	68.49	71.22
SEm(±)	V=0.19	L=0.16	T=0.44	VxL=0.15	VxT=0.62	LxT=5.19	VxLxT=0.87		
CD (P=0.05)	V=0.54	L=0.44	T=1.21	VxL=0.41	VxT=1.71	LxT=14.45	VxLxT=2.43		

Table 3.17: Effect of seed priming treatments, lots and varieties on Seedling vigour index I in kabuli chickpea.

Treatments (T)	CSJK 6		Mean	CSJK 21		Mean	Mean (LxT)		Mean
	Lot 1	Lot 2	(VXT)	(VXT)	Lot 2	(VxT)	** L1	** L2	(Treat)
	(L)	(L)							
T1	3568	3123	3346	3459	3241	3350	3514	3182	3348
T2	3601	3087	3344	3489	3208	3349	3545	3148	3346
T3	3876	3678	3777	3867	3546	3707	3872	3612	3742

T4	3897	3675	3786	3786	3659	3723	3842	3667	3754
T5	4098	3856	3977	3897	3765	3831	3998	3811	3904
T6	3987	3876	3932	3770	3678	3724	3879	3777	3828
T7	3978	3789	3884	3808	3567	3688	3893	3678	3786
T8	4032	3770	3901	3789	3653	3721	3911	3712	3811
T9	4086	3884	3985	3769	3765	3767	3928	3825	3876
T10	3976	3805	3891	3800	3513	3657	3888	3659	3774
T11	4032	3865	3948	3780	3589	3685	3906	3727	3816
T12	4123	3810	3967	3738	3550	3644	3931	3680	3805
T13	4276	3987	4132	3987	3889	3938	4132	3938	4035
T14	4235	3912	4073	3965	3865	3915	4100	3888	3994
T15	4076	3961	4018	3980	3862	3921	4028	3911	3970
T16	4138	3980	4059	3890	3865	3877	4014	3922	3968
T17	4238	4120	4179	4287	4098	4192	4262	4109	4186
T18	**4323**	**4123**	**4223**	**4235**	**4110**	**4172**	**4279**	**4116**	**4198**
T19	4239	4087	4163	4132	4168	4150	4186	4127	4156
SEm(±)	V= 16.19	L= 13.50	T= 34.31	VxL= 13.59	VxT= 48.52	LxT= 126.12	VxLxT=68.62		
CD (p=0.05)	V= 45.13	L= 37.61	T= 95.62	VxL= 37.81	VxT= 135.22	LxT= 351.46	VxLxT= 191.24		

Table 3.18: Effect of seed priming treatments, lots and varieties on Seedling vigour index II in kabuli chickpea.

Treatments (T)	CSJK 6		Mean	CSJK 21		Mean	Mean (LxT)		Mean
	Lot 1 (L)	Lot 2 (L)	(VXT)	(VXT)	Lot 2	(VxT)	** L1	** L2	(Treat)
T1	178.5	171.7	175.1	169.5	164.6	167.0	174.0	168.1	171.0
T2	180.7	170.5	175.6	167.4	164.6	166.0	174.0	167.5	170.8
T3	185.6	184.2	184.9	182.5	175.3	178.9	184.1	179.7	181.9
T4	186.4	183.0	184.7	184.6	178.5	181.5	185.5	180.8	183.1
T5	191.0	185.0	188.0	186.1	179.0	182.6	188.6	182.0	185.3
T6	187.2	183.0	185.1	185.1	177.1	181.1	186.1	180.1	183.1
T7	188.1	182.0	185.1	184.1	176.1	180.1	186.1	179.1	182.6
T8	187.2	182.0	184.6	184.2	176.2	180.2	185.7	179.1	182.4
T9	190.0	184.1	187.1	183.0	178.2	180.6	186.5	181.2	183.8
T10	189.0	186.0	187.5	185.0	172.3	178.7	187.0	179.2	183.1
T11	188.1	182.9	185.5	184.0	175.0	179.5	186.0	179.0	182.5
T12	194.0	189.3	191.6	189.2	180.1	184.6	191.6	184.7	188.1
T13	193.0	191.0	192.0	190.0	182.0	186.0	191.5	186.5	189.0
T14	192.0	188.0	190.0	189.0	181.0	185.0	190.5	184.5	187.5
T15	190.9	189.1	190.0	188.0	181.0	184.5	189.5	185.0	187.3

T16	192.0	190.0	191.0	191.0	182.9	187.0	191.5	186.5	189.0
T17	200.0	197.0	198.5	200.5	195.4	197.9	200.2	196.2	198.2
T18	201.1	200.1	175.9	200.6	191.5	196.0	176.1	195.8	185.9
T19	200.4	200.1	200.3	196.0	191.7	193.9	198.2	195.9	197.1
SEm(±)	V=1.02	L=0.97	T=3.10	VxL=1.49	VxT=4.38	LxT=8.98	VxLxT=6.19		
CD (P=0.05)	V=1.83	L=2.70	T=8.63	VxL=4.17	VxT=12.20	LxT=25.02	VxLxT=17.26		

Table 3.19: Effect of seed priming treatments, lots and varieties on speed of emergence (%) in kabuli chickpea (angular transformed values are mentioned here).

Treatments (T)	CSJK 6		Mean	CSJK 21		Mean	Mean (LxT)		Mean
	Lot 1 (L)	Lot 2 (L)	(VXT)	(VXT)	Lot 2	(VxT)	** L1	** L2	(Treat)
T1	39.23	38.05	38.64	38.64	37.46	38.05	38.94	37.76	38.35
T2	42.13	39.23	40.68	38.06	38.05	38.05	40.09	38.64	39.37
T3	47.29	45.00	46.15	39.23	40.98	40.10	43.26	42.99	43.13
T4	46.15	46.72	46.43	40.98	41.55	41.26	43.56	44.14	43.85
T5	47.87	47.29	47.58	43.85	42.13	42.99	45.86	44.71	45.29
T6	47.29	46.15	46.72	43.28	41.55	42.42	45.29	43.85	44.57
T7	47.87	46.72	47.30	42.71	40.40	41.55	45.29	43.56	44.42
T8	48.45	45.00	46.72	42.13	42.71	42.42	45.29	43.85	44.57
T9	47.29	47.87	47.58	43.85	42.13	42.99	45.57	45.00	45.29
T10	46.72	46.72	46.72	40.97	41.55	41.26	43.85	44.14	43.99
T11	46.15	46.15	46.15	42.13	42.13	42.13	44.14	44.14	44.14
T12	53.73	50.78	52.25	45.00	46.15	45.57	49.36	48.46	48.91
T13	52.54	51.94	52.24	47.29	45.57	46.43	49.92	48.76	49.34
T14	53.73	51.36	52.54	46.15	47.30	46.72	49.94	49.33	49.63
T15	50.77	52.54	51.65	45.00	46.15	45.57	47.89	49.34	48.61
T16	53.73	50.77	52.25	45.00	45.00	45.00	49.37	47.89	48.63
T17	57.43	53.74	55.58	52.54	47.87	50.20	54.98	50.80	52.89
T18	56.80	55.55	56.17	53.73	50.19	51.96	55.26	52.87	54.07
SEm(±)	V=0.24	L=0.20	T=0.23	VxL=0.26	VxT=0.33	LxT=0.86	VxLxT=0.46		
CD (p=0.05)	V=0.68	L=0.56	T=0.64	VxL=0.72	VxT=0.91	LxT=2.41	VxLxT=1.28		

Table 3.20: Effect of seed priming treatments, lots and varieties on plant stand in kabuli chickpea

Treatments (T)	CSJK 6		Mean	CSJK 21		Mean	Mean (LxT)		Mean
	Lot 1	Lot 2	(VXT)	(VXT)	Lot 2	(VxT)	** L1	** L2	(Treat)

	(L)	(L)							
T1	35.00	28.00	31.50	33.00	30.00	31.50	34.00	29.00	31.50
T2	35.00	29.00	32.00	32.00	30.00	31.00	33.50	29.50	31.50
T3	38.00	32.00	35.00	35.00	34.00	34.50	36.50	33.00	34.75
T4	39.00	34.00	36.50	36.00	34.00	35.00	37.50	34.00	35.75
T5	39.00	34.00	36.50	36.00	35.00	35.50	37.50	34.50	36.00
T6	38.00	35.00	36.50	35.00	36.00	35.50	36.50	35.50	36.00
T7	38.00	35.00	36.50	35.00	34.00	34.50	36.50	34.50	35.50
T8	37.00	34.00	35.50	36.00	35.00	35.50	36.50	34.50	35.50
T9	38.00	35.00	36.50	35.00	36.00	35.50	36.50	35.50	36.00
T10	38.00	36.00	37.00	37.00	35.00	36.00	37.50	35.50	36.50
T11	37.00	36.00	36.50	37.00	36.00	36.50	37.00	36.00	36.50
T12	40.00	42.00	41.00	38.00	38.00	38.00	39.00	40.00	39.50
T13	42.00	40.00	41.00	39.00	37.00	38.00	40.50	38.50	39.50
T14	42.00	40.00	41.00	38.00	38.00	38.00	40.00	39.00	39.50
T15	60.00	63.00	61.50	50.00	52.00	51.00	55.00	57.50	56.25
T16	65.00	60.00	62.50	50.00	50.00	50.00	57.50	55.00	56.25
T17	71.00	65.00	68.00	63.00	55.00	59.00	67.00	60.00	63.50
T18	**70.00**	**68.00**	**69.00**	**65.00**	**59.00**	**62.00**	**67.50**	**63.50**	**65.50**
T19	68.00	70.00	69.00	60.00	60.00	60.00	64.00	65.00	64.50
SEm(±)	V=0.65	L=0.36	T=0.35	VxL=0.32	VxT=0.50	LxT=2.27	VxLxT=0.71		
CD (p=0.05)	V=1.80	L=1.01	T=0.99	VxL=0.89	VxT=1.40	LxT=6.33	VxLxT=1.98		

Conclusion: Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biogrow was found to be best among all the treatments.

Crop: Rice

UAS, Bengaluru

Experimental details:
Varieties: IR-64 (V1), MTU-1001(V2)
Lots: Fresh (L1) and I-Revalidated (L2)

Results: Effect of seed priming treatments on seed quality traits is given in table 3.21 -3.29

Table 3.21: Effect of seed priming treatments, lots and varieties on seed moisture content (%) in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LxT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	

T_1	9.20	12.00	10.60	12.55	11.45	12.00	10.88	11.73	11.30
T_2	9.65	12.00	10.83	10.70	10.30	10.50	10.18	11.15	10.66
T_3	11.40	11.40	11.40	12.70	11.70	12.20	12.05	11.55	11.80
T_4	12.50	12.50	12.50	13.25	12.05	12.65	12.88	12.28	12.58
T_5	12.70	13.25	12.98	13.35	13.15	13.25	13.03	13.20	13.11
T_6	12.30	13.20	12.75	13.15	12.95	13.05	12.73	13.08	12.90
T_7	12.65	13.05	12.85	12.20	12.80	12.50	12.43	12.93	12.68
T_8	12.35	12.90	12.63	12.50	12.90	12.70	12.43	12.90	12.66
T_9	11.70	13.00	12.35	13.20	11.70	12.45	12.45	12.35	12.40
T_{10}	12.20	13.25	12.73	13.35	12.50	12.93	12.78	12.88	12.83
T_{11}	13.30	13.20	13.25	11.90	13.05	12.48	12.60	13.13	12.86
T_{12}	11.50	11.80	11.65	12.15	12.55	12.35	11.83	12.18	12.00
T_{13}	12.45	12.20	12.33	12.30	12.20	12.25	12.38	12.20	12.29
T_{14}	11.40	12.10	11.75	12.40	11.95	12.18	11.90	12.03	11.96
T_{15}	12.75	11.85	12.30	12.25	11.50	11.88	12.50	11.68	12.09
T_{16}	12.05	12.05	12.05	12.00	12.50	12.25	12.03	12.28	12.15
T_{17}	12.60	12.20	12.40	11.65	12.25	11.95	12.13	12.23	12.18
T_{18}	12.80	12.40	12.60	12.75	12.05	12.40	12.78	12.23	12.50
T_{19}	11.90	11.60	11.75	13.10	12.70	12.90	12.50	12.15	12.33
Mean	11.97	12.42	12.19	12.50	12.22	12.36	12.23	12.32	12.28
SEm(±)	V	0.041	L	0.041	V x L	0.058	T	0.127	
CD(p=0.05)		0.116		0.116		0.164		0.357	
SEm(±)	V x T	0.180	L x T	0.180	VxLxT	0.255	CV (%)	2.93	
CD(p=0.05)		0.507		0.507		0.718			

Table 3.22: Effect of seed priming treatments, vigour lots and varieties on first count (%) in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LxT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	
T_1	100.00	77.00	88.50	93.50	91.00	92.25	96.75	82.25	89.50
T_2	98.00	78.00	88.00	93.50	90.75	92.13	95.75	83.00	89.38
T_3	**98.50**	**82.50**	**90.50**	**96.50**	**93.50**	**95.00**	**97.50**	**84.25**	**90.88**
T_4	98.50	78.50	88.50	96.50	92.50	94.50	97.50	82.50	90.00
T_5	98.50	84.00	91.25	98.00	94.63	96.31	98.25	86.25	92.25
T_6	98.00	76.00	87.00	91.50	89.25	90.38	94.75	81.00	87.88
T_7	99.50	77.50	88.50	96.00	92.25	94.13	97.75	81.75	89.75
T_8	99.50	79.00	89.25	93.50	91.38	92.44	96.50	82.75	89.63
T_9	99.00	86.00	92.50	96.00	94.25	95.13	97.50	87.50	92.50
T_{10}	99.00	80.50	89.75	94.50	92.13	93.31	96.75	83.00	89.88
T_{11}	92.50	47.50	70.00	65.00	67.50	66.25	78.75	51.25	65.00
T_{12}	99.00	87.50	93.25	95.00	94.13	94.56	97.00	89.50	93.25
T_{13}	100.00	80.00	90.00	95.50	92.75	94.13	97.75	85.50	91.63
T_{14}	98.50	75.00	86.75	94.50	90.63	92.56	96.50	80.50	88.50
T_{15}	99.00	83.00	91.00	97.50	94.25	95.88	98.25	84.00	91.13
T_{16}	99.00	85.00	92.00	94.50	93.25	93.88	96.75	85.00	90.88
T_{17}	98.50	75.00	86.75	95.00	90.88	92.94	96.75	78.25	87.50
T_{18}	99.00	77.00	88.00	97.50	92.75	95.13	98.25	82.75	90.50
T_{19}	100.00	75.50	87.75	97.50	92.63	95.06	98.75	83.50	91.13
Mean	98.63	78.13	88.38	93.76	91.07	92.42	96.20	81.82	89.01

SEm(±)	V	0.288	L	0.288	V x L	0.407	T	0.886	
CD(p=0.05)		0.809		0.809		1.144		2.494	
SEm(±)	V x T	1.253	L x T	1.253	VxLxT	1.772	CV (%)	3.44	
CD(p=0.05)		3.527		3.527		4.988			

Table 3.23: Effect of seed priming treatments, vigour lots and varieties on germination (%) in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LxT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	
T_1	87.50	74.00	80.75	86.00	68.50	77.25	86.75	71.25	79.00
T_2	92.00	73.00	82.50	95.00	78.50	86.75	93.50	75.75	84.63
T_3	**93.50**	**73.50**	**83.50**	**93.00**	**77.50**	**85.25**	**93.25**	**75.50**	**84.38**
T_4	93.00	77.50	85.25	92.50	87.00	89.75	92.75	82.25	**87.50**
T_5	89.50	76.50	83.00	91.00	79.00	85.00	90.25	77.75	84.00
T_6	93.00	67.50	80.25	93.00	84.50	88.75	93.00	76.00	84.50
T_7	92.00	65.00	78.50	92.00	82.50	87.25	92.00	73.75	82.88
T_8	90.00	74.00	82.00	88.50	73.50	81.00	89.25	73.75	81.50
T_9	90.50	77.00	83.75	89.50	79.50	84.50	90.00	78.25	84.13
T_{10}	85.50	77.00	81.25	84.00	85.00	84.50	84.75	81.00	82.88
T_{11}	82.00	45.00	63.50	83.00	60.50	71.75	82.50	52.75	67.63
T_{12}	90.50	64.00	77.25	87.00	78.00	82.50	88.75	71.00	79.88
T_{13}	90.50	79.50	85.00	92.00	73.50	82.75	91.25	76.50	83.88
T_{14}	88.00	70.00	79.00	90.00	76.00	83.00	89.00	73.00	81.00
T_{15}	90.00	76.50	83.25	88.00	73.50	80.75	89.00	75.00	82.00
T_{16}	90.00	79.00	84.50	93.50	87.00	90.25	91.75	83.00	87.38
T_{17}	86.50	65.50	76.00	93.50	77.50	85.50	90.00	71.50	80.75
T_{18}	90.00	73.00	81.50	88.00	67.50	77.75	89.00	70.25	79.63
T_{19}	91.00	68.00	79.50	90.50	84.50	87.50	90.75	76.25	83.50
Mean	89.74	71.34	80.54	90.00	77.55	83.78	89.87	74.45	82.16
SEm(±)	V	0.137	L	0.137	V x L	0.194	T	0.422	
CD(p=0.05)		0.386		0.386		0.545		1.189	
SEm(±)	V x T	0.597	L x T	0.597	VxLxT	0.845	CV (%)	1.81	
CD(p=0.05)		1.681		1.681		2.378			

Table 3.24: Effect of seed priming treatments, vigour lots and varieties on mean seedling length (cm) in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LxT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	
T_1	34.77	37.63	36.20	28.73	22.00	25.36	31.75	29.81	30.78
T_2	37.68	33.59	35.63	32.39	19.73	26.06	35.03	26.66	30.85
T_3	**42.45**	**35.35**	**38.90**	**37.93**	**22.95**	**30.44**	**40.19**	**29.15**	**34.67**
T_4	32.35	37.23	34.79	33.97	21.05	27.51	33.16	29.14	31.15
T_5	42.08	30.65	36.36	33.64	19.20	26.42	37.86	24.93	31.39
T_6	39.10	34.80	36.95	35.36	22.60	28.98	37.23	28.70	32.96
T_7	38.35	19.97	29.16	29.77	19.55	24.66	34.06	19.76	26.91
T_8	33.98	29.38	31.68	33.33	22.10	27.72	33.65	25.74	29.70
T_9	34.08	35.28	34.68	30.56	22.53	26.54	32.32	28.90	30.61
T_{10}	32.36	35.43	33.89	30.66	21.05	25.85	31.51	28.24	29.87

T_{11}	35.32	26.81	31.06	34.02	19.90	26.96	34.67	23.36	29.01
T_{12}	33.49	33.85	33.67	32.47	21.70	27.09	32.98	27.78	30.38
T_{13}	37.40	42.53	39.96	30.53	21.00	25.76	33.96	31.76	32.86
T_{14}	36.01	44.53	40.27	34.55	20.25	27.40	35.28	32.39	33.83
T_{15}	31.29	37.33	34.31	29.57	22.95	26.26	30.43	30.14	30.28
T_{16}	31.14	39.76	35.45	33.41	23.00	28.20	32.27	31.38	31.83
T_{17}	33.75	38.18	35.96	37.28	20.55	28.92	35.52	29.36	32.44
T_{18}	39.78	37.03	38.40	33.29	23.17	28.23	36.53	30.10	33.32
T_{19}	38.07	37.20	37.64	27.80	20.20	24.00	32.94	28.70	30.82
Mean	35.97	35.08	35.52	32.59	21.34	26.97	34.28	28.21	31.24
SEm(±)	V	0.549	L	0.549	V x L	0.777	T	1.693	
CD (p=0.05)		1.546		1.546		2.186		4.764	
SEm(±)	V x T	2.394	L x T	2.394	VxLxT	3.386	CV (%)	5.32	
CD (p=0.05)		6.737		6.737		9.528			

Table 3.25: Effect of seed priming treatments, vigour lots and varieties on mean seedling dry weight (mg) in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LxT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	
T_1	10.15	9.70	9.93	10.20	10.35	10.28	10.18	10.03	10.10
T_2	11.20	9.05	10.13	10.25	9.80	10.03	10.73	9.43	10.08
T_3	**10.20**	**10.35**	**10.28**	**10.60**	**11.55**	**11.08**	**10.40**	**10.95**	**10.68**
T_4	10.55	10.00	10.28	10.00	9.70	9.85	10.28	9.85	10.06
T_5	11.95	9.30	10.63	10.70	9.55	10.13	11.33	9.43	10.38
T_6	11.95	9.35	10.65	10.55	10.00	10.28	11.25	9.68	10.46
T_7	10.00	11.05	10.53	8.80	10.00	9.40	9.40	10.53	9.96
T_8	10.80	9.75	10.28	9.70	9.65	9.68	10.25	9.70	9.98
T_9	10.65	10.75	10.70	9.85	10.90	10.38	10.25	10.83	10.54
T_{10}	10.80	9.80	10.30	10.80	9.65	10.23	10.80	9.73	10.26
T_{11}	10.25	7.00	8.63	9.50	10.05	9.78	9.88	8.53	9.20
T_{12}	10.55	10.00	10.28	10.35	9.55	9.95	10.45	9.78	10.11
T_{13}	11.65	11.40	11.53	9.15	11.25	10.20	10.40	11.33	10.86
T_{14}	11.25	12.70	11.98	10.50	9.85	10.18	10.88	11.28	11.08
T_{15}	10.40	11.65	11.03	9.70	10.90	10.30	10.05	11.28	10.66
T_{16}	12.55	10.05	11.30	9.60	10.45	10.03	11.08	10.25	10.66
T_{17}	10.05	11.00	10.53	10.55	9.70	10.13	10.30	10.35	10.33
T_{18}	10.85	10.30	10.58	8.95	9.80	9.38	9.90	10.05	9.98
T_{19}	10.50	8.80	9.65	9.30	9.65	9.48	9.90	9.23	9.56
Mean	10.86	10.11	10.48	9.95	10.12	10.04	10.40	10.11	10.26
SEm(±)	V	0.019	L	0.019	V x L	0.027	T	0.060	
CD (p=0.05)		0.054		0.054		0.077		0.167	
SEm(±)	V x T	0.084	L x T	0.084	VxLxT	0.119	CV (%)	1.64	
CD (p=0.05)		0.237		0.237		0.335			

Table 3.26: Effect of seed priming treatments, vigour lots and varieties on seedling vigour index I in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LXT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	

T_1	3046	2783	2915	2479	1509	1994	2763	2146	2454
T_2	3466	2449	2957	3085	1550	2317	3275	1999	2637
T_3	**3969**	**2601**	**3285**	**3526**	**1777**	**2652**	**3748**	**2189**	**2968**
T_4	3009	2883	2946	3137	1830	2484	3073	2357	2715
T_5	3766	2343	3054	3061	1519	2290	3413	1931	2672
T_6	3634	2350	2992	3288	1911	2599	3461	2130	**2796**
T_7	3528	1297	2413	2733	1611	2172	3131	1454	2293
T_8	3052	2177	2614	2949	1623	2286	3001	1900	2450
T_9	3086	2718	2902	2728	1792	2260	2907	2255	2581
T_{10}	2763	2731	2747	2579	1791	2185	2671	2261	2466
T_{11}	2896	1208	2052	2823	1206	2014	2859	1207	2033
T_{12}	3032	2161	2597	2831	1693	2262	2931	1927	2429
T_{13}	3384	3380	3382	2814	1542	2178	3099	2461	**2780**
T_{14}	3161	3112	3136	3105	1538	2322	3133	2325	2729
T_{15}	2811	2855	2833	2595	1688	2141	2703	2271	2487
T_{16}	2800	3139	2970	3125	2003	2564	2962	2571	2767
T_{17}	2921	2503	2712	3484	1592	2538	3203	2048	2625
T_{18}	3581	2705	3143	2927	1564	2245	3254	2134	2694
T_{19}	3464	2526	2995	2520	1708	2114	2992	2117	2554
Mean	3230	2522	2876	2936	1655	2296	3083	2089	2586
SEm(±)	V	47.453	L	47.453	V x L	67.109	T	146.260	
CD (p=0.05)		133.545		133.545		188.861		411.613	
SEm(±)	V x T	206.843	L x T	206.843	VxLxT	292.520	CV (%)	6.00	
CD (p=0.05)		582.108		582.108		823.225			

Table 3.27: Effect of seed priming treatments, vigour lots and varieties on seedling vigour index II in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LxT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	
T_1	888	718	803	877	710	793	883	714	798
T_2	1030	661	846	974	769	872	1002	715	859
T_3	**954**	**761**	**857**	**986**	**895**	**940**	**970**	**828**	**899**
T_4	981	775	878	925	844	884	953	809	881
T_5	1070	712	891	974	754	864	1022	733	877
T_6	1111	631	871	981	845	913	1046	738	**892**
T_7	920	718	819	810	825	817	865	772	818
T_8	972	722	847	858	709	784	915	715	815
T_9	964	828	896	882	866	874	923	847	885
T_{10}	924	755	839	907	820	864	915	787	851
T_{11}	841	315	578	789	608	698	815	462	638
T_{12}	955	640	798	901	745	823	928	693	810
T_{13}	1054	906	980	842	827	834	948	867	**907**
T_{14}	990	889	939	945	749	847	968	819	893
T_{15}	936	891	914	854	801	827	895	846	871
T_{16}	1130	794	962	898	909	903	1014	852	**933**

T_{17}	869	721	795	986	752	869	928	736	832
T_{18}	977	752	864	788	662	725	882	707	794
T_{19}	956	598	777	842	816	829	899	707	803
Mean	975	726	850	896	785	840	935	755	845
SEm(±)	V	2.436	L	2.466	V x L	3.445	T	7.509	
CD (p=0.05)		6.856		6.940		9.696		21.131	
SEm(±)	V x T	10.619	L x T	10.619	VxLxT	15.017	CV (%)	2.51	
CD (p=0.05)		29.884		29.884		42.262			

Table 28: Effect of seed priming treatments, vigour lots and varieties on speed of emergence in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LxT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	
T_1	69.75	52.69	61.22	40.01	28.03	34.02	54.88	40.36	47.62
T_2	56.33	51.97	54.15	32.76	55.89	50.78	44.54	60.39	52.46
T_3	**53.93**	**78.00**	**65.96**	**58.82**	**68.80**	**57.36**	**56.37**	**66.95**	**61.66**
T_4	52.82	60.87	56.85	61.94	68.02	64.98	57.38	64.44	60.91
T_5	38.59	40.74	39.66	63.95	62.47	63.21	51.27	51.60	51.44
T_6	41.52	40.42	40.97	55.25	50.42	52.84	48.39	45.42	46.90
T_7	35.99	31.02	33.50	55.87	73.67	64.77	45.93	52.34	49.14
T_8	26.26	36.85	31.55	63.69	54.49	59.09	44.97	45.67	45.32
T_9	40.89	36.29	38.59	71.31	67.10	69.21	56.10	51.70	53.90
T_{10}	25.48	34.84	30.16	50.73	73.34	62.04	38.11	54.09	46.10
T_{11}	19.04	18.02	18.53	17.82	16.44	17.13	18.43	17.23	17.83
T_{12}	64.27	62.08	63.18	52.19	48.84	50.51	58.23	55.46	56.84
T_{13}	67.66	40.28	53.97	53.64	57.76	55.70	60.65	49.02	54.83
T_{14}	71.55	48.74	60.15	48.06	65.39	56.72	59.81	57.07	58.44
T_{15}	82.48	46.07	64.28	48.49	68.31	58.40	65.49	57.19	61.34
T_{16}	76.00	55.18	65.59	73.77	64.45	69.11	74.89	59.81	**67.35**
T_{17}	80.57	7.00	43.78	71.72	61.99	66.85	76.14	34.50	55.32
T_{18}	89.65	56.15	72.90	60.91	53.66	57.28	75.28	54.91	65.09
T_{19}	74.31	19.00	46.65	39.60	38.83	39.22	56.95	28.92	42.94
Mean	56.16	42.96	49.56	53.71	56.73	55.22	54.94	49.85	52.39
SEm(±)	V	0.147	L	0.147	V x L	0.208	T	0.453	
CD(p=0.05)		0.414		0.414		0.585		1.276	
SEm(±)	V x T	0.641	L x T	0.641	VxLxT	0.907	CV (%)	11.25	
CD(p=0.05)		1.805		1.805		2.552			

Table 3.29: Effect of seed priming treatments, vigour lots and varieties on final plant stand (%) in paddy

Treatment (T)	IR 64 (V_1)		Mean (VxT)	MTU 1001 (V_2)		Mean (VxT)	Mean (LxT)		Mean (T)
	L_1	L_2		L_1	L_2		L_1	L_2	
T_1	88	84	86	85	86	85	86	85	86
T_2	85	87	86	91	91	91	88	89	88
T_3	97	100	98	100	96	98	99	98	98
T_4	98	95	96	100	84	92	99	89	94
T_5	96	96	96	100	91	95	98	94	96
T_6	98	65	82	96	93	95	97	79	88

T_7	95	52	74	100	96	98	98	74	86
T_8	88	73	81	100	76	88	94	75	84
T_9	87	86	86	100	86	93	93	86	89
T_{10}	88	74	81	91	84	87	89	79	84
T_{11}	63	30	46	36	31	33	49	30	40
T_{12}	100	98	99	100	100	100	100	99	100
T_{13}	100	87	93	100	100	100	100	93	97
T_{14}	100	81	90	100	100	100	100	90	95
T_{15}	100	100	100	100	99	99	100	99	100
T_{16}	**100**	**97**	**98**	**100**	**99**	**99**	**100**	**98**	**99**
T_{17}	99	97	98	100	97	99	100	97	98
T_{18}	100	95	97	100	90	95	100	92	96
T_{19}	100	99	100	76	75	75	88	87	87
Mean	94	84	89	93	88	91	93	86	90
SEm(±)	V	0.643	L	0.643	V x L	0.909	T	1.981	
CD (p=0.05)		1.808		1.808		2.558		5.574	
SEm(±)	V x T	2.801	L x T	2.801	VxLxT	3.961	CV (%)	7.37	
CD (p=0.05)		7.883		7.883		11.148			

Conclusion: Among the various seed priming methods, halo priming with salicylic acid 800 ppm has recorded higher germination (87%), but the higher vigour parameters were recorded in hydro-priming for 30h and air drying at 25^0C for 48h *viz.*; seedling vigour index I (2968), seedling vigour index II (899), speed of emergence (61.66) and final field establishment (98%) at six weeks after sowing, which was on par with seed coating (on hydro primed seeds) with Biophos (containing 1 x 10^9 cfu). Hydro priming has proven to be better in improving the vigour of old seed lots too.

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Experimental details: One year old (L_1) and fresh (L_2) seeds of two popular rice varieties Naveen (V_1) and Lalat (V_2) were procured for the experiment. The fresh seeds were of Rabi 2017-18 produce while the one-year old seeds were of Rabi 2016-17 produce.

Results: The differences in moisture contents between the seeds of two varieties, between the two seed lots of each variety and among the seeds of all treatments were statistically non-significant. Significant differences in first count, seed germination and vigour parameters were observed between the two seed lots of both the varieties as a result of various treatments. The germination of untreated seeds of Rabi 2017-18 produce (L_2) and Rabi 2016-17 produce (L_1) were 89.67% and 80.67%, respectively, for variety Naveen, while these were 89.00% and 81.00%, respectively, for variety Lalat. The priming and coating treatments had a positive effect on seed quality parameters, which was more pronounced on L_1 than L_2, the increase in germination being to the extent of 9.5% and 5.2%, respectively. The seed vigour indices also showed similar enhancement over the control (table 3.30 to 3.37).

Table 3.30: Moisture content (%) of fresh and one year old seeds of two rice varieties (cv. Naveen and Lalat) as influenced by various priming and coating treatments

Treatments	Seed moisture content (%)					
	Var–Naveen			Var–Lalat		
	L_1	L_2	Mean	L_1	L_2	Mean
T_1	11.43	11.73	11.58	11.60	11.87	11.73
T_2	11.63	11.57	11.60	11.47	11.57	11.52
T_3	11.70	11.60	11.65	11.60	11.70	11.65
T_4	11.60	11.87	11.73	11.73	11.73	11.73
T_5	11.73	11.50	11.62	11.63	11.47	11.55
T_6	11.63	11.70	11.67	11.67	11.77	11.72
T_7	11.67	11.73	11.70	11.63	11.50	11.57
T_8	11.63	11.47	11.55	11.53	11.83	11.68
T_9	11.53	11.63	11.58	11.73	11.70	11.72
T_{10}	11.73	11.87	11.80	11.70	11.53	11.62
T_{11}	11.70	11.43	11.57	11.83	11.77	11.80
T_{12}	11.73	11.70	11.72	11.70	11.47	11.58
T_{13}	11.60	11.53	11.57	11.60	11.70	11.65
T_{14}	11.47	11.77	11.62	11.73	11.63	11.68
T_{15}	11.63	11.67	11.65	11.57	11.73	11.65
T_{16}	11.73	11.77	11.75	11.43	11.70	11.57
T_{17}	11.70	11.50	11.60	11.73	11.60	11.67
T_{18}	11.57	11.67	11.62	11.57	11.87	11.72
T_{19}	11.43	11.47	11.45	11.60	11.50	11.55
Mean	11.62	11.64	11.63	11.64	11.66	11.65
	L	T	L x T	L	T	L x T
SEm(±)	0.030	0.092	0.131	0.029	0.089	0.125
CD(p=0.05)	NS	NS	NS	NS	NS	NS

Table 3.31: First count (%) of fresh and one year old seeds of two rice varieties (cv. Naveen and Lalat) during germination test as influenced by various priming and coating treatments

Treatments	First count (%)					
	Var - Naveen			Var–Lalat		
	L_1	L_2	Mean	L_1	L_2	Mean
T_1	27.67 (31.73)	34.67 (36.07)	31.17 (33.90)	27.33 (31.52)	34.67 (36.07)	31.00 (33.79)
T_2	27.67 (31.73)	35.00 (36.27)	31.33 (34.00)	27.67 (31.73)	35.33 (36.47)	31.50 (34.10)
T_3	29.67 (33.00)	36.33 (37.07)	33.00 (35.03)	29.67 (33.00)	36.33 (37.07)	33.00 (35.03)
T_4	30.00 (33.21)	36.67 (37.27)	33.33 (35.24)	30.00 (33.21)	36.67 (37.27)	33.33 (35.24)
T_5	29.67 (33.00)	35.67 (36.67)	32.67 (34.84)	29.67 (33.00)	35.67 (36.67)	32.67 (34.84)
T_6	30.00 (33.21)	36.67 (37.27)	33.33 (35.24)	30.00 (33.21)	36.67 (37.27)	33.33 (35.24)
T_7	30.00 (33.21)	35.67 (36.67)	32.83 (34.94)	29.67 (33.00)	35.67 (36.67)	32.67 (34.84)

T_8	29.67 (33.00)	36.33 (37.07)	33.00 (35.03)	29.67 (33.00)	36.33 (37.07)	33.00 (35.03)
T_9	30.00 (33.21)	36.33 (37.07)	33.17 (35.14)	29.67 (33.00)	36.33 (37.07)	33.00 (35.03)
T_{10}	30.00 (33.21)	35.67 (36.67)	32.83 (34.94)	29.33 (32.79)	35.67 (36.67)	32.50 (34.73)
T_{11}	30.00 (33.21)	36.67 (37.27)	33.33 (35.24)	30.00 (33.21)	36.67 (37.27)	33.33 (35.24)
T_{12}	30.33 (33.42)	35.67 (36.67)	33.00 (35.04)	29.67 (33.00)	35.67 (36.67)	32.67 (34.84)
T_{13}	29.67 (33.00)	36.33 (37.07)	33.00 (35.03)	29.67 (33.00)	36.33 (37.07)	33.00 (35.03)
T_{14}	30.00 (33.21)	36.33 (37.07)	33.17 (35.14)	30.00 (33.21)	36.33 (37.07)	33.17 (35.14)
T_{15}	29.67 (33.00)	36.67 (37.27)	33.17 (35.13)	30.00 (33.21)	36.67 (37.27)	33.33 (35.24)
T_{16}	29.33 (32.79)	36.00 (36.87)	32.67 (34.83)	29.67 (33.00)	36.00 (36.87)	32.83 (34.94)
T_{17}	30.00 (33.21)	36.00 (36.87)	33.00 (35.04)	29.67 (33.00)	36.00 (36.87)	32.83 (34.94)
T_{18}	29.67 (33.00)	36.67 (37.27)	33.17 (35.13)	30.67 (33.63)	36.67 (37.27)	33.67 (35.45)
T_{19}	29.67 (33.00)	35.67 (36.67)	32.67 (34.84)	29.67 (33.00)	35.67 (36.67)	32.67 (34.84)
Mean	29.61 (32.97)	36.05 (36.90)	32.83 (34.93)	29.56 (32.93)	36.07 (36.91)	32.82 (34.92)
	L	T	L x T	L	T	L x T
SEm(±)	0.055	0.171	0.241	0.056	0.172	0.243
CD(p=0.05)	0.156	0.480	NS	0.157	0.484	NS

*Figures in the parenthesis are arc sine transformed values

Table 3.32: Germination (%) of fresh and one year old seeds of two rice varieties (cv. Naveen and Lalat) as influenced by various priming and coating treatments

Treatments	Seed germination (%)					
	Var–Naveen			Var–Lalat		
	L_1	L_2	Mean	L_1	L_2	Mean
T_1	80.67 (8.98)	89.67 (9.47)	85.17 (9.23)	81.00 (9.00)	89.00 (9.43)	85.00 (9.22)
T_2	82.00 (9.06)	90.00 (9.49)	86.00 (9.27)	81.67 (9.04)	90.33 (9.50)	86.00 (9.27)
T_3	87.33 (9.34)	93.33 (9.66)	90.33 (9.50)	87.67 (9.36)	93.33 (9.66)	90.50 (9.51)
T_4	88.00 (9.38)	93.67 (9.68)	90.83 (9.53)	88.00 (9.38)	93.67 (9.68)	90.83 (9.53)
T_5	87.67 (9.36)	91.67 (9.57)	89.67 (9.47)	86.67 (9.31)	91.67 (9.57)	89.17 (9.44)
T_6	88.00 (9.38)	94.00 (9.70)	91.00 (9.54)	88.33 (9.40)	94.00 (9.70)	91.17 (9.55)
T_7	87.67 (9.36)	92.00 (9.59)	89.83 (9.48)	87.00 (9.33)	92.00 (9.59)	89.50 (9.46)
T_8	86.67 (9.31)	93.00 (9.64)	89.83 (9.48)	87.33	93.00	90.17

				(9.34)	(9.64)	(9.49)
T_9	88.00 (9.38)	93.33 (9.66)	90.67 (9.52)	87.67 (9.36)	93.33 (9.66)	90.50 (9.51)
T_{10}	88.33 (9.40)	92.00 (9.59)	90.17 (9.49)	86.67 (9.31)	92.00 (9.59)	89.33 (9.45)
T_{11}	88.00 (9.38)	94.00 (9.70)	91.00 (9.54)	88.33 (9.40)	94.00 (9.70)	91.17 (9.55)
T_{12}	88.33 (9.40)	91.67 (9.57)	90.00 (9.49)	86.67 (9.31)	91.67 (9.57)	89.17 (9.44)
T_{13}	87.33 (9.34)	93.33 (9.66)	90.33 (9.50)	87.67 (9.36)	93.33 (9.66)	90.50 (9.51)
T_{14}	88.00 (9.38)	93.00 (9.64)	90.50 (9.51)	87.67 (9.36)	93.00 (9.64)	90.33 (9.50)
T_{15}	87.00 (9.33)	93.67 (9.68)	90.33 (9.50)	88.00 (9.38)	93.67 (9.68)	90.83 (9.53)
T_{16}	86.33 (9.29)	92.33 (9.61)	89.33 (9.45)	87.00 (9.33)	92.33 (9.61)	89.67 (9.47)
T_{17}	88.00 (9.38)	92.67 (9.63)	90.33 (9.50)	87.33 (9.34)	92.67 (9.63)	90.00 (9.49)
T_{18}	87.00 (9.33)	94.33 (9.71)	90.67 (9.52)	89.33 (9.45)	94.33 (9.71)	91.83 (9.58)
T_{19}	87.33 (9.34)	92.00 (9.59)	89.67 (9.47)	87.00 (9.33)	92.00 (9.59)	89.50 (9.46)
Mean	86.93 (9.32)	92.61 (9.62)	89.77 (9.47)	86.89 (9.32)	92.60 (9.62)	89.75 (9.47)
	L	T	L x T	L	T	L x T
SEm(±)	0.011	0.034	0.049	0.011	0.035	0.050
CD(p=0.05)	0.031	0.097	NS	0.032	0.099	NS

*Figures in the parenthesis are square root transformed values

Table 3.33: Seed vigour index - I of fresh and one year old seeds of two rice varieties (cv. Naveen and Lalat) during germination test as influenced by various priming and coating treatments

Treatments	Seed vigour index – I					
	Var–Naveen			Var–Lalat		
	L_1	L_2	Mean	L_1	L_2	Mean
T_1	1948.56	2230.71	2089.64	1859.84	2312.53	2086.18
T_2	1975.60	2456.91	2216.26	2057.84	2379.69	2218.77
T_3	2080.64	2436.72	2258.68	2112.32	2450.50	2281.41
T_4	2154.24	2451.54	2302.89	2126.24	2395.90	2261.07
T_5	2112.16	2398.67	2255.42	2093.36	2399.28	2246.32
T_6	2140.64	2403.01	2271.82	2084.72	2451.97	2268.35
T_7	2104.48	2391.65	2248.07	2087.68	2288.09	2187.88
T_8	2095.20	2366.52	2230.86	2051.84	2539.25	2295.54
T_9	2141.04	2507.27	2324.15	2173.92	2433.17	2303.54
T_{10}	2155.52	2390.44	2272.98	2086.24	2406.21	2246.23
T_{11}	2069.44	2452.93	2261.18	2106.40	2459.69	2283.04
T_{12}	2162.32	2375.53	2268.93	2121.60	2383.68	2252.64
T_{13}	2116.32	2427.79	2272.06	2111.12	2375.71	2243.41

T_{14}	2112.00	2345.29	2228.64	2131.92	2498.69	2315.30
T_{15}	2116.24	2548.78	2332.51	2111.12	2433.95	2272.53
T_{16}	2092.88	2417.74	2255.31	2101.44	2406.39	2253.91
T_{17}	2077.12	2407.34	2242.23	2122.48	2399.45	2260.97
T_{18}	2101.76	2559.01	2330.38	2186.88	2452.84	2319.86
T_{19}	2103.04	2303.95	2203.49	2108.56	2320.41	2214.49
Mean	2097.85	2414.31	2256.08	2096.61	2409.86	2253.23
	L	T	L x T	L	T	L x T
SEm(±)	13.372	41.214	58.286	12.006	37.004	52.331
CD(p=0.05)	37.663	NS	NS	33.815	104.226	NS

Table 3.34: Seed vigour index - II of fresh and one year old seeds of two rice varieties (cv. Naveen and Lalat) during germination test as influenced by various priming and coating treatments

Treatments	Seed vigour index – II					
	Var - Naveen			Var–Lalat		
	L_1	L_2	Mean	L_1	L_2	Mean
T_1	5.93	6.95	6.44	5.66	7.20	6.43
T_2	6.01	7.65	6.83	6.26	7.41	6.84
T_3	6.33	7.59	6.96	6.42	7.63	7.03
T_4	6.55	7.64	7.09	6.47	7.46	6.97
T_5	6.42	7.47	6.95	6.37	7.47	6.92
T_6	6.51	7.49	7.00	6.34	7.64	6.99
T_7	6.40	7.45	6.93	6.35	7.13	6.74
T_8	6.37	7.37	6.87	6.24	7.91	7.08
T_9	6.51	7.81	7.16	6.61	7.58	7.10
T_{10}	6.56	7.45	7.00	6.35	7.50	6.92
T_{11}	6.29	7.64	6.97	6.41	7.66	7.03
T_{12}	6.58	7.40	6.99	6.45	7.43	6.94
T_{13}	6.44	7.56	7.00	6.42	7.40	6.91
T_{14}	6.42	7.31	6.87	6.48	7.78	7.13
T_{15}	6.44	7.94	7.19	6.42	7.58	7.00
T_{16}	6.37	7.53	6.95	6.39	7.50	6.94
T_{17}	6.32	7.50	6.91	6.46	7.48	6.97
T_{18}	6.39	7.97	7.18	6.65	7.64	7.15
T_{19}	6.40	7.18	6.79	6.41	7.23	6.82
Mean	6.38	7.52	6.95	6.38	7.51	6.94
	L	T	L x T	L	T	L x T
SEm(±)	0.041	0.127	0.180	0.037	0.114	0.161
CD(P=0.05)	0.116	NS	NS	0.104	0.321	NS

Table 3.35: Seed borne pathogen incidence (%) of fresh and one year old seeds of two rice varieties (cv. Naveen and Lalat) as influenced by various priming and coating treatments

Treatments	Seed borne pathogen incidence (%)					
	Var - Naveen			Var–Lalat		
	L_1	L_2	Mean	L_1	L_2	Mean
T_1	17.33 (4.16)	9.33 (3.05)	13.3 (3.60)	17.00 (4.12)	10.0 (3.14)	13.5 (3.63)
T_2	6.00 (2.43)	4.00 (1.99)	5.00 (2.21)	6.33 (2.50)	3.67 (1.88)	5.00 (2.19)
T_3	10.67 (3.26)	5.67 (2.35)	8.17 (2.81)	10.33 (3.21)	5.67 (2.35)	8.00 (2.78)

T_4	10.00 (3.16)	5.33 (2.29)	7.67 (2.73)	10.00 (3.16)	5.33 (2.29)	7.67 (2.73)
T_5	10.33 (3.21)	7.33 (2.70)	8.83 (2.95)	11.33 (3.36)	7.33 (2.70)	9.33 (3.03)
T_6	10.00 (3.16)	5.00 (2.23)	7.50 (2.69)	9.67 (3.11)	5.00 (2.23)	7.33 (2.67)
T_7	10.33 (3.21)	7.00 (2.64)	8.67 (2.93)	11.00 (3.31)	7.00 (2.64)	9.00 (2.98)
T_8	11.33 (3.35)	6.00 (2.41)	8.67 (2.88)	10.67 (3.26)	6.00 (2.41)	8.33 (2.83)
T_9	10.00 (3.16)	5.67 (2.33)	7.83 (2.75)	10.33 (3.20)	5.67 (2.33)	8.00 (2.77)
T_{10}	9.67 (3.11)	7.00 (2.63)	8.33 (2.87)	11.33 (3.36)	7.00 (2.63)	9.17 (3.00)
T_{11}	10.00 (3.15)	5.00 (2.23)	7.50 (2.69)	9.67 (3.11)	5.00 (2.23)	7.33 (2.67)
T_{12}	3.67 (1.88)	3.33 (1.79)	3.50 (1.84)	4.33 (2.06)	3.33 (1.79)	3.83 (1.93)
T_{13}	5.67 (2.37)	3.67 (1.87)	4.67 (2.12)	5.33 (2.29)	3.67 (1.87)	4.50 (2.08)
T_{14}	10.00 (3.16)	6.00 (2.44)	8.00 (2.80)	10.33 (3.21)	6.00 (2.44)	8.17 (2.83)
T_{15}	11.00 (3.31)	5.33 (2.29)	8.17 (2.80)	10.00 (3.16)	5.33 (2.29)	7.67 (2.73)
T_{16}	11.67 (3.41)	6.67 (2.55)	9.17 (2.98)	11.00 (3.31)	6.67 (2.55)	8.83 (2.93)
T_{17}	10.00 (3.16)	6.33 (2.49)	8.17 (2.83)	10.67 (3.26)	6.33 (2.49)	8.50 (2.88)
T_{18}	11.00 (3.31)	4.67 (2.15)	7.83 (2.73)	8.67 (2.94)	4.67 (2.15)	6.67 (2.54)
T_{19}	10.67 (3.26)	7.00 (2.64)	8.83 (2.95)	11.00 (3.31)	7.00 (2.64)	9.00 (2.98)
Mean	9.96 (3.12)	5.81 (2.37)	7.89 (2.75)	9.95 (3.12)	5.82 (2.37)	7.89 (2.75)
	L	T	L x T	L	T	L x T
SEm(±)	0.041	0.127	0.179	0.042	0.129	0.182
CD(p=0.05)	0.116	0.357	NS	0.118	0.363	NS

*Figures in the parenthesis are square root transformed values

Table 3.36: Speed of emergence of fresh and one year old seeds of two rice varieties (cv. Naveen and Lalat) as influenced by various priming and coating treatments

Treatments	Speed of emergence					
	Var–Naveen			Var–Lalat		
	L_1	L_2	Mean	L_1	L_2	Mean
T_1	11.52	16.01	13.77	11.57	15.89	13.73
T_2	11.71	16.07	13.89	11.67	16.13	13.90
T_3	12.48	16.67	14.57	12.52	16.67	14.60
T_4	12.57	16.73	14.65	12.57	16.73	14.65
T_5	12.52	16.37	14.45	12.38	16.37	14.38
T_6	12.57	16.79	14.68	12.62	16.79	14.70
T_7	12.52	16.43	14.48	12.43	16.43	14.43
T_8	12.38	16.61	14.49	12.48	16.61	14.54
T_9	12.57	16.67	14.62	12.52	16.67	14.60
T_{10}	12.62	16.43	14.52	12.38	16.43	14.40
T_{11}	12.57	16.79	14.68	12.62	16.79	14.70
T_{12}	12.62	16.37	14.49	12.38	16.37	14.38
T_{13}	12.48	16.67	14.57	12.52	16.67	14.60
T_{14}	12.57	16.61	14.59	12.52	16.61	14.57
T_{15}	12.43	16.73	14.58	12.57	16.73	14.65
T_{16}	12.33	16.49	14.41	12.43	16.49	14.46
T_{17}	12.57	16.55	14.56	12.48	16.55	14.51
T_{18}	12.43	16.85	14.64	12.76	16.85	14.80
T_{19}	12.48	16.43	14.45	12.43	16.43	14.43
Mean	12.42	16.54	14.48	12.41	16.54	14.47
	L	T	L x T	L	T	L x T
SEm(±)	0.035	0.107	0.152	0.036	0.110	0.156
CD(P=0.05)	0.098	0.303	NS	0.101	0.311	NS

Table 3.37: Final plant stand (%) after 6 weeks of fresh and one year old seeds of two rice varieties (cv. Naveen and Lalat) as influenced by various priming and coating treatments

Treatments	Final plant stand (%) after 6 weeks					
	Var–Naveen			Var–Lalat		
	L_1	L_2	Mean	L_1	L_2	Mean
T_1	64.67 (53.53)	76.33 (60.89)	70.50 (57.21)	64.67 (53.53)	75.67 (60.46)	70.17 (56.99)
T_2	65.33 (53.93)	76.67 (61.12)	71.00 (57.52)	65.33 (53.93)	77.00 (61.35)	71.17 (57.64)
T_3	70.00 (56.79)	79.33 (62.98)	74.67 (59.88)	70.00 (56.79)	79.33 (62.98)	74.67 (59.88)
T_4	70.00 (56.79)	79.67 (63.21)	74.83 (60.00)	70.33 (57.00)	79.67 (63.21)	75.00 (60.10)
T_5	70.00 (56.79)	78.00 (62.03)	74.00 (59.41)	69.33 (56.38)	78.00 (62.03)	73.67 (59.20)
T_6	70.33 (57.00)	80.00 (63.44)	75.17 (60.22)	70.33 (57.00)	80.00 (63.44)	75.17 (60.22)
T_7	70.00 (56.79)	78.00 (62.03)	74.00 (59.41)	69.67 (56.58)	78.00 (62.03)	73.83 (59.31)
T_8	69.33 (56.38)	79.33 (62.98)	74.33 (59.68)	69.67 (56.59)	79.33 (62.98)	74.50 (59.78)
T_9	70.33 (57.00)	79.67 (63.22)	75.00 (60.11)	70.00 (56.79)	79.67 (63.22)	74.83 (60.01)
T_{10}	70.33 (57.00)	78.00 (62.04)	74.17 (59.52)	69.33 (56.37)	78.00 (62.04)	73.67 (59.21)
T_{11}	70.33 (57.00)	80.00 (63.44)	75.17 (60.22)	70.33 (57.00)	80.00 (63.44)	75.17 (60.22)
T_{12}	70.67 (57.21)	78.00 (62.03)	74.33 (59.62)	69.33 (56.38)	78.00 (62.03)	73.67 (59.20)
T_{13}	70.00 (56.79)	79.33 (62.98)	74.67 (59.88)	70.00 (56.79)	79.33 (62.98)	74.67 (59.88)
T_{14}	70.00 (56.79)	79.00 (62.73)	74.50 (59.76)	70.00 (56.79)	79.00 (62.73)	74.50 (59.76)
T_{15}	69.67 (56.58)	79.67 (63.21)	74.67 (59.89)	70.33 (57.00)	79.67 (63.21)	75.00 (60.10)
T_{16}	69.00 (56.17)	78.67 (62.51)	73.83 (59.34)	69.67 (56.59)	78.67 (62.51)	74.17 (59.55)
T_{17}	70.33 (57.00)	78.67 (62.51)	74.50 (59.75)	70.00 (56.79)	78.67 (62.51)	74.33 (59.65)
T_{18}	69.67 (56.59)	80.33 (63.68)	75.00 (60.13)	71.33 (57.63)	80.33 (63.68)	75.83 (60.66)
T_{19}	70.00 (56.79)	78.00 (62.03)	74.00 (59.41)	69.67 (56.58)	78.00 (62.03)	73.83 (59.31)
Mean	69.47 (56.47)	78.77 (62.58)	74.12 (59.53)	69.44 (56.45)	78.75 (62.57)	74.10 (59.51)
	L	T	L x T	L	T	L x T
SEm(±)	0.119	0.365	0.517	0.120	0.370	0.524
CD(p=0.05)	0.334	1.029	NS	0.339	1.044	NS

*Figures in the parenthesis are arc sine transformed values

Mustard

ICAR-IARI, New Delhi

Experimental details: In seed priming of mustard varieties a total of 5 varieties were taken viz. Pusa Vijay, Pusa Karishma, PM 30 (Single zero variety), PM 31 and PDZ 5 (Double zero variety).

Results: Among the varieties, it was found that the germination percentage of Pusa Vijay and PM31 as significantly higher compared to other while PDZ5 showed significantly lower germination percentage. Among the treatments, T2 (Hydroprimed), T5 (Soaking in KH2PO4 (@0.5%) solution and drying) and T14 (Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biogrow) and T16 (Seed coating (on hydro primed seeds) with Zn solubilising bacteria) gave significantly higher germination percentage compared to control while T3 (Soaking in KNO_3 (@0.3%) solution and drying) showed significantly lower germination percentage.

Table 3.38: Effect of priming on seed germination (%) of mustard varieties

Treat.	P. Vijay	P. Karishma	PM 30	PM 31	PDZ 5	Mean
T1	100 (90.0)	98.3 (82.7)	96.6 (79.6)	91.3 (73.0)	94.6 (77.1)	96.2 (80.5)
T2	**99.3 (87.3)**	**98 (83.4)**	**100 (90.0)**	**100 (90.0)**	**97.3 (80.7)**	**98.9 (86.3)**
T3	100 (90.0)	99.3 (87.3)	98.6 (86.1)	100 (90.0)	80.6 (64.3)	95.7 (83.5)
T4	97.3 (84.5)	99.3 (87.3)	100 (90.0)	100 (90.0)	97.3 (80.7)	98.7 (86.5)
T5	**98.6 (84.6)**	**100 (90.0)**	**100 (90.0)**	**100 (90.0)**	**98 (83.4)**	**99.3 (87.6)**
T6	99.3 (87.3)	96 (79.1)	98 (81.9)	100 (90.0)	98.6 (86.1)	98.4 (84.9)
T7	100 (90.0)	99.3 (87.3)	96.6 (79.8)	100 (90.0)	97.3 (82.6)	98.6 (85.9)
T8	99.3 (87.3)	97.3 (84.5)	94.6 (77.1)	100 (90.0)	95.3 (77.6)	97.3 (83.3)
T9	100 (90.0)	95.3 (80.0)	98 (83.4)	100 (90.0)	96.6 (79.6)	98 (84.6)
T10	100 (90.0)	98.6 (84.6)	94.6 (77.1)	96 (78.7)	99.3 (87.3)	97.7 (83.5)
T11	100 (90.0)	96 (81.1)	96 (78.7)	100 (90.0)	97.3 (80.7)	97.8 (84.1)
T12	99.3 (87.3)	98 (83.4)	100 (90.0)	100 (90.0)	96 (78.7)	98.6 (85.9)
T13	100 (90.0)	96 (78.7)	97.3 (82.6)	100 (90.0)	96.6 (81.4)	98 (84.5)
T14	**100 (90.0)**	**99.3 (87.3)**	**100 (90.0)**	**100 (90.0)**	**97.3 (80.7)**	**99.3 (87.6)**
T15	100 (90.0)	96.6 (81.4)	98 (83.4)	100 (90.0)	96 (78.5)	98.1 (84.7)
T16	98.6 (86.1)	99.3 (87.3)	98 (81.9)	100 (90.0)	98.6 (84.6)	98.9 (86.0)
Mean	99.4 (88.4)	97.9 (83.13)	97.9 (83.8)	99.2 (88.2)	96.0 (80.3)	98.1 (85.0)
SEd(±)	V=0.60; T=1.07; VXT=2.39					
CD (p=0.05)	V=1.67;T=2.98; VXT=6.67					

*Values in the parenthesis are arc-sine transformed of the original

Effect of priming on seed vigour index I of mustard varieties: Among the varieties, it was found that Pusa Vijay had significantly higher SVI-I while PDZ 5 showed significantly lower SVI-I . Among the treatments, T5 (Soaking in KH2PO4(@0.5%) solution and drying) was found significantly superior followed by T11 (Seed coating (on hydro primed seeds) with Biogrow (containing 1 x 109 cfu)), T15 (Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biophos) and T13 (Seed coating (on hydro primed seeds)) with

Drought Alleviating Bacteria + BioNPK) gave significantly higher SVI-I compared to control while T2 (Hydroprimed) and T8 (Soaking in ZnSO4 (@0.3%) + MnSO4 (@0.5%) solution for and drying) showed significantly lower SVI-I.

Table 3.39: Effect of priming on seed vigour index I of mustard varieties

Treatment	P. Vijay	P. Karishma	PM30	PM31	PDZ5	Mean
T1	1202	1202	1058	1041	921	1085
T2	1165	971	961	1232	773	1020
T3	1200	1107	1362	1126	532	1065
T4	1153	1108	1170	1172	866	1094
T5	**1232**	**1341**	**1268**	**1329**	**911**	**1216**
T6	1085	1225	1124	1104	648	1037
T7	1196	1119	1161	1170	644	1058
T8	1023	1222	1130	1020	702	1019
T9	1358	1175	1079	1094	776	1096
T10	1081	1164	1140	1171	947	1101
T11	**1315**	**1202**	**1226**	**1102**	**932**	**1155**
T12	1413	999	1262	1133	923	1146
T13	1333	1131	1076	1224	1021	1157
T14	1227	1182	1046	1158	915	1106
T15	1418	1043	1138	1451	807	1171
T16	1156	1161	1312	1202	850	1136
Mean	1222	1147	1157	1171	823	1104
SEd(±)	V =13; T=24; VXT=53					
CD (p=0.05)	V=63; T =160; VXT=464					

Effect of priming on seed Vigour index II of mustard varieties: Among the varieties, it was found that Pusa Vijay had significantly higher SVI-II followed by PM 30 and PDZ 5 while P. Karishma had significantly lower SVI-II. Among the treatments, T2 (Hydroprimed), T4 (Soaking in KNO3 (@0.3%) solution and drying) and T 16 (Seed coating (on hydro primed seeds) with Zn solubilising bacteria) gave significantly higher SVI-II while T7 (Soaking in MnSO4 (@ 0.5%) solution and drying) and T11 (Seed coating (on hydro primed seeds) with Biogrow (containing 1 x 109 cfu)) showed significantly lower SVI-I.

Table 3.40: Effect of priming on seed vigour index II

Treatment	P. Vijay	P. Karishma	PM 30	PM 31	PDZ 5	Mean
T1	1.22	0.893	1.058	0.866	0.905	0.9884
T2	**1.149**	**0.483**	**1.207**	**1.027**	**1.151**	**1.0034**
T3	1.213	0.487	1.182	0.97	0.851	0.9406
T4	**0.903**	**0.622**	**1.1**	**0.953**	**1.415**	**0.9986**
T5	0.978	0.53	1.223	0.89	1.103	0.9448
T6	0.98	0.529	1.052	0.96	1.145	0.9332
T7	1	0.483	1.065	0.927	0.759	0.8468
T8	0.994	0.739	1.043	1.11	1.001	0.9774
T9	1.173	0.569	0.997	0.893	0.909	0.9082
T10	1.413	0.49	0.977	0.901	1.13	0.9822
T11	1.106	0.458	0.958	0.767	0.831	0.824

T12	1.297	0.703	1.11	1.027	0.922	1.0118
T13	1.17	0.467	1.186	0.812	0.899	0.9068
T14	1.073	0.665	1.08	0.963	1.084	0.973
T15	1.463	0.451	0.992	0.983	1.008	0.9794
T16	1.579	0.563	0.98	0.867	1.031	1.004
Mean	1.16	0.57	1.07	0.93	1.0	0.95
SEd(±)	V= 0.014; T =0.025; VXT= 0.056					
CD (p=0.05)	V=0.06; T =0.16; VXT= 0.48					

Effect of priming on Field emergence: The field emergence percentage (FEP) (transformed values) data is shown in table 3.41. All priming treatments had deleterious effect on field emergence.

Table 3.41: Effect of priming on field emergence

Treat.	P. Vijay	P. Karishma	PM 30	PM 31	PDZ 5	Mean
T1	61.3 (51.7)	10.6 (18.9)	31.3 (34.0)	32 (34.4)	14.6 (22.3)	30 (32.3)
T2	60.6 (51.2)	9.3 (17.7)	23.3 (28.7)	28 (31.9)	5.3 (10.8)	25.3 (28.1)
T3	54.6 (47.7)	14 (21.8)	24.6 (29.7)	27.6 (31.7)	6 (13.31)	25.4 (28.8)
T4	50.6 (45.4)	14.6 (22.3)	15.3 (22.9)	16 (23.5)	10.6 (18.9)	21.4 (26.6)
T5	46 (42.7)	12.6 (20.6)	16.6 (24.0)	45.3 (42.3)	9 (17.3)	25.9 (29.4)
T6	56 (48.5)	20.6 (26.8)	16.6 (23.9)	26 (30.3)	9.3 (14.5)	25.7 (28.9)
T7	51.3 (45.7)	16.6 (23.9)	19.3 (25.8)	19.3 (25.9)	14 (21.7)	24.1 (28.6)
T8	46.3 (42.8)	10.6 (18.8)	18 (24.8)	17.3 (24.5)	14.6 (20.8)	21.4 (26.4)
T9	31.3 (34.)	24.6 (29.7)	31.3 (34.0)	28 (31.9)	15.3 (22.6)	26.1 (30.4)
T10	38.6 (38.4)	12.6 (20.6)	16.6 (24.0)	30 (33)	20.6 (26.5)	23.7 (28.5)
T11	32 (34.3)	10 (18.3)	30.6 (33.5)	22.6 (28.4)	15.3 (22.8)	22.1 (27.5)
T12	32.6 (34.7)	21.3 (27.3)	21.3 (27.3)	23.3 (28.8)	15.3 (22.6)	22.7 (28.1)
T13	35.6 (36.6)	21.3 (27.4)	26.6 (31.0)	32.6 (34.8)	10.6 (19.0)	25.4 (29.8)
T14	36 (36.7)	10.6 (18.9)	23 (28.6)	32.6 (34.7)	10 (15.1)	22.4 (26.8)
T15	22 (27.9)	26 (30.5)	23 (28.5)	18 (25.0)	6 (11.6)	19 (24.7)
T16	34 (35.5)	26 (30.6)	32.6 (34.8)	36.3 (37.0)	9.3 (17.3)	27.6 (31.0)
Mean	43.0 (40.9)	16.3 (23.4)	23.1 (28.5)	27.2 (31.1)	11.6 (18.6)	24.2 (28.5)
SEd(±)	V =0.7; T=1.3; VXT=2.8					
CD	V=3.4; T=8.5; VXT= 24.5					

#Values in the parenthesis are arc-sine transformed of the original

Effect of priming on Plant stand establishment: The plant stand establishment (PSE) (transformed values) data is shown in table 3.42. All priming treatments had deleterious effect on plant stand establishment.

Table 3.42: Effect of priming on plant stand establishment

Treat.	P. Vijay	P. Karishma	PM 30	PM 31	PDZ 5	Mean
T1	46.3 (42.9)	8.6 (17.0)	16.6 (23.8)	14.6 (22.2)	6.6 (14.8)	18.6 (24.1)
T2	43.6 (41.3)	6 (14.1)	10 (18.2)	14.6 (22.3)	2.6 (7.6)	15.4 (20.7)
T3	35 (36.1)	6.6 (14.7)	12.6 (20.7)	19.3 (26.0)	3.3 (9.3)	15.4 (21.4)
T4	27 (31.2)	2 (7.9)	7.3 (15.4)	6 (14.0)	5.6 (13.3)	9.6 (16.4)
T5	24 (29.3)	9.3 (17.5)	10 (18.4)	34 (35.6)	4 (11.2)	16.2 (22.4)
T6	30.6 (33.6)	15.3 (22.8)	6.6 (14.9)	18.6 (25.5)	5.6 (11.2)	15.4 (21.6)

T7	35.3 (36.4)	6.3 (14.3)	5.3 (13.1)	10.3 (18.6)	4 (9.4)	12.2 (18.4)
T8	20 (26.4)	8 (16.1)	7.3 (15.4)	9.3 (16.7)	7.3 (12.8)	10.3 (17.5)
T9	24 (29.3)	10 (18.3)	19.3 (25.9)	21.3 (27.4)	4.6 (10.2)	15.8 (22.2)
T10	20 (26.5)	7.3 (15.3)	12 (20.1)	12.6 (20.3)	6.6 (14.4)	11.7 (19.3)
T11	17.3 (24.4)	6 (13.9)	20 (26.4)	13.3 (21.3)	7.3 (15.4)	12.7 (20.3)
T12	16.6 (23.9)	10.6 (18.9)	8 (16.3)	12.6 (20.7)	6.3 (14.3)	10.8 (18.9)
T13	23.3 (28.8)	10 (18.2)	13.3 (21.2)	13.3 (21.4)	6 (11.4)	13.1 (20.2)
T14	24.6 (29.7)	8 (15.6)	14 (21.8)	9.3 (17.7)	2 (4.7)	11.6 (17.9)
T15	6.6 (14.8)	4.6 (12.2)	7.3 (15.3)	11.6 (19.8)	2 (4.7)	6.4 (13.4)
T16	24.6 (29.7)	9.3 (17.7)	20 (26.4)	24.6 (29.5)	3.6 (10.1)	16.4 (22.7)
Mean	26.2 (30.3)	8.0 (15.9)	11.8 (19.6)	15.3 (22.4)	4.8 (10.9)	13.2 (19.8)
SEd(±)	V =0.6; T =1.1; VXT= 2.6					
CD (p=0.05)	V=3.1; T=7.7; VXT=22.4					

*Values in the parenthesis are arc-sine transformed of the original

Conclusion: Among the varieties Pusa Vijay is showed best seed quality parameters while P. Karishma and PDZ 5 performed poorly. Among the treatments T16 (Seed coating (on hydro primed seeds) with Zn solubilising bacteria) gave significantly higher seed quality than control. While all priming treatment had deleterious effect on seed emergence and plant establishment.

AAU, Anand

Varieties and seed lots

V_1L_1 : Gujarat-2 (15763-Fresh)

V_1L_2 : Gujarat-2 (15763-Aged)

V_2L_1 : GDM-4 (15765-Fresh)

V_2L_2 : GDM-4 (15765- Aged)

Treatment: 07

T_1 : Control (Untreated)

T_2 : Thiram 75% WS s3g/kg seed

T_3 : Hydropriming – Soaking in water for 4h (at 20°C) and air-dried at 25°C for 48h. The period, temperature and drying specified above was the same for all other priming treatments

T_4 : Seed coating (on hydro primed seeds) with T. viride (CFU – 2 X 109per gm) @ 10 g / kg seed (Mix 10g in 50 ml of water and applied on 1 kg of seed uniformly. Shade drying the seeds for 20 – 30 minutes before sowing

T_5 : Seed coating (on hydro primed seeds)) with Drought Alleviating Bacteria + BioNPK

T_6 : Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biogrow

T_7 : Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biophos

Results: The seed moisture content of all the lots ranged from 5 to 15 % which showed non-significant with variety. Seed germination of all the treated lots was above the IMSCS level. First count was found significant with all the treatments. Final plant stand was found to be non-significant (Table 3.43).

Table 3.43: Effects of Bio-priming treatments on various laboratory and field parameters observed in fresh and aged seeds of mustard

Variety/Lot/ Treatment			Germination %	Moisture content %	First count %	Seedling length (cm)	Vigour index-I	Speed of Germination	Final plant stand %
			Under laboratory conditions					Under field conditions	
$V_1L_1T_1$			100	10	50	14.35	1435	14.03	92
$V_1L_2T_1$			100	15	35	13.56	1356	10.95	73
$V_2L_1T_1$			100	15	51	15.75	1575	13.51	100
$V_2L_2T_1$			100	6	55	15.06	1506	15.16	100
$V_1L_1T_2$			100	7	26	18.00	1800	9.61	70
$V_1L_2T_2$			95	15	30	16.00	1520	10.56	77
$V_2L_1T_2$			95	9	50	17.67	1679	15.06	100
$V_2L_2T_2$			100	13	46	14.50	1450	14.59	100
$V_1L_1T_3$			100	12	51	15.50	1550	15.90	100
$V_1L_2T_3$			95	12	34	14.50	1378	11.53	82
$V_2L_1T_3$			100	7	82	15.50	1550	17.42	97
$V_2L_2T_3$			100	10	80	15.50	1550	18.45	100
$V_1L_1T_4$			75	11	26	14.80	1110	9.80	72
$V_1L_2T_4$			85	15	30	15.00	1275	11.25	82
$V_2L_1T_4$			100	12	100	14.26	1426	20.81	100
$V_2L_2T_4$			100	11	50	16.95	1695	15.56	97
$V_1L_1T_5$			90	13	57	15.65	1409	15.28	100
$V_1L_2T_5$			100	12	53	16.00	1600	14.75	88
$V_2L_1T_5$			100	15	70	16.35	1635	17.40	100
$V_2L_2T_5$			95	6	58	15.80	1501	15.53	96
$V_1L_1T_6$			85	9	53	16.50	1403	15.30	98
$V_1L_2T_6$			55	13	53	16.50	908	15.63	100
$V_2L_1T_6$			100	12	76	14.50	1450	16.75	100
$V_2L_2T_6$			85	15	75	14.50	1233	17.23	99
$V_1L_1T_7$			95	8	70	15.00	1425	16.38	100
$V_1L_2T_7$			95	5	40	16.93	1608	12.78	99
$V_2L_1T_7$			100	12	68	16.20	1620	17.29	100
$V_2L_2T_7$			90	14	50	15.20	1368	13.15	87
C.V. %			4.38	7.64	3.25	8.76	7.50	11.29	9.41
V	SEm(±)		0.64	NS	0.27	NS	16.96	0.26	1.35
	CD(p=0.05)		1.80	0.37	0.77	0.59	48.06	0.72	3.83
L	SEm(±)		0.63	0.13	0.27	NS	16.96	0.25	NS
	CD(p=0.05)		1.80	0.37	0.77	0.59	48.06	0.72	3.83
T	SEm(±)		1.19	0.25	0.51	0.39	31.73	0.47	2.52
	CD(p=0.05)		3.37	0.70	1.44	1.11	89.91	1.35	7.16
V×L	SEm(±)		NS	0.18	0.38	NS	NS	NS	NS
	CD(p=0.05)		2.55	0.53	1.09	0.84	67.97	1.02	5.41

V×T	SEm(±)	1.68	0.35	0.72	NS	44.88	0.67	3.57
	CD(p=0.05)	4.76	0.99	2.04	1.57	127.16	1.92	10.13
L×T	SEm(±)	1.68	0.35	0.71	0.55	44.88	0.67	NS
	CD(p=0.05)	4.76	0.99	2.03	1.57	127.16	1.92	10.13
V×L×T	SEm(±)	2.38	0.49	1.01	NS	63.47	0.95	NS
	CD(p=0.05)	6.73	1.40	2.88	2.23	179.83	2.71	14.33

Cotton

ICAR-CICR, Nagpur (ICAR-CICR-Regional Station, Coimbatore)

Experimental details: For development of priming technologies for enhanced planting value of seed under sub-optimal conditions in field crops, following treatments will be given;

T1 Control (Untreated)
T2 Control (Imidacloprid treatment)
T3 Hydropriming
T4 Halopriming- Soaking in 800ppm solution of Salicylic acid and drying
T5 Halopriming- Soaking in KNO3(@0.3%) solution and drying
T6 Halopriming- Soaking in KH2PO4(@0.5%) solution and drying
T7 Halopriming- Soaking in ZnSO4 (@0.3%) solution and drying
T8 Halopriming- Soaking in MnSO4 (@0.5%) solution and drying
T9 Halopriming- Soaking in ZnSO4 (@0.3%) + MnSO4 (@0.5%) solution for and drying
T10 Seed coating (on hydro primed seeds) with *Pseudomonas fluorescence*
T11 Seed coating (on hydro primed seeds) with *T. viride*
T12 Seed coating (on hydro primed seeds) with BioNPK (containing 1 x 10^9 cfu)
T13 Seed coating (on hydro primed seeds) with Biogrow (containing 1 x 10^9 cfu)
T14 Seed coating (on hydro primed seeds) with Biophos (containing 1 x 10^9 cfu)
T15 Seed coating (on hydro primed seeds)) with Drought Alleviating Bacteria + BioNPK
T16 Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biogrow
T17 Seed coating (on hydro primed seeds) with Drought Alleviating Bacteria + Biophos

Results: The experiment was conducted in two cotton varieties Surabhi (V1) with two seed lots of 2016-17 produced (L1) and 2017-18 (L2) and LRA 5166 (V2) with two lots of 2015-16 produced (L1) and 2016-17 (L2). The results on effect of 17 seed soaking and coating treatments on cotton seed quality parameters observed under laboratory and field conditions (Table 3.44 to 3.58). The germination (%) was higher in the fresh lots of two varieties when compared to revalidated lots. The treatments which showed significantly higher germination per cent were KH_2PO_4 (85), *Trichoderma viride* (84), *Pseudomonas fluorescens* (84), BioNPK (84), Drought Alleviating Bacteria + BioNPK (82) over the control (76). In the field experiment, fresh lots of both varieties performed superior over revalidated seeds in all the treatments of both varieties. The treatments viz., seed soaking

with KH_2PO_4, seed coating with *Trichoderma viride*, *Pseudomonas fluorescens*, BioNPK, Biogrow, Biophos, Drought Alleviating Bacteria+ BioNPK were performed significantly superior over control in field study also.

Table 3.44: Effect of seed soaking and coating treatments on cotton seed moisture content

Moisture content %							
	Surabhi (V1)		Mean	LRA 5166 (V2)		Mean	G. Mean
Treatments	2016-17 (L1)	2017-18 (L2)		2015-16 (L1)	2016-17 (L2)		
Control (T1)	5.55	6.80	6.18	6.60	5.40	6.00	6.09
Imidacloprid (T2)	7.12	7.07	7.10	7.14	7.15	7.14	7.12
Hydropriming (T3)	6.09	6.58	6.34	6.43	6.42	6.43	6.38
Salicylic acid (T4)	6.10	7.77	6.93	6.76	6.10	6.43	6.68
KNO3 (T5)	6.26	6.52	6.39	6.94	5.85	6.39	6.39
KH2PO4 (T6)	5.87	6.11	5.99	6.90	6.08	6.49	6.24
ZnSO4 (T7)	6.25	7.94	7.10	6.29	6.46	6.37	6.73
MnSO4 (T8)	5.82	6.51	6.17	7.04	5.19	6.12	6.14
ZnSO4+MnSO4 (T9)	6.02	6.19	6.10	5.28	5.66	5.47	5.79
Pseudomonas (T10)	7.68	8.05	7.86	7.94	7.61	7.77	7.82
Trichoderma viride (T11)	7.84	7.60	7.72	7.86	7.91	7.88	7.80
BioNPK (T12)	8.29	8.36	8.32	7.93	7.86	7.89	8.11
Biogrow (T13)	8.50	8.45	8.48	8.53	8.87	8.70	8.59
Biophos (T14)	9.03	8.40	8.72	8.07	8.64	8.35	8.54
DAB+BioNPK (T15)	7.57	8.03	7.80	8.38	7.34	7.86	7.83
DAB +Biogrow (T16)	9.21	8.06	8.63	8.81	8.29	8.55	8.59
DAB +Biophos (T17)	8.35	9.09	8.72	8.65	8.31	8.48	8.60
MEAN	7.15	7.50	7.33	7.38	7.01	7.20	7.26
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.37	0.13	0.13	0.52	0.52	0.19	0.74
CD (p=0.01)	1.00	0.35	0.35	1.46	1.46	0.51	1.99

Table 3.45: Effect of seed soaking and coating treatments on cotton seed germination

Germination (%)							
Treatments	Surabhi (V1)		Mean	LRA 5166 (V2)		Mean	G. Mean
	2016-17 (L1)	2017-18 (L2)		2015-16 (L1)	2016-17 (L2)		
Control (T1)	76	81	78	68	78	73	76
Imidacloprid (T2)	76	81	79	68	78	73	76
Hydropriming (T3)	76	82	79	68	78	73	76
Salicylic acid (T4)	76	80	78	67	78	73	75
KNO3 (T5)	79	83	81	69	80	75	78
KH2PO4 (T6)	**84**	**89**	**87**	**77**	**89**	**83**	**85**

ZnSO4 (T7)	79	82	80	71	81	76	78
MnSO4 (T8)	81	82	81	72	81	76	79
ZnSO4+MnSO4 (T9)	79	81	80	69	82	75	78
Pseudomonas (T10)	84	91	87	76	86	81	84
Trichoderma viride (T11)	84	89	87	77	86	81	84
BioNPK (T12)	**84**	**88**	**86**	**77**	**87**	**82**	**84**
Biogrow (T13)	79	82	80	72	81	76	78
Biophos (T14)	77	82	80	70	80	75	77
DAB+BioNPK (T15)	83	89	86	76	80	78	82
DAB +Biogrow (T16)	79	83	81	71	82	77	79
DAB +Biophos (T17)	79	82	80	71	83	77	79
Mean	80	84	82	72	82	77	79
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.46	0.16	0.16	0.65	0.65	0.22	0.93
CD (p=0.01)	1.2	0.41	0.41	1.7	1.7	0.58	2.41

Table 3.46: Effect of seed soaking and coating treatments on cotton seed Root length (cm)

Root length (cm)							
Treatments	**Surabhi (V1)**		**Mean**	**LRA 5166 (V2)**		**Mean**	**G. Mean**
	2016-17 (L1)	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	16.10	16.82	16.46	13.56	19.16	16.36	16.41
Imidacloprid (T2)	17.80	19.70	18.75	18.43	21.70	20.06	19.41
Hydropriming (T3)	16.28	14.63	15.45	16.43	19.88	18.15	16.80
Salicylic acid (T4)	11.85	13.89	12.87	17.05	16.55	16.80	14.84
KNO3 (T5)	19.40	22.04	20.72	18.53	21.55	20.04	20.38
KH2PO4 (T6)	**20.70**	**21.91**	**21.30**	**18.88**	**22.65**	**20.76**	**21.03**
ZnSO4 (T7)	20.48	19.94	20.21	19.40	20.54	19.97	20.09
MnSO4 (T8)	19.45	20.50	19.97	19.53	22.59	21.06	20.51
ZnSO4+MnSO4 (T9)	20.18	21.67	20.92	20.60	21.88	21.24	21.08
Pseudomonas (T10)	19.48	21.43	20.45	20.62	22.58	21.60	21.03
Trichoderma viride (T11)	17.95	20.88	19.41	20.72	23.18	21.95	20.68
BioNPK (T12)	18.69	19.40	19.04	19.60	22.60	21.10	20.07
Biogrow (T13)	18.38	20.43	19.40	19.08	22.80	20.94	20.17
Biophos (T14)	17.90	18.81	18.36	18.68	22.43	20.55	19.45
DAB+BioNPK (T15)	17.55	19.59	18.57	21.48	23.39	22.43	20.50
DAB +Biogrow (T16)	20.71	21.56	21.13	19.29	23.16	21.22	21.18
DAB +Biophos (T17)	17.89	19.79	18.84	20.65	23.98	22.31	20.58
Mean	18.28	19.59	18.93	18.97	21.80	20.38	19.66
	T	V	L	VT	LT	VL	VLT

SEd(±)	0.63	0.22	0.22	0.90	0.90	0.31	1.27
CD (p=0.01)	1.65	0.56	0.56	2.33	2.33	0.80	3.29

Table 3.47: Effect of seed soaking and coating treatments on cotton seed shoot length

Shoot length (cm)							
	Surabhi (V1)		Mean	LRA 5166 (V2)		Mean	G. Mean
Treatments	**2016-17 (L1)**	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	10.60	10.13	10.36	8.70	13.02	10.86	10.61
Imidacloprid (T2)	13.15	11.10	12.12	11.24	15.34	13.29	12.71
Hydropriming (T3)	13.98	11.63	12.80	14.83	17.63	16.23	14.51
Salicylic acid (T4)	6.38	7.24	6.81	11.29	14.61	12.95	9.88
KNO3 (T5)	12.91	14.07	13.49	11.08	15.64	13.36	13.42
KH2PO4 (T6)	**14.45**	**12.89**	**13.67**	**14.50**	**16.07**	**15.29**	**14.48**
ZnSO4 (T7)	14.04	11.78	12.91	11.29	14.90	13.09	13.00
MnSO4 (T8)	14.24	13.56	13.90	13.63	17.35	15.49	14.69
ZnSO4+MnSO4 (T9)	12.68	13.25	12.96	11.98	16.80	14.39	13.68
Pseudomonas (T10)	**14.38**	**15.53**	**14.95**	**15.38**	**17.76**	**16.57**	**15.76**
Trichoderma viride (T11)	12.55	13.70	13.13	15.23	16.95	16.09	14.61
BioNPK (T12)	10.78	10.80	10.79	11.68	14.12	12.90	11.84
Biogrow (T13)	10.35	10.63	10.49	11.28	14.00	12.64	11.56
Biophos (T14)	8.87	9.35	9.11	11.18	14.37	12.78	10.94
DAB+BioNPK (T15)	10.53	10.28	10.41	12.61	14.33	13.47	11.94
DAB +Biogrow (T16)	12.32	11.74	12.03	9.89	15.29	12.59	12.31
DAB +Biophos (T17)	9.21	10.45	9.83	11.46	13.46	12.46	11.14
Mean	11.85	11.65	11.75	12.19	15.39	13.79	12.77
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.47	0.16	0.16	0.66	0.66	0.23	0.94
CD (p=0.01)	1.22	0.42	0.42	1.72	1.72	0.59	2.43

Table 3.48: Effect of seed soaking and coating treatments on cotton seed Vigour Index I

Vigour Index I							
	Surabhi (V1)		Mean	LRA 5166 (V2)		Mean	G. Mean
Treatments	**2016-17 (L1)**	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	2023	2182	2102	1515	2510	2012	2057
Imidacloprid (T2)	2344	2494	2419	2002	2870	2436	2427
Hydropriming (T3)	2305	2159	2232	2110	2934	2522	2377
Salicylic acid (T4)	1376	1680	1528	1897	2440	2168	1848
KNO3 (T5)	2537	2997	2767	2050	2982	2516	2642
KH2PO4 (T6)	**2963**	**3090**	**3026**	**2577**	**3428**	**3003**	**3015**
ZnSO4 (T7)	2710	2587	2648	2179	2863	2521	2584

MnSO4 (T8)	2710	2802	2756	2387	3214	2800	2778
ZnSO4+MnSO4 (T9)	2597	2840	2718	2256	3152	2704	2711
Pseudomonas (T10)	**2824**	**3344**	**3084**	**2735**	**3461**	**3098**	**3091**
Trichoderma viride (T11)	2568	3076	2822	2751	3461	3106	2964
BioNPK (T12)	2469	2641	2555	2399	3177	2788	2671
Biogrow (T13)	2257	2555	2406	2184	2971	2578	2492
Biophos (T14)	2064	2310	2187	2098	2944	2521	2354
DAB+BioNPK (T15)	2330	2651	2490	2598	3026	2812	2651
DAB +Biogrow (T16)	2593	2746	2670	2071	3162	2616	2643
DAB +Biophos (T17)	2148	2464	2306	2279	3087	2683	2494
MEAN	2401	2625	2513	2240	3040	2640	2576
	T	V	L	VT	LT	VL	VLT
SEd(±)	76.69	26.30	26.30	108.45	108.45	37.2	153.38
CD (p=0.01)	199.43	68.40	68.40	282.04	282.04	96.74	398.87

Table 3.49: Effect of seed soaking and coating treatments on cotton seed Vigour Index II

Vigour Index II							
	Surabhi (V1)		**Mean**	**LRA 5166 (V2)**		**Mean**	**G. Mean**
Treatments	**2016-17 (L1)**	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	12	15	14	10	15	13	13
Imidacloprid (T2)	15	16	15	13	16	14	15
Hydropriming (T3)	13	16	14	11	15	13	14
Salicylic acid (T4)	14	16	15	12	16	14	14
KNO3 (T5)	16	21	18	12	18	15	17
KH2PO4 (T6)	**20**	**25**	**23**	**16**	**23**	**20**	**21**
ZnSO4 (T7)	17	18	17	15	19	17	17
MnSO4 (T8)	19	20	20	15	18	17	18
ZnSO4+MnSO4 (T9)	16	20	18	14	19	16	17
Pseudomonas (T10)	21	25	23	18	24	21	22
Trichoderma viride (T11)	21	25	23	18	24	21	22
BioNPK (T12)	**20**	**24**	**22**	**18**	**25**	**21**	**22**
Biogrow (T13)	17	20	19	15	20	17	18
Biophos (T14)	15	19	17	14	20	17	17
DAB+BioNPK (T15)	20	24	22	18	23	20	21
DAB +Biogrow (T16)	18	20	19	14	21	17	18
DAB +Biophos (T17)	20	21	20	15	20	17	19
MEAN	17	20	19	14	20	17	18
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.54	0.18	0.18	0.76	0.76	0.26	1.07
CD (p=0.01)	1.40	0.48	0.48	1.97	1.97	0.68	2.79

Table 3.50: Effect of seed soaking and coating treatments on cotton dry matter production

Dry matter production							
	Surabhi (V1)		Mean	LRA 5166 (V2)		Mean	G. Mean
Treatments	**2016-17 (L1)**	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	0.16	0.18	0.17	0.15	0.19	0.17	0.17
Imidacloprid (T2)	0.19	0.20	0.19	0.19	0.21	0.20	0.20
Hydropriming (T3)	0.17	0.19	0.18	0.17	0.19	0.18	0.18
Salicylic acid (T4)	0.18	0.20	0.19	0.18	0.20	0.19	0.19
KNO3 (T5)	0.20	0.25	0.23	0.18	0.22	0.20	0.21
KH2PO4 (T6)	**0.24**	**0.28**	**0.26**	**0.21**	**0.26**	**0.24**	**0.25**
ZnSO4 (T7)	0.22	0.22	0.22	0.21	0.23	0.22	0.22
MnSO4 (T8)	0.24	0.25	0.24	0.21	0.23	0.22	0.23
ZnSO4+MnSO4 (T9)	0.21	0.25	0.23	0.20	0.23	0.22	0.22
Pseudomonas (T10)	0.25	0.28	0.26	0.24	0.28	0.26	0.26
Trichoderma viride (T11)	0.25	0.28	0.26	0.23	0.27	0.25	0.26
BioNPK (T12)	**0.24**	**0.28**	**0.26**	**0.24**	**0.28**	**0.26**	**0.26**
Biogrow (T13)	0.22	0.25	0.23	0.21	0.25	0.23	0.23
Biophos (T14)	0.20	0.23	0.21	0.20	0.25	0.22	0.22
DAB+BioNPK (T15)	0.24	0.28	0.26	0.23	0.28	0.26	0.26
DAB +Biogrow (T16)	0.23	0.24	0.23	0.19	0.25	0.22	0.23
DAB +Biophos (T17)	0.25	0.25	0.25	0.21	0.24	0.22	0.24
MEAN	0.21	0.24	0.23	0.20	0.24	0.22	0.22
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.006	0.002	0.002	0.009	0.009	0.003	0.013
CD (p=0.01)	0.016	0.006	0.006	0.023	0.023	0.008	0.033

Table 3.51: Effect of seed soaking and coating treatments on speed of germination

Speed of germination							
Treatments	Surabhi (V1)		Mean	LRA 5166 (V2)		Mean	G. Mean
	2016-17 (L1)	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	7.66	9.11	8.39	5.32	13.09	9.21	8.80
Imidacloprid (T2)	8.14	9.95	9.04	4.87	13.74	9.31	9.17
Hydropriming (T3)	7.76	9.76	8.76	5.99	13.65	9.82	9.29
Salicylic acid (T4)	2.44	4.49	3.46	3.33	13.02	8.18	5.82
KNO3 (T5)	**10.90**	**12.01**	**11.46**	**4.33**	**15.94**	**10.13**	**10.79**
KH2PO4 (T6)	6.00	11.68	8.84	5.19	15.72	10.45	9.65
ZnSO4 (T7)	8.52	11.73	10.12	5.21	15.30	10.25	10.19
MnSO4 (T8)	6.63	9.81	8.22	5.33	14.71	10.02	9.12
ZnSO4+MnSO4 (T9)	9.54	9.88	9.71	4.60	15.29	9.95	9.83

Pseudomonas (T10)	8.19	10.26	9.22	5.03	13.11	9.07	9.15
Trichoderma viride (T11)	8.50	10.02	9.26	5.71	14.40	10.06	9.66
BioNPK (T12)	7.67	10.39	9.03	5.37	15.59	10.48	9.75
Biogrow (T13)	7.28	10.54	8.91	5.56	15.07	10.32	9.61
Biophos (T14)	6.46	10.07	8.26	5.65	14.97	10.31	9.29
DAB+BioNPK (T15)	6.69	10.14	8.41	5.41	15.45	10.43	9.42
DAB +Biogrow (T16)	4.91	9.13	7.02	3.34	13.65	8.49	7.76
DAB +Biophos (T17)	5.88	7.87	6.88	3.44	10.38	6.91	6.89
Mean	7.25	9.81	8.53	4.92	14.30	9.61	9.07
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.28	0.10	0.10	0.40	0.40	0.14	0.56
CD (p=0.01)	0.73	0.25	0.25	1.03	1.03	0.35	1.46

Table 3.52: Effect of seed soaking and coating treatments on field emergence

Field emergence (%)							
	Surabhi (V1)		Mean	LRA 5166 (V2)		Mean	G. Mean
Treatments	2016-17 (L1)	2017-18 (L2)		2015-16 (L1)	2016-17 (L2)		
Control (T1)	74	79	76	65	75	70	73
Imidacloprid (T2)	74	79	76	66	76	71	74
Hydropriming (T3)	74	79	77	66	76	71	74
Salicylic acid (T4)	75	79	77	66	75	70	74
KNO3 (T5)	75	79	77	67	77	72	74
KH2PO4 (T6)	**83**	**84**	**84**	**74**	**85**	**79**	**81**
ZnSO4 (T7)	77	80	78	69	78	74	76
MnSO4 (T8)	77	80	79	70	78	74	76
ZnSO4+MnSO4 (T9)	77	79	78	69	78	74	76
Pseudomonas (T10)	84	88	86	76	85	80	83
***Trichoderma viride* (T11)**	**84**	**87**	**85**	**75**	**85**	**80**	**83**
BioNPK (T12)	**83**	**86**	**84**	**75**	**85**	**80**	**82**
Biogrow (T13)	78	80	79	69	79	74	77
Biophos (T14)	79	80	79	69	79	74	77
DAB+BioNPK (T15)	84	87	86	74	78	76	81
DAB +Biogrow (T16)	80	80	80	70	79	75	77
DAB +Biophos (T17)	80	80	80	68	79	73	76
Mean	79	81	80	70	79	74	77
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.39	0.13	0.13	0.55	0.55	0.19	0.78
CD (p=0.01)	1.02	0.35	0.35	1.44	1.44	0.49	2.04

Table 3.53: Effect of seed soaking and coating treatments on cotton seed root length (cm)

Root length (cm)							
Treatments	Surabhi (V1)		Mean	LRA 5166 (V2)		Mean	G. Mean
	2016-17 (L1)	2017-18 (L2)		2015-16 (L1)	2016-17 (L2)		
Control (T1)	9.58	11.48	10.53	7.43	10.20	8.81	9.67
Imidacloprid (T2)	10.63	11.63	11.13	8.28	12.45	10.36	10.74
Hydropriming (T3)	10.83	12.03	11.43	9.20	9.20	9.20	10.31
Salicylic acid (T4)	6.63	7.55	7.09	8.45	9.10	8.78	7.93
KNO3 (T5)	11.30	11.75	11.53	8.58	11.95	10.26	10.89
KH2PO4 (T6)	15.15	16.43	15.79	9.68	11.58	10.63	13.21
ZnSO4 (T7)	11.28	11.21	11.24	10.45	11.93	11.19	11.21
MnSO4 (T8)	8.50	7.98	8.24	10.08	14.88	12.48	10.36
ZnSO4+MnSO4 (T9)	11.65	10.40	11.03	11.08	12.95	12.01	11.52
Pseudomonas (T10)	14.83	16.00	15.41	7.30	11.73	9.51	12.46
Trichoderma viride (T11)	14.63	16.35	15.49	10.05	11.63	10.84	13.16
BioNPK (T12)	14.70	15.73	15.21	9.18	12.08	10.63	12.92
Biogrow (T13)	12.13	12.10	12.11	10.13	12.65	11.39	11.75
Biophos (T14)	11.15	9.98	10.56	8.23	10.70	9.46	10.01
DAB+BioNPK (T15)	14.90	11.28	13.09	11.58	12.80	12.19	12.64
DAB +Biogrow (T16)	8.18	7.50	7.84	7.30	8.48	7.89	7.86
DAB +Biophos (T17)	8.76	8.20	8.48	6.85	7.70	7.28	7.88
Mean	11.46	11.62	11.54	9.05	11.29	10.17	10.85
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.41	0.14	0.14	0.57	0.57	0.20	0.81
CD (p=0.01)	1.05	0.36	0.36	1.49	1.49	0.51	2.11

Table 3.54: Effect of seed soaking and coating treatments on cotton seed shoot length

Shoot length (cm)							
Treatments	**Surabhi (V1)**		**Mean**	**LRA 5166 (V2)**		**Mean**	**G. Mean**
	2016-17 (L1)	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	14.90	16.95	15.93	14.30	22.08	18.19	17.06
Imidacloprid (T2)	18.60	18.65	18.63	17.40	23.25	20.33	19.48
Hydropriming (T3)	19.33	22.25	20.79	26.85	26.85	26.85	23.82
Salicylic acid (T4)	9.93	11.10	10.51	15.18	17.00	16.09	13.30
KNO3 (T5)	15.70	17.15	16.43	14.88	18.60	16.74	16.58
KH2PO4 (T6)	19.10	20.95	20.03	15.83	19.53	17.68	18.85
ZnSO4 (T7)	16.15	19.13	17.64	15.25	22.63	18.94	18.29
MnSO4 (T8)	17.45	18.18	17.81	16.40	21.20	18.80	18.31
ZnSO4+MnSO4 (T9)	16.53	15.55	16.04	12.85	18.03	15.44	15.74
Pseudomonas (T10)	17.78	21.03	19.40	15.18	21.63	18.40	18.90

Trichoderma viride (T11)	18.88	21.15	20.01	15.03	18.65	16.84	18.43
BioNPK (T12)	19.00	20.45	19.73	13.83	18.33	16.08	17.90
Biogrow (T13)	12.68	11.62	12.15	11.40	15.45	13.43	12.79
Biophos (T14)	13.10	15.03	14.06	10.75	16.50	13.63	13.84
DAB+BioNPK (T15)	16.65	11.90	14.28	14.30	15.93	15.11	14.69
DAB +Biogrow (T16)	5.90	7.85	6.88	5.73	8.75	7.24	7.06
DAB +Biophos (T17)	9.35	9.45	9.40	7.43	9.45	8.44	8.92
Mean	15.35	16.37	15.86	14.27	18.46	16.36	16.11
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.45	0.15	0.15	0.64	0.64	0.22	0.90
CD (p=0.01)	1.17	0.40	0.40	1.66	1.66	0.57	2.34

Table 3.55: Effect of seed soaking and coating treatments on cotton seed vigour Index I

Vigour Index I							
Treatments	**Surabhi (V1)**		**Mean**	**LRA 5166 (V2)**		**Mean**	**G. Mean**
	2016-17 (L1)	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	1805	2238	2022	1412	2413	1912	1967
Imidacloprid (T2)	2157	2392	2275	1694	2723	2208	2242
Hydropriming (T3)	2241	2715	2478	2378	2722	2550	2514
Salicylic acid (T4)	1232	1478	1355	1546	1964	1755	1555
KNO3 (T5)	2026	2268	2147	1578	2351	1964	2056
KH2PO4 (T6)	2837	3150	2993	1881	2630	2256	2624
ZnSO4 (T7)	2113	2411	2262	1774	2703	2239	2250
MnSO4 (T8)	2004	2085	2044	1854	2797	2325	2185
ZnSO4+MnSO4 (T9)	2177	2045	2111	1650	2416	2033	2072
Pseudomonas (T10)	2722	3266	2994	1698	2833	2265	2630
Trichoderma viride (T11)	2796	3253	3025	1874	2573	2224	2624
BioNPK (T12)	2788	3112	2950	1714	2583	2148	2549
Biogrow (T13)	1941	1897	1919	1492	2220	1856	1887
Biophos (T14)	1923	1989	1956	1314	2135	1724	1840
DAB+BioNPK (T15)	2660	2010	2335	1915	2248	2081	2208
DAB +Biogrow (T16)	1122	1224	1173	909	1366	1138	1155
DAB +Biophos (T17)	1444	1412	1428	963	1346	1155	1291
Mean	2117	2291	2204	1626	2354	1990	2097
	T	V	L	VT	LT	VL	VLT
SEd(±)	53.13	18.22	18.22	75.14	75.14	25.77	106.26
CD (p=0.01)	138	47	47	195	195	67	276

Table 3.56: Effect of seed soaking and coating treatments on cotton seed vigour Index II

Vigour Index II							
Treatments	**Surabhi (V1)**		**Mean**	**LRA 5166 (V2)**		**Mean**	**G. Mean**
	2016-17 (L1)	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	192	286	239	226	296	261	250
Imidacloprid (T2)	274	287	281	243	315	279	280
Hydropriming (T3)	286	273	279	220	306	263	271
Salicylic acid (T4)	206	259	232	221	320	270	251
KNO3 (T5)	222	290	256	251	337	294	275
KH2PO4 (T6)	388	354	371	265	460	362	367
ZnSO4 (T7)	260	325	293	267	409	338	315
MnSO4 (T8)	234	269	251	270	386	328	290
ZnSO4+MnSO4 (T9)	275	308	291	165	318	241	266
Pseudomonas (T10)	435	432	434	264	505	385	409
Trichoderma viride (T11)	394	395	394	220	416	318	356
BioNPK (T12)	391	413	402	256	470	363	382
Biogrow (T13)	242	345	294	247	411	329	312
Biophos (T14)	235	312	273	236	380	308	291
DAB+BioNPK (T15)	349	403	376	281	349	315	346
DAB +Biogrow (T16)	320	315	317	221	376	298	308
DAB +Biophos (T17)	284	309	296	173	350	261	279
Mean	293	328	311	237	377	307	309
	T	V	L	VT	LT	VL	VLT
SEd(±)	19.50	6.69	6.69	27.58	27.58	9.46	39.00
CD (p=0.01)	50	17	17	71	71	24	101

Table 3.57: Effect of seed soaking and coating treatments on cotton dry matter production

Dry matter production							
Treatments	**Surabhi (V1)**		**Mean**	**LRA 5166 (V2)**		**Mean**	**G. Mean**
	2016-17 (L1)	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	3.44	3.50	3.47	3.00	4.12	3.56	3.52
Imidacloprid (T2)	3.69	3.60	3.64	3.63	3.98	3.81	3.72
Hydropriming (T3)	3.93	3.56	3.74	3.57	4.33	3.95	3.85
Salicylic acid (T4)	2.66	3.04	2.85	3.32	4.56	3.94	3.39
KNO3 (T5)	2.96	3.72	3.34	3.86	4.38	4.12	3.73
KH2PO4 (T6)	5.06	4.86	4.96	3.61	5.87	4.74	4.85
ZnSO4 (T7)	3.03	3.59	3.31	3.90	4.74	4.32	3.81
MnSO4 (T8)	2.90	3.20	3.05	3.65	5.28	4.47	3.76
ZnSO4+MnSO4 (T9)	3.78	4.14	3.96	2.02	3.45	2.73	3.35

Pseudomonas (T10)	4.93	4.87	4.90	3.63	5.67	4.65	4.77
Trichoderma viride (T11)	5.37	4.83	5.10	3.33	5.73	4.53	4.81
BioNPK (T12)	4.70	4.67	4.68	3.39	5.61	4.50	4.59
Biogrow (T13)	2.52	4.28	3.40	3.51	4.91	4.21	3.80
Biophos (T14)	2.89	4.09	3.49	3.29	4.73	4.01	3.75
DAB+BioNPK (T15)	4.75	4.63	4.69	3.90	4.58	4.24	4.47
DAB +Biogrow (T16)	3.65	3.87	3.76	2.74	4.59	3.67	3.71
DAB +Biophos (T17)	3.68	3.68	3.68	2.76	4.45	3.61	3.64
Mean	3.76	4.01	3.88	3.36	4.76	4.06	3.97
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.15	0.05	0.05	0.22	0.22	0.07	0.31
CD (p=0.01)	0.4	0.14	0.14	0.57	0.57	0.19	0.8

Table 3.58: Effect of seed soaking and coating treatments on cotton Plant stand (%)

Plant stand (%)							
Treatments	**Surabhi (V1)**		**Mean**	**LRA 5166 (V2)**		**Mean**	**G. Mean**
	2016-17 (L1)	**2017-18 (L2)**		**2015-16 (L1)**	**2016-17 (L2)**		
Control (T1)	73	78	75	65	74	69	72
Imidacloprid (T2)	72	78	75	65	76	70	73
Hydropriming (T3)	73	79	76	65	76	70	73
Salicylic acid (T4)	73	78	75	65	75	70	73
KNO3 (T5)	74	77	76	67	76	72	74
KH2PO4 (T6)	82	83	83	73	84	78	80
ZnSO4 (T7)	76	79	77	69	78	74	76
MnSO4 (T8)	77	78	77	70	77	73	75
ZnSO4+MnSO4 (T9)	77	77	77	68	77	73	75
Pseudomonas (T10)	82	87	84	75	84	80	82
Trichoderma viride (T11)	82	85	83	74	84	79	81
BioNPK (T12)	**81**	**85**	**83**	**74**	**84**	**79**	**81**
Biogrow (T13)	77	79	78	69	79	74	76
Biophos (T14)	78	79	79	69	77	73	76
DAB+BioNPK (T15)	83	86	84	73	78	75	80
DAB +Biogrow (T16)	79	80	79	69	79	74	77
DAB +Biophos (T17)	78	80	79	67	77	72	75
Mean	77	80	79	69	78	74	76
	T	V	L	VT	LT	VL	VLT
SEd(±)	0.43	0.15	0.15	0.60	0.6	0.21	0.85
CD (p=0.01)	1.11	0.38	0.38	1.56	1.56	0.54	2.21

Specialty Maize

ICAR-IARI, New Delhi

Experimental details: The study was undertaken in *Rabi* 2019 at ICAR-IARI with five specialty maize varieties viz. VL Amber popcorn(V1), CMVL Sweet corn -1(V2), Vivek QPM-9 (V3), CMVL Baby corn -2(V4), Vivek maize hybrid (V5) The seeds of all the varieties were accelerated aged at 42^0C for 3 days to create low vigour lot.

Results: The study showed that seed moisture content varied from 11.39 to 15.64% among seed lots wherein among hydropriming treatments (T2, T3) moisture ranged from 11.24 to 12.25 and among halopriming treatments it ranged from 13.21 to 15.36% whereas in bio-priming treatments from 12.11 to 15.64%.This indicated that seed halo priming treatments showed maximum seed moisture content and bio priming the least among the treatments compared on specialty maize.

Among treatments seed hydropriming followed by dry dressing with Thiram, halopriming with KNO3, Halopriming with Znso4 @0.3% + Mnso4 @0.5%, biopriming with *T. harzianum* and drought alleviating bacteria along with Bio phos were significantly better than other treatments for improving seed germination, vigour under laboratory conditions and field stand establish and speed of emergence under field for alleviating effect of sub optimum temperatures during sowing. Microbial consortium individually had not showed significant enhancement but combined treatments were more effective in improving field stand establishment in specialty maize. Seed treatment with Nitric oxide @0.25mM had detrimental effect on seed germination of maize genotypes.

Conclusion or Salient Finding(s):

Suboptimum temperatures had severe effect on seed germination and field performance of specialty maize; among them QPM and sweet corn genotypes were most sensitive to suboptimum conditions.

Among treatments seed hydropriming followed by dry dressing with Thiram, halopriming with KNO3, Halopriming with Znso4 @0.3% + Mnso4 @0.5%, bio priming with *T. harzianum* and drought alleviating bacteria along with Bio phos were significantly better in improving seed germination, vigour and field stand under sub optimum conditions.

Experiment 3: Sub. Experiment II (As per Objective 2): Validation of standardized priming technologies in pigeonpea for sub-optimal conditions

Materials:

For validation of standardized priming technologies in pigeon pea for sub-optimal conditions, the primed seeds of two IARI varieties; Pusa 991 and Pusa 992 of Pigeon pea will be provided to each centre by ICAR-IARI, New Delhi. However, each center may use the seeds of two; location specific and most popular varieties and treat them as per the details given below;

Treatments:

1. Control (Untreated).
2. Hydropriming (Soaking in water for 10 h at 25-30°C) and drying- standardized for rainfed conditions.
3. Exposure of seeds for 24 hr at 40°C (Standardized for heat stress conditions).
4. Osmopriming (Soaking in PEG-6000 solution of 60% available water (-0.62MPa) for 11h at 25-30°C) and drying- standardized for moisture stress conditions. For preparing solution of 60% available water add 21g PEG-6000 per litre of water. *Kindly note that available soil water also depends upon the soil texture.*
5. Halopriming (Soaking in NaCl + $CaCl_2$ solution having EC of 6dSm^{-1} for 8 hrs at 25-30^{0}C) and drying. For preparing solution of 6dSm^{-1} EC, use 1.7532g NaCl + 4.4106g $CaCl_2$ $2H_2O$ (Dihydrate) of 58.44g and 147.02g Molar weights, respectively in 1 lt of water. You may still require adjusting the EC.

Experiment Design:

Number of Treatments: Five
Number of Varieties: Two
Plot size: 3X6.25m
Row Length: 6.25m
Plant to plant: 25cm (25seeds/row)
Row to row: 75cm
Number of rows per replication: Four (100 seeds/replication)
Number of replications: Four
Total Area required for experiment: 750 sqm

Laboratory observations:

1. Seed Moisture content (ISTA)
2. First count %
3. Germination % (ISTA)
4. Vigour index-I & II (Abdul Baki and Anderson, 1973)

Field observations:

1. Speed of emergence(Maguire, 1962)
2. Final plant stand establishment (%) after 6 weeks
3. Seed yield (g/plot)

Pigeon pea

ICAR-IARI, New Delhi

Experimental details: Two most popular IARI varieties of Pigeonpea i.e.; Pusa-991 and Pusa-992 were used for the experiment of validation of standardized priming technologies for sub-optimal conditions. These varieties were used for three different sowing times after priming treatments. Eight treatments were used for the experiment in three replications as follows:

T1-Control: Fresh untreated seeds were used for control in all three sowing time.

T2-Hydropriming: Seeds were soaked in water for 10 h at 25°C followed by drying for 48 hours at room temperature.

T3-Thermo-priming: Seeds of both the varieties were kept in hot air oven for 6 hours at 40°C for thermo-priming.

T4-Thermo-priming: Seeds of both the varieties were kept in hot air oven for 24 hours at 40°C for thermo-priming.

T5-Osmopriming: For osmopriming, PEG-6000 solution of 60% available water was prepared using PEG-6000. 21g PEG-6000 salt dissolved in one litre of water for making PEG-6000 solution of 60% available water. Seeds were soaked in PEG-6000 solution of 60% available water (-0.62MPa) for 11 hours at 25°C followed by drying for 48 hours at room temperature.

T6-Osmopriming: Seeds were soaked in PEG-6000 solution of 60% available water (-0.62MPa) for 8 hours at 25°C followed by drying for 48 hours at room temperature.

T7-Halopriming: For halopriming, two salts i.e., NaCl and $CaCl_2$ were used for preparing 6dSm^{-1} EC solution. 1.7532g NaCl and 4.4106g $CaCl_2$ $2H_2O$ (Dihydrate) of 58.44g and 147.02g Molar weights, respectively, weighed and dissolved in 1 litre of distilled water. Seeds were soaked in 6dSm^{-1} EC solution for 5 hours at 25°C followed by drying for 48 hours at room temperature.

T8-Halopriming: Seeds were soaked in 6dSm^{-1} EC solution for 8 hours at 25°C followed by drying for 48 hours at room temperature.

Field observations: The field experiment was laid out in a randomized block design with eight treatments (T1 to T8) in three replication/treatments. The healthy and bold seeds were dibbled on bed with a spacing of 5.0m x 1.5m in three sowing periods i.e., 04.06.2018, 20.06.2018 and 02.07.2018. The weather data (3 day mean) during the emergence has been given in the table 3.59. The maximum temperature of 43^{0}C recorded was during June 23-25, 2018 whereas June 13-15, 2018 minimum was 33^{0}C. The mean day temperature from June 5-26, 2018 hovered between 34–37 ^{0}C. During third sowing and germination it rained from 4.4 mm on 04.07.2018 to 122.4cm (maximum of the season) on 14.07.2018. After fourth day of sowing field emergence were observed daily in the morning for 14 days up to final

count of plant stand. The yield attributes like plant height, primary branches, secondary branches, pods on main shoot, seeds per pod, biological yield and seed yield were observed.

Table 3.59: Weather data (3 day mean) from June 3 to July 30, 2018 at IARI, New Delhi

Day	Tmax	Tmin	Tmean	RH(M)	RH(E)	Rhmean	Rainfall	Sunshine
	°C	°C	°C	%	%	%	mm	hours
03-Jun-18	39.1	25.8	32.5	71.0	44.7	58.3	0.0	7.8
06-Jun-18	39.4	28.0	33.7	66.3	47.7	57.3	0.0	6.2
09-Jun-18	38.5	28.5	33.5	74.7	48.7	62.0	0.0	3.9
12-Jun-18	38.9	26.0	32.4	84.3	36.7	57.3	3.4	6.5
15-Jun-18	41.3	29.6	35.2	61.0	39.7	50.7	0.0	1.2
18-Jun-18	39.1	26.7	32.9	64.7	49.3	57.3	0.0	3.2
21-Jun-18	39.8	26.7	33.1	67.7	32.7	50.3	1.0	6.9
24-Jun-18	42.5	28.1	35.3	52.0	31.0	41.7	0.0	7.4
27-Jun-18	39.7	27.5	33.6	74.0	42.3	57.3	10.3	4.6
30-Jun-18	34.2	24.5	28.6	85.3	73.7	80.0	10.3	4.7
03-Jul-18	35.6	25.5	30.2	78.7	59.7	69.3	8.9	2.6
06-Jul-18	35.3	24.3	29.8	85.0	55.3	70.3	7.8	5.8
09-Jul-18	37.8	26.7	32.3	74.0	46.3	59.7	0.0	8.4
12-Jul-18	35.9	27.3	32.3	86.3	61.0	74.0	1.3	4.3
15-Jul-18	33.7	24.6	29.2	87.3	72.7	80.0	40.8	0.9
18-Jul-18	34.2	26.2	30.2	81.7	70.3	76.0	9.5	4.3
21-Jul-18	34.7	26.1	30.4	85.7	51.3	81.0	10.0	5.4
24-Jul-18	33.1	25.4	29.3	90.0	64.3	77.3	5.1	3.2
27-Jul-18	31.4	25.2	28.5	94.0	88.7	91.3	31.6	1.8
30-Jul-18	31.0	23.3	27.1	86.7	70.0	78.7	11.9	2.3

Results:

Seed yield: Among the varieties, mean seed yield/plant was significantly higher in P-991 (40.2 gm) as compared to P-992 (33.5 gm). During SD1, seed yield/plant was ranged from 30.8 gm to 70.0 gm with an average of 50.1 gm in P-991. Highest seed yield/plant (70.0 gm) was recorded with the treatment of T4 [Exposure for 24 hr at 40°C] and T8 [Halopriming with Salt (6EC for 8h)], while minimum (30.8 gm) was observed with treatment of T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)]. In the case of P-992, seed yield/plant was ranged from 40.8 gm to 79.2 gm with an average of 57.6 gm. **Maximum seed yield/plant (79.2 gm) was recorded with the treatment of T4 [Exposure for 24 hr at 40°C],** while minimum (40.8 gm) was observed in T7 [Halopriming with Salt (6EC for 5h)] during SD1.

During SD2, seed yield/plant was ranged from 18.3 gm to 95.0 gm with an average of 43.8 gm in P-991. Highest seed yield/plant (95.0 gm) was recorded with the treatment of T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)], while minimum (18.3 gm) was observed with treatment of T3 [Exposure for 24 hr at 40°C]. In the case of P-992, seed yield/plant was ranged from 20.0 gm to 47.5 gm with an average of 215.8 gm. **Maximum seed yield/plant**

(47.5 gm) was recorded with the treatment of T8 [Halopriming with Salt (6EC for 8h)], while minimum (20.0 gm) was observed in control (T1) during SD2.

During SD3, seed yield/plant was ranged from 15.0 gm to 36.7 gm with an average of 26.7 gm in P-991. Highest seed yield/plant (36.7 gm) was recorded with the treatment of T2 [Hydropriming for 10 hr at 25°C], while minimum (15.0 gm) was observed with treatment of T3 [Exposure for 6 hr at 40°C]. In the case of P-992, seed yield/plant was ranged from 10.0 gm to 18.3 gm with an average of 14.0 gm. **Maximum seed yield/plant (18.3 gm) was recorded with the treatment of T3 [Exposure for 6 hr at 40°C],** while minimum (10.0 gm) was observed in T6 [Osmopriming-PEG-6000 (8h at 25°C in 60% PEG)] during SD3.

Overall among the three sowing dates, mean seed yield/plant was found significantly higher during SD1 followed by SD2 and SD3 in both the varieties.

With respect to the treatments, Highest mean seed yield/plant (48.1 gm) was recorded with T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)] in P-991 variety. Overall, in variety P-991, mean seed yield/plant was ranged from 24.7 gm to 48.1 gm with an average of 40.2 gm. Highest seed yield/plant (48.1 gm) was observed with the treatment of T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)], while minimum (24.7 gm) was found with T3 [Exposure for 6 hr at 40°C] in all three sowing dates. Similarly in variety P-992, plant height was ranged from 27.2 gm to 44.4 gm with an average of 33.5. Highest seed yield/plant (44.4 gm) was observed with the treatment of T4 [Exposure for 24 hr at 40°C], while minimum (27.2 gm) was found with T7 [Halopriming with Salt (6EC for 5h)] in all three sowing dates (Table 70).

Overall seed yield/plant ranged from 10.0 gm in T6 during third sowing to 79.2 gm in T4 during First sowing in variety P-992. However, the interaction between variety and sowing dates was found significant but remaining all interaction was found non-significant.

Field emergence: Among the varieties, average mean emergence time was significantly higher in P-991 (7.3) as compared to P-992 (6.6). During SD1, mean emergence time was ranged from 7.9 to 11.5 with an average of 9.0 in P-991. Maximum mean emergence time (11.5) was recorded with the treatment of T4 [Exposure for 24 hr at 40°C], while minimum (7.9) was observed with treatment of T7 [Halopriming with Salt (6EC for 5h)]. In the case of P-992, mean emergence time was ranged from 6.1 to 7.4 with an average of 6.9. Maximum mean emergence time (7.4) was recorded with the treatment of T2 [Hydropriming (10 h at 25°C] and T8 [Halopriming with Salt (6EC for 8h)], while minimum (6.1) was observed in control (T1) followed by T7 (6.4) during SD1.

During SD2, mean emergence time was ranged from 4.9 to 6.6 with an average of 5.7 in P-991. Maximum mean emergence time (6.6) was recorded with the treatment of T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)], while minimum (4.9) was observed in control (T1). Similarly in the case of P-992, mean emergence time was ranged from 5.3 to 9.2 with an average of 6.3. Maximum mean emergence time (9.2) was recorded with the treatment of T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)], while minimum (5.3) was observed in T7 [Halopriming with Salt (6EC for 5h)] during SD2.

During SD3, mean emergence time was ranged from 6.5 to 7.8 with an average of 7.1 in P-991. Maximum mean emergence time (7.8) was recorded with the treatment of T3 [Exposure for 6 hr at 40°C], while minimum (6.5) was observed in control T1. In the case of P-992, mean emergence time was ranged from 5.7 to 7.1 with an average of 6.5. Maximum mean emergence time (7.1) was recorded with the treatment of T2 [Hydropriming (10 h at 25°C] andT3 [Exposure for 6 hr at 40°C], while minimum (5.7) was observed in T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)] during SD3.

Overall among the three sowing dates, average mean emergence time was found significantly higher during SD1 followed by SD3 and SD2 in both the varieties.

With respect to the treatments, maximum average mean emergence time (8.0) was recorded with T4 [Exposure for 24 hr at 40°C] in P-991 variety, while treatment T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)] (7.1) was found better for mean emergence time in P-992.

Overall, in variety P-991, average mean emergence time was ranged from 6.8 to 8.0 with an average of 7.3. Maximum mean emergence time (8.0) was observed with the treatment of T4 [Exposure for 24 hr at 40°C], while minimum (6.8) was found with T8 [Halopriming with Salt (6EC for 8h)] in all three sowing dates. Similarly in variety P-992, plant height was ranged from 5.9 to 7.1 with an average of 6.6. Maximum mean emergence time (7.1) was observed in T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)], while minimum (5.9) was found in T7 [Halopriming with Salt (6EC for 5h)] and with control (T1) in all the sowing dates (Table 71).

Overall mean emergence time ranged from 4.9 in T1 during second sowing to 11.5 in T4 during First sowing in variety P-991. However, the overall interaction was found non-significant.

Table 3.60: Effect of priming treatments on seed yield/pl (gm) of pigeonpea varieties under different sowings dates/temperature conditions

Variety (V)	Treatments (Tr) Sowing Date(SD)	T1	T2	T3	T4	T5	T6	T7	T8	Mean
V1 (P 991)	SD1	45.8	56.7	40.8	70.0	30.8	35.8	50.8	70.0	50.1
	SD2	50.8	40.0	18.3	35.8	95.0	31.7	35.8	43.3	43.8
	SD3	29.2	36.7	15.0	23.3	18.3	30.8	35.0	25.0	26.7
	Mean	41.9	44.4	24.7	43.1	48.1	32.8	40.6	46.1	40.2
V2(P 992)	SD1	77.5	50.8	50.8	79.2	57.5	53.5	40.8	50.8	57.6
	SD2	20.0	21.7	26.7	39.2	23.3	26.2	27.5	47.5	29.0
	SD3	17.5	13.3	18.3	15.0	14.2	10.0	13.3	10.3	14.0
	Mean	38.3	28.6	31.9	44.4	31.7	29.9	27.2	36.2	33.5
Grand Mean		40.1	36.5	28.3	43.8	39.9	31.3	33.9	41.2	36.9
CD (p=0.05)	V= 5.07	SD= 6.22	Tr= 10.15	VxSD= 8.79	VxTr = NS	SDxTr= 17.58		VxSDxTr= 24.86		

Table 3.61: Effect of priming treatments on mean emergence time of pigeonpea varieties under different sowings dates/temperature conditions

Variety (V)	Treatments (Tr) Sowing Date(SD)	T1	T2	T3	T4	T5	T6	T7	T8	Mean
V1 (P 991)	SD1	9.8	8.1	9.3	11.5	8.5	8.7	7.9	8.5	9.0
	SD2	4.9	5.5	5.8	5.6	6.6	5.6	6.2	5.3	5.7
	SD3	6.5	7.0	7.8	6.9	7.1	7.7	6.9	6.6	7.1
	Mean	7.1	6.9	7.6	8.0	7.4	7.3	7.0	6.8	7.3
V2(P 992)	SD1	6.1	7.4	7.1	7.0	6.5	7.3	6.4	7.4	6.9
	SD2	5.4	5.7	5.8	6.9	9.2	6.3	5.3	5.6	6.3
	SD3	6.3	7.1	7.1	6.8	5.7	6.8	5.9	6.5	6.5
	Mean	5.9	6.7	6.7	6.9	7.1	6.8	5.9	6.5	6.6
Grand Mean		6.5	6.8	7.2	7.5	7.3	7.1	6.4	6.7	6.9
CD (p=0.05)	**V= 0.49**	**SD= 0.60**	**Tr= 0.98**	**VxSD= NS**	**VxTr = NS**	**SDxTr= NS**		**VxSDxTr= NS**		

First count: Among the varieties, average first count was significantly higher in P-991 (90.2%) as compared to P-992 (80.9%). During SP0, first count was ranged from 88.7% to 94.7% with an average of 91.4% in P-991. Maximum first count (94.7%) was recorded in T7 [Halopriming with Salt (6EC for 5h)], while minimum (88.7%) was observed with treatment of T3 [Exposure for 6 hr at 40°C] and T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)]. In the case of P-992, first count was ranged from 77.5% to 87.3% with an average of 81.0%. Maximum first count (87.3%) was recorded with the treatment of T7 [Halopriming with Salt (6EC for 5h)], while minimum (77.5%) was observed in control (T1) during SP0.

During SP1, first count was ranged from 83.3% to 94.7% with an average of 88.9% in P-991. Maximum first count (94.7%) was recorded in T3 [Exposure for 6 hr at 40°C], while minimum (83.3%) was observed with treatment of T2 [Hydropriming (10 h at 25°C]. In the case of P-992, first count was ranged from 76.0% to 85.3% with an average of 80.8%. Maximum first count (85.3%) was recorded with the treatment of T3 [Exposure for 6 hr at 40°C], while minimum (76.0%) was observed in control (T1) during SP1.

Overall among the two storage periods, average first count was found significantly higher during SP0 followed by SP1 in both the varieties.

With respect to the treatments, maximum average first count (93.0%) was recorded with T8 [Halopriming with Salt (6EC for 8h)] and Control (T1) in P-991 variety, while treatment T7 [Halopriming with Salt (6EC for 5h)] (85.7%) was found better for first count in P-992.

Overall, in variety P-991, average first count was ranged from 86.7% to 93.0% with an average of 90.2%. Maximum first count (93.0%) was observed with the treatment of T8 [Halopriming with Salt (6EC for 8h)], while minimum (86.7%) was found with T2 [Hydropriming for 10 hr at 25°C] in both the storage periods. Similarly in variety P-992, plant height was ranged from 76.0 to 85.7% with an average of 80.9%. Maximum first count (85.7%) was observed in T7 [Halopriming with Salt (6EC for 5h)], while minimum (76.0%) was found in control (T1) in both the storage periods (Table 73).

Overall first count ranged from 76.0% in control (T1) during SP1 in variety P-992 to 94.7% in T7 during SP0 and T3 SP1 in variety P-991, respectively. However, the overall interaction was found non-significant.

Table 3.62: Effect of seed quality enhancement treatments on first count (%) of primed pigeonpea variety seeds stored under ambient conditions

Variety (V)	Treatments (T) Storage Period (SP)	T1	T2	T3	T4	T5	T6	T7	T8	Mean
V1 (P 991)	Initial (SP0)	92.0 (73.7)	90.0 (71.7)	88.7 (70.4)	92.7 (74.4)	88.7 (70.6)	90.7 (72.3)	94.7 (77.1)	94.0 (76.5)	91.4 (73.3)
	One month (SP1)	84.0 (66.5)	83.3 (66.1)	94.7 (76.9)	91.3 (72.9)	86.7 (68.9)	90.7 (73.3)	88.7 (71.6)	92.0 (73.7)	88.9 (71.2)
	Mean	88.0 (70.1)	86.7 (68.9)	91.7 (73.6)	92.0 (73.7)	87.7 (69.8)	90.7 (72.8)	91.7 (74.4)	93.0 (75.1)	90.2 (72.3)
V2 (P 992)	Initial (SP0)	77.5 (61.7)	78.0 (62.1)	78.7 (62.6)	78.7 (62.8)	78.7 (62.7)	83.3 (65.9)	87.3 (69.4)	86.0 (68.5)	81.0 (64.5)
	One month (SP1)	76.0 (60.8)	76.7 (61.2)	85.3 (67.5)	78.7 (62.6)	81.3 (64.8)	80.7 (64.3)	84.0 (66.5)	83.3 (66.0)	80.8 (64.2)
	Mean	76.8 (61.3)	77.3 (61.7)	82.0 (65.1)	78.7 (62.7)	80.0 (63.7)	82.0 (65.1)	85.7 (68.0)	84.7 (67.2)	80.9 (64.3)
Grand Mean		82.4 (65.7)	82.0 (65.3)	86.8 (69.3)	85.3 (68.2)	83.8 (66.7)	86.3 (69.0)	88.7 (71.2)	88.8 (71.2)	85.5 (68.3)
CD(p=0.05)		V= 1.65	SP= NS	T= 3.47	VXSP=NS	VXT= NS	SPXT= NS	VXSPXT= NS		

Germination: Among the varieties, average germination was significantly higher in P-991 (90.7%) as compared to P-992 (81.4%). During SP0, germination was ranged from 88.7% to 95.3% with an average of 92.3% in P-991. Maximum germination (95.3%) was recorded in T8 [Halopriming with Salt (6EC for 8h)], while minimum (88.7%) was observed with treatment of T3 [Exposure for 6 hr at 40°C]. In the case of P-992, germination was ranged from 77.5% to 88.7% with an average of 81.9%. Maximum germination (88.7%) was recorded with the treatment of T7 [Halopriming with Salt (6EC for 5h)], while minimum (77.5%) was observed in control (T1) during SP0.

During SP1, germination was ranged from 84.0% to 94.7% with an average of 89.1% in P-991. Maximum germination (94.7%) was recorded in T3 [Exposure for 6 hr at 40°C], while minimum (84.0%) was observed with treatment of T2 [Hydropriming (10 h at 25°C] and control (T1). In the case of P-992, germination was ranged from 76.0% to 86.7% with an average of 80.9%. Maximum germination (86.7%) was recorded with the treatment of T3 [Exposure for 6 hr at 40°C], while minimum (76.0%) was observed in control (T1) during SP1.

Overall among the two storage periods, average germination was found significantly higher during SP0 followed by SP1 in both the varieties.

With respect to the treatments, maximum average germination (93.7%) was recorded with T8 [Halopriming with Salt (6EC for 8h)] and Control (T1) in P-991 variety, while treatment T7 [Halopriming with Salt (6EC for 5h)] (86.3%) was found better for germination in P-992.

Overall, in variety P-991, average germination was ranged from 88.0% to 93.7% with an average of 90.7%. Maximum germination (93.7%) was observed with the treatment of T8 [Halopriming with Salt (6EC for 8h)], while minimum (88.0%) was found with T2 [Hydropriming for 10 hr at 25°C] and T5 [Osmopriming-PEG-6000 (11h at 25°C in 60% PEG)] in both the storage periods. Similarly in variety P-992, plant height was ranged from 76.8 to 86.3% with an average of 81.4%. Maximum germination (86.3%) was observed in T7 [Halopriming with Salt (6EC for 5h)], while minimum (76.0%) was found in control (T1) in both the storage periods (Table 74).

Overall germination ranged from 76.0% in control (T1) during SP1 in variety P-992 to 94.7% in T7 during SP0 and T3 during SP1 in variety P-991, respectively. However, the overall interaction was found non-significant.

Table 3.63: Effect of seed quality enhancement treatments on germination (%) of primed pigeonpea variety seeds stored under ambient conditions

Variety (V)	Treatments (T) Storage Period (SP)	T1	T2	T3	T4	T5	T6	T7	T8	Mean
V1 (P 991)	Initial (SP0)	92.5 (74.2)	92.0 (73.7)	88.7 (70.4)	94.0 (76.2)	89.3 (71.1)	92.0 (73.7)	94.7 (77.1)	95.3 (78.0)	92.3 (74.3)
	One month (SP1)	84.0 (66.5)	84.0 (66.5)	94.7 (76.9)	91.3 (72.9)	86.7 (68.9)	90.7 (73.3)	89.3 (74.3)	92.0 (73.7)	89.1 (71.6)
	Mean	88.3 (70.3)	88.0 (70.1)	91.7 (73.6)	92.7 (74.6)	88.0 (70.0)	91.3 (73.5)	92.0 (75.7)	93.7 (75.8)	90.7 (73.0)
V2 (P 992)	Initial (SP0)	77.5 (61.7)	78.7 (62.5)	78.7 (62.6)	80.7 (64.3)	80.7 (64.1)	83.3 (65.9)	88.7 (70.7)	87.3 (69.7)	81.9 (65.2)
	One month (SP1)	76.0 (60.8)	76.7 (61.2)	86.7 (68.6)	78.7 (62.6)	81.3 (64.8)	80.7 (64.3)	84.0 (66.5)	83.3 (66.0)	80.9 (64.4)
	Mean	76.8 (61.3)	77.7 (61.9)	82.7 (65.6)	79.7 (63.5)	81.0 (64.5)	82.0 (65.1)	86.3 (68.6)	85.3 (67.8)	81.4 (64.8)
Grand Mean		82.5 (65.8)	82.8 (66.0)	87.2 (69.6)	86.2 (69.0)	84.5 (67.2)	86.7 (69.3)	89.2 (72.2)	89.5 71.8()	86.1 (68.9)
CD(p=0.05)		V= 1.82	SP= NS	T= 3.83	VXSP=NS	VXT= NS	SPXT= NS		VXSPXT= NS	

Vigour index II: Among the varieties, average vigour index II was significantly higher in P-991 (27.24) as compared to P-992 (25.48). During SP0, vigour index II was ranged from 24.38 to 38.94 with an average of 28.27 in P-991. Maximum vigour index II (38.94) was recorded in T8 [Halopriming with Salt (6EC for 8h)], while minimum (24.38) was observed in control (T1). In the case of P-992, vigour index II was ranged from 21.80 to 26.08 with an average of 24.68. Maximum vigour index II (26.08) was recorded with the treatment of T7 [Halopriming with Salt (6EC for 5h)], while minimum (21.80) was observed in T4 [Exposure for 24 hr at 40°C] during SP0.

During SP1, vigour index II was ranged from 21.14 to 29.59 with an average of 26.22 in P-991. Maximum vigour index II (29.59) was recorded in T3 [Exposure for 6 hr at 40°C], while minimum (21.14) was observed in T2 [Hydropriming (10 h at 25°C)]. In the case of P-992, vigour index II was ranged from 24.63 to 27.98 with an average of 26.29. Maximum vigour index II (27.98) was recorded with the treatment of T7 [Halopriming with Salt (6EC for 5h)], while minimum (24.63) was observed in T2 [Hydropriming (10 h at 25°C)] during SP1.

Overall among the two storage periods, average vigour index II was found significantly higher during SP0 followed by SP1 in P-991 while in P-992 it was higher in SP1 followed by SP0.

With respect to the treatments, maximum average vigour index II (33.57) was recorded with T8 [Halopriming with Salt (6EC for 8h)] in P-991 variety, while treatment T7 [Halopriming with Salt (6EC for 5h)] (27.03) was found better for vigour index II in P-992.

Overall, in variety P-991, average vigour index II was ranged from 22.96 to 33.57 with an average of 27.24. Maximum vigour index II (33.57) was observed with the treatment of T8 [Halopriming with Salt (6EC for 8h)], while minimum (22.96) was found with control (T1) in both the storage periods. Similarly in variety P-992, plant height was ranged from 23.35 to 27.03 with an average of 25.48. Maximum vigour index II (27.03) was observed in T7 [Halopriming with Salt (6EC for 5h)], while minimum (23.35) was found in T4 in both the storage periods (Table 75).

Overall vigour index II ranged from 21.14 in T2 to 29.59 in T3 during SP1 in variety P-991. However, the overall interaction was found non-significant.

Table 3.64: Effect of seed quality enhancement treatments on vigour index II of primed pigeonpea variety seeds stored under ambient conditions

Variety (V)	Treatments (T) Storage Period (SP)	T1	T2	T3	T4	T5	T6	T7	T8	Mean
V1(P 991)	Initial (SP0)	24.38	27.98	27.86	29.32	24.65	25.75	27.26	38.94	28.27
	One month (SP1)	21.54	21.14	29.59	26.49	25.15	28.99	28.65	28.19	26.22
	Mean	22.96	24.56	28.72	27.91	24.90	27.37	27.95	33.57	27.24
V2(P 992)	Initial (SP0)	23.40	25.84	23.07	21.80	25.67	25.55	26.08	26.00	24.68
	One month (SP1)	24.72	24.63	27.88	24.90	26.95	26.45	27.98	26.83	26.29
	Mean	24.06	25.24	25.47	23.35	26.31	26.00	27.03	26.41	25.48
	Grand Mean	23.51	24.90	27.10	25.63	25.61	26.69	27.49	29.99	26.36
	CD(p=0.05)	V= 1.71	SP= NS	T= 3.6	VXSP=2.4	VXT= NS	SPXT= NS		VXSPXT= NS	

Conclusion: Priming treatments resulted in significant differences for seed yield/pl (gm) between pigeonpea varieties grown under different temperature conditions, which could be due to the genetic potential of a variety. Seed yield in both the varieties significantly decreased with delay of sowings, however the exposure of seeds for 24 hr at 40°C resulted in highest seed yield/pl (gm) under temperature stress conditions which was at par with seed exposure for 6 hr at 40°C treatment. Under laboratory conditions, haloprimed seeds when tested under salt stress conditions (6EC) resulted in significantly higher vigour index II over control.

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Experimental details: The field experiment was laid out in randomized completely block design with four priming treatments along with one control in two pigeonpea varieties viz., Pusa 991 and Pusa 992.

Treatments:

1. Control (Untreated).
2. Hydropriming (Soaking in water for 10 h at 25-30°C) and drying
3. Exposure of seeds for 24 h at 40°C
4. Osmopriming (Soaking in PEG-6000 solution of 60% available water (-0.62MPa) for 11h at 25-30°C) and drying
5. Halopriming (Soaking in NaCl + $CaCl_2$ solution having EC of 6dSm^{-1} for 8 h at 25-30^{0}C) and drying.

Laboratory observations recorded:

1. Seed Moisture content (as per ISTA)
2. Germination % (as per ISTA)
3. Vigour index-I & II (Abdul Baki and Anderson, 1973)

Remarks: At first count, no germination was observed in all the treatments, so it may be considered nil

Field observations recorded:

1. Final plant stand establishment (%) after 6 weeks
2. Seed yield (g/plot)

Remarks: Due to continuous rainfall after sowing, it was not possible to take daily counts of field emergence as field was in highly wet condition.

Results: Seeds of two pigeonpea varieties differed significantly in their moisture content with Pusa 991 maintaining a significantly lesser moisture content than Pusa 992. Among the different treatments, unprimed seeds and seeds which were exposed to high temperature were maintained significantly least moisture content compared to other priming treatments. While, highest seed moisture content was observed in hydro-priming treatment (Table 3.65).

Germination in all treatments along with control was below minimum germination per cent i.e. 75% (IMSCS, 2013) (Table 3.66).

Table 3.65: Effect of priming treatments on moisture content (%) in pigeonpea

Treatment	Varieties		Mean
	Pusa 991	Pusa 992	
T_1: Control (unprimed)	9.02	8.74	8.88
T_2: Hydropriming	9.80	11.39	10.59
T_3: Heat stress priming	9.05	8.70	8.87
T_4: Osmopriming	9.17	9.10	9.13
T_5: Halopriming	9.38	9.75	9.56

Mean	9.28	9.53	
Source of Variation	V	T	VxT
SEd(±)	0.06	0.10	0.15
CD (P=0.05)	0.15	0.24	0.34

Table 3.66: Effect of priming treatments on germination (%) in pigeonpea under controlled conditions

Treatment	Varieties		Mean
	Pusa 991	Pusa 992	
T_1: Control (unprimed)	54.5 (47.5)	64.7(53.5)	59.6(50.5)
T_2: Hydropriming	63.2(52.7)	69.2 (56.3)	66.2 (54.5)
T_3: Heat stress priming	58.5 (49.9)	69.5 (56.5)	64.0(53.2)
T_4: Osmopriming	49.2 (44.6)	64.0(53.2)	56.6 (48.9)
T_5: Halopriming	64.5 (53.4)	64.7 (53.6)	64.6 (53.5)
Mean	57.9(49.6)	66.4 (54.6)	
Source of Variation	V	T	VxT
SEd(±)	0.77	1.23	1.74
CD (P=0.05)	1.59	2.51	NS

*Values in the parenthesis are arc-sine transformed values

Constraints: As there was continuous rainfall after sowing in the field, the seed germination was affected in many of the plots. Because of this, the final plant stand and seed yield/plot were not reliable on priming treatments.

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Experimental details: For validation of standardized priming technologies in pigeon pea for sub-optimal conditions, the primed seeds of two IARI varieties; Pusa 991 and Pusa 992 of Pigeon pea is provided by ICAR-IARI, New Delhi. Trial was done in rain fed condition in September 2018 with lifesaving irrigation for defining moisture stress.

Results: Observation were taken as directed in the technical guide line. Analysed data is presented in the table 3.67.

Remark: The varieties are of non-synchronous type. Harvesting is not over; therefore yield data is not included.

Table 3.67: **priming technologies for enhancing planting value of Pigeon pea under water stress condition at Jorhat**

Sl no.	Variety	Storage period (months)	Mean							
			Germination %	Final count %	Seedling length (cm)	Average seedling Dry weight (mg)	Vigour index-I	Vigour index-II	Speed of emergence	Final plant stand establishment
1.	*V1*	1	82.625	89.75	21.00	71.62	1886.07	6430.81	2.78	73.25
		2	91.125	94.5	23.36	64.78	2206.84	6119.26	5.98	81.75
		3	87.75	93.25	20.97	69.53	1947.2	6467.32	4.68	64.75
		4	86.625	91	21.66	68.83	1969.93	6261.48	3.78	65.75
		5	88.375	92.25	21.44	57.37	1979.07	5294.52	5.18	72
		Mean	87.3	92.15	21.686	66.426	1997.82	6114.68	4.48	71.5
2.	*V2*	1	83.375	86.75	23.31	80.67	2022.33	6465.69	3.1	72.48
		2	77.5	85	18.38	75.28	1567.29	6411.99	6.25	80.75
		3	81.5	87.75	18.14	82.55	1592.74	7249.72	5.25	66.75
		4	77.125	84	17.62	72.1	1480.46	6315.11	4.03	66
		5	82.625	89.75	17.55	77.3	1575.82	6939.42	5.18	72.25
		Mean	80.425	86.65	19	77.58	1647.73	6676.39	4.762	71.646
Total variety mean			83.86	89.4	20.34	72.003	1822.78	6395.53	4.621	71.573
	SEm (±)		1.688	1.4	0.421	1.002	48.456	202.969	0.154	0.676
	CD (p=0.05)		5.013	4.16	1.253	2.976	143.909	602.788	0.459	2.008
	CV%		6.366	4.955	6.559	4.383	8.406	10.035	10.588	2.988
	V=		6158.09	14403	25917.1	16235.3	44000000	560000000	14682.8	9849.49
	SP/L=		1282.72	2834.86	9801.27	3239.84	4987249	59000000	10367.4	2336.58
	V x SP/L=		2666.83	5803.47	14948.2	6073.83	14257267	173000000	13294.1	4045.01

PAU, Ludhiana

Experimental details:

Varieties: Four; V1-Pusa 991, V2-Pusa 992, V3-AL 881 and V4-AL 882

There was high ambient temperature (38.3-42.1°C) prevailing during emergence and early growth period of crop as given in table 3.68.

Table 3.68: Weather conditions during emergence of pigeonpea

	Max. Temp. (° C)	Min. Temp (° C)	Max. RH (%)	Min. RH (%)	Sunshine hrs (h)	Rainfall (mm)
1 week of sowing	38.4	23.4	50.6	22.9	6.2	0.0
2 week after sowing	42.1	23.7	33.0	8.6	10.1	0.0
3 week after sowing	40.9	27.9	45.1	24.3	7.7	0.0
4 week after sowing	38.7	27.2	65.9	39.9	7.6	37.8
5 week after sowing	37.8	28.1	60.6	37.0	5.2	66.8
6 week after sowing	38.3	26.3	60.7	36.3	8.7	0.0

Results: Under controlled conditions in the laboratory, pigeonpea varieties differed significantly in their moisture content, final germination, seedling vigour index I and II. Different seed priming treatments exhibited significant effect on moisture content, first count, final germination, seedling vigour index I and II. Hydropriming treatment recorded highest first count, final germination, seedling vigour index I and II which were significantly higher than their respective values recorded in non-primed seeds. Priming for heat stress, osmopriming and halopriming recorded significant reduction in first count, final germination, seedling vigour index I and II as compared to control. However, there were no interaction effects of varieties and seed priming treatments on different parameters tested (Tables 3.69 & 3.70).

Under field conditions, pigeon pea varieties differed significantly in their speed of emergence; while final stand establishment and seed yield of different varieties was at par with each other. Variety Pusa 991 recorded superior speed of emergence which was statistically at par with AL 882. Different seed priming treatments exhibited significant effect on speed of emergence, final stand establishment and seed yield. Hydropriming treatment recorded higher final stand establishment than control and it was statistically at par with heat stress priming treatment; while osmopriming and halopriming treatments recorded significant reduction in final stand establishment as compared to control. Heat stress priming treatment recorded maximum seed yield/plot which was statistically at par with hydropriming but was significantly higher than control and other priming treatments. There were no interaction effects of varieties and seed priming treatments on different parameters studied under field conditions (Table 3.71).

Conclusion: Heat stress priming treatment recorded maximum seed yield/plot, which was statistically at par with hydropriming but was significantly higher than control and other priming treatments. This could be correlated to greater final stand establishment under heat stress priming and hydropriming treatments.

Table 3.69: Effect of priming treatments on moisture content (%), first count (%) and germination (%) of pigeon pea varieties under controlled conditions in the laboratory

Treatment	Moisture content (%)	First count (%)	Germination (%)
Varieties			
Pusa 991	10.22	73.0	86.2
Pusa 992	10.20	73.3	83.4
AL 881	10.03	71.1	81.7
AL 882	10.07	70.9	82.5
SEd (±)	0.04	0.98	0.49
CD (p=0.05)	0.10	NS	1.39
Seed priming treatments			
Control (no priming)	10.10	73.8	84.9
Hydropriming	10.69	75.3	88.3
Heat stress priming	9.62	70.8	82.4
Osmopriming	9.83	69.7	81.8
Halopriming	10.42	70.6	79.8
SEd (±)	0.03	0.83	0.78
CD (p=0.05)	0.06	1.95	1.84
Interaction CD	NS	NS	NS

Table 3.70: Effect of priming treatments on moisture content (%), first count (%) and germination (%) of pigeon pea varieties under controlled conditions in the laboratory

Treatment	Seedling vigour index I	Seedling vigour index II
Varieties		
Pusa 991	2083	2350
Pusa 992	2145	2251
AL 881	1923	2189
AL 882	2499	2285
SEd (±)	42.3	25.4
CD (p=0.05)	119.6	71.8
Seed priming treatments		
Control (no priming)	2195	2366
Hydropriming	2313	2402
Heat stress priming	2119	2254
Osmopriming	2131	2180
Halopriming	2057	2141
SEd (±)	40.9	46.1
CD (p=0.05)	96.3	108.5
Interaction CD	NS	NS

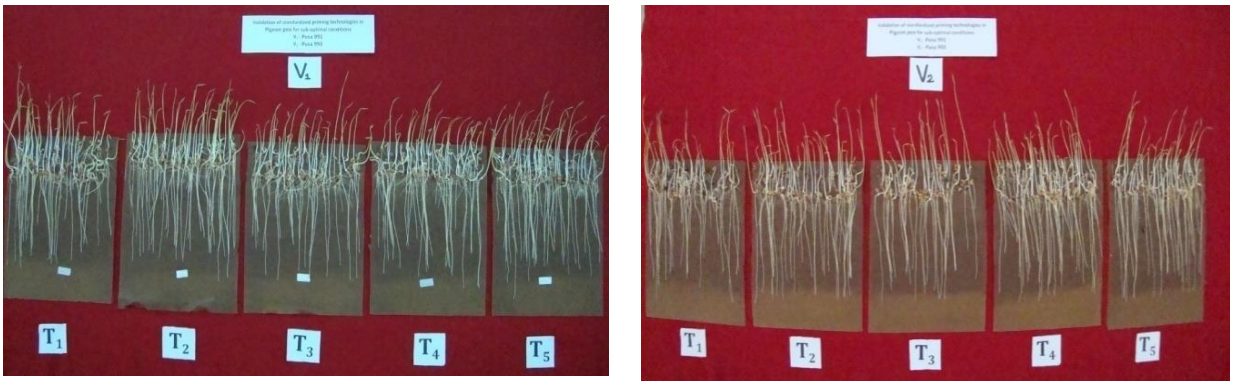
Table 3.71: Effect of priming treatments on speed of emergence, final stand establishment and seed yield of pigeon pea varieties under temperature stress conditions in the field

Treatment	Speed of emergence	Final stand establishment (%)	Seed yield (g/plot)
Varieties			
Pusa 991	9.61	71.2	3662.50
Pusa 992	8.56	71.8	3737.50
AL 881	7.61	68.2	3597.50
AL 882	8.98	65.8	3335.00
SEd (±)	0.36	3.15	150.87
CD (p=0.05)	0.82	NS	NS
Seed priming treatments			
Control (no priming)	8.56	69.2	3562.50
Hydropriming	9.19	75.0	3765.63
Heat stress priming	9.18	73.7	3887.50
Osmopriming	8.24	64.5	3312.50
Halopriming	8.30	63.8	3387.50
SEd (±)	0.40	1.98	148.49
CD (p=0.05)	0.81	3.98	298.46
Interaction CD	NS	NS	NS

PAJANCOA&RI, Karaikal

Experimental details:
Varieties: V_1 – Pusa 991 and V_2 – Pusa 992

Results: The results revealed that, among the priming treatments hydroprimed seeds registered significantly higher mean seed moisture content (10.83%) followed by halopriming (10.13%). The least moisture was found in heat stress conditioned seeds (8.38%). Osmoprimed seeds recorded maximum germination of 91% followed by hydropriming (89%). Haloprimed seeds excelled other priming treatments in all vigour traits studied *viz.,* root length, shoot length, dry weight of seedlings. The results on field evaluation indicated that hydroprimed seeds recorded higher speed of emergence (15.61) followed by haloprimed seeds (14.74); minimum was observed in heat stress (13.43). The final field stand establishment (6 weeks after sowing) was maximum in halopriming (85 %) and was also on par with control (85%). The results on seed yield, harvest index and 100 seed weight also indicated the superiority of halopriming followed by osmopriming treatments (Table 3.72 to 3.74).



Germination test of treated pigeonpea seed at PAJANCOA&RI, Karaikal

Conclusion: Between varieties, the performance of V_1 (Pusa 991) was better than V_2 (Pusa 992) in all traits studied. Based on the results obtained it could be concluded that Halopriming is found to be the best seed priming treatment in pigeonpea followed by osmopriming.

Table 3.72: Effect of seed priming on seed moisture content (%) and seed vigour attributes in pigeon pea at PAJANCOA & RI, Karaikal during 2018-19

Treatments	Seed Moisture (%)			First count (%)			Final count (%)			Shoot length (cm)		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1 –Control	9.25	8.15	8.70	75	68	72	89	75	82	12.84	13.14	12.99
T_2 –Hydropriming	10.05	11.60	10.83	87	85	86	92	85	89	11.81	13.72	12.77
T_3 –Heat stress condition	8.70	8.05	8.38	72	53	63	88	75	82	9.27	12.07	10.67
T_4 –Osmopriming	9.15	9.10	9.13	83	87	85	93	88	91	12.14	12.76	12.45
T_5 –Halopriming	**10.25**	**10.00**	**10.13**	**87**	**77**	**82**	**82**	**81**	**82**	**14.44**	**13.74**	**14.09**
Mean	9.48	9.38	9.43	81	74	78	89	81	85	12.10	13.09	12.60
	V	T	V x T	V	T	V x T	V	T	V x T	V	T	V x T
SEd(±)	0.04	0.06	0.08	0.30	0.47	0.67	0.33	0.52	0.74	0.03	0.04	0.06
CD (p=0.05)	0.07	0.11	0.16	0.61	0.97	1.37	0.68	1.07	1.51	0.05	0.08	0.12

Table 3.73: Effect of seed priming on seed vigour attributes in pigeon pea at PAJANCOA & RI, Karaikal during 2018-19

Treatments	Root length (cm)			Dry weight (g/10 seedlings)			VI-I			VI-II		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1 –Control	15.14	18.53	16.84	0.218	0.206	0.212	2496	2404	2450	19.48	18.53	19.01
T_2 –Hydropriming	15.13	17.70	16.42	0.223	0.220	0.222	2460	2668	2564	20.52	17.70	19.11
T_3 –Heat stress condition	14.67	16.64	15.66	0.197	0.209	0.203	2111	2145	2128	17.42	16.64	17.03
T_4 –Osmopriming	**16.36**	**17.73**	**17.05**	**0.223**	**0.209**	**0.216**	**2657**	**2663**	**2660**	**20.67**	**17.73**	**19.20**
T_5 –Halopriming	18.45	16.32	17.39	0.229	0.243	0.236	2691	2418	2555	18.89	16.32	17.61
Mean	15.95	17.38	16.67	0.218	0.217	0.218	2483	2460	2471	19.40	17.38	18.39
	V	T	V x T	V	T	V x T	V	T	V x T	V	T	V x T
SEd(±)	0.13	0.20	0.28	NS	0.003	0.005	NS	37.90	53.59	0.52	NS	NS
CD (p=0.05)	0.26	0.41	0.58		0.007	0.009		77.39	109.45	1.06		

Table 3.74: Effect of seed priming on seed vigour attributes in pigeon pea at PAJANCOA & RI, Karaikal during 2018-19

Treatments	Speed of emergence (Field)			Final field stand establishment (6^{th} week)			100 seed weight (g)			Seed yield (g/plot)			Harvest Index (%)		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
T_1 –Control	15.26	13.75	**14.51**	92	77	**85**	7.49	7.33	**7.41**	223	327	**275**	40	42	**41**
T_2 –Hydropriming	15.19	16.03	**15.61**	76	79	**78**	7.50	7.63	**7.56**	327	287	**307**	39	33	**36**
T_3 –Heat stress condition	14.45	12.40	**13.43**	82	73	**78**	7.08	7.17	**7.13**	410	260	**335**	47	36	**42**
T_4 –Osmopriming	16.10	13.02	**14.56**	85	78	**82**	7.60	7.63	**7.61**	567	363	**465**	59	39	**49**
T_5 –Halopriming	**16.44**	**13.04**	**14.74**	**92**	**78**	**85**	**7.81**	**7.94**	**7.87**	**643**	**493**	**568**	**56**	**52**	**54**
Mean	**15.49**	**13.65**	**14.57**	**85**	**77**	**81**	**7.49**	**7.54**	**7.52**	**360.2**	**299.2**	**329.7**	**48**	**40**	**44**
	V	**T**	**V x T**	**V**	**T**	**V x T**	**V**	**T**	**V x T**	**V**	**T**	**V x T**	**V**	**T**	**V x T**
SEd(±)	0.07	0.11	0.16	0.37	0.59	0.83	NS	0.03	0.04	0.005	0.008	0.011	0.24	0.38	0.53
CD (p=0.05)	0.14	0.23	0.32	0.76	1.20	1.69		0.06	0.08	0.010	0.016	0.022	0.50	0.79	1.11

Experiment 3: Sub. Experiment III (As per Objective 3): Development of seed enhancement techniques for low temperature stress during seedling establishment in maize and rice

Materials: Each centre will use the seeds of three most popular varieties (preferably one each from normal, tolerant and susceptible to low temperature stress at their locality). Please note the initial seed moisture content should be below 10.0% (on dry weight basis).

Treatments:

1. Control (Untreated)
2. Control (Crop and location specific recommended seed treatment(s) as per package of practices)
3. Hydropriming – Soaking in water for 18h (at 20°C for maize) and 30h (at 20°C for Paddy) and drying
4. Chilling treatment (Place the *seeds* in contact with the moist substratum at 4^0C for five days)
5. Thermal treatment (at 40^0C for 24h)
6. Chilling followed by Thermal treatment
7. Priming with Gibberellic acid (@100 mg/l) and drying
8. Halopriming- Soaking in 800ppm solution of Salicylic acid and drying
9. Halopriming- Soaking in 400ppm solution of Salicylic acid and drying
10. Halopriming- Soaking in 50µM solution of Melatonin and drying
11. Halopriming- Soaking in 500 µmol l^{-1}solution of GABA (Gamma-aminobutyric acid) and drying
12. Halopriming- Soaking in aerated solution 2.2% of $CaCl_2$and drying
13. Microbial consortia (1) for abiotic stress mitigation
14. Microbial consortia (As supplied and treatment method suggested by the ICAR-ICAR-*VPKAS*, *Almora*).

Rice

AAU, Jorhat

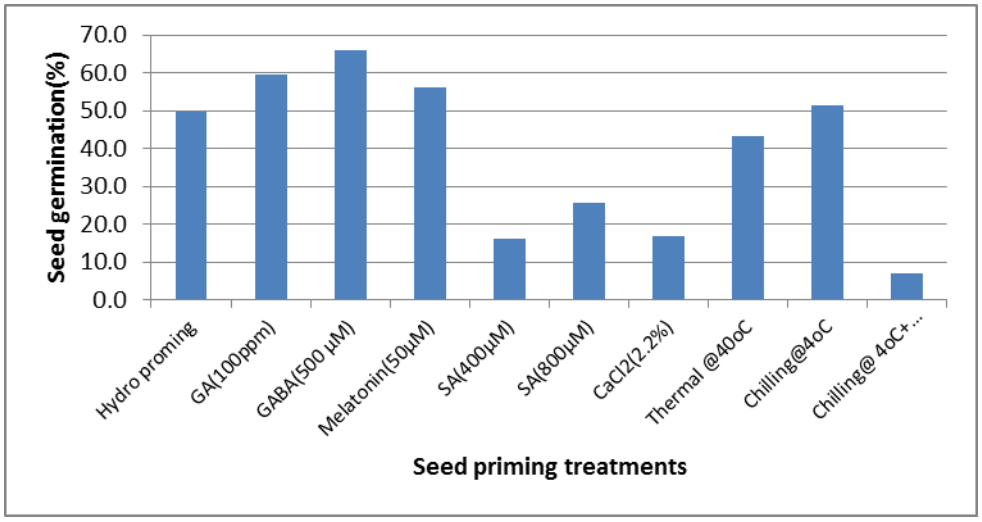
Experimental Details: Variety Jyoti prasad and Bishnu Prasad along with tolerant variety Luit was taken for treatments. First sowing was done in 27th November, poor germination was found in the field condition and the experiment was abandoned due to adverse climatic condition. A new set of experiment was planned and sowing was done as *early Ahu* condition on 22nd of January 2019.

Remark: The experiment may be first tried in cold chambers in laboratory condition and treatments should be selected for field experiment based on those results.

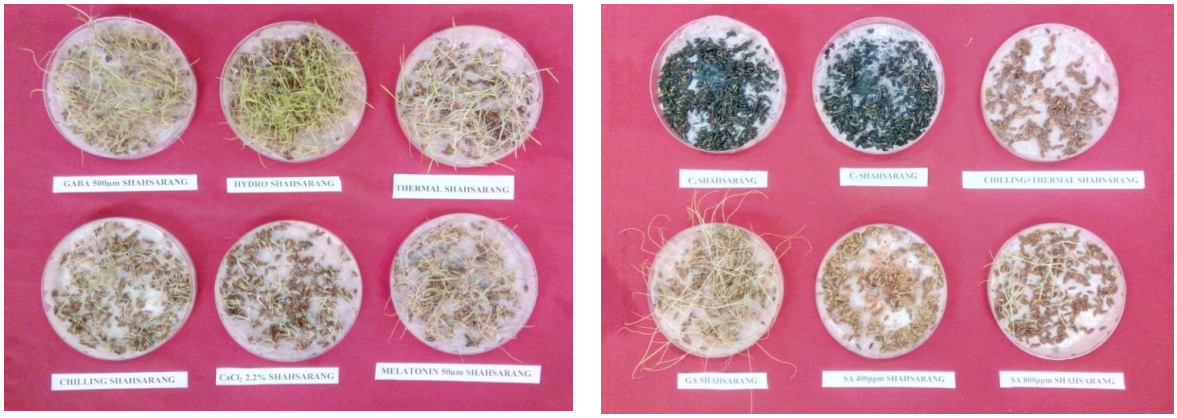
ICAR, RC NEH Region - Manipur Centre

Experimental details: Efforts to prime seeds of traditional rice cultivar (var. Shashrang) of Meghalaya have been undertaken in the present study. Appropriate quantities of rice seed is soaked with different priming substances for 24 hr and incubated under optimum growth conditions.

Results: The recorded observations on seed germination indicate priming of seeds with GABA (500µM), GA (100ppm) and Melatonin (50µM) has enhanced seed germination significantly. Seed priming with Salicylic acid at both concentration (400 and 800ppm), $CaCl_2$ (2.2%) and exposing the seeds to chilling and thermal treatments has caused hindrance for seed germination. Interestingly, rice seeds exposed to both thermal @40^{o}C and chilling @ 4^{o}C alone did not cause any impact on seed germination illustrating the stress resilience of the tested rice variety Shashrang which possibly adapted to low temperature and soil acidity environments of NER over a period of time.



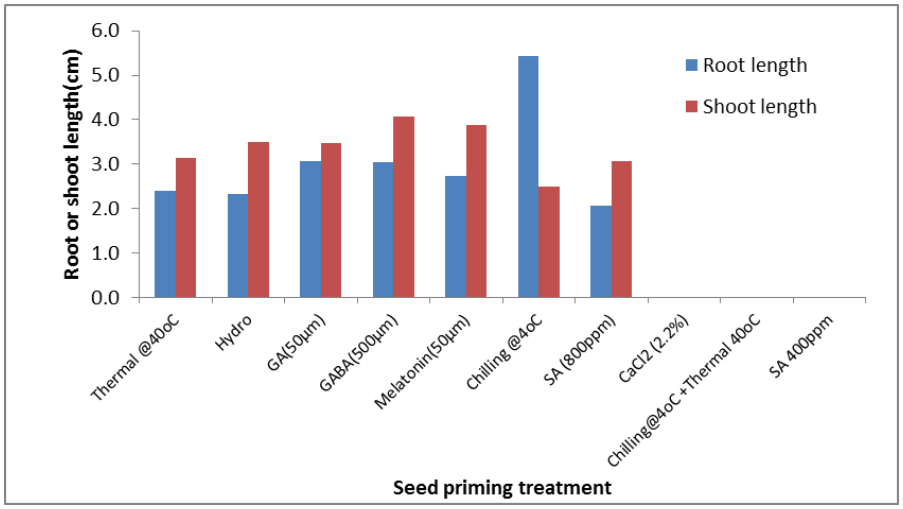
Effect of seed priming on seed germination of traditional rice (Shashrang)



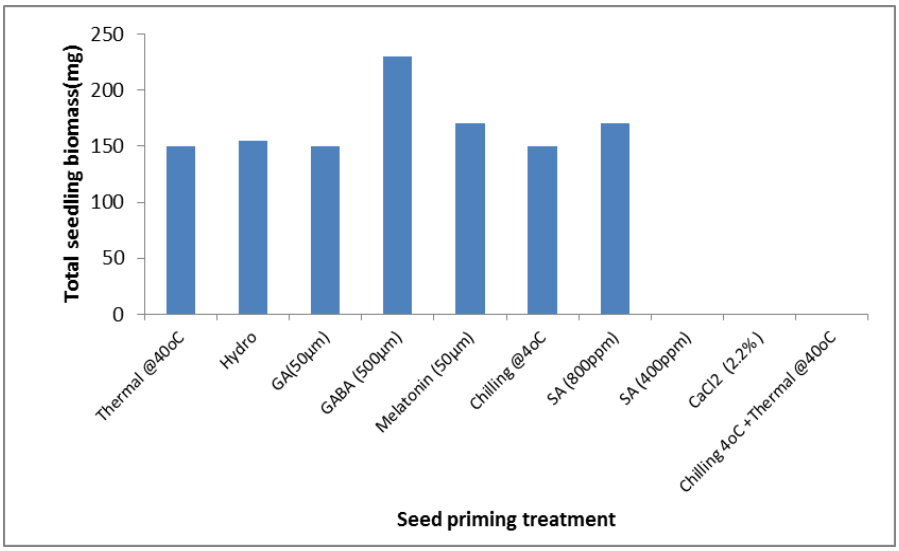
Effect of seed priming on seed germination of traditional rice (Shashrang) under different seed priming treatments

In the similar line, root lengths of seeds treated with chilling, GA (100ppm) and GABA (500µM) treatment have been increased significantly which is followed by seed priming with melatonin (50 µM) and hydro treatment. Shoot length of rice seeds treated with GABA (500µM) and melatonin (50 µM) was slightly higher compare to other treatments. No shoot

growth was found in treatments of $CaCl_2$ (2.2%), Chilling (4°C) followed by thermal (40°C) exposure which possibly due to adverse impacts of physical and osmotic factors hindering the seed germination significantly. Moreover total seedling biomass of seeds treated with GABA (500 µM) was found significantly higher compare to other seed priming treatments whereas no seedling biomass recorded under SA (400ppm), $CaCl_2$ (2.2%), Chilling (4°C) followed by thermal (40°C) exposure. **This clearly indicates, seed priming with GABA (500µM) and GA (100ppm) is beneficial** to enhance seed germination, seedling vigour, seedling biomass and thereby augmenting favourable crop stand and increased productivity of traditional rice cultivar of Meghalaya which further need to be tested under field conditions of north eastern region.



Effect of seed priming on seedling traits of traditional rice (Shashrang)



Effect of seed priming on total seedling biomass of traditional rice (Shashrang)

Experiment 4: Use of nano-particles in enhancing seed quality and storability of seeds

Note: In this experiment, three more crops; Paddy, Soybean and Onion were included with an additional experiment "Evaluation of silver nano-conjugates as seed priming agents against

Fusarium fuzikoroi causing Bakkane disease of rice" with ICAR-IARI, New Delhi and PAU, Ludhiana as new centres.

Year of start: 2016

Objectives:

1. To standardize the optimum concentration of different nano-particles for seed treatment
2. To know the effect of different nano-particles on seed quality and storability of treated seeds
3. To evaluate silver nano-conjugates as seed priming agents against *Fusarium fuzikoroi* causing Bakkane disease of rice

Crops		**Centres**
Pigeon pea	**:**	TNAU, Coimbatore and UAS, Bengaluru
Onion & Soybean (Year of start: 2018)	**:**	ICAR-IARI, New Delhi and TNAU, Coimbatore
Paddy (Year of start: 2018)	**:**	PAU, Ludhiana

Technical programme

Materials:

Crops and Varieties: Use any two recommended local varieties
Pigeon pea: BRG 2 and BRG4
Soybean: **Pusa 9712 and Pusa 9814**
Onion: Pusa Madhvi, Pusa Riddhi and Pusa Red
Paddy: Only in Basmati varieties; Pusa Basmati 1509 and Pusa 1121

Treatments:

Nano-particles: Zinc oxide, Silver, Silicon dioxide (both bulk and nano form).
Dosage: Control (no treatment); 100 ppm, 250 ppm, 500 ppm, 750 ppm and 1000 ppm

Formulation: Dry form

Experiment Details:

Treatment combinations: Nano-particle x bulk x concentration (3 x 3 x 5) = 45
Replication: Three
Design: FCRD

Sub. Experiment I (As per Objective 1): Standardization of optimum concentration of different Nano-particles for seed treatment

Methodology:

- Freshly harvested seeds will be dried to safe and uniform moisture level (8 - 9%).
- The seeds will be directly treated with the selected chemicals (bulk &nano form) in a plastic or glass jar by mixing thoroughly for even distribution.

- Thereafter, the treated seeds shall be evaluated for various seed quality attributes like seed moisture content (SMC), germination and vigour, electrical conductivity (EC) and total dehydrogenase activity (TDH) etc.

Observations:

1. Seed Moisture content and Seed germination (%) (ISTA)- First count, final count and T_{50} value
2. Seedling vigour index I and II (Abdul Baki and Anderson, 1973)
3. Electrical conductivity of seed leachate (µS/cm/g)
4. Total dehydrogenase activity (A_{480} nm)
5. Seed health (infection and infestation)
6. Field emergence %

Crop: Pigeon pea

Year of start: 2016

Centre: TNAU, Coimbatore

Experiment Details: Seeds of Pigeon pea varieties; BRG 2 and RG4 were collected from GKVK, Bangalore. The seeds were treated with dry form of nano particles and bulk formulations of Zinc oxide, Titanium oxide, Silicon dioxide each with 100 ppm, 250 ppm, 500 ppm, 750 ppm and 1000 ppm along with control in three replications.

Observations Recorded:

1. Moisture content (%)
2. First Count (%)
3. Final count (%), T_{50} value
4. Germination (%)
5. Vigour index I & II
6. Electrical conductivity (dSm^{-1})
7. Dehydogenase activity (480 nm)
8. Seed health (%)
9. Field emergence (%)

Methodology adopted for observations: Moisture estimation was carried out as per (ISTA, 2013) by low constant temperature in a hot air oven maintained at $103^0 \pm 2^0$C for 16 $\pm$ 1 h. Germination test was carried out with four replicates of 100 seeds each in sand medium (ISTA, 2013) in a germination room maintained at a temperature of $25^0 \pm 1.5^0$C and RH 96 $\pm$ 2 per cent with diffuse light (approx. 10 h) during the day. Final count on normal seedlings was recorded on 6th day for pigeon pea and percent germination computed (Plate 4.1). Vigour index I & II were calculated using the formula (Abdul-Baki and Anderson, 1973) and the mean values were expressed in whole number.

Vigour index I = Germination (%) X Total seedling length (cm)

Vigour index II = Germination (%) X Dry matter production (g $seedlings^{-10}$)

Time to 50% germination (T50) was determined using the formula of Farooq *et al*. (2005):

T50 = ti + (N/2 – ni)(tj – ti) / (nj – ni) where N is the final number of germinating seeds, nj and ni are the cumulative number of seeds germinated at times t j and t i , respectively, when ni<N/2<ni.

The dehydrogenase activity of the seeds was estimated in duplicate following the method of Kittock and Law, (1968). For onion seeds from each treatment were soaked in distilled water for 18 h. From this five embryos were separated and incubated in darkness with 10 ml of 0.2 per cent tetrazolium chloride solution in glass vials for two hours. After incubation, the tetrazolium chloride solution was decanted and the embryos were thoroughly washed with distilled water and surface dried with blotters. The formazan was eluted by soaking the stained embryos in five ml of methyl cellosolve (2- methoxy ethanol) for two h. and the optical density was measured in Cary UV spectrophotometer at 480 nm.



Plate 4.1: Red gram seedling evaluation

For pigeon pea, 25 seeds from each treatment were preconditioned for 12 h. in between folds of moistened filter papers. From this, five embryonic axes were separated and incubated in darkness with ten ml of 0.2 per cent tetrazolium chloride solution in glass vials for one h. After incubation, the tetrazolium chloride solution was decanted and the embryos were thoroughly washed with distilled water and surface dried with blotters. The formazan

was eluted by soaking the stained embryos in five ml of methyl cellosolve (2- methoxy ethanol) for one h. and the optical density was measured in Cary UV spectrophotometer at 480 nm. Electrical conductivity of 25 Pigeon pea seeds soaked for 8h in 50 ml of deionised water was measured (Presley, 1958).

Result: The results revealed that among the nano chemicals zinc oxide recorded better results for all the seed quality parameters than the other chemicals irrespective of varieties. Pigeon pea BRG 2 and BRG 4 Seeds treated with 500 ppm zinc oxide of nano particle recorded significantly higher values for first count (73% & 74 % ,respectively), final count (92% & 94 % ,respectively), field emergence (87 % & 91 %, respectively) than control (63% & 66% ; 83% & 84 % , 79 % & 81 %, respectively) (Table 4.1, 4.2 & 4.3). The same treatment recorded lowest value for T_{50} *i.e.* it increases the speed of germination (3.3 days & 3.5 days, respectively) than control (4.2 & 3.9 days) (Table 4.4). The moisture content was unaltered by nano treatments (Table 4.5). Among the different concentrations, 500 ppm in all nano chemicals recorded significantly higher values of vigour index I for Pigeon pea varieties BRG 2 and BRG 4 (2796 & 3412, respectively) than control (2133 & 2662) (Table 4.6). The dehydrogenase activity was maximum with 500 ppm zinc oxide (0.316 & 0.381 OD) than control (0.246 & 0.312 OD, respectively) Table 4.8.

In bulk formulation treatment also zinc oxide was effective than other chemicals and control but the effect was lesser than the nano formulation. BRG 2 and BRG 4 seeds treated with 750 ppm zinc oxide of bulk formulation recorded significantly higher values for first count (70 % & 71 % , respectively), final count (88 % & 90 % , respectively), field emergence (83 % & 85 %, respectively) than control (63% & 66% ; 83 % & 84 % ; 79 % & 81 %, respectively) (Table 4.11, 4.12 & 4.13). The same treatment recorded lowest value for T_{50} *i.e.* it increases the speed of germination (3.8 days & 3.6 days, respectively) than control (4.2 & 4.0 days) (Table 4.14). The moisture content was not significantly influenced by seed treatments (Table 4.15). Among the different chemicals zinc oxide recorded significantly higher values of vigour index II (3766 & 4331, respectively) than control (3635 & 3923) (Table 4.17). The dehydrogenase activity was maximum with 750 ppm zinc oxide (0.290 and 0.360 OD) than control (0.246 & 0.312, respectively) (Table 4.18). Significant differences did not observe in seed health (Table 4.20).

Table 4.1: Effect of nano particle treatment on first count (%) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	63	63	63	63	66	66	66	66
T2-100 ppm	66	65	65	65	69	65	68	67
T3-250 ppm	68	65	67	67	71	67	69	69
T4-500 ppm	73	67	68	69	74	69	71	70
T5-750 ppm	71	66	66	68	73	68	70	70
T6-1000 ppm	63	66	66	65	70	68	68	69
Mean	67	65	66	66	71	67	69	69
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.22	0.31	0.51	0.62	NS	NS	NS	
CD (p=0.05)	0.43	0.61	1.02	1.25	NS	NS	NS	

Table 4.2: Effect of nano particle treatment on germination (%) (final count) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	83	83	83	83	84	84	84	84
T2-100 ppm	85	82	84	84	87	86	87	87
T3-250 ppm	89	84	86	86	88	86	87	87
T4-500 ppm	92	84	88	88	94	89	88	90
T5-750 ppm	90	83	87	87	93	89	90	91
T6-1000 ppm	86	82	85	84	88	87	86	87
Mean	88	83	86	85	89	87	87	88
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.71	0.83	NS	0.92	NS	1.23	NS	
CD (p=0.05)	1.43	1.62	NS	1.84	NS	2.46	NS	

Table 4.3: Effect of nano particle treatment on field emergence (%) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	79	79	79	79	81	81	81	81
T2-100 ppm	81	78	79	79	84	83	82	83
T3-250 ppm	84	80	82	82	87	85	82	85
T4-500 ppm	87	82	85	85	91	88	85	88
T5-750 ppm	85	82	84	84	86	88	89	88
T6-1000 ppm	82	80	84	82	86	84	86	85
Mean	83	80	82	82	86	85	84	85
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.32	0.51	0.63	0.73	NS	NS	NS	
CD (p=0.05)	0.64	1.02	1.25	1.47	NS	NS	NS	

Table 4.4: Effect of nano particle treatment on T_{50} (days) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	4.2	4.2	4.2	4.2	3.9	3.9	3.9	3.9
T2-100 ppm	4.0	4.2	4.0	4.0	3.8	4.0	4.0	3.9
T3-250 ppm	4.0	4.0	3.4	3.8	3.8	4.1	4.1	4.0
T4-500 ppm	3.3	4.0	3.6	3.6	3.5	4.0	4.0	3.8
T5-750 ppm	3.6	4.2	3.8	3.8	3.5	3.8	3.8	3.7
T6-1000 ppm	4.1	4.2	4.2	4.1	3.7	3.8	3.8	3.7
Mean	3.8	4.1	3.8	3.9	3.7	3.9	3.9	3.8
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.08	0.11	NS	0.13	NS	NS	NS	
CD (p=0.05)	0.16	0.22	NS	0.26	NS	NS	NS	

Table 4.5: Effect of nano particle treatment on seed moisture (%) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)

T1-Control	8.6	8.6	8.6	8.6	8.3	8.3	8.3	8.3
T2-100 ppm	8.6	8.7	8.6	8.6	8.4	8.1	8.3	8.2
T3-250 ppm	8.5	8.6	8.7	8.6	8.2	8.2	8.4	8.2
T4-500 ppm	8.4	8.6	8.6	8.5	8.2	8.2	8.3	8.2
T5-750 ppm	8.5	8.5	8.5	8.5	8.0	8.1	8.2	8.1
T6-1000 ppm	8.5	8.2	8.6	8.4	8.1	8.0	8.2	8.1
Mean	8.5	8.5	8.6	8.5	8.2	8.1	8.2	8.2
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	NS	NS	0.07	0.09	NS	NS	NS	
CD (p=0.05)	NS	NS	0.14	0.17	NS	NS	NS	

Table 4.6: Effect of nano particle treatment on vigour index I in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	2133	2133	2133	2133	2663	2663	2663	2663
T2-100 ppm	2406	2148	2218	2257	2862	2743	2845	2817
T3-250 ppm	2474	2226	2417	2372	3045	2795	2871	2904
T4-500 ppm	2797	2150	2499	2482	3412	2839	2939	3064
T5-750 ppm	2673	2125	2453	2417	3292	2777	2997	3022
T6-1000 ppm	2451	1993	2270	2238	3106	2688	2786	2860
Mean	2489	2129	2332	2317	3063	2751	2850	2888
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	8.1	9.4	11.7	14.2	16.4	18.5	21.2	
CD (p=0.05)	16.3	18.7	23.4	28.5	32.7	37.0	42.5	

Table 4.7: Effect of nano particle treatment on vigour index II in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	3635	3635	3635	3635	3923	3923	3923	3923
T2-100 ppm	3757	3624	3637	3673	4193	4076	4167	4146
T3-250 ppm	4032	3763	3801	3865	4303	4068	4220	4197
T4-500 ppm	4398	3805	3951	4051	4813	4317	4444	4524
T5-750 ppm	4221	3685	3828	3911	4706	4210	4608	4508
T6-1000 ppm	3853	3542	3655	3683	4338	4089	4283	4237
Mean	3983	3676	3751	3803	4379	4114	4274	4256
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	6.3	7.2	10.1	13.3	15.0	19.5	26.7	
CD (p=0.05)	12.5	14.5	20.2	26.6	30.1	39.2	NS	

Table 4.8: Effect of nano particle treatment on dehydrogenase activity (OD) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.246	0.246	0.246	0.246	0.312	0.312	0.312	0.312

T2-100 ppm	0.267	0.266	0.254	0.262	0.354	0.341	0.338	0.344
T3-250 ppm	0.282	0.253	0.267	0.267	0.362	0.336	0.357	0.351
T4-500 ppm	0.316	0.242	0.281	0.279	0.381	0.340	0.362	0.361
T5-750 ppm	0.307	0.240	0.294	0.280	0.377	0.347	0.370	0.364
T6-1000 ppm	0.392	0.251	0.276	0.306	0.336	0.341	0.350	0.342
Mean	0.301	0.249	0.269	0.273	0.353	0.336	0.348	0.346
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.003	0.005	0.007	0.011	0.016	0.019	0.024	
CD (p=0.05)	0.006	0.010	0.014	0.022	NS	NS	NS	

Table 4.9: Effect of nano particle treatment on electrical conductivity (dSm^{-1}) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.412	0.412	0.412	0.412	0.386	0.386	0.386	0.386
T2-100 ppm	0.406	0.410	0.400	0.405	0.374	0.381	0.392	0.382
T3-250 ppm	0.400	0.422	0.392	0.404	0.378	0.372	0.381	0.377
T4-500 ppm	0.373	0.406	0.387	0.388	0.363	0.370	0.380	0.371
T5-750 ppm	0.386	0.344	0.382	0.370	0.370	0.384	0.74	0.498
T6-1000 ppm	0.408	0.399	0.391	0.399	0.392	0.388	0.377	0.385
Mean	0.397	0.398	0.394	0.396	0.377	0.380	0.442	0.400
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.001	0.003	0.007	0.012	0.018	0.021	0.028	
CD (p=0.05)	0.002	0.006	0.014	0.024	NS	NS	NS	

Table 4.10: Effect of nano particle treatment on seed health (%) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	5.2	5.2	5.2	5.2	3.8	3.8	3.8	3.8
T2-100 ppm	5.0	5.2	5.0	5.0	3.4	3.6	4.0	3.6
T3-250 ppm	5.3	4.6	5.0	4.9	3.6	3.5	3.7	3.6
T4-500 ppm	4.8	4.8	4.6	4.7	3.5	3.6	3.9	3.6
T5-750 ppm	4.3	5.1	4.8	4.7	3.6	3.7	3.6	3.6
T6-1000 ppm	5.2	5.1	4.8	5.0	3.6	3.7	3.5	3.6
Mean	4.9	5	4.9	4.9	3.5	3.6	3.7	3.6
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.009	0.011	0.015	0.019	0.021	0.027	0.058	
CD (p=0.05)	0.018	0.022	0.031	0.038	0.042	0.034	NS	

Table 4.11: Effect of bulk formulation treatment on first count (%) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	63	63	63	63	66	66	66	66
T2-100 ppm	65	62	66	64	68	67	69	68

T3-250 ppm	65	63	65	64	68	67	69	68
T4-500 ppm	69	64	67	67	70	65	70	68
T5-750 ppm	70	66	67	68	71	64	67	67
T6-1000 ppm	67	62	64	64	65	64	67	65
Mean	67	63	65	65	68	66	68	67
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0. 22	0.41	1.21	1.32	1.53	1.65	2.12	
CD (p=0.05)	0.45	0.87	NS	2.65	NS	NS	NS	

Table 4.12: Effect of bulk formulation treatment on germination (%) (final count) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	83	83	83	83	84	84	84	84
T2-100 ppm	82	83	85	83	85	84	85	85
T3-250 ppm	86	85	84	85	87	86	86	86
T4-500 ppm	88	87	86	87	89	89	86	88
T5-750 ppm	88	86	85	86	90	87	88	88
T6-1000 ppm	85	86	85	85	86	87	85	86
Mean	85	85	85	85	87	86	86	86
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.62	0.77	0.92	1.12	1.42	1.75	2.14	
CD (p=0.05)	1.24	1.54	NS	2.25	NS	NS	NS	

Table 4.13: Effect of bulk formulation treatment on field emergence (%) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	79	79	79	79	81	81	81	81
T2-100 ppm	78	80	81	80	83	80	83	82
T3-250 ppm	78	78	81	79	85	82	82	83
T4-500 ppm	83	81	83	82	85	83	87	85
T5-750 ppm	81	80	81	81	83	86	88	86
T6-1000 ppm	80	80	82	81	83	86	85	85
Mean	80	80	81	80	83	83	84	84
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.21	0.40	0.68	0.91	1.23	1.84	2.25	
CD (p=0.05)	0.42	0.82	1.26	1.82	2.46	NS	NS	

Table 4.14: Effect of bulk formulation treatment on T_{50} (days) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	4.2	4.2	4.2	4.2	4.0	4.0	4.0	4.0
T2-100 ppm	4.3	4.2	4.1	4.2	3.9	4.0	4.1	4.0

T3-250 ppm	4.2	4.3	4.0	4.1	3.8	4.2	4.0	4.0
T4-500 ppm	4.0	4.3	4.0	4.1	3.6	4.2	4.0	3.9
T5-750 ppm	3.8	4.0	4.2	4.0	3.6	4.0	3.8	3.8
T6-1000 ppm	4.2	4.2	4.2	4.2	4.0	4.0	3.8	3.9
Mean	4.1	4.2	4.1	4.1	3.8	4.0	3.9	3.9
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.09	0.12	0.32	0.54	1.03	1.34	1.88	
CD (p=0.05)	0.18	0.24	NS	1.08	NS	NS	NS	

Table 4.15: Effect of bulk formulation treatment on seed moisture (%) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	8.6	8.6	8.6	8.6	8.3	8.3	8.3	8.3
T2-100 ppm	8.5	8.5	8.4	8.4	8.0	8.2	8.3	8.1
T3-250 ppm	8.5	8.4	8.5	8.4	8.1	8.2	8.1	8.1
T4-500 ppm	8.4	8.4	8.5	8.4	8.0	8.0	8.1	8.0
T5-750 ppm	8.5	8.3	8.3	8.3	8.2	8.0	8.2	8.1
T6-1000 ppm	8.5	8.4	8.3	8.4	8.2	8.7	8.2	8.3
Mean	8.5	8.4	8.4	8.4	8.1	8.2	8.2	8.1
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.09	0.15	0.21	0.32	0.48	0.63	0.72	
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	

Table 4.16: Effect of bulk formulation treatment on vigour index I in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	2133	2133	2133	2133	2663	2663	2663	2663
T2-100 ppm	2173	2050	2168	2130	2627	2587	2703	2639
T3-250 ppm	2313	2066	2142	2174	2871	2683	2692	2749
T4-500 ppm	2508	2140	2288	2312	2946	2661	2743	2783
T5-750 ppm	2499	1926	2312	2246	3114	2671	2851	2879
T6-1000 ppm	2219	1875	2210	2101	2838	2584	2686	2703
Mean	2308	2032	2209	2183	2843	2642	2723	2736
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	4.1	6.4	13.5	15.2	18.3	22.6	27.4	
CD (p=0.05)	8.3	13.0	17.1	30.4	36.5	NS	NS	

Table 4.17: Effect of bulk formulation treatment on vigour index II in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	3635	3635	3635	3635	3923	3923	3923	3923
T2-100 ppm	3526	3569	3740	3612	4004	3973	4097	4025

T3-250 ppm	3775	3757	3721	3751	4167	4162	4257	4196
T4-500 ppm	3934	3898	3879	3903	4308	4210	4197	4238
T5-750 ppm	3986	3784	3808	3859	5355	4089	4356	4600
T6-1000 ppm	3740	3810	3791	3780	4231	4037	4106	4125
Mean	3766	3742	3762	3757	4331	4066	4156	4184
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	7.2	9.3	11.2	13.6	16.3	20.3	25.6	
CD (p=0.05)	14.5	18.6	22.1	27.3	NS	40.6	NS	

Table 4.18: Effect of bulk formulation treatment on dehydrogenase activity (OD) in Pigeon pea varieties Dehydrogenase (Bulk)

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.246	0.246	0.246	0.246	0.312	0.312	0.312	0.312
T2-100 ppm	0.252	0.248	0.255	0.251	0.337	0.327	0.346	0.336
T3-250 ppm	0.266	0.256	0.261	0.261	0.348	0.321	0.351	0.340
T4-500 ppm	0.284	0.250	0.273	0.269	0.367	0.330	0.357	0.351
T5-750 ppm	0.290	0.242	0.278	0.270	0.360	0.341	0.362	0.354
T6-1000 ppm	0.260	0.241	0.268	0.256	0.327	0.326	0.353	0.335
Mean	0.266	0.247	0.263	0.259	0.341	0.326	0.346	0.338
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.006	0.008	0.017	0.012	0.025	0.032	0.046	
CD (p=0.05)	0.012	0.016	NS	0.024	NS	NS	NS	

Table 4.19: Effect of bulk formulation treatment on electrical conductivity (dSm^{-1}) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.412	0.412	0.412	0.412	0.386	0.386	0.386	0.386
T2-100 ppm	0.410	0.423	0.403	0.412	0.382	0.387	0.384	0.384
T3-250 ppm	0.412	0.410	0.400	0.407	0.379	0.383	0.385	0.382
T4-500 ppm	0.406	0.408	0.388	0.400	0.371	0.378	0.376	0.375
T5-750 ppm	0.400	0.424	0.375	0.399	0.368	0.375	0.381	0.374
T6-1000 ppm	0.417	0.421	0.392	0.410	0.382	0.380	0.384	0.382
Mean	0.409	0.416	0.395	0.406	0.378	0.381	0.382	0.380
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.003	0.005	0.016	0.018	0.021	0.028	0.034	
CD (p=0.05)	0.007	0.010	NS	NS	NS	NS	NS	

Table 4.20: Effect of bulk formulation treatment on seed health (%) in Pigeon pea varieties

	BRG2			Mean	BRG4			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	5.2	5.2	5.2	5.2	3.8	3.8	3.8	3.8
T2-100 ppm	5.2	5.1	5.0	5.1	3.7	3.9	3.7	3.7

T3-250 ppm	5.3	5.3	5.0	5.2	3.8	3.7	3.7	3.7
T4-500 ppm	5.4	5.3	5.2	5.3	3.6	4.0	3.5	3.7
T5-750 ppm	5.0	5.2	4.8	5	3.6	3.9	3.6	3.7
T6-1000 ppm	5.0	5.2	4.8	5.0	3.8	3.8	3.6	3.7
Mean	5.1	5.2	5.0	5.1	3.7	3.8	3.6	3.7
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.007	0.009	0.012	0.016	0.021	0.035	0.058	
CD (p=0.05)	0.014	0.018	0.024	0.032	0.042	0.071	NS	

Salient findings: Nano particle seed treatments with zinc oxide 500 ppm recorded maximum values for all seed quality parameters than control irrespective of varieties and bulk formulation of 750 ppm zinc oxide also recorded similar results but the effect was lesser than the nano treatment.

Crop: Onion

Year of start: 2018
Centre: IARI, New Delhi

Experiment Details: The seeds of onion varieties Pusa Madhvi, Pusa Red and Pusa Riddhi were procured from IARI regional Station Karnal and was treated by TNAU Coimbatore (Plate 4.2). The seeds were treated with dry form of nano particles and bulk formulations of Zinc oxide, Titanium oxide, Silicon dioxide each with 100 ppm, 250 ppm, 500 ppm, 750 ppm and 1000 ppm along with control in three replications.



Plate 4.2: Seed treatments with nanoparticles in Onion and Soybean at TNAU, Coimbatore

Observations Recorded: The standard methods were followed in each case. The field emergence studies were undertaken in the divisional field and counted at regular intervals.

1. Seed Moisture content (%)
2. First Count (%)
3. Germination (%)
4. Vigour index I & II
5. Field emergence (%)
6. Electrical conductivity (dSm^{-1})

7. Dehydrogenase activity (480 nm)
8. Seed Health

Results: The data are presented in the table 4.21- 4.27. The perusal of data revealed that nano particles were effective in enhancing the seed quality of onion seeds. The seed treatments had no significant effect on the seed moisture content, as no hydration was involved. However, other seed quality parameters *viz.* first count, germination percentage, field mergence, vigour indices, EC, dehydrogenase activity were significantly influenced by the seed treatments. Nano formulation of Zinc oxide @ 500 ppm was observed to be the most effective in enhancing the seed quality parameters, irrespective of the varieties and followed by Titanium oxide @250 ppm. These treatments were associated with higher germination percentage, field emergence and vigour indices. The seed heath tests also indicated that the incidence of seed borne fungi was lower in case of seed treatment with nano-forms. Moreover, nano-particles were found to be effective at lower doses, as the seed germination was adversely affected at higher concentrations. The seed treatment with bulk formulations also registered an increase in the seed quality parameters, but to lesser extent. Amongst the varieties, maximum germination percentage was recorded in case of Pusa Madhavi, followed by Pusa Riddhi and Pusa Red. *Alternaria alterenata*, *Aspergillus niger, Aspergillus flavus*, *Fusarium moniliforme* were the fungi observed**.**

Table 4.21: Effect of seed treatments on the seed moisture content of different onion cultivars

Seed treatments			**Pusa Madhvi**	**Pusa Red**	**Pusa Riddhi**
Control			8.62	8.78	8.97
Nano	ZnO	100 ppm	8.70	8.92	9.06
		250 ppm	8.73	8.95	9.14
		500 ppm	8.74	8.89	9.11
		750 ppm	8.71	8.97	9.16
		1000 ppm	8.75	8.83	9.13
	Titanium	100 ppm	8.61	8.98	9.09
		250 ppm	8.72	8.82	9.12
		500 ppm	8.76	8.93	9.00
		750 ppm	8.61	8.99	9.08
		1000 ppm	8.71	8.94	9.11
	SiO_2	100 ppm	8.80	8.91	9.15
		250 ppm	8.78	8.85	9.00
		500 ppm	8.76	8.92	9.03
		750 ppm	8.71	8.87	9.15
		1000 ppm	8.56	8.75	9.02
Bulk	ZnO	100 ppm	8.57	8.84	9.10
		250 ppm	8.70	8.96	9.14
		500 ppm	8.75	8.77	9.03
		750 ppm	8.64	8.88	8.96
		1000 ppm	8.58	8.91	9.11
	Titanium	100 ppm	8.74	8.74	9.06
		250 ppm	8.62	8.73	8.93

		500 ppm	8.59	8.78	9.09
		750 ppm	8.66	8.75	8.91
		1000 ppm	8.68	8.81	9.10
	SiO_2	100 ppm	8.76	8.76	8.95
		250 ppm	8.55	8.79	8.92
		500 ppm	8.69	8.80	9.03
		750 ppm	8.57	8.76	9.07
		1000 ppm	8.67	8.84	9.09
CD (p=0.05)			**NS**	**NS**	**0.221**
SEm(±)			**0.090**	**0.094**	**0.076**

Table 4.22: Effect of seed treatments on the first count of different onion cultivars

Seed treatments			**Pusa Madhvi**	**Pusa Red**	**Pusa Riddhi**
Control			84.25	73.25	76.50
Nano	ZnO	100 ppm	87.00	77.50	81.00
		250 ppm	90.75	79.25	82.75
		500 ppm	88.50	78.50	81.50
		750 ppm	86.00	77.25	80.75
		1000 ppm	83.25	73.50	78.00
	Titanium	100 ppm	84.00	73.75	78.25
		250 ppm	87.75	76.25	79.50
		500 ppm	87.25	73.50	77.75
		750 ppm	82.75	72.25	76.50
		1000 ppm	82.25	71.75	76.75
	SiO_2	100 ppm	83.00	72.50	77.25
		250 ppm	81.50	71.00	79.50
		500 ppm	86.75	76.50	78.75
		750 ppm	83.25	72.50	76.25
		1000 ppm	81.00	71.00	76.50
Bulk	ZnO	100 ppm	84.25	73.25	78.00
		250 ppm	84.50	74.00	79.25
		500 ppm	85.00	74.75	78.50
		750 ppm	84.50	75.25	77.50
		1000 ppm	84.25	74.00	78.00
	Titanium	100 ppm	84.00	73.00	76.25
		250 ppm	83.25	73.25	77.00
		500 ppm	84.50	74.25	78.25
		750 ppm	85.25	75.00	77.75
		1000 ppm	85.00	74.50	78.50
	SiO_2	100 ppm	84.75	73.25	77.25
		250 ppm	84.50	74.25	79.00
		500 ppm	85.25	75.25	78.75
		750 ppm	85.00	74.50	78.50
		1000 ppm	84.25	74.00	77.50
CD (p=0.05)			**3.33**	**2.30**	**2.78**
SEm(±)			**1.185**	**0.820**	**0.989**

Table 4.23: Effect of seed treatments on the seed germination of different onion cultivars

Seed treatments			Pusa Madhvi	Pusa Red	Pusa Riddhi
Control			86.25	78.00	80.50
Nano	ZnO	100 ppm	89.50	81.75	84.25
		250 ppm	92.75	83.75	86.00
		500 ppm	90.50	83.25	84.75
		750 ppm	88.00	81.50	84.00
		1000 ppm	86.00	78.00	81.75
	Titanium	100 ppm	86.50	78.25	82.00
		250 ppm	89.75	80.50	83.25
		500 ppm	89.25	80.00	81.50
		750 ppm	85.50	77.25	80.50
		1000 ppm	85.00	76.50	80.75
	SiO_2	100 ppm	85.75	77.50	81.00
		250 ppm	84.25	75.75	83.00
		500 ppm	88.75	80.75	82.25
		750 ppm	85.50	77.00	80.50
		1000 ppm	83.50	75.75	80.00
Bulk	ZnO	100 ppm	86.75	77.75	81.75
		250 ppm	87.00	78.50	82.75
		500 ppm	87.50	79.25	82.25
		750 ppm	87.25	79.50	81.25
		1000 ppm	86.75	78.50	81.75
	Titanium	100 ppm	86.25	77.75	80.25
		250 ppm	86.00	78.00	80.75
		500 ppm	87.25	78.75	81.75
		750 ppm	87.75	79.50	81.50
		1000 ppm	87.50	79.00	82.00
	SiO_2	100 ppm	87.25	77.75	81.00
		250 ppm	87.00	78.75	82.50
		500 ppm	87.50	79.50	82.25
		750 ppm	87.25	79.00	82.00
		1000 ppm	86.50	78.50	81.25
CD (p=0.05)			**3.56**	**2.79**	**2.24**
SEm(±)			**1.266**	**0.989**	**0.994**

Table 4.24: Effect of seed treatments on the Seedling Vigour Index I of different onion cultivars

Seed treatments			Pusa Madhvi	Pusa Red	Pusa Riddhi
Control			967	707	865
Nano	ZnO	100 ppm	1150	916	1077
		250 ppm	1244	921	1131
		500 ppm	1234	920	1101
		750 ppm	1096	901	1071
		1000 ppm	909	716	881

	Titanium	100 ppm	971	720	888
		250 ppm	1151	881	1043
		500 ppm	1105	862	887
		750 ppm	868	658	802
		1000 ppm	789	598	790
	SiO_2	100 ppm	874	673	823
		250 ppm	773	594	773
		500 ppm	1099	887	1050
		750 ppm	850	652	798
		1000 ppm	767	556	752
Bulk	ZnO	100 ppm	983	726	849
		250 ppm	983	762	916
		500 ppm	1079	825	979
		750 ppm	1026	857	1032
		1000 ppm	975	781	910
	Titanium	100 ppm	938	674	842
		250 ppm	923	717	862
		500 ppm	1001	808	933
		750 ppm	1093	855	1029
		1000 ppm	1085	818	954
	SiO_2	100 ppm	1026	673	830
		250 ppm	1000	811	919
		500 ppm	1072	840	1001
		750 ppm	1038	817	950
		1000 ppm	967	781	916
CD (p=0.05)			**177**	**126**	**136**
SEm(±)			**63.088**	**44.864**	**48.493**

Table 4.25: Effect of seed treatments on the Seedling Vigour Index II of different onion cultivars

Seed treatments			**Pusa Madhvi**	**Pusa Red**	**Pusa Riddhi**
Control			1917	1890	1743
Nano	ZnO	100 ppm	3155	3250	2921
		250 ppm	3351	3536	3189
		500 ppm	3256	3372	3128
		750 ppm	2739	3236	2816
		1000 ppm	1898	1954	1888
	Titanium	100 ppm	2089	2031	1896
		250 ppm	3206	3135	2681
		500 ppm	2840	1775	1831
		750 ppm	1836	1445	1511
		1000 ppm	1532	1410	1493
	SiO_2	100 ppm	1861	1502	1620
		250 ppm	1215	1367	1326
		500 ppm	2800	3157	2785
		750 ppm	1785	1436	1505

		1000 ppm	1177	1712	1395
Bulk	ZnO	100 ppm	2232	1724	1637
		250 ppm	2306	2483	1910
		500 ppm	2544	2940	2367
		750 ppm	2417	3057	2491
		1000 ppm	2112	2049	1948
	Titanium	100 ppm	1913	1652	1725
		250 ppm	1868	1884	1731
		500 ppm	2500	2670	2037
		750 ppm	2714	3033	2478
		1000 ppm	2516	2899	2203
	SiO_2	100 ppm	2426	1757	1721
		250 ppm	2266	2658	1987
		500 ppm	2529	2991	2394
		750 ppm	2408	2852	2247
		1000 ppm	2024	2125	1968
CD (p=0.05)			**567**	**663**	**670**
SEm(±)			**201**	**236**	**238**

Table 4.26: Effect of seed treatments on the field emergence of different onion cultivars

Seed treatments			**Pusa Madhvi**	**Pusa Red**	**Pusa Riddhi**
Control			79.50	66.50	71.00
Nano	ZnO	100 ppm	82.50	69.50	74.25
		250 ppm	85.50	71.25	75.75
		500 ppm	83.50	71.00	74.75
		750 ppm	81.00	69.50	74.00
		1000 ppm	79.25	66.50	72.00
	Titanium	100 ppm	79.75	66.75	79.75
		250 ppm	89.75	68.50	73.50
		500 ppm	82.25	66.50	71.75
		750 ppm	78.75	65.75	71.00
		1000 ppm	78.25	65.25	71.25
	SiO_2	100 ppm	79.00	66.00	71.50
		250 ppm	77.75	64.50	73.25
		500 ppm	81.75	68.75	72.50
		750 ppm	78.75	65.50	70.50
		1000 ppm	77.00	64.50	70.50
Bulk	ZnO	100 ppm	80.00	66.25	72.00
		250 ppm	80.25	66.75	73.00
		500 ppm	80.50	67.50	72.50
		750 ppm	80.50	67.75	71.50
		1000 ppm	80.00	66.75	72.00
	Titanium	100 ppm	79.50	66.25	70.75
		250 ppm	79.25	66.50	71.25
		500 ppm	80.50	67.00	72.00
		750 ppm	80.75	67.75	71.75
		1000 ppm	80.75	67.25	72.25

	SiO_2	100 ppm	80.50	66.25	71.50
		250 ppm	80.25	67.00	72.75
		500 ppm	80.75	67.75	72.50
		750 ppm	80.50	79.00	72.25
		1000 ppm	79.75	78.50	71.50
CD (p=0.05)			**2.92**	**2.09**	**2.16**
SEm(±)			**1.046**	**0.745**	**0.769**

Table 4.27: Effect of seed treatments on the seed health status (% incidence) of different onion cultivars

Seed treatments			**Pusa Madhvi**	**Pusa Red**	**Pusa Riddhi**
Control			3.33	1.33	2.00
Nano	ZnO	100 ppm	5.33	0.33	5.33
		250 ppm	4.67	0.00	1.67
		500 ppm	4.67	0.33	5.33
		750 ppm	5.67	0.67	5.33
		1000 ppm	5.67	0.67	4.33
	Titanium	100 ppm	4.00	0.33	2.33
		250 ppm	3.33	0.67	2.67
		500 ppm	2.00	1.33	3.33
		750 ppm	4.00	0.67	1.33
		1000 ppm	3.67	0.67	2.67
	SiO_2	100 ppm	4.67	0.00	2.00
		250 ppm	3.33	0.67	2.00
		500 ppm	1.33	1.00	3.00
		750 ppm	3.67	0.00	3.67
		1000 ppm	2.00	0.67	2.00
Bulk	ZnO	100 ppm	9.00	1.67	2.00
		250 ppm	4.67	0.67	2.33
		500 ppm	5.33	1.67	1.33
		750 ppm	5.33	2.33	3.33
		1000 ppm	4.33	3.00	2.67
	Titanium	100 ppm	3.33	2.33	2.33
		250 ppm	6.00	1.67	3.00
		500 ppm	4.67	2.33	1.33
		750 ppm	5.67	2.00	2.00
		1000 ppm	3.33	1.67	3.00
	SiO_2	100 ppm	2.67	1.67	3.33
		250 ppm	5.33	1.67	2.33
		500 ppm	3.00	1.00	4.00
		750 ppm	5.67	0.67	2.33
		1000 ppm	6.67	2.33	2.67
CD (p=0.05)			**2.73**	**2.89**	**3.28**

Conclusion: Based on the above results, it can be concluded that Nano formulations of Zinc oxide @ 500 ppm and Titanium oxide @250 ppm can be used effectively for enhancing the

seed quality status of onion lots. Based on the standardisation of concentration of the nano-particles, the subsequent studies will be undertaken for evaluating the effect of nano-particles on the storability of onion seeds.

Crop: Onion

Centre: TNAU, Coimbatore

Experiment Details: Seeds of Onion varieties; Pusa Madhvi, Pusa Riddhi and Pusa Red were supplied by ICAR-IARI, New Delhi and were treated by TNAU Coimbatore. The seeds were treated with dry form of nano particles and bulk formulations of Zinc oxide, Titanium oxide, Silicon dioxide each with 100 ppm, 250 ppm, 500 ppm, 750 ppm and 1000 ppm along with control in three replications.

Methodology:

The dehydrogenase activity of the seeds was estimated in duplicate following the method of Kittock and Law, (1968). For onion, 25 seeds from each treatment were preconditioned for 12 h. in between folds of moistened filter papers. From this, five embryonic axes were separated and incubated in darkness with ten ml of 0.2 per cent tetrazolium chloride solution in glass vials for one h. After incubation, the tetrazolium chloride solution was decanted and the embryos were thoroughly washed with distilled water and surface dried with blotters. The formazan was eluted by soaking the stained embryos in five ml of methyl cellosolve (2- methoxy ethanol) for one h. and the optical density was measured in Cary UV spectrophotometer at 480 nm. Electrical conductivity of 25 Onion seeds soaked for 16h in 25 ml of deionised water was measured (Presley, 1958).

Results: The results revealed that among the nano chemicals titanium oxide recorded better results for all the seed quality parameters than the other chemicals irrespective of onion varieties. Pusa Madhvi, Pusa Red and Pusa Riddhi seeds treated with 250 ppm titanium oxide of nano particle recorded significantly higher values for first count (46%, 48 % & 42 % respectively), final count (96%, 97 % & 93 % ,respectively), field emergence (94 %, 94 % & 91 %, respectively) than control (32%, 34% & 32%, ; 85 %, 87 % & 84 % , 79 %, 81 % & 80 %, respectively) (Table 4.28, 4.29 & 4.30). The same treatment recorded lowest value for T_{50} *ie* it increases the speed of germination (8.3 days, 8.6 days & 8.9 days, respectively) than control (9.4, 9.7 & 10.2 days) (Table 4.31). Higher concentration of 1000 ppm in all the nano formulations reduced the seed germination in all the three varieties (86 % in Pusa Madhvi, 85 % in Pusa Red and 87 % in Pusa Riddhi). The moisture content was unaltered by nano treatments (Table 4.32). Among the different concentrations, 250 ppm in all nano chemicals recorded significantly higher values of vigour index I for onion varieties Pusa Madhvi, Pusa Red and Pusa Riddhi (1938, 1948 & 1853, respectively) (Table 4.33). The dehydrogenase activity was maximum with 250 ppm titanium oxide (0.071 in Pusa Madhvi, 0.082 in Pusa Red and 0.077 in Pusa Riddhi) than control (0.053, 0.062 & 0.057, respectively). The electrical conductivity was minimum with titanium oxide 250 ppm in all three varieties (0.272, 0.305, 0.300 dSm^{-1}, respectively) than control (0.327, 0.368, 0.347 dSm^{-1}) (Table 4.35 & 4.36).

In bulk formulation treatment also titanium oxide was effective than other chemicals and control but the effect was lesser than the nano formulation. Pusa Madhvi, Pusa Red and Pusa

Riddhi seeds treated with 250 ppm titanium oxide of bulk formulation recorded significantly higher values for first count (43%, 45% & 40% respectively), final count (94%, 94 % & 91 % respectively), field emergence (90 %, 90 % & 89 %, respectively) than control (32%, 34% & 32%, ; 85 %, 87 % & 84 % , 79 %, 81 % & 80 %, respectively) (Table 4.38, 4.39 & 4.40). The same treatment recorded lowest value for T_{50} *ie* it increases the speed of germination (8.4 days, 8.7 days & 9.0 days, respectively) than control (9.4, 9.7 & 10.2 days) (Table 4.41). The moisture content was unaltered by seed treatments (Table 4.42). Among the different chemicals titanium oxide recorded significantly higher values of vigour index II for onion varieties Pusa Madhvi, Pusa Red and Pusa Riddhi (1672, 1631 & 1592, respectively) (Table 4.44). The dehydrogenase activity was maximum with 250 ppm titanium oxide (0.067 in Pusa Madhvi, 0.078 in Pusa Red and 0.074 in Pusa Riddhi) than control (0.053, 0.062 & 0.057, respectively). The electrical conductivity was minimum with titanium oxide 250 ppm in all three varieties (0.284, 0.321, 0.317 dSm^{-1}, respectively) than control (0.327, 0.368, 0.347 dSm^{-1}) (Table 4.45 & 4.46). Significant differences did not observe in seed health (Table 4.47).

Better performance of Titanium oxide **Poor performance of Zinc oxide**



Plate 4.3: Onion seedling evaluation



Plate 4.4: Field emergence - Onion

Table 4.28: Effect of nano particle treatment on first count (%) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	32	32	32	32	34	34	34	34	32	32	32	32
T2-100 ppm	34	40	38	37	38	42	32	37	34	38	35	36
T3-250 ppm	38	46	40	41	46	48	42	45	38	42	36	37
T4-500 ppm	40	45	40	42	44	45	40	43	38	40	41	40
T5-750 ppm	37	42	43	41	44	44	44	44	34	40	40	38
T6-1000 ppm	35	38	36	36	40	40	38	39	34	37	36	36
Mean	36	41	38	38	41	42	38	40	35	38	37	37
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.17	0.22	0.27	0.51	0.91	1.25	1.62					
CD (p=0.05)	0.38	0.44	0.55	1.02	NS	NS	NS					

Table 4.29: Effect of nano particle treatment on germination (%) (final count) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	85	85	85	87	87	87	87	83	84	84	84	84
T2-100 ppm	88	89	88	86	88	91	89	82	86	88	85	87
T3-250 ppm	94	96	91	85	95	97	90	82	90	93	89	91
T4-500 ppm	91	92	90	85	92	94	84	81	88	93	89	90
T5-750 ppm	86	90	93	86	86	90	90	82	88	90	91	90
T6-1000 ppm	82	88	84	86	82	88	81	82	86	87	88	87
Mean	88	90	89	86	88	91	87	82	87	89	88	88
SEd(±)	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
	0.32	0.73	0.81	0.84	1.23	1.46	1.68					
CD (p=0.05)	C=0.65	0.46	1.63	1.69	NS	NS	NS					

Table 4.30: Effect of nano particle treatment on field emergence (%) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	79	79	79	79	81	81	81	81	80	80	80	80
T2-100 ppm	82	85	82	83	83	87	85	85	84	87	85	85
T3-250 ppm	91	94	89	91	90	94	86	90	88	91	87	89
T4-500 ppm	87	91	88	89	87	86	85	86	87	90	85	87
T5-750 ppm	85	87	90	87	87	85	89	87	85	86	88	86
T6-1000 ppm	78	84	80	81	83	82	82	82	85	84	83	84
Mean	84	87	85	85	85	86	85	85	85	86	85	85
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.23	0.32	0.62	0.82	1.52	1.72	1.87					
CD (p=0.05)	0.47	0.65	NS	1.65	NS	NS	NS					

Table 4.31: Effect of nano particle treatment on T_{50} (days) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	9.4	9.4	9.4	9.4	9.7	9.7	9.7	9.7	10.2	10.2	10.2	10.2
T2-100 ppm	8.8	8.5	9.0	8.7	9.2	9.0	9.0	9.0	9.4	9.1	9.7	9.4
T3-250 ppm	8.5	8.3	9.0	8.6	8.7	8.6	8.8	8.7	9.0	8.9	9.2	9.0
T4-500 ppm	8.5	8.4	8.7	8.5	9.1	8.7	8.8	8.8	9.1	9.2	8.9	9.0
T5-750 ppm	8.6	8.5	8.6	8.5	9.0	8.7	8.6	8.7	9.3	9.0	8.9	9.0
T6-1000 ppm	9.1	8.9	8.9	8.9	9.3	9.0	9.0	9.1	9.3	9.2	9.3	9.2
Mean	8.8	8.6	8.9	8.7	9.1	8.9	8.9	8.9	9.3	9.2	9.3	9.2
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.09	0.13	0.31	0.60	0.82	1.02	1.58					
CD (p=0.05)	0.18	0.25	0.62	1.20	NS	NS	NS					

Table 4.32: Effect of nano particle treatment on seed moisture (%) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	8.42	8.42	8.42	8.42	8.36	8.36	8.36	8.36	8.72	8.72	8.72	8.72
T2-100 ppm	8.97	8.46	8.40	8.61	8.35	8.37	8.32	8.34	8.72	8.70	8.70	8.70
T3-250 ppm	8.38	8.35	8.39	8.37	8.37	8.33	8.35	8.35	8.71	8.72	8.71	8.71
T4-500 ppm	8.39	8.40	8.38	8.39	8.35	8.34	8.35	8.34	8.70	8.72	8.69	8.70
T5-750 ppm	8.42	8.41	8.41	8.41	8.36	8.30	8.33	8.33	8.72	8.69	8.70	8.70
T6-1000 ppm	8.38	8.39	8.40	8.39	8.32	8.33	8.36	8.33	8.70	8.70	8.68	8.69
Mean	8.49	8.40	8.40	8.43	8.35	8.33	8.34	8.34	8.71	8.70	8.7	8.70
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.04	0.09	0.12	0.18	0.24	0.42	0.67					
CD (p=0.05)	0.08	NS	0.25	NS	NS	NS	NS					

Table 4.33: Effect of nano particle treatment on vigour index I in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	1518	1518	1518	1518	1289	1289	1289	1289	1427	1427	1427	1427
T2-100 ppm	1772	2028	1653	1818	1422	1909	1630	1654	1546	1786	1566	1633
T3-250 ppm	2011	2144	1661	1938	1827	2238	1780	1948	1703	2076	1781	1853
T4-500 ppm	1758	1917	1773	1816	1580	2006	1783	1789	1680	1730	1772	1727
T5-750 ppm	1626	1764	1889	1760	1536	1731	1872	1713	1523	1609	1881	1671
T6-1000 ppm	1505	1627	1650	1594	1752	1820	1522	1698	1484	1519	1572	1525
Mean	1698	1833	1691	1741	1568	1832	1646	1682	1560	1691	1666	1639
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	6.2	8.9	10.6	12.5	17.3	21.2	27.8					
CD (p=0.05)	12.5	17.7	21.2	25.0	NS	NS	NS					

Table 4.34: Effect of nano particle treatment on vigour index II in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	1496	1496	1496	1496	1462	1462	1462	1462	1445	1445	1445	1445
T2-100 ppm	1628	1709	1601	1646	1522	1674	1531	1576	1574	1628	1530	1577
T3-250 ppm	1956	2016	1775	1916	1796	1998	1593	1796	1773	1897	1709	1793
T4-500 ppm	1794	1895	1864	1851	1684	1842	1628	1718	1729	1823	1673	1742
T5-750 ppm	1736	1782	1880	1799	1566	1620	1822	1669	1655	1737	1665	1686
T6-1000 ppm	1583	1681	1663	1642	1514	1549	1537	1533	1531	1583	1549	1554
Mean	1699	1763	1713	1725	1591	1691	1595	1626	1618	1686	1595	1633
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	5.1	6.7	8.6	11.2	14.1	18.6	20.3					
CD (p=0.05)	10.3	13.4	17.2	22.5	28.2	NS	NS					

Table 4.35: Effect of nano particle treatment on dehydrogenase activity (OD) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.053	0.053	0.053	0.053	0.062	0.062	0.062	0.062	0.057	0.057	0.057	0.057
T2-100 ppm	0.058	0.062	0.056	0.058	0.072	0.075	0.067	0.071	0.068	0.071	0.064	0.067
T3-250 ppm	0.067	0.071	0.060	0.066	0.077	0.082	0.071	0.076	0.073	0.077	0.068	0.072
T4-500 ppm	0.062	0.070	0.060	0.064	0.075	0.081	0.070	0.075	0.072	0.075	0.073	0.073
T5-750 ppm	0.057	0.067	0.063	0.062	0.070	0.079	0.075	0.074	0.066	0.071	0.073	0.07
T6-1000 ppm	0.055	0.056	0.056	0.055	0.066	0.073	0.069	0.069	0.062	0.067	0.065	0.064
Mean	0.058	0.063	0.058	0.059	0.070	0.075	0.069	0.071	0.066	0.069	0.066	0.067
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.002	0.003	0.007	0.007	0.015	0.018	0.032					
CD (p=0.05)	0.004	0.006	NS	0.014	NS	NS	NS					

Table 4.36: Effect of nano particle treatment on electrical conductivity (dSm^{-1}) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.327	0.327	0.327	0.327	0.368	0.368	0.368	0.368	0.347	0.347	0.347	0.347
T2-100 ppm	0.302	0.248	0.316	0.288	0.342	0.327	0.344	0.337	0.326	0.312	0.336	0.324
T3-250 ppm	0.286	0.272	0.304	0.287	0.317	0.305	0.326	0.316	0.310	0.300	0.332	0.314
T4-500 ppm	0.294	0.284	0.300	0.292	0.326	0.313	0.320	0.319	0.331	0.321	0.326	0.326
T5-750 ppm	0.308	0.296	0.282	0.295	0.339	0.329	0.314	0.327	0.338	0.327	0.312	0.325
T6-1000 ppm	0.317	0.308	0.296	0.307	0.346	0.346	0.339	0.343	0.342	0.338	0.330	0.336
Mean	0.305	0.289	0.304	0.299	0.339	0.331	0.335	0.335	0.332	0.324	0.330	0.328
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.004	0.006	0.009	0.011	0.016	0.024	0.044					
CD (p=0.05)	0.008	0.012	NS	0.022	NS	NS	NS					

Table 4.37: Effect of nano particle treatment on seed health (%) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	4.6	4.6	4.6	4.6	3.2	3.2	3.2	3.2	1.7	1.7	1.7	1.7
T2-100 ppm	4.5	4.3	4.6	4.4	3.0	3.2	3.3	3.1	1.8	1.5	1.5	1.6
T3-250 ppm	4.5	4.0	4.5	4.3	3.2	3.0	3.2	3.1	1.6	1.3	1.6	1.5
T4-500 ppm	4.3	4.0	4.5	4.2	3.2	3.0	3.2	3.1	1.8	1.3	1.6	1.5
T5-750 ppm	4.3	4.1	4.5	4.3	3.0	3.2	3.0	3.0	1.7	1.5	1.7	1.6
T6-1000 ppm	4.4	4.1	4.5	4.3	3.1	3.2	3.0	3.1	1.7	1.5	1.7	1.6
Mean	4.4	4.1	4.5	4.3	3.1	3.1	3.1	3.1	1.7	1.4	1.6	1.5
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.05	0.09	0.15	0.18	0.21	0.34	0.53					
CD (p=0.05)	0.10	0.18	0.31	NS	NS	NS	NS					

Table 4.38: Effect of bulk formulation treatment on first count (%) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	32	32	32	32	34	34	34	34	32	32	32	32
T2-100 ppm	35	37	35	36	36	39	35	37	33	36	32	34
T3-250 ppm	36	43	38	39	40	45	38	41	36	40	36	37
T4-500 ppm	36	40	40	39	40	42	40	41	35	38	39	37
T5-750 ppm	38	40	40	39	38	40	40	39	33	37	40	37
T6-1000 ppm	30	36	34	33	35	38	36	36	33	35	36	35
Mean	35	38	37	36	37	40	37	38	34	36	36	35
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.13	0.19	0.23	0.41	0.83	1.25	1.62					
CD (p=0.05)	0.26	0.40	0.46	0.82	NS	NS	NS					

Table 4.39: Effect of bulk formulation treatment on germination (%) (final count) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	85	85	85	85	87	87	87	87	84	84	84	84
T2-100 ppm	88	88	86	87	87	90	86	88	85	86	87	86
T3-250 ppm	92	94	90	92	92	94	90	92	88	91	90	90
T4-500 ppm	90	90	88	89	90	93	88	90	88	90	88	89
T5-750 ppm	87	88	87	87	90	90	88	89	86	88	88	87
T6-1000 ppm	85	88	82	85	88	87	84	86	85	85	84	85
Mean	88	89	86	88	89	90	87	89	86	87	87	87
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.27	0.67	NS	0.75	0.92	1.12	1.66					
CD (p=0.05)	0.54	0.39	NS	1.50	NS	NS	NS					

Table 4.40: Effect of bulk formulation treatment on field emergence (%) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	79	79	79	79	81	81	81	81	80	80	80	80
T2-100 ppm	81	83	78	81	82	83	84	83	81	83	84	83
T3-250 ppm	88	90	85	88	87	90	86	88	85	89	86	87
T4-500 ppm	86	88	85	86	88	89	86	88	85	88	84	86
T5-750 ppm	81	84	82	82	86	86	82	85	82	85	85	84
T6-1000 ppm	77	80	74	77	83	85	79	82	79	81	80	80
Mean	82	84	81	82	85	86	83	84	82	84.3	83	83
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.17	0.21	0.56	0.61	NS	1.42	1.85					
CD (p=0.05)	0.35	0.40	NS	1.23	NS	NS	NS					

Table 4.41: Effect of bulk formulation treatment on T_{50} (days) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	9.4	9.4	9.4	9.4	9.7	9.7	9.7	9.7	10.2	10.2	10.2	10.2
T2-100 ppm	9.1	8.8	9.2	9.0	9.3	9.1	9.0	9.1	9.6	9.4	9.9	9.6
T3-250 ppm	8.7	8.4	8.8	8.6	8.8	8.7	8.8	8.7	9.2	9.0	9.2	9.1
T4-500 ppm	8.7	8.6	8.8	8.7	8.8	8.7	8.9	8.8	9.0	8.8	9.4	9.0
T5-750 ppm	9.0	8.8	9.0	8.9	9.1	8.9	8.8	8.9	9.2	9.1	9.4	9.2
T6-1000 ppm	9.3	9.1	9.2	9.2	9.2	8.9	9.0	9.0	9.6	9.3	9.7	9.5
Mean	9.0	8.8	9.0	8.9	9.1	9	9.0	9.0	9.4	9.3	9.6	9.4
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.010	0.017	0.023	0.052	0.12	0.25	0.44					
CD (p=0.05)	0.021	0.034	NS	0.104	NS	NS	NS					

Table 4.42: Effect of bulk formulation treatment on seed moisture (%) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	8.42	8.42	8.42	8.42	8.36	8.36	8.36	8.36	8.72	8.72	8.72	8.72
T2-100 ppm	8.38	8.40	8.42	8.4	8.32	8.35	8.35	8.34	8.73	8.70	8.70	8.71
T3-250 ppm	8.38	8.38	8.39	8.38	8.36	8.36	8.30	8.34	8.70	8.72	8.71	8.71
T4-500 ppm	8.39	8.39	8.40	8.39	8.35	8.33	8.34	8.34	8.72	8.72	8.70	8.71
T5-750 ppm	8.41	8.41	8.41	8.41	8.33	8.33	8.32	8.32	8.72	8.70	8.72	8.71
T6-1000 ppm	8.40	8.42	8.42	8.41	8.35	8.32	8.35	8.34	8.70	8.73	8.72	8.71
Mean	8.39	8.40	8.41	8.40	8.34	8.34	8.33	8.33	8.71	8.71	8.71	8.71
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.06	0.09	0.11	0.17	NS	NS	NS					
CD (p=0.05)	NS	NS	0.23	NS	NS	NS	NS					

Table 4.43: Effect of bulk formulation treatment on vigour index I in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	1518	1518	1518	1518	1289	1289	1289	1289	1427	1427	1427	1427
T2-100 ppm	1630	1801	1711	1714	1127	1777	1308	1404	1578	1809	1616	1668
T3-250 ppm	1767	2077	1913	1919	1343	2080	1534	1652	1705	2028	1845	1859
T4-500 ppm	1667	1873	1695	1745	1231	1773	1392	1465	1590	1684	1680	1652
T5-750 ppm	1593	1752	1603	1649	1229	1568	1390	1396	1466	1566	1680	1571
T6-1000 ppm	1418	1678	1452	1516	1140	1570	1277	1329	1431	1525	1435	1464
Mean	1599	1783	1649	1677	1227	1676	1365	1423	1533	1673	1614	1607
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	4.2	6.3	8.6	12.6	NS	15.3	NS					
CD (p=0.05)	8.5	12.5	17.3	25.2	NS	30.6	NS					

Table 4.44: Effect of bulk formulation treatment on vigour index II in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	Titanium	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	1496	1496	1496	1496	1462	1462	1462	1462	1445	1445	1445	1445
T2-100 ppm	1584	1646	1531	1587	1505	1602	1479	1529	1513	1557	1583	1551
T3-250 ppm	1822	1918	1728	1822	1702	1833	1647	1727	1628	1747	1674	1683
T4-500 ppm	1683	1737	1619	1680	1638	1748	1584	1657	1584	1674	1584	1614
T5-750 ppm	1583	1637	1627	1616	1530	1638	1531	1566	1531	1610	1566	1569
T6-1000 ppm	1471	1602	1476	1516	1461	1505	1403	1456	1471	1522	1428	1473
Mean	1606	1672	1579	1619	1550	1631	1518	1566	1529	1592	1547	1556
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	3.3	5.1	7.0	10.6	NS	13.0	NS					
CD (p=0.05)	6.7	10.0	14.1	21.2	NS	26.1	NS					

Table 4.45: Effect of bulk formulation treatment on dehydrogenase activity (OD) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.053	0.053	0.053	0.053	0.062	0.062	0.062	0.062	0.057	0.057	0.057	0.057
T2-100 ppm	0.055	0.060	0.058	0.057	0.070	0.072	0.071	0.071	0.062	0.067	0.063	0.064
T3-250 ppm	0.062	0.067	0.064	0.064	0.074	0.078	0.073	0.075	0.071	0.074	0.069	0.071
T4-500 ppm	0.060	0.067	0.060	0.062	0.073	0.075	0.071	0.073	0.070	0.069	0.067	0.068
T5-750 ppm	0.059	0.063	0.061	0.061	0.069	0.071	0.068	0.069	0.068	0.068	0.068	0.068
T6-1000 ppm	0.055	0.057	0.053	0.055	0.065	0.069	0.064	0.066	0.060	0.064	0.062	0.062
Mean	0.057	0.061	0.058	0.058	0.068	0.071	0.068	0.069	0.064	0.066	0.064	0.064
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.001	0.003	0.004	0.006	NS	NS	NS					
CD (p=0.05)	0.102	0.006	0.008	0.012	NS	NS	NS					

Table 4.46: Effect of bulk formulation treatment on electrical conductivity (dSm^{-1}) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.327	0.327	0.327	0.327	0.368	0.368	0.368	0.368	0.347	0.347	0.347	0.347
T2-100 ppm	0.311	0.306	0.306	0.307	0.357	0.339	0.347	0.347	0.341	0.327	0.344	0.337
T3-250 ppm	0.295	0.284	0.290	0.289	0.338	0.321	0.321	0.326	0.332	0.317	0.330	0.326
T4-500 ppm	0.290	0.291	0.304	0.295	0.346	0.330	0.337	0.337	0.338	0.322	0.334	0.331
T5-750 ppm	0.305	0.298	0.296	0.299	0.340	0.342	0.341	0.341	0.340	0.328	0.338	0.335
T6-1000 ppm	0.320	0.310	0.317	0.315	0.352	0.346	0.355	0.351	0.345	0.332	0.342	0.339
Mean	0.308	0.302	0.306	0.305	0.350	0.341	0.344	0.345	0.340	0.328	0.339	0.335
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.004	0.007	0.009	0.016	NS	NS	NS					
CD (p=0.05)	0.008	0.015	0.018	0.033	NS	NS	NS					

Table 4.47: Effect of bulk formulation treatment on seed health (%) in onion varieties

	Pusa Madhvi			Mean	Pusa Red			Mean	Pusa – Riddhi			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	4.6	4.6	4.6	4.6	3.2	3.2	3.2	3.2	1.7	1.7	1.7	1.7
T2-100 ppm	4.5	4.3	4.4	4.4	3.3	3.2	3.1	3.2	1.7	1.6	1.7	1.6
T3-250 ppm	4.6	4.3	4.5	4.4	3.4	3.3	3.3	3.3	1.8	1.6	1.8	1.7
T4-500 ppm	4.3	4.0	4.5	4.2	3.3	3.3	3.2	3.2	1.8	1.7	1.8	1.7
T5-750 ppm	4.2	4.1	4.4	4.2	3.3	3.2	3.3	3.2	1.6	1.6	1.7	1.6
T6-1000 ppm	4.3	4.0	4.4	4.2	3.2	3.0	3.3	3.1	1.6	1.6	1.8	1.6
Mean	4.4	4.2	4.4	4.3	3.2	3.2	3.2	3.2	1.7	1.6	1.7	1.6
	C	NNP	V	CxNNP	CxV	NNPxV=	CxNNPxV					
SEd(±)	0.03	0.05	0.11	0.25	0.36	0.42	0.60					
CD (p=0.05)	0.06	0.11	0.21	NS	NS	NS	NS					

Salient findings: Nano particle seed treatments with Titanium oxide 250 ppm recorded maximum values for all seed quality parameters than control irrespective of varieties and bulk formulation of 250 ppm Titanium oxide also recorded similar results but the effect was lesser than the nano treatment.

Crop: Soybean

Year of start: 2018
Centre: ICAR-IARI, New Delhi
Experiment Details: Seeds of Soybean varieties; Pusa 9712 and Pusa 9814 were supplied by ICAR-IARI, New Delhi and treated by TNAU Coimbatore were used for the present study.
Treatments:
Nano-Particles: (Both Bulk and Nano-Form)

- Zinc Oxide
- Titanium
- Silicon Dioxide

Dosage:

- Control (No Treatment)
- 100 ppm
- 250 ppm
- 500 ppm
- 750 ppm
- 1000 ppm

Observations recorded:

- Field Emergence %
- Seed Germination %
- Vigour Index I and II
- Electrical Conductivity Of Seed Leachate
- Total Dehydrogenase Activity

Results: The study revealed non-significant differences w.r.t germination percentage and seed vigour indices for different concentrations for both the nano and bulk form of all the nano-particles. However, significant differences were recorded in the nano formulations for field emergence percentage (out of twenty five seeds each), both nano and bulk formulations w.r.t electrical conductivity and nano formulations for dehydrogenase activity (Table 48).

Table 48: Effect of nano and bulk formulations of various nanoparticles on field emergence, electrical conductivity and dehydrogenase activity

FIELD EMERGENCE						
Conc. (C)	**Variety (V1) Pusa 9712**			**Variety (V2) Pusa 9814**		
NANO FORM	**ZnO**	**Titanium**	**Si O2**	**ZnO**	**Titanium**	**SiO2**
T1(Control)	17	17	17	18	18	18
T2 (100ppm)	16.5	17	22	18.5	17.5	19
T3 (250 ppm)	18	15.5	20	16	14.5	16.5
T4 (500 ppm)	16.5	9.5	19.5	17	16.5	12.5
T5 (750 ppm)	16	15.5	22	20.5	19	18
T6 (1000 ppm)	17	18	18	17.5	20.5	14
Mean	**16.83**	**15.42**	**19.75**	**17.92**	**17.58**	**16.33**
Factors	**C.D.**	**SE(d)**	**SE(m)**	***Factor A: Varieties***		
Factor(A)	N/A	0.768	0.543	***Factor B: Treatments (Zinc***		
Factor(B)	N/A	0.941	0.665	***oxide, titanium and silicon***		
Interaction A X B	2.7	1.331	0.941	***dioxide)***		
Factor(C)	N/A	1.331	0.941	***Factor C: Concentrations***		
Interaction A X C	N/A	1.882	1.331	***(control, 100ppm, 250ppm,***		
Interaction B X C	N/A	2.305	1.63	***500ppm, 750ppm, 1000ppm)***		
BULK FORM						
T1(Control)	17	17	17	18	18	18
T2 (100ppm)	16	13.5	20.5	14	17.5	15
T3 (250 ppm)	15.5	15	16.5	15.5	16.5	20
T4 (500 ppm)	15	18.5	20.5	13	14	18.5
T5 (750 ppm)	17.5	14.5	20	15	17	19
T6 (1000 ppm)	16.5	13.5	17.5	21	16	15.5
Mean	**16.25**	**15.33**	**18.67**	**16.08**	**16.50**	**17.17**
Factors	**C.D.**	**SE(d)**	**SE(m)**			
Factor(A)	N/A	0.764	0.54			
Factor(B)	N/A	0.935	0.661			
Interaction A X B	N/A	1.323	0.935			
Factor(C)	N/A	1.323	0.935			
Interaction A X C	N/A	1.871	1.323			
Interaction B X C	N/A	2.291	1.62			
Interaction A X B X C	N/A	3.24	2.291			

ELECTRICAL CONDUCTIVITY						
	Variety (V1) Pusa 9712			Variety (V2) Pusa 9814		
NANO FORM	**ZnO**	**Titanium**	**SiO2**	**ZnO**	**Titanium**	**SiO2**
T1(Control)	0.46	0.46	0.46	0.46	0.46	0.46
T2 (100ppm)	0.39	0.39	0.42	0.49	0.70	0.42
T3 (250 ppm)	0.43	0.37	0.38	0.43	0.73	0.43
T4 (500 ppm)	0.36	0.40	0.45	0.50	0.74	0.41
T5 (750 ppm)	0.38	0.35	0.41	0.43	0.79	0.47
T6 (1000 ppm)	0.41	0.42	0.44	0.51	0.52	0.49
Mean	**0.39**	**0.38**	**0.41**	**0.46**	**0.65**	**0.44**
Factors	**C.D.**	**SE(d)**	**SE(m)**			
Factor(A)	0.014	0.007	0.005			
Factor(B)	0.018	0.009	0.006			
Interaction A X B	0.025	0.012	0.009			
Factor(C)	0.025	0.012	0.009			
Interaction A X C	0.035	0.017	0.012			
Interaction B X C	0.043	0.021	0.015			
Interaction A X B X C	0.061	0.03	0.021			
BULK FORM						
T1(Control)	0.46	0.46	0.46	0.46	0.46	0.46
T2 (100ppm)	0.43	0.45	0.36	0.72	0.71	0.38
T3 (250 ppm)	0.44	0.44	0.45	0.51	0.45	0.37
T4 (500 ppm)	0.42	0.40	0.49	0.43	0.45	0.45
T5 (750 ppm)	0.40	0.37	0.34	0.49	0.79	0.47
T6 (1000 ppm)	0.35	0.40	0.40	0.44	0.76	0.46
Mean	**0.41**	**0.40**	**0.40**	**0.50**	**0.59**	**0.42**
Factors	**C.D.**	**SE(d)**	**SE(m)**			
Factor(A)	0.015	0.008	0.005			
Factor(B)	0.019	0.009	0.007			
Interaction A X B	0.027	0.013	0.009			
Factor(C)	0.027	0.013	0.009			
Interaction A X C	0.038	0.019	0.013			
Interaction B X C	0.046	0.023	0.016			
Interaction A X B X C	0.065	0.032	0.023			

DEHYDROGENASE ACTIVITY						
	Variety (V1) Pusa 9712			Variety (V2) Pusa 9814		
NANO FORM	**ZnO**	**Titanium**	**SiO2**	**ZnO**	**Titanium**	**SiO2**

T1(Control)	.30	.30	.30	.34	.34	.34
T2 (100ppm)	.35	.18	.71	.55	.27	.18
T3 (250 ppm)	.37	.39	.41	.37	.33	.39
T4 (500 ppm)	.40	.49	.27	.43	.25	.14
T5 (750 ppm)	.34	.36	.34	.43	.21	.28
T6 (1000 ppm)	.46	.37	.24	.40	.24	.26
Mean	**0.37**	**0.35**	**0.38**	.42	.27	.27
	C.D.	**SE(d)**	**SE(m)**			
Factor(A)	0.015	0.007	0.005			
Factor(B)	0.019	0.009	0.006			
Interaction A X B	0.026	0.013	0.009			
Factor(C)	0.026	0.013	0.009			
Interaction A X C	0.037	0.018	0.013			
Interaction B X C	0.045	0.022	0.016			
Interaction A X B X C	0.064	0.032	0.022			
BULK FORM						
T1(Control)	.30	.30	.30	.34	.34	.34
T2 (100ppm)	.53	.49	.083	.38	.14	.16
T3 (250 ppm)	.34	.26	.308	.44	.17	.25
T4 (500 ppm)	.39	.22	.57	.30	.19	.23
T5 (750 ppm)	.30	.32	.24	.30	.24	.36
T6 (1000 ppm)	.29	.32	.47	.32	.25	.22
Mean	**.35**	**0.32**	**0.33**	**0.35**	**0.22**	**0.26**
Factors	**C.D.**	**SE(d)**	**SE(m)**			
Factor(A)	N/A	2.224	1.573			
Factor(B)	N/A	2.724	1.926			
Interaction A X B	N/A	3.852	2.724			
Factor(C)	N/A	3.852	2.724			
Interaction A X C	N/A	5.448	3.852			
Interaction B X C	N/A	6.672	4.718			

The *Electrical Conductivity (EC) reflects* the damage to seed; and higher value of EC for control indicated low vigour of seed as compared to the treated ones and vice versa. *Dehydrogenase activity in seed* was estimated following the method of Kittock and Law (1968). Dehydrogenase is a measure of viability of embryo and high vigour. Viable embryo has high dehydrogenase activity and vice versa.

Based on the result obtained from field emergence, electrical conductivity and dehydrogenase activity, it was observed that in case of variety Pusa 9712, nano and bulk formulation of silicon dioxide @ 500-750 ppm, followed by titanium @750 ppm and zinc oxide @ 1000ppm was found to be the most effective treatment. For variety Pusa 9814, nano and bulk formulation of silicon

dioxide @ 750 ppm, followed by Zinc oxide @500 ppm and Titanium@ 1000ppm was found to be the most effective treatment for enhancing the seed quality.

Crop: Soybean

Centre: TNAU, Coimbatore



Plate 4.5: Soybean seedling evaluation



Plate 4.6: Field emergence - Soybean

Results: The results revealed that among the nano chemicals zinc oxide recorded better results for all the seed quality parameters than the other chemicals irrespective of varieties. Pusa 9712 and Pusa 9814 seeds treated with 500 ppm zinc oxide of nano particle recorded significantly higher values for first count (66 % & 61 % ,respectively), final count (96% & 94 % ,respectively), field emergence (91 % & 90 %, respectively) than control (56% & 53% ; 85 %, & 82 % , 82 % & 80 %, respectively) (Table 4.49, 4.50 & 4.51). The same treatment recorded lowest value for T_{50} *ie* it increases the speed of germination (3.3 days & 3.7 days, respectively) than control (4.4 & 4.8 days) (Table 4.52). Higher concentration of 1000 ppm in all the nano formulations reduced the seed germination in all the three varieties (86 % in Pusa 9712 & 88 % in Pusa 9814). The moisture content was unaltered by nano treatments (Table 4.53). Among the different

concentrations, 500 ppm in all nano chemicals recorded significantly higher values of vigour index I for soybean varieties Pusa 9712 and Pusa 9814 (3465 & 3566, respectively) than control (2796 & 2878) (Table 4.54). The dehydrogenase activity was maximum with 500 ppm zinc oxide (1.63 & 1.72 OD) than control (1.24 & 1.42 OD, respectively).

In bulk formulation treatment also zinc oxide was effective than other chemicals and control but the effect was lesser than the nano formulation. Pusa 9712 and Pusa 9814 seeds treated with 1000 ppm zinc oxide of bulk formulation recorded significantly higher values for first count (63% & 65 % , respectively), final count (92% & 90 % , respectively), field emergence (90 % & 88 %, respectively) than control (56% & 53% ; 85 % & 82 % ; 82 % & 80 %, respectively) (Table 4.59, 4.60 & 4.61). The same treatment recorded lowest value for T_{50} *ie* it increases the speed of germination (3.6 days & 3.9 days, respectively) than control (4.4 & 4.8 days) (Table 4.62). The moisture content was not significantly influenced by seed treatments (Table 4.63). Among the different chemicals zinc oxide recorded significantly higher values of vigour index II (5888 & 6048, respectively) (Table 4.65) than control (5159 & 5133). The dehydrogenase activity was maximum with 1000 ppm zinc oxide (1.59 and 1.68 OD) than control (1.24 & 1.42, respectively) (Table 4.66). Significant differences did not observe in seed health (Table 4.68).

Table 4.49: Effect of nano particle treatment on first count (%) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	56	56	56	56	53	53	53	53
T2-100 ppm	59	61	57	59	58	62	57	59
T3-250 ppm	62	60	61	61	61	60	60	60
T4-500 ppm	66	60	62	63	67	61	63	64
T5-750 ppm	63	58	61	61	65	60	61	62
T6-1000 ppm	63	58	60	60	65	57	61	61
Mean	62	59	60	60	62	59	59	60
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.16	0.21	NS	0.42	0.61	NS	NS	
CD (p=0.05)	0.33	0.43	NS	0.81	1.22	NS	NS	

Table 4.50: Effect of nano particle treatment on germination (%) (final count) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	85	85	85	85	82	82	82	82
T2-100 ppm	89	92	90	90	86	89	85	87
T3-250 ppm	92	90	92	91	89	87	88	88
T4-500 ppm	96	90	93	93	94	87	91	91
T5-750 ppm	90	87	86	88	92	84	90	89
T6-1000 ppm	88	84	86	86	92	85	87	88

Mean	90	88	89	89	89	86	87	87
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.82	0.91	NS	1.12	NS	NS	NS	
CD (p=0.05)	1.64	1.80	NS	2.25	NS	NS	NS	

Table 4.51: Effect of nano particle treatment on field emergence (%) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	82	82	82	82	80	80	80	80
T2-100 ppm	85	89	84	86	83	87	82	84
T3-250 ppm	88	89	85	87	85	87	86	86
T4-500 ppm	91	86	88	88	92	86	89	89
T5-750 ppm	89	81	86	85	90	82	87	86
T6-1000 ppm	86	80	83	83	86	81	84	84
Mean	87	85	85	85	86	84	85	85
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.21	0.36	NS	0.41	NS	NS	NS	
CD (p=0.05)	0.42	0.72	NS	0.83	NS	NS	NS	

Table 4.52: Effect of nano particle treatment on T_{50} (days) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	4.4	4.4	4.4	4.4	4.8	4.8	4.8	4.8
T2-100 ppm	4.1	3.9	4.2	4.0	4.5	4.0	4.4	4.3
T3-250 ppm	4.0	4.0	3.9	3.9	4.3	4.1	4.2	4.2
T4-500 ppm	3.3	4.0	3.8	3.7	3.7	4.5	3.9	4.0
T5-750 ppm	3.8	4.2	3.9	3.9	4.0	4.5	4.1	4.2
T6-1000 ppm	4.0	4.2	4.1	4.1	4.0	4.7	4.3	4.3
Mean	3.9	4.1	4.0	4.0	4.2	4.4	4.2	4.3
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.06	0.08	NS	0.11	NS	NS	NS	
CD (p=0.05)	0.12	0.16	NS	0.22	NS	NS	NS	

Table 4.53: Effect of nano particle treatment on seed moisture (%) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	8.4	8.4	8.4	8.4	8.7	8.7	8.7	8.7
T2-100 ppm	8.3	8.3	8.4	8.3	8.5	8.6	8.7	8.6
T3-250 ppm	8.4	8.4	8.2	8.3	8.6	8.6	8.6	8.6
T4-500 ppm	8.3	8.4	8.2	8.3	8.5	8.5	8.5	8.5
T5-750 ppm	8.3	8.3	8.3	8.3	8.4	8.6	8.5	8.5
T6-1000 ppm	8.2	8.3	8.2	8.2	8.4	8.5	8.4	8.4

Mean	8.3	8.3	8.2	8.3	8.5	8.5	8.5	8.5
SEd(±)	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
	NS	NS	0.04	NS	NS	NS	NS	
CD (p=0.05)	NS	NS	0.08	NS	NS	NS	NS	

Table 54: Effect of nano particle treatment on vigour index I in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	2797	2797	2797	2797	2878	2878	2878	2878
T2-100 ppm	3075	3441	3042	3186	3139	3444	3043	3209
T3-250 ppm	3450	3285	3266	3334	3346	3323	3265	3312
T4-500 ppm	3725	3213	3460	3466	3807	3280	3613	3567
T5-750 ppm	3285	3010	2976	3090	3560	3032	3465	3353
T6-1000 ppm	3089	2806	2804	2899	3478	3009	3193	3227
Mean	3237	3092	3057	3129	3368	3161	3243	3257
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	6.2	7.3	8.7	10.2	12.2	NS	NS	
CD (p=0.05)	12.5	14.7	17.5	20.6	24.6	NS	NS	

Table 55: Effect of nano particle treatment on vigour index II in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	5160	5160	5160	5160	5133	5133	5133	5133
T2-100 ppm	5563	5759	5553	5625	5564	6008	5423	5665
T3-250 ppm	5870	5607	5851	5776	5945	5812	5773	5843
T4-500 ppm	6211	5580	5943	5911	6524	5759	6188	6157
T5-750 ppm	5760	5342	5332	5478	6164	5519	6093	5925
T6-1000 ppm	5562	5124	5298	5328	6090	5525	5742	5786
Mean	5687	5429	5523	5546	5903	5626	5725	5752
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	4.6	6.3	11.2	13.2	16.1	NS	NS	
CD (p=0.05)	5.3	12.7	12.5	26.5	32.3	NS	NS	

Table 56: Effect of nano particle treatment on dehydrogenase activity (OD) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	1.24	1.24	1.24	1.24	1.42	1.42	1.42	1.42
T2-100 ppm	1.32	1.53	1.30	1.38	1.47	1.62	1.55	1.54
T3-250 ppm	1.46	1.47	1.41	1.44	1.56	1.60	1.62	1.59
T4-500 ppm	1.63	1.48	1.50	1.53	1.72	1.57	1.68	1.65
T5-750 ppm	1.60	1.42	1.46	1.40	1.67	1.55	1.60	1.60

T6-1000 ppm	1.51	1.33	1.37	1.40	1.62	1.40	1.57	1.53
Mean	1.46	1.41	1.38	1.41	1.57	1.52	1.57	1.55
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.003	0.005	0.004	0.007	NS	0.006	NS	
CD (p=0.05)	0.006	0.010	0.007	0.014	NS	0.011	NS	

Table 57: Effect of nano particle treatment on electrical conductivity (dSm^{-1}) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.753	0.753	0.753	0.753	0.814	0.814	0.814	0.814
T2-100 ppm	0.764	0.758	0.751	0.757	0.826	0.822	0.834	0.827
T3-250 ppm	0.768	0.762	0.758	0.762	0.820	0.826	0.820	0.822
T4-500 ppm	0.759	0.760	0.752	0.757	0.817	0.824	0.817	0.819
T5-750 ppm	0.466	0.757	0.760	0.661	0.825	0.830	0.818	0.824
T6-1000 ppm	0.772	0.762	0.768	0.767	0.831	0.833	0.818	0.827
Mean	0.713	0.758	0.757	0.743	0.822	0.825	0.820	0.822
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.002	0.004	0.005	0.006	NS	0.007	NS	
CD (p=0.05)	0.003	0.007	0.010	0.012	NS	0.013	NS	

Table 58: Effect of nano particle treatment on seed health (%) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	2.3	2.3	2.3	2.3	3.2	3.2	3.2	3.2
T2-100 ppm	2.1	2.2	2.3	2.2	3.0	3.0	3.2	3.0
T3-250 ppm	2.2	2.4	2.4	2.3	3.1	3.3	3.0	3.1
T4-500 ppm	2.2	2.4	2.0	2.2	3.0	3.3	2.8	3.0
T5-750 ppm	2.2	2.3	2.0	2.1	3.3	3.2	3.0	3.1
T6-1000 ppm	2.3	2.3	2.1	2.2	3.3	3.2	2.9	3.1
Mean	2.2	2.3	2.1	2.2	3.1	3.2	3.0	3.1
SEd(±)	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
	0.010	0.013	0.017	0.020	0.024	0.032	NS	
CD (p=0.05)	0.021	0.025	0.035	0.041	0.049	0.063	NS	

Table 59: Effect of bulk formulation treatment on first count (%) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	56	56	56	56	53	53	53	53
T2-100 ppm	58	56	58	57	54	57	55	55
T3-250 ppm	61	59	58	59	54	61	55	57
T4-500 ppm	62	62	61	62	60	60	61	60

T5-750 ppm	61	60	61	61	62	60	60	61
T6-1000 ppm	63	61	61	56	64	56	62	61
Mean	60	59	59	59	58	58	58	58
SEd(±)	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
	0.12	0.17	NS	0.32	NS	NS	NS	
CD (p=0.05)	0.25	0.33	NS	0.64	NS	NS	NS	

Table 60: Effect of bulk formulation treatment on germination (%) (final count) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	85	85	85	85	82	82	82	82
T2-100 ppm	86	88	87	87	84	85	84	84
T3-250 ppm	89	88	87	88	87	87	85	86
T4-500 ppm	88	90	88	89	87	88	87	87
T5-750 ppm	91	87	90	89	86	87	87	87
T6-1000 ppm	92	87	90	90	90	83	89	87
Mean	89	88	88	88	86	85	86	86
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.71	0.88	0.82	1.02	NS	NS	NS	
CD (p=0.05)	1.43	1.75	1.64	2.05	NS	NS	NS	

Table 61: Effect of bulk formulation treatment on field emergence (%) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	82	82	82	82	80	80	80	80
T2-100 ppm	84	85	83	84	80	82	84	82
T3-250 ppm	85	86	85	85	84	84	84	84
T4-500 ppm	85	87	85	86	85	84	86	85
T5-750 ppm	88	86	88	87	87	81	86	85
T6-1000 ppm	90	82	88	87	88	78	86	84
Mean	86	85	85	85	84	82	84	83
SEd(±)	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
	0.33	0.52	0.62	0.81	NS	NS	NS	
CD (p=0.05)	0.65	1.03	1.24	1.62	NS	NS	NS	

Table 62: Effect of bulk formulation treatment on T_{50} (days) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	4.4	4.4	4.4	4.4	4.8	4.8	4.8	4.8
T2-100 ppm	4.3	4.1	4.2	4.2	4.6	4.5	4.6	4.5
T3-250 ppm	4.3	4.1	4.3	4.2	4.5	4.3	4.3	4.3
T4-500 ppm	4.0	3.8	4.0	3.9	4.3	4.0	4.1	4.1

T5-750 ppm	3.8	4.0	4.0	3.9	4.0	4.1	4.1	4.0
T6-1000 ppm	3.6	4.0	3.8	3.8	3.9	4.3	4.1	4.1
Mean	4.0	4.0	4.1	4.0	4.35	4.3	4.3	4.3
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.04	0.05	NS	0.09	NS	NS	NS	
CD (p=0.05)	0.08	0.11	NS	0.18	NS	NS	NS	

Table 63: Effect of bulk formulation treatment on seed moisture (%) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	8.4	8.4	8.4	8.4	8.7	8.7	8.7	8.7
T2-100 ppm	8.3	8.3	8.2	8.2	8.6	8.7	8.5	8.6
T3-250 ppm	8.4	8.3	8.2	8.3	8.6	8.6	8.5	8.5
T4-500 ppm	8.2	8.2	8.3	8.2	8.5	8.5	8.4	8.4
T5-750 ppm	8.2	8.2	8.3	8.2	8.5	8.5	8.4	8.4
T6-1000 ppm	8.2	8.2	8.2	8.2	8.5	8.5	8.4	8.4
Mean	8.2	8.2	8.2	8.2	8.5	8.5	8.4	8.5
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	NS	NS	0.07	NS	NS	NS	NS	
CD (p=0.05)	NS	NS	0.14	NS	NS	NS	NS	

Table 64: Effect of bulk formulation treatment on vigour index I in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	2797	2797	2797	2797	2878	2878	2878	2878
T2-100 ppm	2907	3018	2967	2964	2990	3060	3016	3022
T3-250 ppm	3106	3194	3054	3118	3202	3245	3111	3186
T4-500 ppm	3256	3276	3168	3233	3341	3379	3271	3330
T5-750 ppm	3376	3054	3339	3256	3242	3219	3358	3273
T6-1000 ppm	3496	2941	3348	3262	3420	3013	3480	3304
Mean	3156	3047	3112	3105	3179	3132	3186	3166
SEd(±)	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
	5.2	8.1	9.3	11.2	NS	NS	NS	
CD (p=0.05)	10.3	16.2	18.6	22.5	NS	NS	NS	

Table 65: Effect of bulk formulation treatment on vigour index II in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	5160	5160	5160	5160	5133	5133	5133	5133
T2-100 ppm	5298	5606	5446	5450	5292	5474	5418	5395
T3-250 ppm	5580	5544	5394	5506	5690	5803	5585	5692

T4-500 ppm	5456	5616	5553	5542	5690	5817	5759	5755
T5-750 ppm	5788	5368	5715	5624	5719	5716	5742	5726
T6-1000 ppm	5888	5307	5733	5643	6048	5295	5945	5763
Mean	5528	5433	5500	5487	5595	5540	5597	5577
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	6.0	7.7	10.6	14.7	NS	18.3	NS	
CD (p=0.05)	12.1	15.4	20.2	29.4	NS	36.5	NS	

Table 66: Effect of bulk formulation treatment on dehydrogenase activity (OD) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	1.24	1.24	1.24	1.24	1.42	1.42	1.42	1.42
T2-100 ppm	1.28	1.40	1.33	1.33	1.50	1.52	1.47	1.49
T3-250 ppm	1.36	1.47	1.40	1.41	1.54	1.62	1.52	1.56
T4-500 ppm	1.44	1.49	1.45	1.46	1.63	1.65	1.58	1.62
T5-750 ppm	1.53	1.41	1.51	1.48	1.62	1.60	1.62	1.61
T6-1000 ppm	1.59	1.32	1.54	1.48	1.68	1.53	1.65	1.62
Mean	1.40	1.38	1.41	1.40	1.56	1.55	1.54	1.55
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.002	0.003	NS	0.006	NS	0.008	NS	
CD (p=0.05)	0.005	0.006	NS	0.012	NS	0.016	NS	

Table 67: Effect of bulk formulation treatment on electrical conductivity (dSm^{-1}) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	0.753	0.753	0.753	0.753	0.814	0.814	0.814	0.814
T2-100 ppm	0.762	0.766	0.762	0.763	0.824	0.826	0.823	0.824
T3-250 ppm	0.757	0.762	0.760	0.759	0.820	0.823	0.820	0.821
T4-500 ppm	0.763	0.762	0.764	0.763	0.827	0.830	0.824	0.827
T5-750 ppm	0.760	0.771	0.760	0.763	0.824	0.832	0.821	0.825
T6-1000 ppm	0.755	0.770	0.758	0.761	0.826	0.833	0.819	0.826
Mean	0.758	0.764	0.759	0.760	0.822	0.826	0.820	0.823
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.001	0.002	0.004	0.005	NS	0.006	NS	
CD (p=0.05)	0.002	0.003	0.008	0.010	NS	0.011	NS	

Table 68: Effect of bulk formulation treatment on seed health (%) in soybean varieties

	Pusa 9712			Mean	Pusa 9814			Mean
	ZnO	TiO	SiO_2	(VxC)	ZnO	TiO	SiO_2	(VxC)
T1-Control	2.3	2.3	2.3	2.3	3.2	3.2	3.2	3.2
T2-100 ppm	2.2	2.0	1.8	2.0	3.2	3.0	3.2	3.1

T3-250 ppm	2.4	2.2	2.0	2.2	3.3	3.2	3.0	3.1
T4-500 ppm	2.4	2.3	2.0	2.2	3.3	3.2	3.0	3.1
T5-750 ppm	2.0	2.3	1.8	2.0	3.2	3.3	3.0	3.1
T6-1000 ppm	2.0	2.2	1.8	2.0	3.3	3.4	3.0	3.2
Mean	2.2	2.2	1.9	2.1	3.2	3.2	3.0	3.1
	C	NNP	V	CxNNP	CxV	NNPxV	CxNNPxV	
SEd(±)	0.011	0.012	0.015	0.022	0.025	0.031	NS	
CD (p=0.05)	0.022	0.024	0.031	0.045	0.050	0.062	NS	

Experiment 4: Sub. Experiment -II (As per Objective 2): Studies on effect of selected nano particles on seed quality and storability of treated seeds.

Materials and Treatments:

The best treatment (s), which responded positively to nano-particles in Experiment-I shall be selected to study their influence on seed quality and storability. The treated seeds of same varieties will be packed in cloth bag and stored under ambient conditions. Storage studies will be conducted up to 10-12 months and the following observations will be recorded at monthly interval including weather data of storage conditions.

Observations:

1. Seed Moisture content and Seed germination (%) (ISTA)- First count, final count and T50 value
2. Seedling vigour index I and II (Abdul Baki and Anderson, 1973)
3. Electrical conductivity of seed leachate (µS/cm/g)
4. Total dehydrogenase activity (A480 nm)
5. Seed health (infection and infestation)

Crop: Pigeon pea
Year of start: 2016
Centre: TNAU, Coimbatore

Results:

Pigeon pea: The identified best performing nano particle seed treatments with zinc oxide 500 ppm and bulk formulation of 750 ppm zinc oxide will be packed in cloth bag forwarded to storage study under ambient condition along with control.

Onion: The identified best performing treatment of both nano particle and bulk formulation of with Titanium oxide 250 ppm will be packed in cloth bag forwarded to storage study under ambient condition along with control.

Soybean: The identified best performing nano particle seed treatments with zinc oxide 500 ppm and bulk formulation of 1000 ppm zinc oxide will be packed in cloth bag forwarded to storage study under ambient condition along with control.

Crop: Pigeon pea
Centre: UAS, Bengaluru
Experiment Details:
Varieties: BRG-5 **Design:** CRD **Replication**: Four

Standard germination test: The seed germination test was carried out in the laboratory by following the 'between papers' method as per ISTA (2006) guidelines. Hundred seeds in four replications were placed equidistantly between moist Kraft paper towels. The rolled towels were placed in a germination chamber maintained at 25±1 ^{0}C and 90 per cent relative humidity. The seedlings were evaluated on 5thand 10thday of incubation and cumulative percentage of germination was expressed based on normal seedlings (Plate 7).

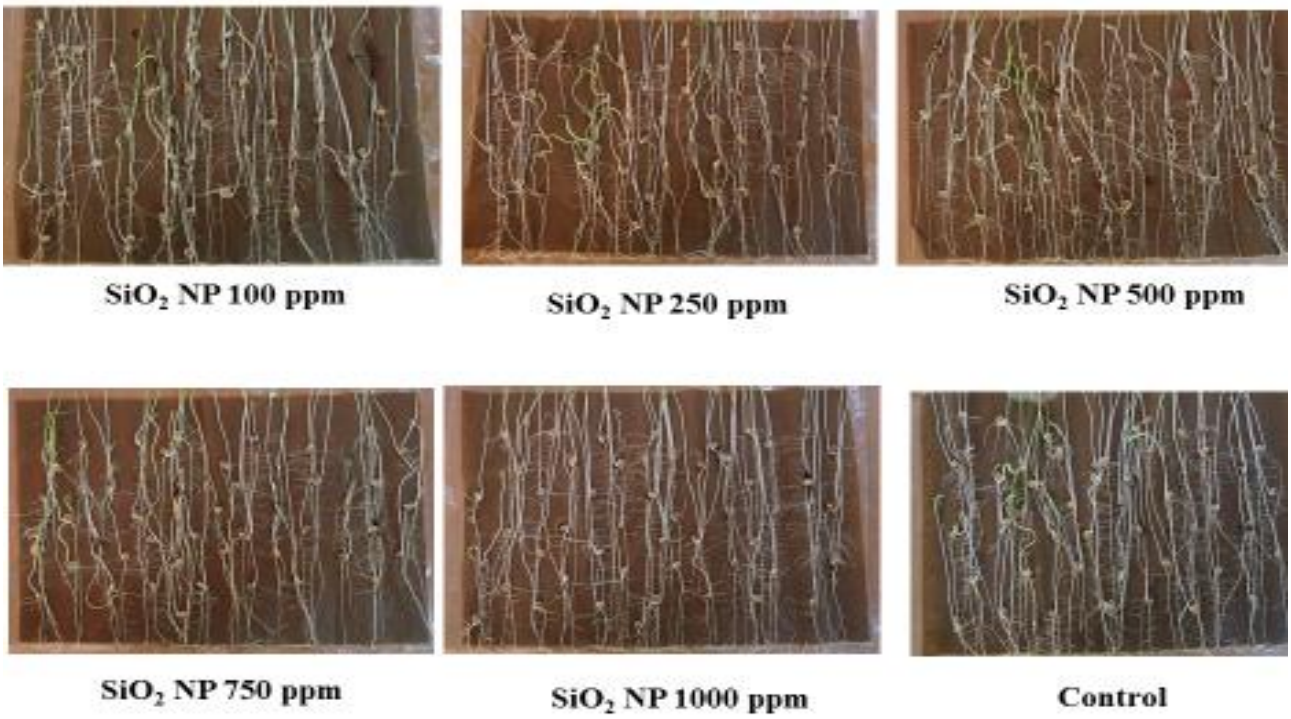


Plate 4.7: Seedling evaluation of Pigeon pea at USA, Bangalore

Mean Seedling length: After incubation on the day of 10thday ten normal seedlings from each replication were selected randomly and seedling length was measured from the tip of the primary leaves to the tip of root and the mean seedling length was calculated and expressed in centimetres.

Dry weight of seedlings: Ten normal seedlings selected randomly for seedling length measurement, they were initially dried under shade for 24 h and then in a hot-air-oven

maintained at 82±1^{0}C for 24 h. After cooling the seedlings in a desiccator containing silica gel, the mean seedlings dry weight was recorded and expressed in milligrams.

Seedling vigour index (SVI): Based on mean seedling length and mean seedling dry weight, the seedling vigour indices (SVI) were calculated as per Abdul-Baki and Anderson (1973) using the following formulae: SVI- I - Mean seedling length (cm) x Germination (%); SVI-II -Mean seedling dry weight (mg) x Germination (%).

Speed of germination (SG): Speed of germination or rate of germination represents the population of fast germinating seeds was tested for germination. Normal seedlings were counted every day till the end of test period. The speed of germination was calculated using the formula suggested by Maguire (1962).

$$SG = \frac{\text{No. of seed germinated}}{\text{First day}} + \frac{\text{No. of seed germinated}}{\text{Second day}} + \ldots\ldots\ldots\ldots + \frac{\text{No. of seed germinated}}{\text{Final day (no)}}$$

$$\frac{}{1} \qquad \frac{}{2}$$

Seed Moisture Content: Moisture content of seeds was determined by low constant temperature (103 ^{0}C for 17 h) method as per the (ISTA, 2006). Moisture content on wet basis was determined and expressed in percentage using the following formula.

$$\text{Moisture content (\%)} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where, W_1 – Weight of empty metal box (g).

W_2 – Weight of metal box with seed sample before drying (g).

W_3 – Weight of metal box with seed sample after drying (g).

Field emergence/ final plant establishment: The field emergence study was made on the seeds sown in the field for field experiment and emergence count was made on sis weeks after sowing, the seedlings were counted and expressed in percentage.

Electrical conductivity (EC): Twenty seeds of uniform size in three replications were soaked in 25ml of distilled water for 24 h at 25±1^{0}C. After collecting the seed leachate, the soaked seeds were surface washed with additional 5ml of water and again collected the leachate. Both the leachates were pooled and filtered through Whatman No.1 filter paper. The filtrate was made up to 25ml with distilled water and EC was measured using a digital Conductivity Meter. The EC was expressed as dSm^{-1} at 25±1^{0}C (ISTA, 1996).

Six months old seeds of pigeon pea variety BRG-5 was obtained from NSP, GKVK and dried to safer and uniform moisture level (8-9 %). Initial seed quality parameters were recorded (Table

4.69) and the Red gram seeds were subjected for dry treatment with different concentrations of Silicon dioxide nano particles *viz.,* 100, 150, 200, 250 and 300 ppm. The treated seeds were tested for different seed quality at two months interval.

Table 4.69: Initial seed quality parameters of red gram

Replication	Seed moisture content (%)	Germination first count (%)	Germination final count (%)	Mean seedling length (cm)	Seedling dry weight (g)	Seedling vigour index I	Seedling vigour index II	EC (µS/cm/g)
R_1	8.86	83.00	89.00	41.77	0.66	3718	5874	13.00
R_2	8.89	85.00	88.00	41.47	0.64	3649	5632	12.00
R_3	8.56	88.00	90.00	42.05	0.61	3785	5490	13.00
R_4	8.84	83.00	87.00	40.19	0.62	3497	5394	15.00
Mean	8.79	84.75	88.50	41.37	0.63	3662	5598	13.25

Table 4.70: Effect of Silicon dioxide Nano particles at different concentrations on seed quality and storability of Red gram variety BRG-5 during September 2018 (2 months after storage)

Treatments	Seed moisture content (%)	Germination first count (%)	Germination final count (%)	Mean seedling length (cm)	Seedling dry weight (g)	Seedling vigour Index I	Seedling vigour index II	EC (µS/cm/g)
Control	8.86	83.50	89.00	37.80	0.53	3364	4742	17.00
100 ppm	**9.09**	**91.00**	**95.25**	**41.45**	**0.54**	**3949**	**5143**	**14.50**
150 ppm	9.56	90.75	94.75	41.28	0.60	3913	5679	15.25
200 ppm	9.48	83.00	93.75	39.78	0.48	3724	4490	15.00
250 ppm	9.46	84.50	89.00	42.05	0.62	3755	5500	16.50
300 ppm	9.59	84.00	91.00	38.83	0.61	3532	5531	15.50
Mean	**9.34**	**86.13**	**92.13**	**40.20**	**0.56**	**3706**	**5181**	**15.63**
SEm(±)	0.169	1.49	1.28	1.54	0.02	162	199	1.46
CD (p=0.05)	0.503	4.44	3.81	ns	0.06	ns	591	ns
CV (%)	3.63	3.47	2.78	7.64	7.44	8.75	7.67	8.70

Table 4.71: Effect of Silicon dioxide Nano particles at different concentrations on seed quality and storability of Red gram variety BRG-5 during November 2018 (4 months after storage)

Treatments	Seed moisture content	Germination first count (%)	Germination final count (%)	Mean seedling length	Seedling dry weight	Seedling vigour	Seedling vigour	EC (µS/cm/g)

	(%)			(cm)	(g)	Index I	index II	
Control	9.43	82.50	88.00	32.16	0.45	2830	3959	24.50
100 ppm	9.22	92.00	93.50	34.90	0.48	3263	4461	17.50
150 ppm	9.35	90.50	91.00	37.87	0.48	3448	4407	18.00
200 ppm	10.08	81.25	94.00	29.15	0.39	2740	3677	16.00
250 ppm	9.60	81.00	87.00	31.65	0.52	2751	4518	17.50
300 ppm	9.34	84.00	85.00	33.21	0.50	2830	4239	22.25
Mean	**9.50**	**85.21**	**89.75**	**33.15**	**0.47**	**2977**	**4210**	**19.29**
SEm(±)	0.30	1.72	1.02	1.60	0.01	151	140	1.20
CD (p=0.05)	NS	5.11	3.03	4.75	0.42	449	417	3.57
CV (%)	6.29	4.03	2.27	9.64	5.99	10.15	6.67	7.44

Table 4.72: Effect of Silicon dioxide Nano particles at different concentrations on seed quality and storability of Red gram variety BRG-5 during January 2019 (6 months after storage)

Treatments	Seed moisture content (%)	Germination first count (%)	Germination Final Count (%)	Mean seedling length (cm)	Seedling dry weight (g)	Seedling Vigour Index I	Seedling vigour index II	EC (µS/cm/g)
Control	9.39	69.50	76.00	28.74	0.37	2185	2788	26.75
100 ppm	8.99	76.00	87.25	34.48	0.41	3003	3616	23.50
150 ppm	9.70	72.50	77.75	33.32	0.37	2418	2677	23.00
200 ppm	9.48	77.75	77.75	28.40	0.30	2208	2358	20.75
250 ppm	9.56	70.25	72.50	30.83	0.42	2398	3268	23.50
300 ppm	8.98	70.00	74.25	32.67	0.39	2426	2885	25.00
Mean	**9.35**	**70.63**	**77.58**	**31.41**	**0.38**	**2440**	**2932**	**23.75**
SEd(±)	0.18	0.77	1.04	0.91	0.01	74	104	1.72
CD (p=0.05)	ns	2.28	3.09	2.70	0.04	220	309	ns
CV (%)	3.88	2.05	2.68	5.79	6.53	6.07	7.09	4.50

Conclusion: During the storage silicon dioxide in nano form @ 100 ppm concentration recorded higher seed quality parameters germination (87%), mean seedling length (34.48cm), seedling dry weight (0.41 g), seedling vigour index I (3003) and vigour index II (3616) followed by silicon dioxide at 150 ppm in nano form germination (78%), mean seedling length (33.32cm), seedling dry weight (0.37g)seedling vigour index I (2418) and vigour index II (2677) compared to other treatments up to six months of storage period. Experiment is in progress.

Experiment 4: Sub. Experiment III (As per Objective 3): Evaluation of silver nano-conjugates as seed priming agents against *Fusarium fuzikoroi* causing Bakkane disease of rice.

Technical programme

Materials:

To develop novel, low dosage antifungal seed treatment agents as an alternative to existing fungicides different doses on nano-conjugates will be tried only in paddy varieties; Pusa Basmati 1509 and Pusa 1121.

Treatments:

T1: Control (Untreated)
T2: Seed priming for 8 hours prior to sowing with silver nano conjugate-A
T3: Seed priming for 8 hours prior to sowing with silver nano conjugate-B
T4: Seed priming for 8 hours prior to sowing with silver nano conjugate-C
T5: Seed priming for 8 hours prior to sowing with silver nano conjugate-D
T6: Seed priming for 8 hours prior to sowing with Carbendazim@ 0.2% + Streptocycline @0.01% + Seedling root dip treatment for 6 hours with Carbendazim@ 0.2%
T7: Hydro-priming for 8 hours prior to sowing
T8: T2 + Seedling root dip treatment before transplanting for 6 hours with A*
T9: T3+ Seedling root dip treatment before transplanting for 6 hours with B*
T10: T4+ Seedling root dip treatment before transplanting for 6 hours with C*
T11: T5+ Seedling root dip treatment before transplanting for 6 hours with D*
***(A)** 1, 2, 4-triazolosulfonamide conjugated Silver nano-particles (TS-AgNPs) aqua emulsions
***(B)** 1, 2, 4-triazolodithiocarbamate conjugated Silver nano-particles (TS-AgNPs) aqua emulsions
***(C)** 1, 2, 4-triazolopyrimidine conjugated Silver nano-particles (TS-AgNPs) aqua emulsions
***(D)** 1, 2, 4-triazolopyridine conjugated Silver nano-particles (TS-AgNPs) aqua emulsions

Observations:

1. Mycoflora and Initial seed health status of seed
2. Disease incidence (in field)%
3. Seed yield/plot
4. Quantification (%) of loss in seed yield
5. Mycoflora and seed health status of harvested seed

Statistical Analysis: RBD

NB: Observations on seed quality parameters recorded on minimum four replications of 100 seeds each, except SMC, estimated on dry weight basis as per ISTA recommendations.

Year of start: 2018
Crop: Paddy
Centre: PAU, Ludhiana
Experiment Details:
Varieties: Pusa 1059 and Pusa 1121 (Basmati type)
Date of sowing nursery: 22.6.18
Date of transplanting: 20.7.18
Design of experiment: RBD
Treatments:

Sr. No	Treatments
T1	Control
T2	Seed priming with silver nano conjugate-A
T3	Seed priming with silver nano conjugate-B
T4	Seed priming with silver nano conjugate-C
T5	Seed priming with silver nano conjugate-D
T6	Seed priming with Carbendazim @ 0.2% + Streptocycline @0.01% + Seedling root dip treatment for 6 hours with Carbendazim@ 0.2%
T7	Hydro-priming
T8	T1+ Seedling root dip treatment before transplanting for 6 hours with A*
T9	T2+ Seedling root dip treatment before transplanting for 6 hours with B*
T10	T3+ Seedling root dip treatment before transplanting for 6 hours with C*
T11	T4+ Seedling root dip treatment before transplanting for 6 hours with D*

***A** 1, 2, 4-triazolosulfonamide conjugated Silver nanoparticles aqua emulsions
***B** 1, 2, 4-triazolodithiocarbamate conjugated Silver nanoparticles aqua emulsions
***C** 1, 2, 4-triazolopyrimidine conjugated Silver nanoparticles aqua emulsions
***D** 1, 2, 4-trialopyridine conjugated Silver nanoparticles aqua emulsions

Mycoflora and Initial seed health status of seed used: Seed was artificially inoculated with spore suspension of *Fusarium fuzikoroi* isolated from infected seeds of basmati rice (Amatulli *et. al.* 2012).

Methodology: Pathogen inoculated seeds were dipped in different Ag nano conjugates as per the treatments (T2-T5 and T8-T11) for a period of 8 hours and the roots of seedlings were dipped in solutions of nano-conjugates for 6 hour before transplanting. The seeds were dipped in carbendazim 0.2%+ streptocycline 0.01% solution for 8 hours prior to sowing and the seedling roots were dipped in 0.2% carbendazim solution for 6 hours before transplanting for Standard fungicide treatment (T6). Hydro-priming treatment was given by dipping seeds in water for 8

hours (T7). Untreated seeds were sown and transplanted as control treatment (T1). The seeds were sown in nursery by following the recommended package of practices for sowing the nursery of basmati rice.

Results: Percent disease incidence was relatively more in variety Pusa 1509 as compared to Pusa 1121 in all the treatments (Table 4.73). Disease incidence was minimum in the plots where seed priming with Ag-nano conjugate B was given. The disease incidence was even less than that obtained in standard fungicide (carbendazim) treated seeds. However, the difference of disease control in T3 and T9 was not very significant. Moreover, in the plots where root dip treated seedlings (T9) were grown, the plants exhibited toxicity symptoms in the beginning which were later recovered with the establishment of seedlings.

Conclusion: Seed priming with silver nano conjugate-B + Seedling root dip treatment before transplanting for 6 hours (T9) with B (1, 2, 4-triazolodithiocarbamate conjugated Silver nanoparticles aqua emulsions) and Seed priming with silver nano conjugate-B (T3) resulted in maximum disease control and also gave maximum seed yield. As the results obtained from T3 and T9 were statistically at par with each other, the need of seedling root dip for the management of seed borne inoculum of *Fusarium fuzikoroi* may not be required.

Table 4.73: Effect of silver nano-conjugates as seed priming agents against disease incidence, seed yield and seed quality parameters of basmati rice varieties

Sr. No	Treatments	Disease incidence (%)		Seed Yield/ plot (Kg)		Germination (%)		SMC (%)		Mycoflora associated with harvested seed	
		Pusa 1509	Pusa 1121	Pusa 1509	Pusa 1121	Pusa 1509	Pusa 1121	Pusa 1509	Pusa 1121	Pusa 1509	Pusa1121
T1	Control	46.25	39.28	2.10	1.90	95	97	13.96	13.16	*Alternaria, Curvularia Fusarium moniliforme, F. fuzikoroi Aspergillus Pennicilium, Chetomium,*	*Alternaria, Curvularia Fusarium moniliforme , F. fuzikoroi Aspergillus Pennicilium,*
T2	Seed priming with silver nano conjugate-A	19.5	14.55	2.25	2.00	95	96	13.35	13.45	*Curvularia Pennicilium, Chetomium*	*Alternaria, Curvularia Pennicilium, Chetomium*
T3	Seed priming with silver nano conjugate-B	5.98	2.89	3.50	3.25	97	96	12.82	12.96	*Alternaria, Curvularia Chetomium*	*Alternaria, Curvularia Chetomium*
T4	Seed priming with silver nano conjugate-C	40.80	32.40	2.25	1.95	96	95	12.35	13.2	*Curvularia Pennicilium, Chetomium, F. fuzikoroi*	*Alternaria, Pennicilium, Chetomium, F. fuzikoroi*
T5	Seed priming with silver nano conjugate-D	45.78	36.76	2.15	1.85	94	94	14.0	13.9	*Alternaria, Curvularia Pennicilium, Chetomium, F. fuzikoroi*	*Alternaria, Curvularia Pennicilium, Chetomium, F. fuzikoroi*
T6	Seed priming with	6.78	3.5	3.50	3.15	96	95	12.65	13.7	*Alternaria,*	*Alternaria,*

	Carbendazim@ 0.2% + Streptocycline @0.01% + Seedling root dip treatment for 6 hours with Carbendazim@ 0.2%									*Curvularia Chetomium, F. fuzikoroi*	*Curvularia F. fuzikoroi*
T7	Hydro-priming	35.75	29.70	2.90	2.78	95	96	12.60	12.56	*Alternaria, Pennicilium, Chetomium F. moniliformae , F. fuzikoroi*	*Alternaria, Curvularia Pennicilium, Chetomium F. fuzikoroi*
T8	T1+ Seedling root dip treatment before transplanting for 6 hours with A*	18.40	14.00	2.95	2.65	94	96	12.38	12.06	*Alternaria, Aspergillus, Curvularia Chetomium,*	*Alternaria, Pennicilium, Curvularia Chetomium,*
T9	T2+ Seedling root dip treatment before transplanting for 6 hours with B*	5.40	1.89	3.60	3.40	96	97	13.16	13.20	*Alternaria, Curvularia Chetomium,*	*Alternaria, Curvularia Chetomium,*
T10	T3+ Seedling root dip treatment before transplanting for 6 hours with C*	40.18	32.00	2.15	1.97	95	96	14.0	13.52	*Alternaria, Curvularia, Chetomium, F. fuzikoroi*	*Alternaria, Curvularia Chetomium, F. fuzikoroi*
T11	T4+ Seedling root dip treatment before transplanting for 6 hours with D*	45.18	35.95	2.05	1.86	94	95	13.30	13.25	*Alternaria, Curvularia Pennicilium, Chetomium, F. fuzikoroi*	*Alternaria, Curvularia Pennicilium, Chetomium, F. fuzikoroi*
	CD (p=0.05)	0.86	1.16	0.29	0.37	0.67	0.55	NS	NS		

Crop: Paddy

Centre: IARI, New Delhi

Experiment Details:

Variety used: Pusa Basmati 1509 and Pusa Basmati 1121

Date of sowing nursery: 13.7.18

Date of transplanting: 8.8.18

Design of experiment: RBD

Treatments:

Sr. No	Treatments
T1	Control (untreated)
T2	Seed priming for 8 hours prior to sowing with silver nano conjugates-A
T3	Seed priming for 8 hours prior to sowing with silver nano conjugates-B
T4	Seed priming for 8 hours prior to sowing with silver nano conjugates-C
T5	Seed priming for 8 hours prior to sowing with silver nano conjugates-D
T6	Seed priming for 8 hours prior to sowing with Carbendazim@ 0.2% + Streptocycline @0.01% + Seedling root dip treatment for 6 hours with Carbendazim@ 0.2%
T7	Hydro-priming
T8	T1+ Seedling root dip treatment before transplanting for 6 hours with A*
T9	T2+ Seedling root dip treatment before transplanting for 6 hours with B*
T10	T3+ Seedling root dip treatment before transplanting for 6 hours with C*
T11	T4+ Seedling root dip treatment before transplanting for 6 hours with D*

***A** 1,2,4-triazolosulfonamide conjugated Silver nanoparticles (TS-AgNPs) aqua emulsions

***B** 1,2,4-triazolodithiocarbamate conjugated Silver nanoparticles (TS-AgNPs) aqua emulsions

***C** 1,2,4-triazolopyrimidine conjugated Silver nanoparticles (TS-AgNPs) aqua emulsions

***D** 1,2,4-trialopyridine conjugated Silver nanoparticles (TS-AgNPs) aqua emulsions

Observations recorded on Artificial inoculation of pathogen: Seeds of paddy were artificially inoculated with the spore suspension of *Fusarium fuzikoroi* collected from Division of plant pathology ICAR-IARI, New Delhi.

Methodology: Seeds inoculated with pathogen were dipped in different Ag nano conjugates as per the treatments mentioned in T2-T5 and T8-T11 for a period of 8 hours and the roots of seedlings were dipped in solutions of nano-conjugates for 6 hours before transplanting. The seeds were dipped in carbendazim 0.2%+ streptocycline 0.01% solution for 8 hours prior to sowing and the seedling roots were dipped in 0.2% carbendazim solution for 6 hours before transplanting as per details in (T6). Hydro-priming treatment was given by dipping seeds in water for 8 hours (T7). Untreated seeds were sown and transplanted as control treatment (T1).

Results: Disease incidence percentage was relatively more in all treatments of variety PUSA 1121 as compared to PUSA 1509. Disease incidence was maximum in control and minimum in the plots where seed priming with Ag-nano conjugate B was given. The difference in

disease incidence between T3 and T9 was quite less. Moreover, as compared to others the total seed yield/plot was also maximum in T3 and T9 treatments (Table 4.74).

Conclusion: Seed priming with silver nano conjugate-B + Seedling root dip treatment before transplanting for 6 hours (T9) with B (1, 2, 4-triazolodithiocarbamate conjugated Silver nanoparticles aqua emulsions) and Seed priming with silver nano conjugate-B (T2) resulted in maximum disease control and also gave maximum seed yield. As the results obtained from T3 and T9 are statistically at par with each other, the experiment in second year can give an idea as this step is required or not. In case of brown spot and sheath rot in paddy the seedling dip has been found effective under different experiments conducted by me at IARI and therefore needs further investigation.



Plate 8: A: Standing symptoms of Bakkane in the paddy field, B: Morphological radial growth of *Fusarium fuzikoroi,* C: Microscopic view of *Fusarium fuzikoroi* spores

Table 4.74: Effect of silver nano-conjugates as seed priming agents against disease incidence, seed yield and seed quality parameters of basmati rice varieties.

Treatment	Disease incidence (%)		Seed Yield/ plot (Kg)		Germination (%)		Mycoflora associated with harvested seed	
	PB-1509	PB-1121	PB-1509	PB-1121	PB-1509	PB-1121	PB- 1509	PB-1121
T1	29.23	31.33	1.27	1.16	96	95	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, F. semitectum, Aspergillus, Bipolaris*	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, F. semitectum, Aspergillus, Bipolaris*
T2	9.38	11.64	2.26	1.84	95.66	95.33	*A. alternata, Curvularia, F. semitectum, Bipolaris*	*A. alternata, Curvularia, F. semitectum, Aspergillus, Bipolaris*
T3	5.15	5.84	2.45	2.20	97.33	95.66	*A. alternata, Curvularia, Bipolaris*	*A. alternata, Curvularia, Bipolaris*
T4	13.85	16.76	2.16	1.26	96	97.66	*A. padwickii, A. alternata, F. fuzikoroi* **,** *Curvularia, Bipolaris*	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, Bipolaris*
T5	19.98	21.44	1.54	1.24	94.33	95.33	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, Bipolaris*	*A. alternata, F. fuzikoroi, Curvularia, Bipolaris*
T6	6.70	8.10	2.24	2.13	96.33	95.33	*A. alternata, Curvularia, Bipolaris*	*A. alternata, F. semitectum, Curvularia, Bipolaris*
T7	27.10	28.87	1.57	1.31	95.66	96.66	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, Bipolaris*	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, Bipolaris*
T8	9.46	10.22	2.30	2.07	95.66	96.66	*A. alternata, F. fuzikoroi, Curvularia, F. semitectum, Bipolaris*	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, Bipolaris*
T9	4.41	6.33	2.53	2.28	97.33	97.66	*A. alternata, Bipolaris*	*A. alternata, Bipolaris*
T10	22.25	23.50	2.20	1.75	96.33	96.66	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, Bipolaris*	*A. padwickii, A. alternata, F. fuzikoroi, Curvularia, Aspergillus, Bipolaris*

T11	18.68	20.23	2.00	1.53	95.66	96.33	*A. alternata, F. fuzikoroi, Curvularia, F. semitectum, Bipolaris*	*A. alternata, F. fuzikoroi, Curvularia, Aspergillus, Bipolaris*
CD(p=0.05)	0.645	1.064	0.137	0.193	1.305	1.149		-
SEm (±)	0.217	0.358	0.046	0.065	0.439	0.387		-
SEd (±)	0.307	0.507	0.065	0.092	0.621	0.547		-
CV%	2.487	3.704	4.836	6.04	0.792	0.698		-

Experiment 5: Influence of terminal heat stress on seed set, seed yield and quality in field crops

Year of start: 2017

Objectives: To evaluate the adverse effect of heat stress during reproductive phase in selected field crops and its mitigation.

Crops		Centres
Wheat	:	ICAR-IARI, New Delhi; PDKV, Akola; JNKVV, Jabalpur; UAS, Dharwad;RAU, TCA, Dholi; PAU, Ludhiana; GBPUAT, Pantnagar; CCSHAU, Hisar; VNMKV, Parbhani; CSAUAT, Kanpur and NDUAT, Faizabad
Sorghum	:	ICAR-IIMR, Hyderabad; MPKV, Rahuri; VNMKV, Parbhani and PDKV, Akola
Rice	:	ICAR-IIRR, Hyderabad; PJTSAU, Hyderabad; UAS, Bengaluru; TNAU, Coimbatore; ICARRC NEH Region - Manipur Centre; OUAT, Bhubaneswar; BSKKV, Dapoli; KAU, RARS, Pattambi and PAJANCOA&RI, Karaikal
Mustard	:	ICAR-IARI, New Delhi; ICAR-CAZRI, Jodhpur; NDUAT, Faizabad and CSAUAT, Kanpur

Crop-wise and centre-wise research findings during 2018-19

Crop: Wheat

Centre: ICAR-IARI, New Delhi

Experimental details: Two varieties viz. One for timely sown (HD 3171) and one for late sown conditions viz. HD 3117 used for the study.The experiment was conducted under three different dates of sowing i.e. normal sowing (25.11.17), late sowing (13.12.17) and very late sowing (02.01.18) conditions, in three replications, with a plot size of 5 rows of 2m length each. Five mitigation treatments viz. Glycine betaine (600 ppm), Salicylic acid (200 ppm), Ascorbic acid (10 ppm), KCl (1%) and Citric acid (1.5%) were given to crop rose under heat stress environment and spraying of these chemicals was done at two stages viz. vegetative and seed filling stage.

Observations recorded:

- Phenological traits (days to booting, days to 50% heading and days to completion of anthesis)
- Morphological traits (plant height, tiller number and 1000-seed weight)
- Seed quality parameters (germination percentage, vigour index I and II)

Results: No significant differences were recorded between the normal sown crop and the crop exposed to heat stress environments for various characters namely, days to booting, days to 50% heading and days to completion of anthesis, plant height, tiller number, number of seeds per spike and vigour indices. However, two characters, namely 1000 seed weight and germination percentage were affected significantly due to heat stress and various mitigation strategies were effective in alleviating the adverse effects of heat stress (Figures 5.1 - 5.4).

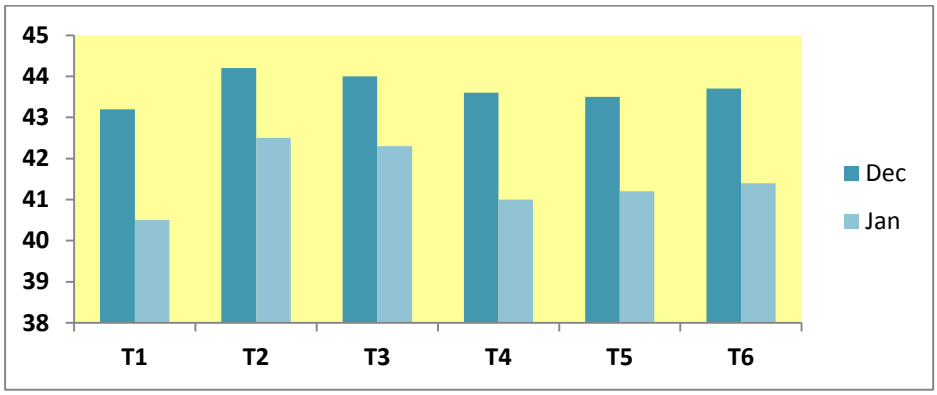


Figure 5.1: Effect of treatments on 1000 seed weight (Normal sown crop: 45g) in HD 31

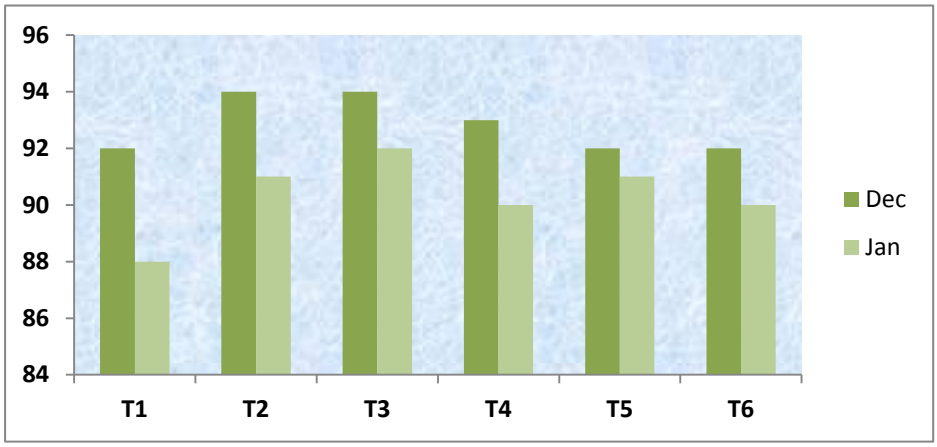


Figure 5.2: Effect of treatments on germination percentage (Normal sown crop: 96%) in HD 3171

Where: T1: Control, T2: Glycine betaine (600 ppm), T3: Salicylic acid (200 ppm), T4: Ascorbic acid (10 ppm), T5: KCl (1%), T6: Citric acid (1.5 %)

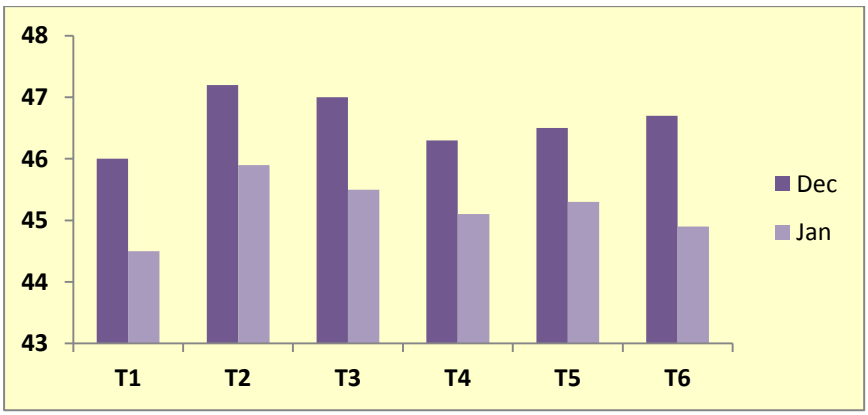


Figure 5.3: Effect of treatments on 1000 seed weight (Normal sown crop: 48g) in HD 31

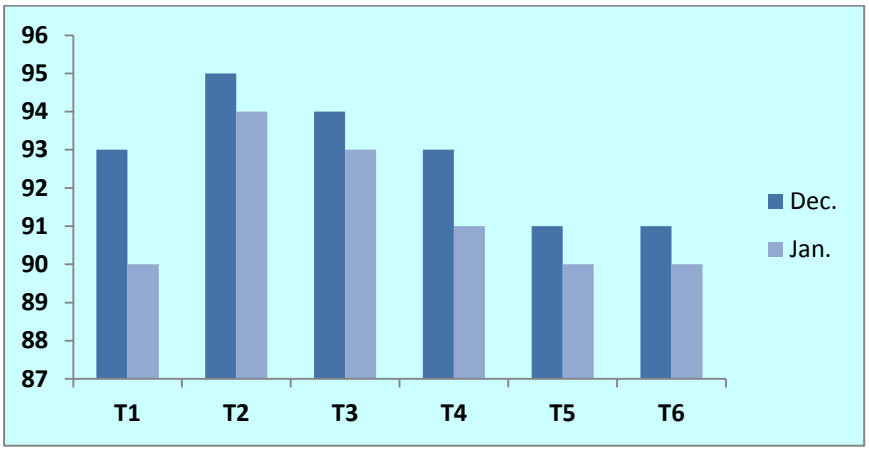


Figure 5.4: Effect of treatments on germination percentage (Normal sown crop: 97%) in HD 3117

Salient Finding: Of the various mitigation strategies, Glycine betaine (600 ppm) followed by Salicylic acid (200 ppm) was found to be the most effective treatment for mitigating the adverse effects of heat stress.

Centre: JNKVV, Jabalpur
Crop: Wheat
Experimental Details:
Dates of sowings: First date of sowing 12th Nov 2017, Second date of sowing 27th Nov 2017, Third date of sowing 12th December 2017, Fourth date of sowing 27thDecember 2017)
Variety : GW322
Treatment : T_1 :Glycine Betaine (600 ppm); T_2 :Cytokinin 100 ppm; T_3 :Salicylic acid 400 ppm; T_4 :Ascorbic acid 100 ppm; T_5 :KCl (1%) and T_6 :Citric acid (1.5%)

Results:
1000 seed weight (g), seed yield (g/m^2), germination Percentage (GP%) and seed vigour index I (SVI-I) differed significantly under different date of sowing (Table 1). 1000 seed weight, grains/ear, tillers/m^2, plant biomass, and harvest index decreased in subsequent dates of sowing due to coincidence of high temperature stress with anthesis and post-anthesis stage of wheat. Salicylic acid 400 ppm treatment was found to be effective in terms of imparting yield stability by retaining high 1000 seed weight (42.55), grains/ear (37.66), tillers/m^2 (338.00), plant biomass (1506.92), and harvest index (31.55), Grain yield/m^2 (474.17 g), Biomass/m^2 (1506.92 g), Germination Percentage (90.25%), Seed Vigour Index I (2485.63), Seed Vigour Index II (18836.58) under high temperature stress condition. After salicylic acid, Glycine betaine 600 ppm also imparts yield stability by retention of high grain yield/m^2 (453.50 g) under post anthesis induced high temperature stress condition.High temperature stress reduces the seed yield and seed vigour significantly. Salicylic acid 400 ppm reduces the devastating effect of anthesis and post anthesis induced high temperature stress on seed quality attributes by minimizing the reduction in germination percentage, seedling vigour index-I and seedling vigour Index-II due to high temperature stress (Tables 5.1-5.12).

Hence it can be concluded that Salicylic acid @ 400 ppm has been recommended for foliar spray at the time of anthesis for mitigating the adverse impact of terminal heat stress on seed yield and seed quality.

Table 5.1: Effect of terminal heat stress mitigation treatments on 1000 seed weight (g) of wheat planted under different dates of sowing

Treatments	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	41.02	40.56	40.12	39.90	**40.40**
Glycine betaine 600ppm	42.00	40.40	39.53	37.93	**39.96**
Cytokinin 100 ppm	43.53	42.93	40.67	39.50	**41.65**
Salicylic acid 400 ppm	43.10	43.53	42.80	40.77	**42.55**
Ascorbic acid 100 ppm	43.10	42.40	39.27	37.97	**40.68**
KCl (1%)	42.30	41.57	39.37	38.40	**40.41**
Citric acid (1.5%)	42.60	42.33	40.20	39.13	**41.06**
Mean sowing over treatment	**42.77**	**42.19**	**40.30**	**38.95**	
CD (p=0.05)	**Sow=0.54**	**T=0.44**	**Sow x T=1.07**		

Table 5.2: Effect of terminal heat stress mitigation treatments on mean Grains/ear of wheat planted under different dates

Treatments	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	39.89	37.98	35.80	34.12	**36.19**
Glycine betaine 600ppm	37.67	36.67	35.00	34.67	**36.00**
Cytokinin 100 ppm	35.00	32.67	36.67	35.33	**34.91**
Salicylic acid 400 ppm	41.33	39.33	35.33	34.67	**37.66**
Ascorbic acid 100 ppm	39.33	33.67	34.67	35.33	**35.75**
KCl (1%)	36.00	37.00	35.33	35.00	**35.83**
Citric acid (1.5%)	39.00	37.33	34.00	34.33	**36.16**
Mean sowing over treatment	**38.05**	**36.11**	**35.16**	**34.88**	
CD (p=0.05)	**Sow=1.11**	**T=0.91**	**Sow x T=2.22**		

Table 5.3: Effect of terminal heat stress mitigation treatments on tillers/m^2 of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	331.00	320.00	309.12	293.00	**313.28**
Glycine betaine 600ppm	324.00	324.00	304.00	286.33	**309.58**
Cytokinin 100 ppm	333.00	324.00	312.33	295.67	**316.25**
Salicylic acid 400 ppm	357.00	349.33	339.67	306.00	**338.00**
Ascorbic acid 100 ppm	335.67	332.67	316.00	282.67	**316.75**
KCl (1%)	326.00	322.67	304.67	286.00	**309.84**
Citric acid (1.5%)	340.67	336.67	320.33	295.33	**323.25**
Mean sowing over treatment	**336.06**	**324**	**304**	**286.33**	
CD (p=0.05)	**Sow=8.48**	**T=6.93**	**Sow x T=16.96**		

Table 5.4: Effect of terminal heat stress mitigation treatments on Biomass/m^2(g) of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	1450.00	1421.89	1398.32	1257.01	**1381.80**
Glycine betaine 600ppm	1458.33	1408.67	1406.67	1227.67	**1375.34**
Cytokinin 100 ppm	1366.67	1360.67	1316.00	1203.33	**1311.67**
Salicylic acid 400 ppm	1580.00	1551.67	1512.00	1384.00	**1506.92**
Ascorbic acid 100 ppm	1501.67	1470.33	1436.00	1224.67	**1408.17**
KCl (1%)	1493.33	1446.00	1421.33	1276.00	**1409.17**
Citric acid (1.5%)	1499.33	1476.67	1455.33	1288.33	**1429.92**
Mean sowing over treatment	**1483.22**	**1452.34**	**1424.56**	**1267.33**	
CD (p=0.05)	**Sow=42.90**	**T=35.03**	**Sow x T=85.81**		

Table 5.5: Effect of terminal heat stress mitigation treatments on Grain Yield/m^2 (g) of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	481.24	471.34	414.56	312.09	**419.80**
Glycine betaine 600ppm	524.33	504.33	439.33	346.00	**453.50**
Cytokinin 100 ppm	439.67	431.33	409.67	336.33	**404.25**
Salicylic acid 400 ppm	526.67	505.67	460.00	404.33	**474.17**
Ascorbic acid 100 ppm	456.00	439.00	413.00	316.33	**406.08**
KCl (1%)	465.67	437.00	384.33	322.67	**402.42**
Citric acid (1.5%)	481.67	451.67	411.00	327.67	**418.00**
Mean sowing over treatment	**482.34**	**461.50**	**419.56**	**342.22**	
CD (p=0.05)	**Sow=12.59**	**T=10.28**	**Sow x T=25.17**		

Table 5.6: Effect of terminal heat stress mitigation treatments on Harvest Index of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	35.78	32.67	28.45	28.12	**31.25**
Glycine betaine 600ppm	36.10	36.00	31.23	28.24	**32.89**
Cytokinin 100 ppm	32.21	32.00	31.16	28.08	**30.86**
Salicylic acid 400 ppm	33.33	33.00	30.44	29.41	**31.55**
Ascorbic acid 100 ppm	30.36	30.00	28.78	25.90	**28.76**
KCl (1%)	31.18	30.00	27.07	25.29	**28.39**
Citric acid (1.5%)	32.12	31.00	28.24	25.53	**29.22**
Mean sowing over treatment	**32.55**	**32.00**	**29.49**	**27.08**	
CD (p=0.05)	**Sow=1.40**	**T=1.15**	**Sow x T=2.81**		

Table 5.7: Effect of terminal heat stress mitigation treatments on days to anthesis of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	81.04	75.90	74.53	71.23	**75.675**
Glycine betaine 600ppm	84.33	79.33	75.33	70.67	**77.42**
Cytokinin 100 ppm	80.33	76.67	74.33	70.00	**75.33**
Salicylic acid 400 ppm	84.67	80.33	76.00	72.00	**78.25**
Ascorbic acid 100 ppm	82.33	80.67	76.67	71.33	**77.75**
KCl (1%)	81.67	76.00	74.00	68.33	**75.00**
Citric acid (1.5%)	84.00	81.33	76.33	71.67	**78.33**
Mean sowing over treatment	**82.89**	**79.06**	**75.44**	**70.67**	
CD (p=0.05)	**Sow=2.11**	**T=1.72**	**Sowx T=4.22**		

Table 5.8: Effect of terminal heat stress mitigation treatments on Germination (%) of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	90.25	88.25	86.23	82.07	**86.70**
Glycine betaine 600ppm	91.67	89.33	86.00	85.67	**88.17**
Cytokinin 100 ppm	93.67	90.33	85.67	85.00	**88.67**
Salicylic acid 400 ppm	96.00	92.00	86.67	86.33	**90.25**
Ascorbic acid 100 ppm	89.00	86.67	85.33	84.67	**86.42**
KCl (1%)	89.00	86.00	83.33	82.33	**85.17**
Citric acid (1.5%)	90.33	87.67	85.67	79.67	**85.84**
Mean sowing over treatment	**91.61**	**88.67**	**85.45**	**83.95**	
CD (p=0.05)	**Sow=1.30**	**T=1.06**	**Sow x T=2.59**		

Table 5.9: Effect of terminal heat stress mitigation treatments on seedling length (cm) of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	28.10	27.46	26.72	24.26	**26.64**
Glycine betaine 600ppm	27.57	27.30	25.48	23. 61	**26.78**
Cytokinin 100 ppm	27.57	27.30	25.48	23. 61	**26.78**
Salicylic acid 400 ppm	29.18	28.86	27.65	24.22	**27.48**
Ascorbic acid 100 ppm	26.66	26.20	26.58	23.10	**25.64**
KCl (1%)	24.24	21.29	20.14	19.25	**21.23**
Citric acid (1.5%)	25.24	23.05	22.49	20.14	**22.73**
Mean sowing over treatment	**26.83**	**25.69**	**24.84**	**22.19**	
CD (p=0.05)	**Sow=0.09**	**T=0.77**	**Sow x T=0.17**		

Table 5.10: Effect of terminal heat stress mitigation treatments on Seed moisture content (%) of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	11.34	11.32	10.89	10.50	**11.06**
Glycine betaine 600ppm	11.40	11.30	11.03	10.50	
Cytokinin 100 ppm	10.73	10.67	10.40	9.77	**10.39**
Salicylic acid 400 ppm	10.70	10.43	10.50	9.40	**10.26**
Ascorbic acid 100 ppm	11.17	11.03	10.63	10.30	**10.78**
KCl (1%)	11.27	11.13	10.93	10.53	**10.97**
Citric acid (1.5%)	11.20	11.23	10.97	10.63	**11.01**
Mean sowing over treatment	**11.08**	**10.97**	**10.74**	**10.19**	
CD (p=0.05)	**Sow=0.11**	**T=0.09**	**Sow x T=0.23**		

Table 5.11: Effect of terminal heat stress mitigation treatments on Seedling Vigour Index I of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Glycine betaine 600ppm	2575.67	2453.13	2298.04	2078.27	**2351.28**
Cytokinin 100 ppm	2582.07	2457.24	2183.14	2006.80	**2307.31**
Salicylic acid 400 ppm	2800.97	2654.80	2395.98	2090.78	**2485.63**
Ascorbic acid 100 ppm	2390.89	2270.57	2267.86	1955.95	**2221.32**
KCl (1%)	2167.81	1830.99	1678.68	1584.98	**1815.62**
Citric acid (1.5%)	2279.93	2020.73	1926.86	1604.58	**1958.03**
Mean sowing over treatment	**2466.22**	**2281.24**	**2125.09**	**1886.89**	
CD (p=0.05)	**Sow=32.08**	**T=26.19**	**Sow x T=64.16**		

Table 5.12: Effect of terminal heat stress mitigation treatments on Seedling Vigour Index II of wheat planted under different dates of sowing

Treatments(T)	Variety				Mean treatment over sowing
	Sow 1	Sow 2	Sow 3	Sow 4	
Control	18985.21	17956.35	16584.25	15847.00	**17343.20**
Glycine betaine 600ppm	18976.00	18106.00	16685.33	16019.67	**17446.75**
Cytokinin 100 ppm	18861.33	17997.33	16421.33	15553.67	**17208.42**
Salicylic acid 400 ppm	20899.00	19687.33	18370.00	16390.00	**18836.58**
Ascorbic acid 100 ppm	18648.67	17880.67	17379.33	15757.00	**17416.42**
KCl (1%)	17208.67	16429.33	15501.33	14658.00	**15949.33**
Citric acid (1.5%)	18037.33	17036.67	16163.33	14343.33	**16395.17**
Mean sowing over treatment	**18771.83**	**17856.22**	**16753.44**	**15453.61**	
CD (p=0.05)	**Sow=314.82**		**T=257.05**		**Sow x T=629.65**

Crop: Wheat

Centre: UAS, Dharwad

Experimental Details: Experiment was conducted involving three varieties of wheat DWR-162 (suitable for early sowing), UAS-304 (suitable for medium to late sowing) and Mass 6222 (suitable for late sowing) and seven foliar spray with respective chemicals were applied at 35 days after sowing and at anthesis stage as per the details mentioned below.

Design: Split-Split Plot

Main plot: (Varieties)

V_1: DWR 162

V_2: UAS 304

V_3: Mass 6222

Sub plot: (Dates of sowing)

S1: October-25; S2: Nov-15; and S3: Dec-5

Sub-sub plot: (Foliar spray)

T_1: Control; T_2: Salicylic acid (800 ppm); T_3: Salicylic acid (400 ppm); T_4: Ascorbic acid (10 ppm); T_5: KCL (%); T_6: Thiourea (400 ppm); T_7: Cycocel (2 ml in 350 ml water)

Sub- Sub Plot size: 3.0 x 3.0 m

Spacing: 30 x 10 cm

Replications: 2

Spray schedule: 35-40 days after sowing and at flowering stage

Results: The experiment is under progress, plant growth parameters such as height, number of tiller, panicle length were recorded from the October 25th sown crop, whereas 15thNovember and 5th December sown wheat is under vegetative stage. The observations on plant height (cm) and number of tillers per plant have been recorded. The experiment is under progress.

Crop: Wheat

Centre: GBPUAT, Pantnagar

Experimental Details:

Date of sowing: Three at 20 days interval i.e.

D1= Nov. 22, 2018 UP 2565

D2= Dec. 12, 2018 variety UP 2425 and

D3=Jan. 2, 2019 variety DBW16

Mitigation treatments:

F1= control; F2= Salicylic acid (400 ppm); F3= Salicylic acid (800 ppm); F4= Ascorbic acid 10 ppm; F5= KCl (1%); F6= thiourea (400 ppm); F7= Cycocel (2mlin 350 ml of water

Spray schedule:

V1=Vegetative stage (40DAS)

V2= Anthesis stage

V3= Vegetative + Anthesis stage

Total Treatments: Mitigation treatments (7) x spray schedule =21

Replications: Three

Design: Factorial RBD

Remarks: The crop was planted in the field on three dates of sowing i.e. November 22, 2018; December 12, 2018 and January 2, 2019 in factorial RBD with three replications. The spray of chemicals will be done at the time of vegetative and anthesis as per technical programme and the observations are being recorded as per technical programme.

Crop: Wheat

Centre: CCSHAU, Hisar

Experimental Details:

Varieties: WH-711and WH 1124

Date of sowings: 4- normal date and thereafter with 15 days intervals

First date of sowing: 15th Nov. 2017, Second date of sowing: 30th Nov. 2017, Third date of sowing: 15th Dec. 2017 and Fourth date of sowing: 30th Dec. 2017.

Treatments: Spraying of chemicals: During anthesis

T_1 Glycine betaine (600 ppm); T_2 Cytokinin (100 ppm); T_3 Salicylic acid (400 ppm); T_4 Ascorbic acid (10 ppm); T_5 KCl (1%); T_6 Citric acid (1.5 %); T_7 Orthosalicylic acid (20 ppm)

Results: Among all the treatments combinations tried, treatment Salicylic acid (400 ppm)- (T_3) was found significantly superior for 1000 grain weight (g), grain yield per plot (kg) and seed quality parameters in all the four sowing dates for both the varieties. Due to heat stress, in the absence of any mitigation treatment for control plots, the germination percentage ranged from 92 to 96 % which improved to 95.33 to 98 % (WH 1124) sprayed with salicylic acid. In case of variety WH 711, the germination percentage ranged from 89.33 to 96 % improved to 94 to 98.33 % for plots sprayed with Salicylic acid (Tables 5.13-5.18). The average temperature rose up to 4.8 °C during grain filling stage. The temperature at the time of grain filling stage

varied from 35 to 39.5^{0}C in delayed sown wheat crop.

Table 13: Effect of heat stress mitigating treatments on grain yield and quality in wheat variety WH 1124

Treatment	Grain yield per plot (kg)					Grain yield per hectare (q)					1000 grain weight (g)				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
Control -(T_0)	4.05	3.87	3.77	3.67	**3.84**	40.47	38.67	37.68	36.67	**38.37**	37.60	36.37	35.62	33.87	**35.87**
Glycine betaine (600ppm)- (T_1)	5.03	4.82	4.72	4.47	**4.76**	50.33	48.17	47.18	44.67	**47.59**	44.20	41.11	40.33	38.90	**41.14**
Cytokinin(100 ppm)- (T_2)	4.30	4.50	4.40	4.33	**4.38**	43.00	45.00	44.01	43.33	**43.84**	43.93	37.98	36.73	35.20	**38.46**
Salicylic acid (400 ppm) -(T_3)	4.43	4.23	4.13	4.03	**4.21**	44.33	42.33	41.34	40.33	**42.09**	43.70	37.87	39.97	36.77	**39.58**
Ascorbic acid (10 ppm)- (T_4)	4.67	4.50	4.50	4.30	**4.49**	46.67	45.00	45.01	43.00	**44.92**	38.87	40.53	39.37	35.10	**38.47**
KCl (1%) -(T_5)	4.83	4.53	4.68	4.43	**4.62**	48.27	45.33	46.83	44.33	**46.19**	44.03	41.67	40.12	38.70	**41.13**
Citric acid (1.5%)- (T_6)	4.60	4.52	4.50	4.30	**4.48**	46.00	45.23	45.00	43.00	**44.81**	38.97	36.74	39.57	34.77	**37.51**
OrthoSalicylicacid(20 ppm)-T7	4.07	4.00	3.90	3.83	**3.95**	40.67	40.00	39.01	38.33	**39.50**	38.53	37.60	39.80	35.73	**37.92**
Mean	**4.50**	**4.37**	**4.33**	**4.17**	**4.34**	**44.97**	**43.72**	**43.26**	**41.71**	**43.41**	**41.23**	**38.73**	**38.94**	**36.13**	**38.76**
	CD (p=0.05)	Date of sowing- 0.077 Treatment- 0.109 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 0.770 Treatment- 1.088 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 0.773 Treatment- 1.092 Date × Treatment- 2.185			

D_1- First date of sowing (15th Nov.), D_2- Second date of sowing (30th Nov.), D_3- Third date of sowing (15th Dec.), D_4- Fourth date of sowing (30th Dec.)

Table 5.14: Effect of heat stress mitigating treatments on seed quality parameters in wheat variety WH 1124

Treatment	Standard Germination (%)					Seedling length (cm)					Seedling dry weight (mg)				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
Control -(T_0)	96.00	94.67	93.33	92.00	**94.00**	31.50	30.93	30.10	29.13	**30.42**	92.33	86.00	87.00	82.00	**86.83**
Glycine betaine (600ppm)- (T_1)	98.33	97.33	96.00	94.67	**96.58**	34.37	34.07	33.77	31.67	**33.47**	98.00	95.33	90.92	86.67	**92.73**
Cytokinin(100 ppm)- (T_2)	97.33	96.67	95.33	96.67	**96.50**	32.47	31.73	30.43	30.00	**31.16**	94.67	92.33	88.17	83.00	**89.54**
Salicylic acid (400 ppm) -(T_3)	98.00	97.00	96.33	95.33	**96.67**	35.17	34.87	34.27	32.13	**34.11**	100.33	93.33	92.33	90.33	**94.08**
Ascorbic acid (10 ppm)- (T_4)	97.00	96.67	94.00	92.00	**94.92**	33.23	32.80	30.40	29.77	**31.55**	97.00	85.67	89.00	84.33	**89.00**
KCl (1%) -(T_5)	97.33	96.00	94.00	97.67	**96.25**	32.70	32.33	32.30	30.33	**31.92**	96.33	87.67	89.67	85.00	**89.67**
Citric acid (1.5%)-(T_6)	96.00	95.33	93.33	94.00	**94.67**	32.47	32.37	32.57	29.67	**31.77**	93.33	91.00	88.92	86.00	**89.81**
Ortho Salicylic acid(20 ppm)-T7	96.67	94.67	94.67	94.67	**95.17**	32.03	31.70	31.00	29.60	**31.08**	96.30	90.33	87.33	83.00	**89.24**
Mean	**97.08**	**96.04**	**94.62**	**94.63**	**95.59**	**32.99**	**32.60**	**31.85**	**30.29**	**31.93**	**96.04**	**90.21**	**89.17**	**85.04**	**90.11**
	CD (p=0.05)	Date of sowing- 1.005 Treatment- 1.421 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 0.791 Treatment- 1.118 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 2.429 Treatment- 3.435 Date × Treatment- N.S.			

Table 5.15: Effect of heat stress mitigating treatments on seedling vigour I& II in wheat variety WH 1124

Treatment	Vigour index I					Vigour index II				
	D1	**D2**	**D3**	**D4**	**Mean**	**D1**	**D2**	**D3**	**D4**	**Mean**
Control -(T_0)	3,024	2,928	2,809	2,680	**2,860.50**	8870	8144	8117	7544	**8168.75**
Glycine betaine (600ppm)-(T_1)	3,369	3,305	3,253	3,019	**3,236.42**	9611	9253	8760	8259	**8970.75**
Cytokinin (100 ppm)- (T_2)	3,159	3,067	2,901	2,900	**3,007.00**	9217	8927	8404	8024	**8643.00**
Salicylic acid (400 ppm) -(T_3)	3,458	3,393	3,292	3,039	**3,295.33**	9866	9087	8859	8544	**9089.00**
Ascorbic acid (10 ppm)- (T_4)	3,223	3,171	2,858	2,734	**2,996.25**	9414	8285	8360	7758	**8454.25**
KCl (1%) -(T_5)	3,182	3,103	3,035	2,964	**3,071.33**	9376	8418	8433	8299	**8631.50**
Citric acid (1.5%)- (T_6)	3,115	3,086	3,039	2,788	**3,007.00**	8960	8676	8297	8084	**8504.25**
OrthoSalicylicacid (20 ppm)-T7	3,097	3,001	2,933	2,802	**2,958.25**	9306	8548	8263	7857	**8493.50**
Mean	**3,203.46**	**3,131.87**	**3,014.92**	**2,865.79**	**3,054.01**	**9327.50**	**8667.25**	**8436.63**	**8046.13**	**8619.38**
	CD (p=0.05)	Date of sowing- 75.185 Treatment- 106.327 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 251.561 Treatment- 355.761 Date × Treatment- N.S.			

Table 5.16. Effect of heat stress mitigating treatments on grain yield and quality in wheat variety WH 711

Treatment	Grain yield per plot (kg)					Grain yield per hectare (q)					1000 grain weight (g)				
	D1	**D2**	**D3**	**D4**	**Mean**	**D1**	**D2**	**D3**	**D4**	**Mean**	**D1**	**D2**	**D3**	**D4**	**Mean**
Control -(T_0)	3.93	3.75	3.75	4.03	**3.87**	39.33	37.50	37.50	35.50	**37.46**	41.50	40.43	38.30	33.13	**38.34**
Glycine betaine (600ppm)- (T_1)	4.83	4.42	4.51	4.10	**4.46**	48.33	44.17	45.07	43.07	**45.16**	45.43	44.33	43.00	37.77	**42.63**
Cytokinin(100 ppm)- (T_2)	4.47	4.23	4.33	3.95	**4.25**	44.67	42.33	43.33	41.33	**42.92**	43.37	41.67	42.17	35.33	**40.64**
Salicylic acid (400 ppm) -(T_3)	3.93	3.77	3.80	3.30	**3.70**	39.33	37.67	38.00	36.67	**37.92**	44.16	42.13	42.63	36.80	**41.43**
Ascorbic acid (10 ppm)- (T_4)	4.53	4.30	4.44	3.25	**4.13**	45.33	43.00	44.37	42.37	**43.77**	41.70	41.00	40.37	35.33	**39.60**
KCl (1%) -(T_5)	4.60	4.40	4.47	3.92	**4.35**	46.00	44.00	44.67	42.67	**44.33**	45.27	43.33	43.03	37.03	**42.17**
Citric acid (1.5%)- (T_6)	4.45	4.32	4.23	3.73	**4.18**	44.50	44.50	42.33	40.33	**42.92**	41.20	43.13	42.40	34.67	**40.35**
Ortho Salicylic acid (20 ppm)- T7	3.97	3.82	3.83	3.27	**3.72**	39.67	38.23	38.33	36.33	**38.14**	43.67	41.17	42.17	34.03	**40.26**
Mean	**4.34**	**4.13**	**4.17**	**3.69**	**4.08**	**43.40**	**41.43**	**41.70**	**39.78**	**41.58**	**43.29**	**42.15**	**41.76**	**35.51**	**40.68**
	CD (p=0.05)	Date of sowing- 0.098 Treatment- 0.139 Date × Treatment- 0.278				CD (p=0.05)	Date of sowing- 1.220 Treatment- 1.725 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 1.146 Treatment- 1.621 Date × Treatment- N.S.			

D_1- First date of sowing (15th Nov.), D_2- Second date of sowing (30th Nov.), D_3- Third date of sowing (15th Dec.), D_4- Fourth date of sowing (30th Dec.)

Table 5.17: Effect of heat stress mitigating treatments on seed quality parameters in wheat variety WH 711

Treatment	Standard Germination (%)					Seedling length (cm)					Seedling dry weight (mg)				
	D1	**D2**	**D3**	**D4**	**Mean**	**D1**	**D2**	**D3**	**D4**	**Mean**	**D1**	**D2**	**D3**	**D4**	**Mean**
Control -(T_0)	96.00	94.00	93.33	89.33	**93.17**	31.67	31.47	29.20	28.73	**30.27**	89.00	87.67	87.00	77.00	**85.17**
Glycine betaine (600ppm)- (T_1)	98.00	97.33	95.67	93.67	**96.17**	34.27	34.70	32.70	31.97	**33.41**	99.17	95.67	92.67	84.67	**93.04**
Cytokinin(100 ppm)- (T_2)	97.33	95.00	94.33	92.00	**94.67**	32.83	32.73	30.43	30.20	**31.55**	95.00	89.33	89.00	82.00	**88.83**
Salicylic acid (400 ppm) -(T_3)	98.33	97.00	96.33	94.00	**96.42**	34.87	35.00	33.43	32.93	**34.06**	99.67	98.67	95.33	86.67	**95.08**
Ascorbic acid (10 ppm)- (T_4)	96.67	95.33	94.67	91.33	**94.50**	33.87	34.27	30.07	29.93	**32.03**	92.42	93.00	90.00	80.67	**89.02**
KCl (1%) -(T_5)	97.33	96.00	94.00	92.00	**94.83**	33.53	33.57	31.20	30.73	**32.26**	95.50	95.33	86.67	84.00	**90.38**
Citric acid (1.5%)- (T_6)	96.67	96.67	94.33	92.67	**95.08**	33.23	33.03	31.20	30.20	**31.92**	89.33	87.00	92.33	86.00	**88.67**
Ortho Salicylic acid(20 ppm)- T7	97.00	96.33	95.33	91.00	**94.92**	33.33	33.63	30.37	29.13	**31.62**	92.75	93.33	89.33	78.00	**88.35**
Mean	**97.17**	**95.96**	**94.75**	**92.00**	**94.97**	**33.45**	**33.55**	**31.08**	**30.48**	**32.14**	**94.10**	**92.50**	**90.29**	**82.38**	**89.82**
CD (p=0.05)		Date of sowing- 1.218 Treatment- 1.722 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 0.898 Treatment- 1.270 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 3.200 Treatment- 4.525 Date × Treatment- N.S.			

Table 5.18: Effect of heat stress mitigating treatments on seedling vigour I & II in wheat variety WH 711

Treatment	**Vigour index I**					**Vigour index II**				
	D1	D2	D3	D4	Mean	D1	D2	D3	D4	Mean
Control -(T_0)	3,040	2,957	2,744	2,567	**2,827**	8536	8242	8128	6883	**7947**
Glycine betaine (600ppm)- (T_1)	3,336	3,376	3,128	2,984	**3,206**	9749	9280	8928	7963	**8980**
Cytokinin(100 ppm)- (T_2)	3,197	3,098	2,876	2,771	**2,985**	9249	8480	8393	7555	**8419**
Salicylic acid (400 ppm) -(T_3)	3,405	3,384	3,209	3,097	**3,274**	9769	9606	9122	8122	**9154**
Ascorbic acid (10 ppm)- (T_4)	3,286	3,268	2,847	2,733	**3,033**	8930	8867	8515	7377	**8422**
KCl (1%) -(T_5)	3,262	3,222	2,954	2,828	**3,066**	9298	9157	8153	7731	**8584.**
Citric acid (1.5%)- (T_6)	3,213	3,193	2,933	2,798	**3,034**	8640	8415	8710	7980	**8436**
Ortho Salicylic acid(20 ppm)-T7	3,230	3,252	2,894	2,640	**3,004**	8993	8992	8525	7099	**8402**
Mean	**3,246**	**3,218**	**2,948**	**2,802**	3,054	**9146**	**8879**	**8559**	**7589**	**8543**
	CD (p=0.05)	Date of sowing- 85.478 Treatment- 120.884 Date × Treatment- N.S.				CD (p=0.05)	Date of sowing- 349.105 Treatment- 493.7.9 Date × Treatment- N.S.			

D_1- First date of sowing (15th Nov.), D_2- Second date of sowing (30th Nov.), D_3- Third date of sowing (15th Dec.), D_4- Fourth date of sowing (30th Dec.)

Crop: Wheat
Centre: CSAUAT, Kanpur

Experimental Details:
Variety: K1006
Design: R.C.B.D.
Replication: 3
Plot size: 5 x 4 m= 20 m^2
Results (2017-18): The experiment was conducted for two year (Rabi 2016-17 & 2017-18) at New farm (NDF) Kalyanpur Kanpur. The Breeder seed of wheat variety K1006 were obtained from the processing plant of the University. The performance of S_1T_2 with respect to Chlorophyll Intensity (50.30%), No. of effective tillers (16.67), spike length (16.37cm), No. of seeds (52.33), seed yield plant (33.95gm), seed yield/plot (10.50kg). Seed yield (52.10 q/ha), 1000 seed weight (39.66g) was superior than S_2 and other chemicals, respectively while maximum germination (80.20%) was found in S_2T_2 though seed ling length (25.95g) was recommended in S_1T_2 and maximum seed vigour Index (2522.34) also found in S_1T_2 (Table 5.19- 5.20).

Table 5.19: Effect of sowing dates (S) and spray of various chemicals (T) on growth and yield attributing characters of wheat during Rabi (2017-18)

Treatments	Chlorophyll content (before spray)			Chlorophyll content (after spray)			Number of Effective Tillers			Spike length (cm)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_0	43.43	42.70	43.06	43.50	42.80	43.15	13.67	13.00	13.33	14.00	13.37	13.68
T_1	43.32	42.33	42.82	44.20	43.70	43.95	14.33	12.67	13.50	14.97	14.37	14.67
T_2	44.80	44.63	44.71	50.30	48.70	49.50	16.67	15.33	16.00	16.37	15.90	16.13
T_3	43.60	42.79	43.19	44.70	44.19	44.44	14.67	14.00	14.33	15.09	14.50	14.79
T_4	44.30	44.32	44.31	48.89	47.30	48.09	15.67	15.33	15.50	15.97	15.67	15.82
T_5	43.70	42.45	43.07	45.57	44.52	45.04	15.00	14.00	14.50	15.37	15.17	15.27
T_6	44.79	44.40	44.60	47.17	46.67	46.92	15.33	14.00	14.66	15.87	15.53	15.70
Mean	43.99	43.37		46.33	45.41		15.04	14.00		15.37	14.93	
	S	T	S × T	S	T	S × T	S	T	S × T	S	T	S× T
SEd(±)	0.120	0.224	0.317	0.160	0.299	0.422	0.228	0.426	0.602	0.211	0.396	0.559
SEm(±)	0.085	0.159	0.224	0.113	0.211	0.299	0.161	0.301	0.426	0.150	0.280	0.396
CD(p=0.05)	0.247	6.462	N.S	0.328	0.614	N.S.	0.468	0.875	N.S.	0.435	0.813	N.S.

Table 5.19a: Effect of sowing dates (S) and spray of various chemicals (T) on growth and yield attributing characters of wheat during Rabi (2017-18)

Treatments	Number of seeds per spike			Seed yield /plant (g)			Seed yield / plot(kg)			Seed yield q ha^{-1}		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_0	48.33	47.66	47.99	22.10	18.06	20.08	9.17	8.19	8.68	45.70	40.73	43.21
T_1	49.00	48.00	48.50	24.85	18.70	21.77	9.44	8.33	8.88	46.71	42.10	44.40
T_2	52.33	51.33	51.83	33.95	29.66	31.80	10.50	9.79	10.14	52.10	49.26	50.68
T_3	50.33	48.33	49.33	26.16	23.12	24.64	9.50	8.88	9.19	47.16	43.50	45.33
T_4	51.33	50.00	50.66	29.96	27.33	28.64	10.10	9.82	9.96	50.43	47.30	48.86
T_5	51.00	49.00	50.00	26.80	26.47	26.63	9.90	9.00	9.45	48.30	45.10	46.70
T_6	51.33	50.66	50.9	28.88	26.59	27.73	9.98	9.51	9.74	49.26	45.45	47.36
Mean	50.37	49.28		27.52	24.27		9.79	8.93		48.52	51.81	
	S	T	S × T	S	T	S × T	S	T	S × T	S	T	S × T
SEd(±)	0.421	0.787	1.113	0.367	0.686	0.971	0.195	0.365	0.516	0.646	1.208	1.708
SEm(±)	0.298	0.557	0.787	0.259	0.489	0.686	0.138	0.258	0.365	0.457	0.854	1.208
CD (p=0.05)	0.865	1.619	N.S.	0.754	1.411	1.996	0.401	0.751	N.S.	1.328	2.484	N.S.

Table 5.20: Effect of sowing dates (S) and spray of various chemicals (T) on seed quality characters of wheat during Rabi (2017-18).

Treatments	1000 Seed weight (g)			Germination (%)			Root Length (cm)			Shoot Length (cm)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_0	32.66	30.33	31.49	72.74	72.52	72.63	10.70	9.78	10.24	12.81	12.21	12.51
T_1	36.00	32.33	34.16	75.00	74.32	74.66	12.00	10.50	11.25	13.12	13.42	13.27
T_2	39.66	37.33	38.49	80.19	80.20	80.19	12.10	11.20	11.65	13.89	13.40	13.62
T_3	36.66	33.66	35.16	76.06	74.77	75.41	10.55	10.11	10.33	13.70	13.30	13.50
T_4	37.33	36.00	36.66	79.06	76.78	77.92	11.90	10.59	11.24	13.60	13.35	14.47
T_5	36.33	35.33	71.66	77.89	76.95	77.42	11.40	10.37	10.88	13.40	13.25	13.32
T_6	37.00	35.66	36.33	78.32	77.75	78.03	11.70	11.11	11.40	13.50	13.39	13.44
Mean	36.52	34.37		77.03	76.18		11.47	105.2		13.42	13.18	
	S	T	S × T	S	T	S × T	S	T	S × T	S	T	S× T
SEd(±)	0.417	0.779	1.102	0.330	0.618	0.873	0.140	0.262	0.371	0.149	0.279	0.395
SEm(±)	0.295	0.551	0.779	0.233	0.437	0.618	0.099	0.183	0.262	0.106	0.197	0.279
CD (p=0.05)	0.854	1.597	N.S.	0.676	1.265	N.S.	0.287	0.537	N.S.	N.S.	0.572	N.S.

Table 5.20a: Effect of sowing dates (S) and spray of various chemicals (T) on seed quality characters of wheat during Rabi (2017-18).

Treatments	Seedling Dry Weight (g)			Total seedling length (cm)			Vigour Index-I			Vigour Index-II		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_0	0.120	0.116	0.118	23.51	21.99	22.75	2144.11	2001.09	2072.06	10.94	10.56	10.75
T_1	0.151	0.140	0.145	25.12	23.92	24.52	2343.40	2198.84	2271.12	12.22	12.98	12.60
T_2	0.171	0.149	0.16	25.95	24.60	25.27	2522.34	2388.66	2455.50	16.62	14.46	15.54
T_3	0.137	0.133	0.135	24.25	23.41	23.83	228.435	2179.47	2231.91	12.91	12.38	12.64
T_4	0.161	0.151	0.156	25.50	23.94	24.72	2458.20	2303.03	2380.61	15.52	14.53	15.02
T_5	0.142	0.144	0.143	25.20	23.62	24.41	2409.12	2241.54	2325.33	13.58	13.67	13.67
T_6	0.157	0.147	0.152	24.89	24.50	24.69	2386.95	2344.65	2365.80	15.06	15.07	14.56
Mean	0.148	0.14	24.91	23.71			2364.06	2236.75		13.83	13.23	
	S	T	S × T	S	T	S × T	S	T	S × T	S	T	S × T
SEd(±)	0.003	0.006	0.008	0.165	0.308	0.436	11.882	22.228	31.435	0.160	0.299	0.423
SEm(±)	0.002	0.004	0.006	0.117	0.218	0.308	8.401	15.718	22.228	0.113	0.212	0.299
CD(p=0.05)	0.006	0.011	N.S.	0.338	0.632	N.S>	24.345	45.545	N.S.	0.328	0.613	0.868

Crop: Sorghum
Centre: MPKV, Rahuri
Experimental Details:

Variety	:	Swati
Plot size	:	3 X 5m
Treatment Details	:	
Sowing dates(Three)	:	D_1:30 October, D_2: 15 November and D_3: 30 November
Mitigation treatments	:	Spraying of chemicals at anthesis T1: Salycylic acid 400 ppm; T2: Ascorbic acid 10 ppm; T3: KCl 1%; T4: Citric acid 1.5 %; T5: Control

Results: The data on effect of sowing dates and foliar application of mitigation treatments on seed yield and quality parameters of sorghum during 2017-18 are presented in table 5.21 to 5.23.

A) Effect of sowing date: Sowing dates had significant effect on seed yield & quality of sorghum irrespective of foliar spray of mitigation treatments. Panicle length (16.90 cm), No of spikelet per plant (1509), No of filled spikelet (1220) seed set (80.30 %), seed yield per plant (40.88 g), seed yield per plot (3.83 kg), seed yield/ha (1796 kg), 1000 seed weight (31.40 g), germination (82.60%), root shoot length (28.63 cm), seedling dry weight (0.216 g), vigour index I (2375) & vigour index II (17.93) were significantly higher at 30th October sowing (Table 5.21).

Delayed sowing at 30th November recorded reduction in panicle length (16.20 cm), No of spikelet per plant (1296), No of filled spikelet (927) seed set (71.06 %), seed yield per plant (35.80 g), seed yield/plot (2.85 kg), seed yield/ha (1585 kg), 1000 seed weight (27.93 g), germination (79.20 %), root shoot length (26.71 cm), seedling dry weight (0.184 g), vigour index I (2127) & vigour index II (14.70) over earlier sowing.

B) Effect of mitigation treatments: Foliar application of mitigation treatments of PGRs had significant effect on seed yield & quality of sorghum irrespective of different sowing dates. Panicle length (17.16 cm), No of spikelet/plant (1567), No of field spikelet (1256), seed set (80.05 %), seed yield/plant (40.47 g), seed yield/plot (3.65 kg), seed yield/ha (1801 kg), 1000 seed weight (35.58 g), germination (85.33 %), root shoot length (31.43 cm), seedling dry weight (0.230 g), vigour index I (2684) and vigour index II (19.66) were significantly higher in foliar application of salicylic acid (400 ppm) irrespective of sowing time (Table 5.22).

C) Interaction effect: The interaction effect of sowing dates and foliar application of PGRs had significant effect on seed yield and seed quality parameters are not influenced significantly. Number of spikelet/panicle (1687), No of filled spikelet (1460), seed set (86.54 %), seed yield/plot (4.25 kg), seed yield/ha (1920 kg) and 1000 seed weight (32.70 g) were significantly higher in foliar application of salicylic acid (400 ppm) at 30th October sowing (Table 5.23).Interaction effect of sowing dates and mitigation treatments on seed quality of sorghum was non-significant.

Table 5.21: Effect of sowing dates and mitigation treatments on yield and yield contributing parameters of sorghum

Treatments	Panicle length (cm)	No. of spikelet /Panicle	No of Filled Spikelet	Seed Set (%)	Seed yield / Plant (g)	Seed yield / Plot (kg)	Seed yield / ha (kg)	1000 Seed wt (g)
Sowing dates								
D_1: 30 October	16.90	1509	1220	80.30 (63.82)	40.88	3.83	1796	31.40
D_2: 15 November	16.29	1410	1106	77.56 (61.86)	38.40	3.29	1733	29.81
D_3: 30 November	16.20	1296	927	71.06 (57.49)	35.80	2.85	1585	27.93
SEd (±)	**0.179**	**7.128**	**17.058**	**0.215**	**0.320**	**0.030**	**11.978**	**0.109**
CD (p=0.05)	**0.522**	**20.756**	**49.670**	**0.626**	**0.931**	**0.088**	**34.877**	**0.318**
Mitigation treatments								
T_1: Salycylic acid 400 ppm	17.16	1567	1256	80.05 (63.53)	40.47	3.65	1801	30.58
T_2 : Ascorbic acid 10 ppm	16.96	1507	1197	78.88 (62.88)	40.00	3.57	1800	30.26
T_3: KCl 1%	16.04	1373	1067	77.55 (61.79)	37.98	3.24	1642	29.29
T_4: Citric acid1.5 %	16.40	1427	1120	78.29 (62.30)	39.33	3.40	1734	30.13
T_5: Control	15.75	1153	783	66.73 (54.79)	34.00	2.75	1545	28.30
SEd (±)	0.231	**9.203**	**22.022**	**0.278**	**0.413**	**0.039**	**15.463**	**0.141**
CD (p=0.05)	**0.673**	**26.797**	**64.123**	**0.809**	**1.201**	**0.113**	**45.025**	**0.410**

Table 5.22: Effect of sowing dates and mitigation treatments on seed quality of sorghum

Treatments	Germination (%)	R/S length (cm)	Dry wt. (g)	Vigour index I	Vigour index II
Sowing dates					
D_1: 30 October	82.60 (65.46)	28.63	0.216	2375	17.93
D_2: 15 November	80.80 (64.12)	27.81	0.200	2257	16.26
D_3: 30 November	79.20 (63.00)	26.71	0.184	2127	14.70
SEd (±)	**0.656**	**0.078**	**0.006**	**29.618**	**0.626**
CD (p=0.05)	**1.904**	**0.226**	**0.017**	**85.957**	**1.818**
Mitigation treatments					
T_1: Salycylic acid 400ppm	85.33 (67.57)	31.43	0.230	2684	19.66
T_2 : Ascorbic acid 10 ppm	83.67 (66.21)	30.59	0.213	2561	17.91
T_3: KCl 1%	77.67 (61.85)	25.18	0.197	1958	15.35
T_4: Citric acid 1.5 %	81.00 (64.18)	27.88	0.193	2260	15.72
T_5: Control	76.67 (61.16)	23.49	0.167	1802	12.84
SEd (±)	**0.847**	**0.100**	**0.008**	**38.237**	**0.809**
CD (p=0.05)	**2.459**	**0.292**	**0.022**	**110.970**	**2.347**

Table 5.23: Interaction effect of sowing dates and mitigation treatments on seed yield and quality parameters of sorghum

Treatments	Panicle length (cm)	No. of spikelet /Panicle	No of Filled Spikelet	Seed Set (%)	Seed yield/ Plant (g)	Seed yield/ Plot (kg)	Seed yield / ha (kg)	1000 Seed wt (g)	% increase over control
D1T1	18.10	1687	1460	86.54 (68.48)	43.41	4.25	1920	32.70	28.26
D1T2	17.90	1630	1350	82.83 (65.52)	43.00	4.20	1913	32.03	27.79
D1T3	16.20	1492	1200	80.43 (63.74)	40.00	3.80	1710	31.12	14.23
D1T4	16.70	1518	1230	81.02 (64.17)	42.00	3.90	1820	31.92	21.58
D1T5	15.60	1217	860	70.66 (57.20)	36.00	3.00	1615	29.22	7.88
D2T1	17.05	1468	1150	78.33	40.00	3.50	1840	30.23	22.91

				(62.26)					
D2T2	16.60	1590	1298	81.63 (64.62)	41.00	3.60	1850	30.32	23.58
D2T3	16.05	1360	1090	80.47 (63.77)	38.00	3.18	1685	29.42	12.56
D2T4	16.50	1442	1170	81.13 (64.25)	39.00	3.35	1765	30.21	17.90
D2T5	15.25	1193	823	66.21 (54.46)	34.00	2.80	1523	28.86	1.74
D3T1	16.33	1365	980	71.78 (57.91)	37.00	3.00	1650	28.52	10.22
D3T2	16.40	1480	1120	75.68 (60.45)	37.00	3.10	1630	28.71	8.88
D3T3	15.87	1268	910	71.76 (57.90)	36.00	2.75	1530	27.33	2.20
D3T4	16.00	1320	960	72.73 (58.52)	37.00	2.95	1618	28.26	8.08
D3T5	16.40	1050	665	63.34 (52.74)	32.00	2.45	1497	26.82	
SEd (±)	0.401	**15.909**	**38.142**	**0.481**	**0.715**	**0.067**	**26.783**	**0.245**	
CD (p=0.05)	NS	**46.413**	**111.064**	**1.401**	**NS**	**0.196**	**77.986**	**0.710**	

Crop: Rice

Centre: PJTSAU, Hyderabad

Experimental Details:

Varieties

: JGL 18047, Tellahamsa and RNR 15048

Design **:** Split plot design

Replications **:** 3

Plot size

: 33 m^2 (5.5 x 6 m^2)

First DOS

: 16.12.2017

Second DOS **:** 01.02.2018

First date of Transplanting : 18.01.2018

Second date of Transplanting : 28.02.2018.

Treatments: The following chemicals used for the foliar spray were sprayed, twice at vegetative stage and seed filling stage, to mitigate the effect of elevated temperatures on seed set.

T1: Control; T2: Glycine betaine (600 ppm); T3: Cytokinin (100 ppm); T4: Salicylic acid (400 ppm); T5: Ascorbic acid (10 ppm); T6: KCl (1%); T7: Citric acid (1.5 %)

Results: Mitigation treatment revealed that there is less significant differences for all the growth and yield characters except Seed set(%) and Seed yield (Kg/ha). In paddy variety JGL-18047, Citric acid (1.5%), Ascorbic acid and KCl (1%) was found to be effective in increasing number of tillers/hill(18), as it is significantly superior to the control(12 tillers/hill). It was observed that the above chemicals were not effective for Panicle length and Plant Height.In paddy variety Tellahamsa, KCl(1%) and Glycine Betaine (400PPM) were shown effective in increasing no of Tillers/hill and plant height(cm) and spikelets/plant where as Ascorbic acid (10PPM) shown effective increment of seed set(%) and Seed yield kg/ha over control. RNR-15048 variety, application of Glycine Betaine (400PPM) and KCl (1%) chemical recorded an improvement in spikelets/plant and Filled spikelets/plant over control. A significant improvement was observed for Spikelets /Plant (297) and Filled Spikelets/ plant (270) over the control (230 and 203) by applying the chemical KCl (1%). In paddy variety Tellahamsa and RNR-15048, maximum germination (%) was observed by use of Cytokinin (100 ppm) chemical. In JGL-18047 and RNR-15048 increased seedling vigour index was observed by use of Cytokinin (100 ppm). Significant differences were observed among all treatments and varieties for Seed set (%) and Seed yield (Kg/ha) by spraying Ascorbic acid over control. (Table 5.24 and 5.25).However this increase might be due to the fertile spikelets and No of tillers/plant in three varieties.

Table 5.24: Yield and yield attributing characters influenced by different treatments under heat stress

Variety	Treatment		Tillers /hill	Panicle length(cm)	Plant height(m)	Spikelets/ plant	Filled Spikelets/plant	Seed set (%)	Seed yield/ha (Kg)
JGL-18047	V1T1	Control	12	26	93	229.5	192.5	83.88	6875
	V1T2	Glycine Betaine(600PPM)	12	25	94	192.5	168.5	87.53	6967
	V1T3	Cytokinin(100PPM)	13	26	97	234.8	215.7	91.87	6692
	V1T4	Salicylic acid(400PPM)	14	25	97	251.2	229.9	91.52	7059
	V1T5	Ascorbic acid(10PPM)	15	25	93	279.0	274.5	98.39	7118
	V1T6	KCl (1%)	15	27	98	241.0	223.3	92.66	7063
	V1T7	Citric acid (1.5%)	18	25	93	243.0	227.8	93.74	7021
Tellahamsa	V1T1	Control	17	24	99	242.0	204.0	84.30	4554
	V1T2	Glycine Betaine (600PPM)	19	23	100	277.0	224.0	80.87	5075
	V1T3	Cytokinin(100PPM)	18	25	97	235.5	196.9	83.61	4983
	V1T4	Salicylic acid(400PPM)	17	22	94	231.5	197.5	85.31	4317
	V1T5	Ascorbic acid(10PPM)	21	26	102	259.5	239.1	92.31	5800
	V1T6	KCl (1%)	19	23	93	224.0	180.0	80.36	5233
	V1T7	Citric acid (1.5%)	16	25	93	130.4	109.9	84.28	4928
RNR-15048	V1T1	Control	22	24	101	105.0	86.2	82.10	6650
	V1T2	Glycine Betaine(600PPM)	21	24	101	130.8	114.7	87.69	8050
	V1T3	Cytokinin(100PPM)	21	24	100	104.0	87.5	84.13	7217
	V1T4	Salicylic acid(400PPM)	22	24	98	114.3	98.0	85.74	7633
	V1T5	Ascorbic acid(10PPM)	20	24	93	126.2	113.7	90.10	8071
	V1T6	KCl (1%)	22	24	94	149.0	133.4	89.53	7721
	V1T7	Citric acid (1.5%)	17	24	94	109.1	80.6	73.88	7204
CD (p=0.05)			**2.994**	**N/A**	**N/A**	**18.231**	**23.508**	**N/A**	**551.952**
SEm(±)			**1.008**	**0.937**	**3.225**	**6.137**	**7.913**	**3.169**	**185.794**

Table 5.25: Physiological parameters influenced by different treatments under heat stress

Variety	Treatment		Germination %	Seedling length (cm)	Seedling Vigour Index
JGL-18047	V1T1	Control	95.6	11.8	1123.5
	V1T2	Glycine Betaine(600PPM)	95.7	15.0	1437.7
	V1T3	Cytokinin(100PPM)	91.8	17.0	1560.6
	V1T4	Salicylic acid(400PPM)	92.3	12.9	1191.5
	V1T5	Ascorbic acid	94.2	13.3	1250.3
	V1T6	KCl (1%)	94.9	14.1	1337.5
	V1T7	Citric acid (1.5%)	92.8	13.7	1270.7
Tellahamsa	V1T1	Control	93.1	16.4	1527.3
	V1T2	Glycine Betaine(600PPM)	93.8	15.7	1473.5
	V1T3	Cytokinin(100PPM)	94.2	14.1	1324.8
	V1T4	Salicylic acid(400PPM)	92.5	15.1	1396.1
	V1T5	Ascorbic acid	92.3	15.0	1384.8
	V1T6	KCl (1%)	94.7	14.4	1363.0
	V1T7	Citric acid (1.5%)	94.5	14.2	1338.3
RNR-15048	V1T1	Control	91.9	14.1	1290.8
	V1T2	Glycine Betaine(600PPM)	93.8	14.3	1336.0
	V1T3	Cytokinin(100PPM)	95.7	16.3	1559.4
	V1T4	Salicylic acid(400PPM)	92.1	16.6	1528.7
	V1T5	Ascorbic acid	94.2	15.3	1437.0
	V1T6	KCl (1%)	94.0	15.2	1429.4
	V1T7	Citric acid (1.5%)	93.0	15.8	1468.7
CD (p=0.05)			**2.340**	**1.465**	**157.770**
SEm(±)			**0.788**	**0.493**	**53.107**

Crop: Rice
Centre: UAS, Bengaluru
Experimental Details:

Variety	**:**	BR-2555
Plot size	**:**	5.0 x 4.0 m^2
Replication	**:**	3
Date of sowing	**:**	12-01-2018
Date of transplanting	**:**	02-02-2018

Methodology: The field experiment was carried out during *summer* 2018 at Zonal Agricultural Research Station, VC Farm, Mandya. This experiment is being conducted on heat susceptible variety BR-2655 in Randomized Block Design under field condition with three replications by following all the recommended package of practices. The chemicals were sprayed as indicated below:

Treatments		**Stages of application**	
T_1	Control (untreated)	---	
T_2	Glycine betaine (600 ppm)	Vegetative	Seed filling
T_3	Salicylic acid (800 ppm)	Vegetative	Seed filling
T_4	Salicylic acid (400 ppm)	Vegetative	Seed filling
T_5	Ascorbic acid (10 ppm) + Citric acid (1.3%)	Vegetative	Seed filling
T_6	α-Tocopherol (150 ppm)	Vegetative	Seed filling
T_7	KCl 1%	Vegetative	Seed filling

Table 5.26: Effect of foliar application of antioxidants on growth parameters of paddy

Treatments	**Plant height (cm)**	**Number of tillers hill^{-1}**	**Days to 50 per cent flowering**	**Chlorophyll index before spray (SPAD)**	**Chlorophyll index after spray (SPAD)**
T_1: Control	95.00	11.33	105.33	34.30	36.30
T_2: Glycine betaine (600 ppm)	90.00	15.00	103.67	32.85	39.35
T_3: Salicylic acid (800 ppm)	116.00	20.00	103.00	36.55	39.43
T_4: Salicylic acid (400 ppm)	109.00	16.00	104.67	32.85	37.95
T_5: Ascorbic acid (10 ppm) + Citric acid (1.3 %)	114.00	17.33	104.67	33.75	39.15

T_6: α-Tocopherol (150 ppm)	102.00	12.33	104.00	30.70	39.65
T_7: KCL 1%	98.00	13.00	105.00	35.55	38.22
Mean	**103.43**	**15.00**	**104.33**	**33.79**	**38.58**
SEm(±)	**0.34**	**0.94**	**0.28**	**0.70**	**0.66**
CD (p= 0.05)	**1.05**	**2.91**	**0.87**	**2.16**	**2.02**

Table 5.27: Effect of foliar application of antioxidants on growth parameters of paddy

Treatments	No. of panicles	Panicle length (cm)	Number of spikelet's panicle^{-1}	Seed setting (%)	Seed yield per hill (g)	Seed yield (q ha^{-1})
T_1: Control	10.67	27.67	110.50	85.25	29.12	47.08
T_2: Glycine betaine (600 ppm)	15.00	26.33	131.00	87.48	34.21	54.34
T_3: Salicylic acid (800 ppm)	18.67	27.00	168.00	92.11	38.27	58.23
T_4: Salicylic acid (400 ppm)	12.67	26.00	166.67	91.79	36.50	56.08
T_5: Ascorbic acid (10 ppm) + Citric acid (1.3 %)	17.00	27.00	164.00	90.19	32.50	49.13
T_6: α-Tocopherol (150 ppm)	11.67	26.67	146.00	91.60	34.50	55.23
T_7: KCL 1%	12.67	26.33	143.50	87.21	30.19	48.02
Mean	14.24	26.71	147.10	89.38	33.61	52.59
SEm(±)	0.53	0.57	9.11	0.55	0.09	2.08
CD (p= 0.05)	1.65	NS	28.07	1.68	0.29	6.41

Results: Among the treatments Salicylic acid at the rate of 800 ppm recorded higher plant height (116 cm), number of tillers per hill (20), days to 50% flowering (103), chlorophyll index (39.43), no. of panicles (19), no. of spikelets per panicle (168), seed setting (92%), seed yield per hill (38g) and seed yield (58.23q/h). The observations on seed quality parameters are in progress.

Crop: Rice
Centre: TNAU, Coimbatore

Experimental Details: Paddy CO 52 variety was collected from the Department of Rice, TNAU, Coimbatore.Transplanted the paddy CO 52 in both open field condition and also in the growth chamber with 5°C elevated temperature.

Mitigation treatments

T_0 – Control; T_1 - Salicylic acid (800 ppm); T_2 - Salicylic acid (400 ppm); T_3 - Ascorbic acid (10 ppm); T_4 - KCl (1 %); T_5- Cycocel (2 ml in 350ml water)

FoliarSpray Schedule

1. Vegetative stage (35-40 DAP)
2. Anthesis stage
3. Vegetative and Anthesis stage

Results: The mitigation treatments salicylic acid (800 ppm, 400 ppm), ascorbic acid (10 ppm), KCl (1%), Cycocel (2 ml in 350ml water) were imposed at vegetative stage (40 DAP). Next spray at anthesis stage will be given. 10 plants in each replication were tagged randomly for taking observations. All the plant physiological and yield treatments will be recorded. The experiment is in progress.

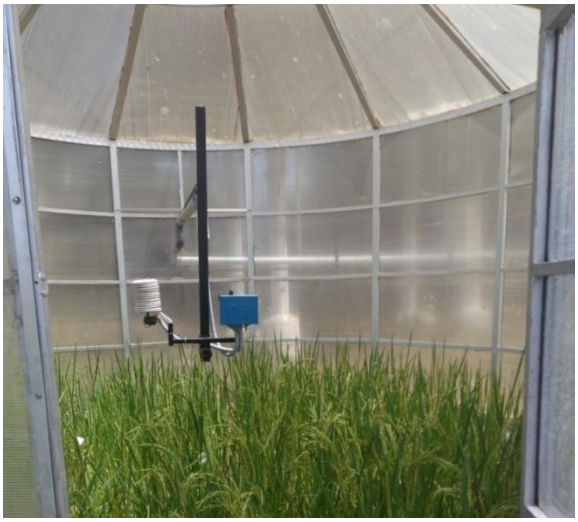


Plate 5.1: Inner view of the elevated temperature chamber



Plate 5.2: Field Trial in Vegetative Stage

Crop: Rice

Centre: OUAT, Bhubaneswar

Experimental details: As the experiment involves exposure of the crop to terminal heat stress, the crop has been taken up during Rabi-Summer 2018-19. Three popular rice varieties; Hiranmayee, Naveen and Mandakini have been selected for the study. The experiment in open field condition has been taken up by sowing each variety under normal, late and very late sowing dates.

Dates of sowing: 06.12.2018, 21.12.2018 and 05.01.2019.

Status: The crop is in good condition. Observations as per technical programme will be taken at the appropriate stage of crop growth or after harvest.

Experimental details (2017-18): High temperature stress susceptible rice variety Naveen was chosen for the experiment. The experiment was conducted in open field conditions in split plot design with four dates of sowing (main plot treatment) at 15 days interval – 01.12.2017, 16.12.2017, 31.12.2017 and 15.01.2018. For mitigation of high temperature stress, spraying of the following chemicals (sub-plot treatments) was done during anthesis.

T_0: Control; T_1 : Glycine betaine (600 ppm); T_2 : Cytokinin (100 ppm); T_3 : Salicylic acid (400 ppm); T_4: Ascorbic acid (10 ppm); T_5 : KCl (1%); T_6 : Citric acid (1.5 %)

Results: Spraying of Salicylic acid 400 ppm(T_3) during anthesis produced the highest seed yield per plant (15.10 g) and seed yield per hectare (45.07 q), which was followed by Ascorbic acid 10 ppm and Glycine betaine 600 ppm. Lowest seed yield per plant and per hectare were recorded in case of Citric acid (1.5%) and Control. Salicylic acid 400 ppm gave 7.2% higher seed yield over Control. 1000-seed weight and seed germination were highest from Salicylic acid 400 ppm spray, followed by Cytokinin 100 ppm and Glycine Betaine 600 ppm. Lowest 1000-seed weight and germination were recorded in Control. The 1000-seed weight from spray of Salicylic acid 400 ppm (T_3) was 18% higher than that in Control (T_0). The seed vigour and other quality parameters also showed a similar trend among the treatments. Seed yield per plant and per hectare, 1000-seed weight, seed germination and other quality parameters were highest from the first date of sowing, i.e. 1st December 2017 (D_1).The seed yield was 44.06 q/ha from the first date of sowing.

Salient findings: Among the treatments, Salicylic acid 400 ppm proved to be the best treatment, followed by Ascorbic acid (10 ppm) and Glycine betaine (600 ppm), mainly in respect of highest seed yield, 1000-seed weight and germination.

Table 5. 28: Seed yield per plant and per hectare of rice cv. Naveen as influenced by dates of sowing and foliar spray of chemicals

Treatments	Seed yield per plant (g)					Seed yield per ha (q)				
	D_1	D_2	D_3	D_4	Mean	D_1	D_2	D_3	D_4	Mean
T_0	14.08	13.89	13.75	13.60	**13.83**	42.79	42.22	41.78	41.36	**42.04**
T_1	14.85	14.65	14.51	14.36	**14.59**	44.77	44.20	43.39	43.98	**44.09**
T_2	14.37	14.18	13.99	13.84	**14.10**	43.83	44.54	43.90	43.62	**43.97**
T_3	15.40	15.15	15.00	14.84	**15.10**	45.99	45.23	44.78	44.30	**45.07**
T_4	14.74	14.54	14.48	14.24	**14.50**	45.07	44.48	43.98	43.91	**44.36**

T_5	14.17	13.98	13.83	13.64	**13.91**	42.86	42.28	41.85	41.28	**42.07**
T_6	14.15	13.91	13.76	13.67	**13.87**	42.96	42.23	41.79	41.52	**42.13**
Mean	**14.54**	**14.33**	**14.19**	**14.03**	**14.27**	**44.04**	**43.60**	**43.07**	**42.85**	**43.39**
	D	**T**	**D x T**			**D**	**T**	**D x T**		
SEm(±)	**0.046**	**0.114**	**0.227**			**0.156**	**0.319**	**0.637**		
CD(p=0.05)	**0.159**	**0.323**	**NS**			**0.540**	**0.906**	**NS**		

Table 5.29: 1000-seed weight and seed germination of rice cv. Naveen as influenced by dates of sowing and foliar spray of chemicals

Treatments	**1000-seed weight (g)**					**Seed germination (%)**				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**
T_0	20.03	19.77	19.56	19.36	**19.68**	84.00 (9.16)	82.67 (9.09)	81.67 (9.04)	81.00 (9.00)	**82.33 (9.07)**
T_1	22.98	22.66	22.43	22.21	**22.57**	90.67 (9.52)	89.33 (9.45)	88.33 (9.40)	87.33 (9.34)	**88.92 (9.43)**
T_2	23.35	23.04	22.72	22.49	**22.90**	92.00 (9.59)	90.67 (9.52)	89.33 (9.45)	88.33 (9.40)	**90.08 (9.49)**
T_3	23.69	23.30	23.07	22.82	**23.22**	96.00 (9.80)	94.33 (9.71)	93.33 (9.66)	92.33 (9.61)	**94.00 (9.69)**
T_4	21.92	21.63	21.55	21.19	**21.57**	86.33 (9.29)	85.00 (9.22)	85.00 (9.22)	83.67 (9.15)	**85.00 (9.22)**
T_5	22.26	21.95	21.73	21.43	**21.84**	87.33 (9.34)	86.00 (9.27)	85.00 (9.22)	84.33 (9.18)	**85.67 (9.26)**
T_6	22.36	21.98	21.75	21.61	**21.93**	87.33 (9.34)	86.33 (9.29)	85.33 (9.23)	84.67 (9.20)	**85.92 (9.27)**
Mean	**22.37**	**22.05**	**21.83**	**21.59**	**21.96**	**89.10 (9.44)**	**87.76 (9.37)**	**86.86 (9.32)**	**85.95 (9.27)**	**87.42 (9.35)**
	D	**T**	**D x T**			**D**	**T**	**D x T**		
SEm(±)	**0.067**	**0.200**	**0.400**			**0.015**	**0.046**	**0.092**		
CD(p=0.05)	**0.233**	**0.569**	**NS**			**0.052**	**0.131**	**NS**		

Figures in the parenthesis are square root transformed values

Table 5.30: Seedling length and seedling dry weight during seed germination of rice cv. Naveen as influenced by dates of sowing and foliar spray of chemicals

Treatments	**Seedling length (cm)**					**Seedling dry weight (g)**				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**
T_0	26.09	25.75	25.47	25.22	**25.63**	0.076	0.075	0.074	0.073	**0.075**

T_1	26.91	26.55	26.27	26.02	**26.44**	0.078	0.077	0.076	0.075	**0.077**
T_2	27.53	27.16	26.79	26.53	**27.00**	0.079	0.078	0.077	0.076	**0.078**
T_3	27.82	27.37	27.09	26.80	**27.27**	0.080	0.078	0.077	0.077	**0.078**
T_4	26.96	26.60	26.49	26.06	**26.53**	0.078	0.077	0.077	0.075	**0.077**
T_5	26.15	25.80	25.54	25.19	**25.67**	0.076	0.074	0.074	0.073	**0.074**
T_6	26.47	26.02	25.75	25.59	**25.96**	0.077	0.075	0.074	0.074	**0.075**
Mean	**26.85**	**26.46**	**26.20**	**25.91**	**26.36**	**0.078**	**0.076**	**0.076**	**0.075**	**0.076**
	D	**T**	**D x T**			**D**	**T**	**D x T**		
SEm(±)	**0.082**	**0.239**	**0.478**			**0.0002**	**0.0008**	**0.0016**		
CD(p=0.05)	**0.284**	**0.680**	**NS**			**0.0008**	**0.0022**	**NS**		

Table 5.31: Seed vigour indices of rice cv. Naveen as influenced by dates of sowing and foliar spray of chemicals

Treatments	**Seed vigour index – I**					**Seed vigour index – II**				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**
T_0	2193.1	2130.0	2080.4	2044.6	**2112.1**	6.39	6.20	6.04	5.95	**6.15**
T_1	2440.4	2372.2	2321.6	2273.3	**2351.9**	7.07	6.85	6.71	6.58	**6.80**
T_2	2534.0	2463.6	2393.3	2344.5	**2433.8**	7.30	7.08	6.88	6.75	**7.00**
T_3	2671.4	2583.8	2530.6	2475.0	**2565.2**	7.65	7.40	7.23	7.08	**7.34**
T_4	2328.1	2261.1	2251.7	2180.1	**2255.2**	6.71	6.52	6.52	6.30	**6.51**
T_5	2285.0	2218.5	2170.6	2124.5	**2199.7**	6.61	6.39	6.26	6.13	**6.35**
T_6	2313.2	2248.1	2198.7	2166.8	**2231.7**	6.73	6.51	6.35	6.27	**6.46**
Mean	**2395.0**	**2325.3**	**2278.1**	**2229.8**	**2307.1**	**6.92**	**6.71**	**6.57**	**6.44**	**6.66**
	D	**T**	**D x T**			**D**	**T**	**D x T**		
SEm(±)	**15.44**	**38.97**	**77.95**			**0.044**	**0.118**	**0.237**		
CD(p=0.05)	**53.43**	**110.82**	**NS**			**0.151**	**0.336**	**NS**		

Table 5.32: Electrical conductivity of seed leachate and dehydrogenase activity of seeds of rice cv. Naveen as influenced by dates of sowing and foliar spray of chemicals

Treatments	**EC of seed leachate (dS/m)**					**Dehydrogenase activity of seed (OD/g/ml)**				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**
T_0	0.147	0.147	0.148	0.147	**0.147**	0.248	0.245	0.243	0.241	**0.244**
T_1	0.150	0.154	0.151	0.151	**0.152**	0.256	0.252	0.250	0.248	**0.252**
T_2	0.155	0.155	0.155	0.155	**0.155**	0.261	0.260	0.257	0.255	**0.258**
T_3	0.152	0.154	0.155	0.154	**0.154**	0.262	0.260	0.257	0.257	**0.259**
T_4	0.150	0.151	0.151	0.151	**0.151**	0.255	0.253	0.250	0.249	**0.252**

T_5	0.146	0.146	0.146	0.146	**0.146**	0.248	0.246	0.243	0.241	**0.245**
T_6	0.148	0.149	0.149	0.149	**0.149**	0.252	0.248	0.246	0.244	**0.248**
Mean	**0.150**	**0.151**	**0.151**	**0.150**	**0.150**	**0.255**	**0.252**	**0.249**	**0.248**	**0.251**
	D	**T**	**D x T**			**D**	**T**	**D x T**		
SEm(±)	**0.0005**	**0.0013**	**0.0026**			**0.0007**	**0.0023**	**0.0045**		
CD(p=0.05)	**NS**	**0.0037**	**NS**			**0.0023**	**0.0064**	**NS**		

Crop: Rice

Centre: KAU, RARS, Pattambi

Experimental Details:

Variety : 3

Sowing Time : 3

Chemicals : 6

Spraying Time : 3

Replication : 2

The study is being conducted during Rabi 2018-19.Three most popular varieties of Kerala were used for the study. Variety Jaya suited for normal sowing, Jyothi suitable for late sown conditions and Mattatriveni suitable for very late sowing. The varieties were planted 3 times at 15 to 20 day interval. Date of sowing of first set was on 2/11/18 and that of second and third set were on 19/11/18 and 3/12/2018 respectively. The varieties were transplanted to main field with 18 treatments (6 chemical treatments at three different growth phases) and control in 2 replications each (Plate 5.3). One set of experiment is being conducted in field condition and another set in climate chamber with 5 ^{o}C elevated temperature from anthesis onwards (Plate 5.4). The chemicals were applied during vegetative phase (Treatment A), anthesis phase (Treatment C) and Vegetative and anthesis phase (Treatment B). The experiment is progressing. First set started flowering on 19/1/2019 and second and third set on 6/2/19 and 22/2/19 respectively. The plants were treated with Salicylic acid (800 ppm and 400 ppm), Ascorbic acid (10 ppm), KCl (1%), Thiourea (400ppm) and Cycocel (2ml in 350ml water) during anthesis.



Plate 5.3: View of rice crop in the field at RARS KAU Pattambi



Plate 5.4: View of rice crop under controlled condition at RARS KAU Pattambi

Crop: Mustard
Centre: ICAR-CAZRI, Jodhpur

Experimental Details:
Varieties: Laxmi
Treatments Details: T_1: Glycine betaine (600 ppm); T2: Cytokinin (100 ppm); T_3: Salicylic acid (400 ppm); T_4: Ascorbic acid (10 ppm); T_5: KCL (1%); T_6: Citric acid (1.5%); T_7: Control
Date of Sowings (3): (i) 7 November2017, (ii) 22 November 2017 and (iii) 7 December 2017
Plot Size: 2.70 m x 4.0 m (gross): 1.8 m x 3.0 m (net); Replication: 3
Spacing: Row x Row- 45 cm
Seed Rate- 4.0 kg/ha
Fertilisers: NPK- 60:40:0; Sulphur; 40 kg/ha
Irrigated condition

Results: The experiment was sown on 7th November (I sowing), 22nd November (II sowing) and 7th December 2017 (III sowing). Treatments, viz. Glycine Betaine (600 ppm), Cytokinin (100 ppm), Salicylic acid (400 ppm), Ascorbic acid (10 ppm), KCL (1%) and Citric acid (1.5%) along with control were applied on 4th January, 15th January and 31st January 2018 to first, second and third sowing, respectively by spraying the chemicals. Results show that the differences were non-significant between the treatments for all the characters recorded from all the three sowing (Table 5.33 to 5.35). However with early sowing maximum seed yield (2265 and 2257 kg/ha) was recorded from Glycine betaine (600 ppm) and Salicylic acid (400 ppm), whereas from mid sowing Ascorbic acid (10 ppm) and Citric acid (1.5%) had maximum yield (2306 and 2212 kg/ha). Cytokinin (100 ppm) and Salicylic acid (400 ppm) gave maximum yield (1738 and 1702 kg/ha) with late sowing. Yield levels were almost similar for early and mid-sowing, and lower for late sowing. The effect of treatments was not evidenced on seed yield and its components in mustard crop under the three different sowing, thus none of the treatment among these six could be advocated for mitigating the effect of elevated temperature in mustard.

Table 5.33: Seed yield and its parameters in mustard with early sowing

Treatments	First date of sowing (07/11/2017)						
	Pl. ht. (cm)	Main branches/plant	Pod length (cm)	Seeds/pod	Seed wt./pod (g)	1000-SW (g)	Seed yield (kg/ha)
T1	183.2	6.5	5.3	14.9	0.08	5.09	2265
T2	191.6	5.7	5.9	15.0	0.09	4.84	2141
T3	182.8	5.5	6.0	15.9	0.09	4.79	2257
T4	187.5	6.1	5.9	15.4	0.09	4.70	1957
T5	197.2	6.5	5.6	14.1	0.08	4.80	1994
T6	186.3	6.4	5.7	16.3	0.10	5.13	2159
T7 (Control)	185.7	6.0	5.9	15.1	0.09	4.41	1814
Mean	187.8	6.1	5.8	15.3	0.09	4.82	2084
SEm(±)	3.9	0.37	0.27	0.90	0.009	0.29	249
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS
CV%	3.6	10.5	8.0	10.2	17.9	10.3	20.7

Table 5.34: Seed yield and its parameters in mustard with medium sowing

Treatments	Second date of sowing (22/11/2017)						
	Pl. ht. (cm)	Main branches/plant	Pod length (cm)	Seeds/pod	Seed wt./pod (g)	1000-SW (g)	Seed yield (kg/ha)
T1	181.6	6.1	6.3	16.0	0.10	5.04	1756
T2	178.5	5.9	6.0	13.5	0.09	5.29	1958
T3	178.4	6.3	6.2	16.0	0.09	5.06	1657
T4	176.7	5.1	6.2	15.1	0.10	5.15	2306
T5	175.6	5.1	6.3	15.4	0.08	4.97	1908
T6	187.7	6.3	6.7	14.8	0.10	5.02	2212
T7 (Control)	173.6	5.7	5.7	15.2	0.08	5.24	1902
Mean	178.9	5.8	6.2	15.1	0.09	5.11	1957
SEm(±)	5.8	0.49	0.18	1.2	0.01	0.24	176.6
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS
CV%	5.6	14.8	5.2	13.8	20.0	8.2	15.6

Table 5.35: Seed yield and its parameters in mustard with late sowing

Treatments	Third date of sowing (07/12/2017)						
	Pl. ht.	Main	Pod	Seeds/pod	Seed	1000-	Seed

	(cm)	branches/plant	length (cm)		wt./pod (g)	SW (g)	yield (kg/ha)
T1	165.4	5.5	6.3	13.2	0.07	4.13	1372
T2	172.3	5.0	6.2	13.5	0.07	4.22	1738
T3	183.7	5.5	6.0	14.1	0.08	4.19	1702
T4	181.0	5.7	6.2	15.5	0.08	4.09	1684
T5	180.5	5.6	6.0	13.2	0.06	4.12	1464
T6	172.2	5.4	5.9	14.8	0.07	3.95	1322
T7 (Control)	167.2	5.7	5.9	14.3	0.07	4.26	1441
Mean	174.6	5.5	6.1	14.1	0.07	4.14	1532
SEm(±)	6.4	0.34	0.34	1.34	0.008	0.07	106.5
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS
CV%	6.3	10.9	9.7	16.5	18.8	2.8	12.0

Crop: Mustard
Centre: CSAUAT, Kanpur

Experimental Details:
Variety: Mustard (Rohini)
Treatments: Seven; Control (T_0), Glycine Betaine - 600 ppm (T_1), Salicylic acid - 800 ppm (T_2), Salicylic - 400 ppm (T_3), Ascorbic acid - 10 ppm + Citric acid 1.3% (T_4), Alfa Tocopherol - 150 ppm (T_5) and KCL - 1% (T_6)
Stages of application: Two; Vegetative (S_1) and Seed filling (S_2)
Spacing : 45x10 cm
Plot size : Gross: 2.25x4 m and Net: 1.35x3.80 m
Design : RBD
Replication : Three
Sowing : Two dates (one timely (D_1) & other phases heat stress (D_2)
Total No. of plots : 42

Methodology: The present investigation was conducted at New Dairy Farm (NDF) of CSA University Kalyanpur, Kanpur during the *Rabi* season 2015-16 on two sowing date (I^{st} : 03 November & II^{nd}. 17 November 2015). The treatments were applied through foliar spray at two stages i.e. vegetative (S_1) & seed filling stage (S_2).

Results (2017-18): The performance of D_1T_5 was found superior over D_2 and other chemicals with respect to pollen viability (74.50%), No. of silique/plant (360.33), No. of seed/siliqua (12.66), seed yield/plant (10.21g), seed yield/plot, (2.50kg) and test weight (5.12g), while maximum chlorophyll intensity (51.35%) found in D_1T_1. The minimum No. of days taken to approach 50% flowering (59.21%) and maximum No. of primary Branches (6.10) were recorded in D_1T_2 (Table 5.36).

Table 5.36: Influence of terminal heat stress on seed set, seed yield and Quality in Mustard (2017-18)

Treatments	Chlorophyll Intensity (after spray)			Days to 50% Flowering			Pollen Viability in percentage			Number of Primary Branches			Number of Secondary Branches			Number of Siliqua/Plant		
	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean	D_1	D_2	Mean
T_0	49.15	44.25	**46.70**	59.17	69.55	**64.36**	71.00	72.10	**71.55**	4.25	4.05	**4.15**	12.80	13.10	**12.95**	360.16	260.00	**318.08**
T_1	51.35	48.55	**49.95**	60.27	67.25	**63.76**	73.80	72.80	**73.30**	4.91	5.10	**5.00**	14.10	14.91	**14.50**	311.33	299.33	**305.33**
T_2	50.65	45.05	**47.85**	59.21	66.20	**62.70**	74.50	72.40	**73.45**	6.10	5.80	**5.95**	16.87	17.21	**17.04**	346.13	324.66	**335.40**
T_3	46.50	44.45	**45.47**	61.33	67.13	**64.23**	73.60	73.40	**73.50**	5.78	5.50	**5.49**	14.75	15.10	**14.93**	321.26	315.66	**318.46**
T_4	51.15	49.10	**50.12**	61.12	68.15	**64.63**	74.30	73.10	**73.70**	5.30	5.25	**5.27**	17.23	18.10	**17.66**	344.23	325.66	**334.95**
T_5	50.92	48.55	**49.73**	61.50	67.15	**64.32**	74.50	73.80	**74.15**	4.32	4.29	**4.65**	18.51	18.10	**18.30**	360.33	326.33	**343.33**
T_6	47.10	47.35	**47.22**	60.33	67.70	**64.01**	73.90	73.90	**73.90**	5.19	5.15	**5.17**	15.81	16.61	**16.21**	329.66	316.66	**323.16**
Mean	49.54	46.75		60.42	67.59		73.65	73.07			5.12	**5.07**	15.72	16.16		339.01	309.76	
SE (d)	0.178	0.332	**0.470**	0.495	0.927	**1.311**	0.536	1.003	**1.418**	0.082	0.154	**0.218**	0.375	0.701	**0.991**	4.127	7.720	**10.918**
SE (m)	0.126	0.235	**0.332**	0.350	0.655	**0.927**	0.379	0.709	**1.003**	0.058	0.109	**0.154**	0.265	0.496	**0.701**	2.918	5.459	**7.720**
CD (p=0.05)	0.364	0.681	**0.962**	1.018	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.317	**0.449**	0.265	0.496	**0.701**	2.918	5.459	**7.720**

In Wheat: Of the various mitigation strategies, Glycine betaine (600 ppm) followed by Salicylic acid (200 ppm) was found to be the most effective treatment for mitigating the adverse effects of heat stress.
Salicylic acid @ 400 ppm has been recommended for foliar spray at the time of anthesis for mitigating the adverse impact of terminal heat stress on seed yield and seed quality.

Rice: Among the treatments, Salicylic acid 400 ppm proved to be the best treatment, followed by Ascorbic acid (10 ppm) and Glycine betaine (600 ppm), mainly in respect of highest seed yield, 1000-seed weight and germination.

Experiment 6: Standardization of seed testing protocols and development of seed standards for Jatropha under Experiment 7 "Development of Seed Standards for Jatropha" of Seed Production and Certification.

Year of Start: 2018

Objective: To standardize seed standard for Jatropha

Crop : Jatropha

Centre : JNKVV, Jabalpur

A. Identification of optimum temperature and test duration for conducting the germination test

Experimental Details: Four varieties ; CJH3, CJH 5, CJH 9 and CJH 12 were selected for conducting the seed testing studies supplied by TNAU Centre, Coimbatore and procured from Forest College and Research Institute.

Treatment details

ABBREVIATION			
Pre-moistening Treatment (PMT)			
PMT1	Whole seeds soaked in water for 36 hrs		
PMT2	Seed coat, specifically the part opposite the hilum, shall be cracked and seed soaked in water for 24 hrs		
PMT3	Kernel soaked in water for 6 hrs (naked seed)		
Type of Tissue (TT)			
TT1	Cotyledon + embryo	TT2	Embryo
Soaking Duration (SD)			
SD1	Soaking for 2 hours	SD2	soaking for 3 hours
SD3	Soaking for 4 hours		
Variety 1	ICJH-3	Variety 3	ICJH-9
variety 2	ICJH-5	Variety 4	ICJH-12

After the pre-moistening treatment, the seed coats were removed and the kernels were divided into two. Seeds found to be empty, clearly deformed, damaged, decayed or attacked by insects were removed and counted as non-viable. For the remaining undamaged seeds, two types of seed tissues were exposed to TTZ: (1.) cotyledon + embryo (2.) embryo alone. These tissues were completely immersed in 0.5% aqueous solution of 2,3,5-triphenyl tetrazolium chloride for 2, 3, and 4 h and kept in total darkness at 25-30^{o}C. After staining, the treated seeds were washed twice with distilled water and placed in petri dishes with moist filter paper for viability evaluation.

Results: The result revealed that in seed lot CJH 3, seed with cracked seed coat soaked in water for 24 h recorded significantly higher seed viability (82%) than the other treatments (78 %) for whole seeds soaked in water for 36h, 74 % for kernel soaked for 6 h (without seed coat). In the same lot highest viability was observed (79 %) when only the embryo was immersed in TTZ solution than the endosperm +embryo (76 %). With respect to duration, the seeds incubated in TTZ solution for 3 h had the highest viability of 80 % which was at par with 4.0 h duration (79 %). With respect to interaction, whole seed with cracked seed coat soaked in water for 24 h by utilizing the tissue embryo for 3 h TZ staining recorded maximum seed viability (87 %) (Table 6.1).

Table 6.1: Effect of Pre-moistening Treatment (PMT), Type of tissue (TT) and soaking duration (SD) on the seed viability percentage of CJH3 Jatropha variety

Pre-moistening treatment	**Type of tissue**	**Staining duration**			**Mean**	**Grand Mean (TT)**	**Grand Mean (PMT)**
		SD1	**SD2**	**SD3**			
PMT1	TT1	73	79	78	**77**	**76 (TT1)**	**78**
	TT2	75	80	81	**79**	**79(TT2)**	
PMT2	TT1	77	83	81	**80**		**82**
	TT2	79	87	83	**83**		
PMT3	TT1	69	75	74	**73**		**74**
	TT2	72	78	78	**76**		
Mean		74	80	79			
CD (p=0.05)	PMT=0.56	TT=0.73	SD=0.84	PMT x TT=1.09	PMT x SD=0.98	SD x TT=NS	PMT x TT x SD=NS

In seed lot CJH 5, whole seed with cracked seed coat soaked in water for 24 h recorded significantly higher seed viability (75%) than the other treatments (71 % for whole seeds soaked in water for 36 h and 68 % for kernel soaked for 6 h (without seed coat). In the same lot highest viability was observed (73 %) when only the embryo was immersed in TTZ solution than the endosperm +embryo (69 %). With respect to duration, the seeds incubated in TTZ solution for 3 h and 4 h had the highest viability of 73 % than 2.0 h duration (67 %). With respect to interaction, whole seed with cracked seed coat soaked in

water for 24 h by utilizing the tissue embryo for 3 h and 4.0 h TZ staining recorded maximum seed viability (78 % and 79% respectively) than 2.0 h duration (73 %) (Table 6.2).

Table 6.2: Effect of Pre-moistening Treatment (PMT), Type of tissue (TT) and soaking duration (SD) on the seed viability percentage of CJH5 Jatropha variety

Pre-moistening treatment	Type of tissue (TT)	Staining duration			Mean	Grand Mean (TT)	Grand Mean (PMT)
		SD1	SD2	SD3			
PMT1	TT1	66	71	71	**69**	**69 (TT1)**	**71**
	TT2	68	74	74	**72**	**73(TT2)**	
PMT2	TT1	67	74	74	**72**		**75**
	TT2	73	78	79	**77**		
PMT3	TT1	63	67	68	**66**		**68**
	TT2	65	73	74	**71**		
Mean		67	73	73			
CD (p=0.05)	PMT= 0.85	TT= 1.1	SD= 0.9	PMT x TT=1.25	PMT x SD= 1.98	SD x TT=NS	PMT x TT x SD=NS

In seed lot CJH 9, whole seed with cracked seed coat soaked in water for 24 h recorded significantly higher germination (77 %) than the other treatments (73 % for whole seeds soaked in water for 36 h, 72 % for kernel soaked for 6 h (without seed coat). In the same lot highest viability was observed (75 %) when only the embryo was immersed in TTZ solution than the endosperm +embryo (72 %). With respect to duration, the seeds incubated in TTZ solution for 3 h and 4 h had the highest viability of 75 % than 2.0 h duration (70 %). With respect to interaction, whole seed with cracked seed coat soaked in water for 24 h by utilizing the tissue embryo for 3 h recorded maximum seed viability (83 %) than as compared to 4.0 h duration (80 %) (Table 6.3).

Table 6.3: Effect of Pre-moistening Treatment (PMT), Type of tissue (TT) and soaking duration (SD) on the seed viability percentage of CJH9 Jatropha variety

Pre-moistening treatment	Type of tissue	Staining duration			Mean	Grand Mean (TT)	Grand Mean (PMT)
		SD1	SD2	SD3			
PMT1	TT1	68	74	76	**73**	**72(TT1)**	**73**
	TT2	71	75	75	**74**	**75TT2)**	
PMT2	TT1	72	75	74	**74**		**77**
	TT2	77	83	80	**80**		
PMT3	TT1	66	68	69	**68**		**72**
	TT2	63	75	76	**71**		
Mean		70	75	75			
CD	PMT=0.75	TT=1.5	SD=0.3	PMT x	PMT x	SD x	PMT x TT

(p=0.05)				TT=1.56	SD=1.1.86	TT=NS	x SD=NS

In seed lot CJH 12, whole seed with cracked seed coat soaked in water for 24 h recorded significantly higher germination (68 %) than the other treatments (63 % for whole seeds soaked in water for 36 h. In the same lot highest viability was observed (65 %) when only the embryo was immersed in TTZ solution than the endosperm +embryo (64 %). With respect to duration, the seeds incubated in TTZ solution for 3 h and 4 h had the highest viability of 66 % and 65% respectively than 2.0 h duration (63 %). With respect to interaction, whole seed with cracked seed coat soaked in water for 24 h by utilizing the tissue embryo for 4 h recorded maximum germination (71 %) which was on a par with 3.0 h duration (70%) (Table 6.4).

Table 6.4: Effect of Pre-moistening Treatment (PMT), Type of tissue (TT) and soaking duration (SD) on the seed viability percentage of CJH12 Jatropha variety

Pre-moistening treatment	**Type of tissue**	**Staining duratio006E**			**Mean**	**Grand Mean (TT)**	**Grand Mean (PMT)**
		SD1	**SD2**	**SD3**			
PMT1	TT1	60	61	60	**60**	**64(TT1)**	**63**
	TT2	63	66	65	**65**	**65TT2)**	
PMT2	TT1	66	69	69	**68**		**68**
	TT2	65	70	71	**69**		
PMT3	TT1	61	63	65	**63**		**61**
	TT2	61	65	62	**63**		
Mean		63	66	65			
CD (p=0.05)	PMT=0.09	TT=0.6	SD=0.8	PMT x TT=1.2	PMT x SD=1.2	SD x TT=NS	PMT x TT x SD=NS

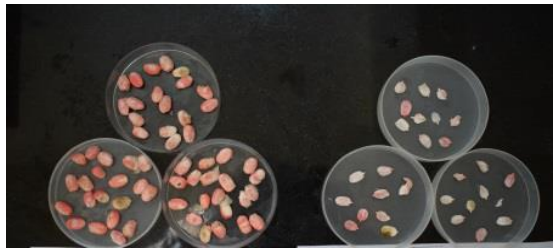
B. Standardization of tetrazolium test for seed viability

Soaking for 2 hrs duration



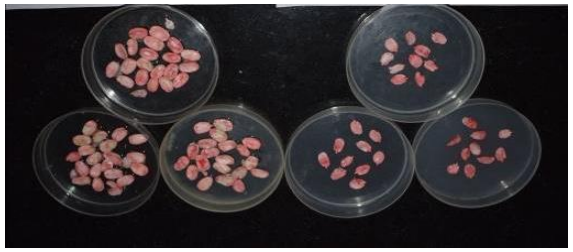
Endosperm + Embryo Embryo

Soaking for 3 hrs duration



Endosperm + Embryo Embryo

Soaking for 3 hrs duration



Endosperm + Embryo Embryo

Plate 6.1: Pre-moistening treatment - Soaking the whole seeds for 36 hrs.

Soaking for 2 hrs duration



Endosperm + Embryo Embryo

Soaking for 3 hrs duration



Endosperm + Embryo Embryo

Soaking for 4 hrs duration



Endosperm + Embryo Embryo

Plate 6.2: Pre-moistening treatment - Soaking the seed coat after cracking the part opposite the hilum for 24 hrs.

Soaking for 2 hrs duration ***Soaking for 3 hrs duration*** ***Soaking for 4 hrs duration***



Endosperm + Embryo ***Embryo*** ***Endosperm + Embryo*** ***Embryo*** ***Endosperm + Embryo*** ***Embryo***

Plate 6.3: Pre-moistening treatment - Soaking the naked seed for 6 hr.

Salient findings: The TZ test results revealed that Jatropha seed viability can be evaluated through the pre-moistening treatment of 24 h using whole seeds with seed coat cracked at opposite to the hilum and soaked in water for 24 h using the embryo as tissue for 3.0 h as staining duration.

C. Development of seed standards.

Methodology: Germination test was conducted in sand media with the temperature of 25 ^{0}C, 30 ^{0}C, 35 ^{0}C, for one lots (CJH 3**)** and daily counts were taken from emergence up to the completion of germination. The numbers of days taken for completion of 50 per cent germination were taken as the day for first count in whole number. Daily counts were taken and the days required for maximum emergence were counted from date of sowing until the final count. Mean germination time (MGT): ∑ (fx)/ ∑x was also calculated. f- number of days from initiation of germination test, x- newly geminated seeds in each day.

Results: The germination percentage was recorded at daily interval from 4th day to 14th day. Irrespective of temperature, the germination percentage of more than 50 was recorded on 7th day, reached the maximum on 11th day and remained unaffected up to 14th day.

In CJH3, germination test conducted under 30 ^{o}C recorded the germination of 56 % on 7th day, reached the maximum of 75 % on 11th day compared to 25 ^{0}C (44 % &68 %, respectively) and 35 ^{0}C (53 % &66 %, respectively) and remained unaffected up to 14th day (Table 6.5).

Table 6.5: Effect of temperature on days to final count for germination in Jatropha CJH3 variety.

Days After Sowing (DAS)	Germination (%)			Mean
	25 ^{0}C	**30 ^{0}C**	**35 ^{0}C**	
4 DAS	21	25	24	**23**
5 DAS	32	28	37	**32**
6 DAS	37	43	45	**42**
7 DAS	44	56	51	**50**
8 DAS	48	62	53	**54**
9 DAS	53	64	58	**58**
10 DAS	58	70	61	**63**
11 DAS	62	75	63	**67**
12 DAS	68	75	66	**69**
13 DAS	68	75	66	**70**
14 DAS	68	75	66	**70**
Mean	**51**	**59**	**53**	**54**
SEd	**DAS=2.12**	**Temp=2.17**	**D X T= 2.03**	
CD (p=0.05)	**DAS=3.25**	**Temp=4.2**	**D X T= 4.89**	

In Jatropha CJH 5 lot , germination test conducted under 30° C recorded the germination of 48 % on 7th day, reached the maximum of 63% on 11th day compared to 25 ^{0} C (44 % &57 %, respectively) and 35 ^{0} C (34% & 55%, respectively) and remained unaffected up to 14th day (Table 6.6).

Table 6.6: Effect of temperature on days to final count for germination in Jatropha CJH5 variety.

Days After Sowing (DAS)	Germination (%)			Mean
	25 ^{0}C	**30 ^{0}C**	**35 ^{0}C**	
4 DAS	24	26	20	**23**
5 DAS	33	35	25	**31**
6 DAS	38	42	31	**37**
7 DAS	44	48	34	**42**
8 DAS	46	54	39	**46**
9 DAS	49	57	45	**50**
10 DAS	53	59	49	**54**
11 DAS	56	61	53	**57**
12 DAS	57	63	55	**58**
13 DAS	57	63	55	**58**
14 DAS	57	63	55	**58**
Mean	**47**	**52**	**42**	**47**
SEd	**DAS=2.7**	**TEMP=3.2**	**D X T=2.9**	
CD (p=0.05)	**DAS=4.22**	**TEMP=3.66**	**D X T=3.61**	

In Jatropha CJH 9 lot , germination test conducted under 30° C recorded the germination of 37 % on 7th day, reached the maximum of 58 % on 11th day compared to 25 ^{0} C (37 % &52%, respectively) and 35 ^{0} C (38 % &53 %, respectively) and remained unaffected up to 14th day (Table 6.7).

Table 6.7: Effect of temperature on days to final count for germination in Jatropha CJH9 variety.

Days After Sowing (DAS)	Germination (%)			Mean
	25^{0}C	**30^{0}C**	**35^{0}C**	
4 DAS	21	25	23	**23**
5 DAS	24	28	27	**26**
6 DAS	29	31	33	**31**
7 DAS	37	37	38	**37**
8 DAS	45	47	48	**47**

9 DAS	49	51	50	**50**
10 DAS	51	54	50	**52**
11 DAS	52	58	50	**53**
12 DAS	52	58	53	**54**
13 DAS	52	58	53	**54**
14 DAS	52	58	53	**54**
Mean	**42**	**46**	**43**	
SEd	**3**	**2.82**	**3.11**	
CD (p=0.05)	**DAS=3.07**	**Temp=2.65**	**DAS x Temp=4.22**	

In Jatropha CJH 12 lot , germination test conducted under 30^{o} C recorded the germination of 46 % on 7th day, reached the maximum of 7 % on 12th day compared to 25 ^{0} C (46 % &67 %, respectively) and 35 ^{0} C (43 % &63 %, respectively) and remained unaffected up to 14th day (Table 6.8).

Table 6.8: Effect of temperature on days to final count for germination in Jatropha CJH12 variety.

Days After Sowing (DAS)	**Germination (%)**			**Mean**
	25^{0}C	**30^{0}C**	**35^{0}C**	
4 DAS	18	22	16	**19**
5 DAS	27	34	22	**28**
6 DAS	35	43	31	**36**
7 DAS	46	50	43	**46**
8 DAS	52	57	50	**53**
9 DAS	58	64	54	**59**
10 DAS	63	68	60	**64**
11 DAS	65	70	62	**66**
12 DAS	67	72	63	**67**
13 DAS	67	72	63	**67**
14 DAS	67	72	63	**67**
Mean	**51**	**57**	**48**	**52**
SEd	**DAS=2.03**	**Temp=2.51**	**DAS x Temp=2.95**	
CD (p=0.05)	**DAS=4.25**	**Temp=4.22**	**DAS x Temp=4.72**	

The minimum mean germination time (MGT) was recorded under 25^{0}C in all the four lots and irrespective of the seed lot the minimum mean germination time is recorded at 30 ^{0}C(6.0) whereas maximum MGT was recorded at 35 ^{0}C (6.4). The MGT recorded at 25^{0}C (6.1). The minimum MGT was recorded for CJH 3 and CJH 9 (6.0) whereas maximum MGT is recorded for CJH 12 (6.5) (Table 6.9).

Table 6.9: The minimum mean germination time (MGT) at three temperature ranges 25°C, 30 °C and 35 °C for the four lots

Lot	Germination Temperature			
	25°C	**30°C**	**35°C**	**Mean**
CJH3	6.8	5.6	5.7	**6.0**
CJH5	6.0	5.9	6.6	**6.2**
CJH9	5.2	6.3	6.5	**6.0**
CJH12	6.6	6.3	6.6	**6.5**
MEAN	**6.1**	**6.0**	**6.4**	

Salient findings: The optimum temperature recorded for the maximum germination of jatropha was 30 ^{0}C and days to take first count was 7th day and final count for jatropha germination (%) was 12th days after germination test and the minimum mean germination time was also recorded at 30 ^{0}C.

Crop : Jatropha
Centre :
TNAU, Coimbatore

A. Standardization of Tetrazolium test for seed viability

Experimental Details: Seven lots of Jatropha seeds were collected from Forest College and Research Institute, Mettuppalayam. Based on the viability percentage, only four lots of CJH 3, CJH 5, CJH 9 and CJH 12 varieties were selected for conducting the seed testing studies and the same four lots of Jatropha seeds were also sent to Jabalpur to carry out the seed testing experiments.

Treatment details

ABBREVIATION	
Pre-moistening Treatment (PMT)	
PMT1	Whole seeds soaked in water for 36 hrs
PMT2	Seed coat, specifically the part opposite the hilum, shall be cracked and seed soaked in water for 24 hrs
PMT3	Kernel soaked in water for 6 hrs (naked seed)
Type of Tissue (TT)	
TT1	Cotyledon + embryo
TT2	Embryo
Staining Duration (SD)	
SD1	staining for 2 hours
SD2	staining for 3 hours
SD3	staining for 4 hours

Variety 1	ICJH-3
Variety 2	ICJH-5
Variety 3	ICJH-9
Variety 4	ICJH-12

After the pre- moistening treatments, the seed coats were removed and the kernels were divided into two. Seeds found to be empty, clearly deformed, damaged, decayed, or attacked by insects or diseases were removed and counted as non-viable. These seeds were discarded and not included in the TTZ test. For the remaining undamaged seeds, two types of seed tissues were exposed to TTZ: (1.) cotyledon + embryo (2.) embryo only. These tissues were completely immersed in 0.5% aqueous solution of 2,3,5-triphenyl tetrazolium chloride for 2, 3, and 4 h while kept in total darkness at 25-30^{o}C. After staining, the treated seeds were washed twice with distilled water and placed in petri dishes with moist filter paper for viability evaluation.

Results: The result revealed that in seed lot CJH 3, whole seed with cracked seed coat soaked in water for 24 h recorded significantly higher germination (81 %) than the other treatments (78 % for whole seeds soaked in water for 36h, 74 % for kernel soaked for 6 h (without seed coat). In the same lot highest viability was observed (79 %) when only the embryo was immersed in TTZ solution than the endosperm +embryo (76 %). With respect to duration, the seeds incubated in TTZ solution for 3 h had the highest viability of 80 % which was on a par with 4.0 h duration (79 %). With respect to interaction, in the seed lot CJH 3, whole seed with cracked seed coat soaked in water for 24 h by utilizing the tissue embryo for 3 h TZ staining recorded maximum germination (85 %) which was on a par with 4.0 h duration (84 %) (Table 6.10).

Table 6.10: Effect of Pre-moistening Treatment (PMT), Type of tissue (TT) and staining duration (SD) on the seed viability percentage of CJH3 Jatropha variety

Pre-moistening treatment	Type of Tissue	Staining Duration (SD)			Mean	Grand Mean (TT)	Grand Mean (PMT)
		SD_1	SD_2	SD_3			
PMT_1	**TT_1**	73 (58.7)	79 (62.5)	78 (62.0)	77 (61.1)	**TT_1 - 76 (60.7)**	**78 (61.8)**
	TT_2	75 (60.0)	80 (63.2)	81 (64.3)	79 (62.5)	**TT_2 - 79 (62.7)**	
PMT_2	**TT_1**	76 (60.6)	82 (64.1)	80 (63.4)	79 (62.7)		**81 (61.0)**
	TT_2	78 (62.2)	85 (67.4)	84 (66.4)	82 (65.3)		
PMT_3	**TT_1**	68 (55.8)	74 (60.9)	73 (58.6)	72 (58.4)		**74 (61.3)**
	TT_2	71 (57.2)	77 (61.5)	78 (62.2)	75 (60.3)		

Mean		74 (59.1)	80 (63.3)	79 (62.8)	77 (61.7)		
	PMT	TT	SD	PMTXTT	PMTXSD	SDXTT	PMTXTTXSD
SEd	0.62	0.51	0.42	0.72	0.84	NS	NS
CD (p=0.05)	1.25	1.03	0.84	1.45	2.68	NS	NS

In seed lot CJH 5, whole seed with cracked seed coat soaked in water for 24 h recorded significantly higher germination (73 %) than the other treatments (70 % for whole seeds soaked in water for 36 h, 67 % for kernel soaked for 6 h (without seed coat). In the same lot highest viability was observed (72 %) when only the embryo was immersed in TTZ solution than the endosperm +embryo (68 %). With respect to duration, the seeds incubated in TTZ solution for 3 h and 4 h had the highest viability of 72 % than 2.0 h duration (66 %). With respect to interaction, in the seed lot CJH 5, whole seed with cracked seed coat soaked in water for 24 h by utilizing the tissue embryo for 3 h and 4.0 h TZ staining recorded maximum germination (77 %) than 2.0 h duration (72 %) (Table 6.11).

In seed lot CJH 9, whole seed with cracked seed coat soaked in water for 24 h recorded significantly higher germination (77 %) than the other treatments (74 % for whole seeds soaked in water for 36 h, 69 % for kernel soaked for 6 h (without seed coat). In the same lot highest viability was observed (75 %) when only the embryo was immersed in TTZ solution than the endosperm +embryo (71 %). With respect to duration, the seeds incubated in TTZ solution for 3 h and 4 h had the highest viability of 75 % than 2.0 h duration (69 %). With respect to interaction, in the seed lot CJH 9, whole seed with cracked seed coat soaked in water for 24 h by utilizing the tissue embryo for 3 h recorded maximum germination (81 %) which was on a par with 4.0 h duration (80 %) (Table 6.12).

Table 11: Effect of Pre-moistening Treatment (PMT), Type of tissue (TT) and staining duration (SD) on the seed viability percentage of CJH5 Jatropha variety

Pre-moistening treatment	Type of Tissue	Staining Duration (SD)			Mean	Grand Mean (TT)	Grand Mean (PMT)
		SD_1	SD_2	SD_3			
PMT_1	**TT_1**	64 (53.2)	70 (57.2)	71 (57.9)	68 (56.1)	**TT_1 - 68 (55.7)**	**70 (57.4)**
	TT_2	68 (55.5)	74 (60.2)	74 (60.2)	72 (58.6)	**TT_2 - 72 (58.4)**	
PMT_2	**TT_1**	68 (55.5)	73 (59.6)	72 (58.0)	71 (57.7)		**73 (59.1)**
	TT_2	72 (58.0)	77 (61.7)	77 (61.7)	75 (60.5)		
PMT_3	**TT_1**	61 (51.4)	66 (54.3)	66 (54.3)	64 (53.3)		**67 (54.7)**

	TT_2	63 (52.5)	72 (58.0)	71 (57.9)	69 (56.1)		
Mean		66 (54.3)	72 (58.5)	72 (58.3)	70 (57.0)		
	PMT	TT	SD	PMTXTT	PMTXSD	SDXTT	PMTXTTXSD
SEd	0.42	0.70	0.35	0.62	0.73	NS	NS
CD (p=0.05)	0.85	1.41	0.72	1.25	2.46	NS	NS

Table 6.12: Effect of Pre-moistening Treatment (PMT), Type of tissue (TT) and staining duration (SD) on the seed viability percentage of CJH 9 Jatropha variety

Pre-moistening treatment (PMT)	**Type of Tissue**	**Staining Duration (SD)**			**Mean**	**Grand Mean (TT)**	**Grand Mean (PMT)**
		SD_1	**SD_2**	**SD_3**			
PMT_1	**TT_1**	67 (54.9)	74 (60.3)	75 (60.9)	72 (58.7)	**TT_1 - 71 (57.7)**	**74 (59.8)**
	TT_2	70 (57.3)	77 (62.7)	77 (62.7)	75 (60.9)	**TT_2 - 75 (60.7)**	
PMT_2	**TT_1**	72 (58.0)	75 (60.8)	74 (60.3)	74 (59.7)		**77 (61.4)**
	TT_2	76 (61.3)	81 (64.2)	80 (63.6)	79 (63.0)		
PMT_3	**TT_1**	64 (52.1)	68 (55.3)	69 (56.4)	67 (54.6)		**69 (56.4)**
	TT_2	65 (53.5)	74 (60.3)	75 (60.8)	71 (58.2)		
Mean		69 (56.2)	75 (60.6)	75 (60.8)	73 (59.2)		
	PMT	TT	SD	PMTXTT	PMTXSD	SDXTT	PMTXTTXSD
SEd	0.62	0.75	0.71	0.83	0.91	NS	NS
CD (p=0.05)	1.25	1.52	1.43	1.66	1.83	NS	NS

In seed lot CJH 12, whole seed with cracked seed coat soaked in water for 24 h recorded significantly higher germination (69 %) than the other treatments (63 % for whole seeds soaked in water for 36 h and kernel soaked for 6 h (without seed coat). In the same lot highest viability was observed (66 %) when only the embryo was immersed in TTZ solution than the endosperm +embryo (63 %). With respect to duration, the seeds incubated in TTZ solution for 3 h and 4 h had the highest viability of 65 % than 2.0 h duration (63 %). With respect to interaction, in the seed lot CJH 5, whole seed with cracked seed coat soaked in water for 24 h by utilizing the

tissue embryo for 4 h recorded maximum germination (72 %) which was on a par with 3.0 h duration (71%) (Table 6.13).

Table 6.13: Effect of Pre-moistening Treatment (PMT), Type of tissue (TT) and staining duration (SD) on the seed viability percentage of CJH 12 Jatropha variety.

Pre-moistening treatment (PMT)	**Type of Tissue**	**Staining Duration (SD)**			**Mean**	**Grand Mean (TT)**	**Grand Mean (PMT)**
		SD_1	**SD_2**	**SD_3**			
PMT_1	**TT_1**	57 (49.7)	63 (52.5)	62 (51.4)	61 (51.2)	**TT_1 - 63 (52.4)**	**63 (52.2)**
	TT_2	62 (51.4)	65 (54.1)	64 (53.8)	64 (53.1)	**TT_2 - 66 (54.2)**	
PMT_2	**TT_1**	64 (53.8)	68 (55.3)	68 (55.3)	67 (54.8)		**69 (55.2)**
	TT_2	66 (54.2)	71 (57.5)	72 (58.4)	70 (56.7)		
PMT_3	**TT_1**	60 (50.4)	62 (51.4)	62 (51.4)	61 (51.1)		**63 (52.0)**
	TT_2	67 (54.8)	63 (52.5)	62 (51.4)	64 (52.9)		
Mean		63 (52.4)	65 (53.9)	65 (53.6)	64 (53.3)		
	PMT	TT	SD	PMTXTT	PMTXSD	SDXTT	PMTXTTXSD
SEd	0.33	0.38	0.40	0.52	0.62	NS	NS
CD (p=0.05)	0.67	0.75	0.81	1.05	1.24	NS	NS

Salient findings: The TZ test results revealed that Jatropha seed viability can be evaluated through the pre-moistening treatment of 26 h using whole seeds with seed coat cracked at opposite to the hilum and soaked in water for 24 h using the embryo as tissue for 3.0 h as staining duration. Even though both the staining duration of 3.0 h and 4.0 h recorded same result three hours can be used for TZ test due to within short duration the result can be evaluated.

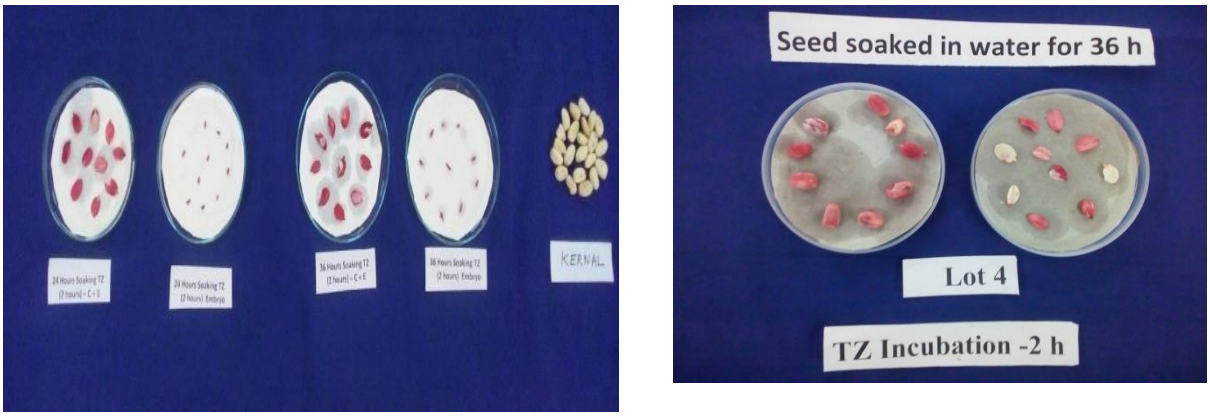
B. Standardization of Tetrazolium test for seed viability

Endosperm + Embryo **Embryo**



Plate 6.4: TZ Staining pattern in different tissues

Jatropha kernel **TZ incubation for 2 h - Embryo**

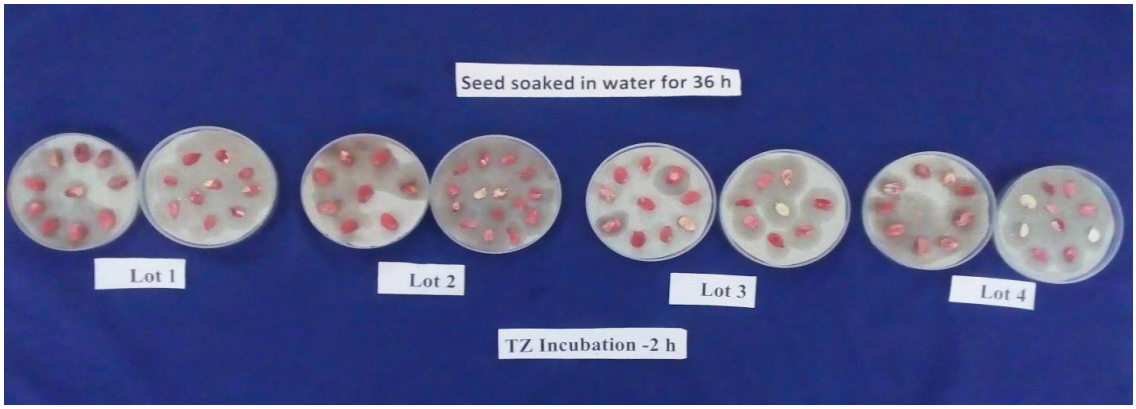


TZ incubation for 3 h -Embryo **TZ incubation for 4 h - Embryo**

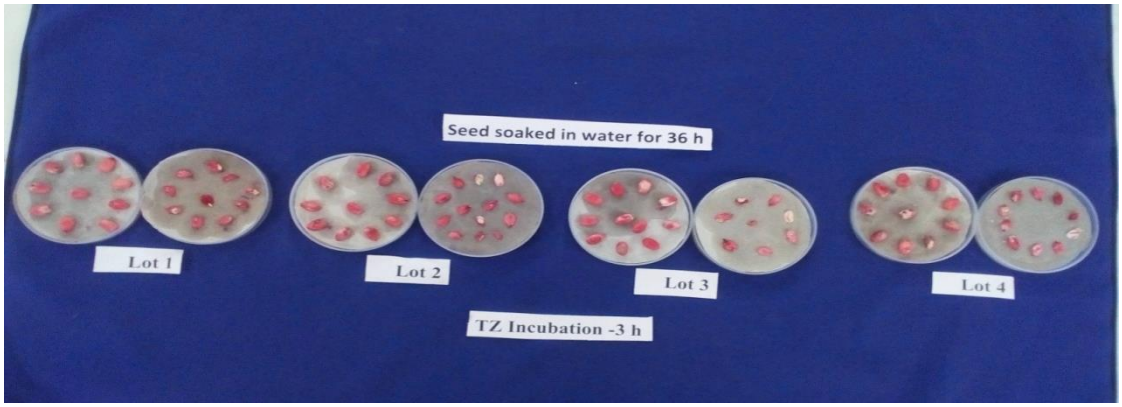


Plate 6.5: Jatropha PMT- 24 h soaking with seed coat crack opposite to Caruncle

Endosperm + embryo



Endosperm + embryo



Endosperm + embryo

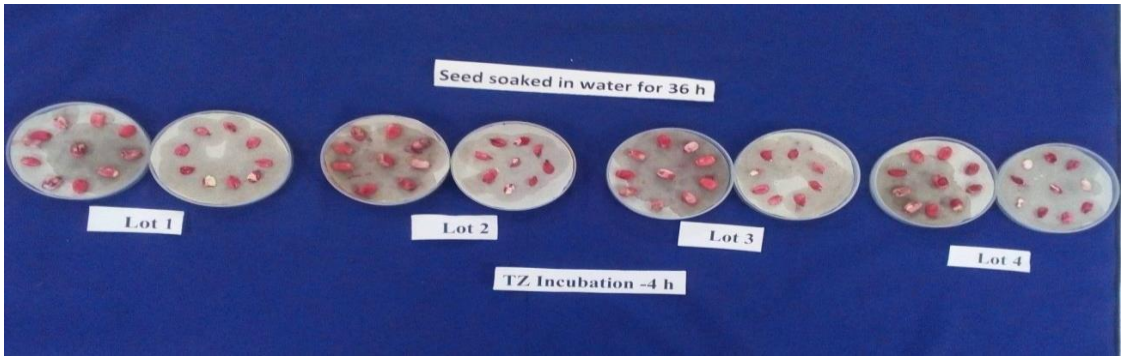


Plate 6. 6: Jatropha PMT- 36 h soaking- TZ staining pattern in different incubation periods

C. Identification of optimum temperature and test duration for conducting the germination test

Experimental Details: Germinated test was conducted in sand media with the temperature of 25 ^{0}C, 30 ^{0}C, 35 ^{0}C, for four lots (CJH 3, CJH 5, CJH 9 and CJH 12) and daily counts were taken from emergence up to the completion of germination and two days thereafter for evaluation of mortality of the seedlings. The numbers of days taken for completion of 50 per cent germination of seedlings with all essential structures were taken as the day for first count in whole number. Daily counts were taken and the days required for maximum emergence as

normal seedling, maximum measurement in shoot length, root length, dry matter production and vigour index were counted from date of sowing until the seedlings started lodging and the days required for final count was determined as whole number. Mean germination time (MGT): ∑ (fx)/ ∑x was calculated for four jatropha lots. f- number of days from initiation of germination test, x- number newly geminated seeds in each day.

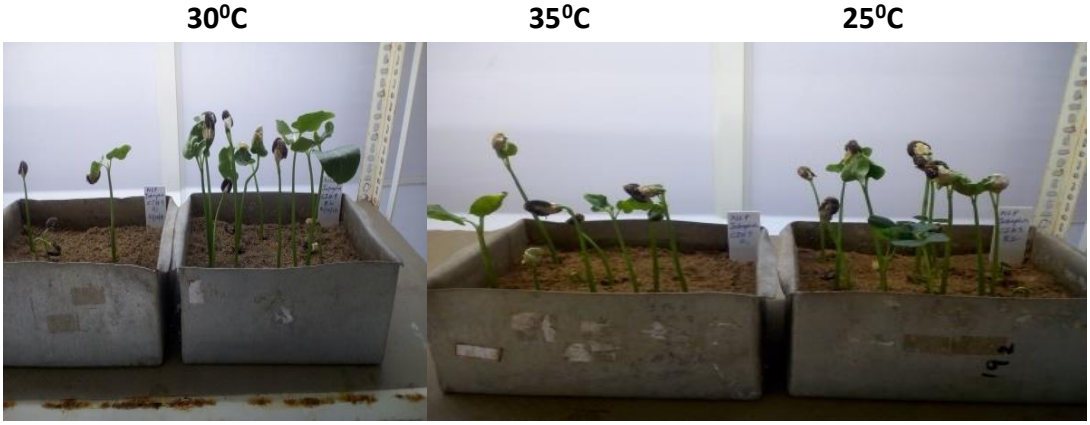


Plate 6.7: Jatropha seed germination under different temperature



Plate 6.8: Jatropha seedling growth

Results: In all jatropha lots, the germination percentage was recorded at daily interval from 4th day to 14th day. Irrespective of temperature, the germination percentage of more than 50 was recorded on 7th day, reached the maximum on 12th day and remained unaffected up to 14th day. Beyond that lodging of seedling occurred with the further extension of germination period (Table 6.14 to 6.26).

In Jatropha CJH3 lot , germination test conducted under 30 ^{o}C recorded the germination of 55 % on 7th day, reached the maximum of 75 % on 12th day compared to 25 ^{0}C (50 % &69 %, respectively) and 35 ^{0}C (43 % & 66 %, respectively) and remained unaffected up to 14th day. The root length of seedling increased gradually from 6.86 cm on 7th day to 10.46 cm on 12th day than 25 ^{0}C (6.17 cm and 10.06 cm, respectively) (Table 6.14).The shoot length was 14.60 cm on 7th day of germination, which increased to 21.15 cm on 12th day than 25 ^{0} C (12.41 cm & 17.84

cm, respectively) and 35 ^{0} C (11.41 cm & 17.13 cm, respectively) (Table 2). The dry matter production was 1.75 g on 7th day, which increased to 2.56 g on 12th day. Thereafter it decreased (Table 6.15). The vigour index also reflected the same trend (Table 6.16).

In Jatropha CJH 5 lot , germination test conducted under 30 ^{o}C recorded the germination of 58 % on 7th day, reached the maximum of 82 % on 12th day compared to 25 ^{0}C (52 % &77 %, respectively) and 35 ^{0}C (48 % &73 %, respectively) and remained unaffected up to 14th day. The root length of seedling increased gradually from 8.31cm on 7th day to 12.87 cm on 12th day than 25 ^{0}C (6.88 cm and 11.53 cm, respectively) (Table 6.17).The shoot length was 13.78 cm on 7th day of germination, which increased to 18.53 on 12th day than 25 ^{0}C (13.36 cm & 17.56 cm, respectively) and 35 ^{0}C (13.42 cm & 17.12 cm, respectively) (Table 6.18). The dry matter production was 1.92 g on 7th day, which increased to 2.72 g on 12th day. Thereafter it decreased (Table 6.18). The vigour index also reflected the same trend (Table 6.19).

Table 6.14: Effect of temperature on days to final count for germination and root length in Jatropha CJH3 variety

Days After Sowing (DAS)	Germination (%)			Mean	Root Length			Mean
	25 ^{0}C	30 ^{0}C	35 ^{0}C		25 ^{0}C	30 ^{0}C	35 ^{0}C	
4 DAS	22	27	17	**22**	4.86	5.14	4.62	**4.87**
5 DAS	31	37	28	**32**	5.21	5.86	5.07	**5.38**
6 DAS	40	48	37	**42**	5.92	6.23	5.68	**5.94**
7 DAS	50	55	43	**49**	6.17	6.86	5.97	**6.33**
8 DAS	54	62	50	**55**	7.00	7.89	6.77	**7.22**
9 DAS	59	67	55	**60**	7.52	8.23	7.26	**7.67**
10 DAS	65	71	62	**66**	8.20	8.90	8.06	**8.39**
11 DAS	68	73	64	**68**	9.41	10.27	9.26	**9.65**
12 DAS	69	75	66	**70**	10.06	10.46	10.00	**10.17**
13 DAS	69	75	66	**70**	10.14	10.53	10.14	**10.27**
14 DAS	69	75	66	**70**	10.26	10.54	10.18	**10.33**
Mean	**54**	**60**	**50**	**55**	**8.00**	**8.00**	**8.00**	**8.00**
SEd	2.12	2.17	2.03		0.11	0.17	0.14	
CD (p=0.05)	4.25	4.40	4.14		0.23	0.38	0.30	

Table 15: Effect of temperature on shoot length (cm) and dry matter production (g 10 seedling^{-1}) in Jatropha CJH3 variety.

Days After Sowing (DAS)	Shoot Length (cm)			Mean	DMP (g 10 seedling^{-1})			Mean
	25 ^{0}C	30 ^{0}C	35 ^{0}C		25 ^{0}C	30 ^{0}C	35 ^{0}C	
4 DAS	9.41	10.62	8.86	**9.63**	1.37	1.48	1.27	**1.37**

5 DAS	10.86	12.34	9.43	**10.88**	1.46	1.55	1.34	**1.45**
6 DAS	11.52	13.72	10.62	**11.95**	1.52	1.62	1.46	**1.53**
7 DAS	12.41	14.60	11.41	**12.81**	1.58	1.75	1.52	**1.62**
8 DAS	14.14	15.74	12.86	**14.25**	1.84	1.92	1.72	**1.83**
9 DAS	15.95	16.83	13.74	**15.51**	1.96	2.07	1.88	**1.97**
10 DAS	16.41	17.17	15.38	**16.32**	2.11	2.23	1.93	**2.09**
11 DAS	17.56	19.41	16.40	**17.79**	2.36	2.45	2.21	**2.34**
12 DAS	17.84	20.15	17.13	**18.37**	2.47	2.56	2.28	**2.44**
13 DAS	17.88	20.26	17.24	**18.46**	2.45	2.55	2.26	**2.42**
14 DAS	17.90	20.27	17.30	**18.49**	2.43	2.55	2.25	**2.41**
Mean	**14.72**	**16.46**	**13.67**	**14.95**	**1.96**	**2.07**	**1.83**	**1.95**
SEd	0.09	0.13	0.10		0.03	0.04	0.02	
CD (p=0.05)	0.19	0.25	0.20		0.05	0.08	0.05	

Table 6.16: Effect of temperature on vigour index in Jatropha CJH3 variety

Days After Sowing (DAS)	**Vigour Index**			**Mean**
	25^{0}C	**30^{0}C**	**35^{0}C**	
4 DAS	314	426	229	**323**
5 DAS	498	673	406	**526**
6 DAS	698	958	603	**753**
7 DAS	929	1180	747	**952**
8 DAS	1142	1465	982	**1196**
9 DAS	1385	1679	1155	**1406**
10 DAS	1600	1851	1453	**1635**
11 DAS	1834	2167	1642	**1881**
12 DAS	1925	2296	1791	**2004**
13 DAS	1933	2309	1807	**2017**
14 DAS	1943	2311	1814	**2022**
Mean	**1291**	**1574**	**1148**	**1338**
SEd	33.5	38.7	40.0	
CD (p=0.05)	67.0	77.4	80.3	

Table 6.17: Effect of temperature on days to final count for germination and root length (cm) in Jatropha CJH5 variety

Days After Sowing (DAS)	**Germination (%)**			**Mean**	**Root Length (cm)**			**Mean**
	25 ^{0}C	**30 ^{0}C**	**35 ^{0}C**		**25 ^{0}C**	**30 ^{0}C**	**35 ^{0}C**	
4 DAS	23	28	19	**23**	4.67	5.87	5.11	**5.22**
5 DAS	33	37	28	**33**	5.30	6.14	5.92	**5.79**

6 DAS	41	45	36	**41**	6.13	7.26	6.71	**6.70**
7 DAS	52	58	48	**53**	6.88	8.31	7.20	**7.46**
8 DAS	64	69	57	**63**	7.18	9.46	8.63	**8.42**
9 DAS	68	73	61	**67**	8.24	10.11	9.04	**9.13**
10 DAS	71	75	66	**71**	9.10	11.62	10.11	**10.28**
11 DAS	76	79	70	**75**	10.62	12.14	11.26	**11.34**
12 DAS	77	82	73	**77**	11.53	12.87	11.40	**11.93**
13 DAS	77	82	72	**77**	11.55	12.85	11.42	**11.94**
14 DAS	77	82	72	**77**	11.54	12.86	11.41	**11.94**
Mean	**60**	**65**	**55**	**60**	**8.00**	**10.00**	**9.00**	**9.00**
SEd	2.60	2.33	1.80		0.42	0.51	0.37	
CD (p=0.05)	5.22	4.66	3.61		0.83	1.03	0.75	

Table 6.18: Effect of temperature on shoot length (cm) and dry matter production (g 10 seedling^{-1}) in Jatropha CJH5 variety

Days After Sowing (DAS)	Shoot Length (cm)			Mean	DMP (g 10 seedling^{-1})			Mean
	25 ^{0}C	**30 ^{0}C**	**35 ^{0}C**		**25 ^{0}C**	**30 ^{0}C**	**35 ^{0}C**	
4 DAS	10.14	11.23	10.70	**10.69**	1.42	1.50	1.36	**1.43**
5 DAS	11.32	12.14	11.52	**11.66**	1.53	1.66	1.47	**1.55**
6 DAS	12.56	12.86	12.00	**12.47**	1.62	1.74	1.52	**1.63**
7 DAS	13.36	13.78	13.11	**13.42**	1.77	1.92	1.70	**1.80**
8 DAS	14.86	15.20	13.86	**14.64**	1.92	2.08	1.86	**1.95**
9 DAS	15.31	16.71	14.34	**15.45**	2.14	2.25	2.00	**2.13**
10 DAS	16.33	17.30	15.62	**16.42**	2.34	2.42	2.21	**2.32**
11 DAS	17.00	18.14	16.74	**17.29**	2.42	2.66	2.36	**2.48**
12 DAS	17.56	18.53	17.12	**17.74**	2.67	2.72	2.57	**2.65**
13 DAS	17.62	18.50	17.16	**17.76**	2.65	2.70	2.57	**2.64**
14 DAS	17.60	18.50	17.15	**17.75**	2.64	2.70	2.55	**2.63**
Mean	**14.88**	**15.72**	**14.48**	**15.03**	**2.10**	**2.21**	**2.02**	**2.11**
SEd	0.32	0.24	0.41		0.05	0.03	0.06	
CD (p=0.05)	0.65	0.50	0.81		0.10	0.06	0.12	

Table 6.19: Effect of temperature on vigour index in Jatropha in CJH5 variety

Days After Sowing (DAS)	Vigour Index			Mean
	25 ^{0}C	**30 ^{0}C**	**35 ^{0}C**	
4 DAS	341	479	300	**373**
5 DAS	548	676	488	**571**
6 DAS	766	905	674	**782**
7 DAS	1052	1281	975	**1103**
8 DAS	1411	1702	1282	**1465**

9 DAS	1601	1958	1426	**1662**
10 DAS	1806	2169	1698	**1891**
11 DAS	2099	2392	1960	**2150**
12 DAS	2240	2575	2082	**2299**
13 DAS	2246	2571	2058	**2292**
14 DAS	2244	2572	2056	**2291**
Mean	1487	1753	1364	**1534**
SEd	28.2	33.4	37.6	
CD (p=0.05)	56.4	66.7	65.3	

In Jatropha CJH 9 lot , germination test conducted under 30 ^{o}C recorded the germination of 55 % on 7th day, reached the maximum of 78 % on 12th day compared to 25 ^{0}C (51 % &73 %, respectively) and 35 ^{0}C (49 % &70 %, respectively) and remained unaffected up to 14th day. The root length of seedling increased gradually from 7.72 cm on 7th day to 13.43 cm on 12th day than 25 ^{0}C (6.70 cm and 11.76 cm, respectively). (Table 6.20).The shoot length was 13.80 cm on 7th day of germination, which increased to 18.94 on 12th day than 25 ^{0}C (12.50 cm & 18.30 cm, respectively) and 35 ^{0}C (11.25 cm & 16.73 cm, respectively) (Table 21). The dry matter production was 1.60 g on 7th day, which increased to 2.35 g on 12th day. Thereafter it decreased (Table 6.21). The vigour index also reflected the same trend (Table 6.22).

Table 6.20: Effect of temperature on days to final count for germination (%) and root length (cm) in Jatropha CJH9 variety

Days After Sowing (DAS)	Germination (%)			Mean	Root Length (cm)			Mean
	25 ^{0}C	30 ^{0}C	35 ^{0}C		25 ^{0}C	30 ^{0}C	35 ^{0}C	
4 DAS	18	22	17	**19**	3.92	4.16	4.00	**4.03**
5 DAS	26	30	25	**27**	4.64	5.23	4.82	**4.90**
6 DAS	39	44	36	**40**	5.72	6.89	5.43	**6.01**
7 DAS	51	55	49	**52**	6.70	7.72	6.11	**5.18**
8 DAS	54	62	52	**56**	7.42	8.61	7.20	**7.74**
9 DAS	58	67	60	**62**	8.90	9.38	8.42	**8.90**
10 DAS	63	71	62	**65**	10.62	10.78	9.86	**10.42**
11 DAS	67	76	65	**69**	11.15	12.14	10.53	**11.27**
12 DAS	73	78	70	**74**	11.76	13.43	11.20	**12.13**
13 DAS	73	78	70	**74**	11.82	13.40	11.20	**12.14**
14 DAS	73	78	70	**74**	11.80	13.42	11.18	**12.13**
Mean	**54**	**60**	**52**	**56**	**8.59**	**9.11**	**8.18**	**8.62**
SEd	3.04	2.82	3.11		0.54	0.41	0.47	
CD (p=0.05)	6.07	5.65	6.22		1.08	0.83	0.95	

Table 6.21: Effect of temperature on shoot length (cm) and dry matter production (g 10 seedling^{-1}) in Jatropha CJH9 variety

Days After Sowing (DAS)	Shoot Length (cm)			Mean	DMP (g 10 seedling^{-1})			Mean
	25 ^{0}C	30 ^{0}C	35 ^{0}C		25 ^{0}C	30 ^{0}C	35 ^{0}C	
4 DAS	9.15	10.14	8.62	**9.30**	1.26	1.32	1.24	**1.27**
5 DAS	10.62	11.30	9.45	**10.46**	1.30	1.39	1.31	**1.33**
6 DAS	11.43	12.62	10.62	**11.56**	1.42	1.52	1.36	**1.43**
7 DAS	12.50	13.80	11.25	**12.52**	1.49	1.60	1.40	**1.50**
8 DAS	13.62	14.20	11.86	**13.23**	1.53	1.71	1.48	**1.57**
9 DAS	14.71	15.77	12.62	**14.37**	1.86	1.83	1.63	**1.77**
10 DAS	15.63	16.82	13.87	**15.44**	1.95	2.07	1.72	**1.91**
11 DAS	17.20	17.52	14.61	**16.44**	2.17	2.27	1.94	**2.13**
12 DAS	18.30	18.94	16.73	**17.99**	2.24	2.35	2.13	**2.24**
13 DAS	18.52	18.99	16.70	**18.07**	2.26	2.35	2.15	**2.25**
14 DAS	18.50	18.92	16.71	**18.04**	2.25	2.32	2.12	**2.23**
Mean	**14.56**	**15.37**	**13.00**	**14.31**	**1.79**	**1.88**	**1.68**	**1.79**
SEd	0.44	0.56	0.47		0.06	0.04	0.08	
CD (p=0.05)	0.90	1.12	0.99		0.13	0.08	0.15	

Table 6.22: Effect of temperature on vigour index in Jatropha in CJH9 variety

Days After Sowing (DAS)	Vigour Index			Mean
	25 ^{0}C	30 ^{0}C	35 ^{0}C	
4 DAS	235	315	215	**255**
5 DAS	397	496	357	**416**
6 DAS	669	858	578	**702**
7 DAS	979	909	851	**913**
8 DAS	1136	1414	991	**1181**
9 DAS	1369	1685	1262	**1439**
10 DAS	1654	1960	1471	**1695**
11 DAS	1899	2254	1634	**1929**
12 DAS	2194	2525	1955	**2225**
13 DAS	2215	2526	1953	**2231**
14 DAS	2212	2523	1952	**2229**
Mean	1360	1588	1202	**1383**
SEd	41.0	38.6	43.3	
CD (p=0.05)	82.0	67.2	86.5	

In Jatropha CJH 12 lot , germination test conducted under 30 ^{o}C recorded the germination of 50 % on 7th day, reached the maximum of 72 % on 12th day compared to 25 ^{0}C (46 % &67 %,

respectively) and 35 ^{0}C (43 % & 63 %, respectively) and remained unaffected up to 14th day. The root length of seedling increased gradually from 6.84 cm on 7th day to 11.86 cm on 12th day than 25 ^{0}C (5.63 cm and 9.45 cm, respectively). (Table 6.23).The shoot length was 11.11 cm on 7th day of germination, which increased to 16.07 on 12th day than 25 ^{0}C (10.78 cm & 15.30 cm, respectively) and 35 ^{0}C (9.73 cm & 13.15 cm, respectively) (Table 6.24). The dry matter production was 1.67 g on 7th day, which increased to 2.41 g on 12th day. Thereafter it decreased (Table 6.24). The vigour index also reflected the same trend (Table 6.25).

Table 6.23: Effect of temperature on days to final count for germination (%) and root length (cm) in Jatropha CJH12 variety

Days After Sowing	Germination (%)			Mean	Root Length (cm)			Mean
	25 ^{0}C	30 ^{0}C	35 ^{0}C		25 ^{0}C	30 ^{0}C	35 ^{0}C	
4 DAS	18	22	16	**19**	3.34	3.96	3.17	**3.49**
5 DAS	27	34	22	**28**	3.92	4.14	3.61	**3.89**
6 DAS	35	43	31	**36**	4.56	5.24	4.26	**4.69**
7 DAS	46	50	43	**46**	5.63	6.84	5.07	**5.85**
8 DAS	52	57	50	**53**	6.81	7.16	6.52	**6.83**
9 DAS	58	64	54	**59**	6.93	8.37	7.17	**7.49**
10 DAS	63	68	60	**64**	7.42	9.90	7.81	**8.38**
11 DAS	65	70	62	**66**	8.11	11.43	9.15	**9.56**
12 DAS	67	72	63	**67**	9.45	11.86	9.70	**10.34**
13 DAS	67	72	63	**67**	9.52	11.78	9.72	**10.34**
14 DAS	67	72	63	**67**	9.50	11.77	9.70	**10.32**
Mean	**51**	**57**	**48**	**52**	**6.84**	**8.40**	**6.90**	**7.38**
SEd	2.13	2.61	2.85		0.32	0.44	0.51	
CD (p=0.05)	4.25	5.22	5.72		0.65	0.89	1.01	

Table 6.24. Effect of temperature on shoot length (cm) and dry matter production (g 10 seedling^{-1}) in Jatropha CJH12 variety

Days After Sowing	Shoot Length (cm)			Mean	DMP (g 10 seedling^{-1})			Mean
	25 ^{0}C	30 ^{0}C	35 ^{0}C		25 ^{0}C	30 ^{0}C	35 ^{0}C	
4 DAS	7.41	8.62	6.94	**7.66**	1.18	1.32	1.08	**1.19**
5 DAS	8.62	9.46	7.56	**8.55**	1.24	1.47	1.13	**1.28**
6 DAS	9.43	10.72	8.41	**9.52**	1.37	1.53	1.21	**1.37**
7 DAS	10.78	11.11	9.73	**10.54**	1.45	1.67	1.38	**1.50**
8 DAS	11.46	12.44	10.62	**11.51**	1.56	1.80	1.42	**1.59**
9 DAS	12.52	13.30	11.51	**12.44**	1.62	1.94	1.58	**1.71**
10 DAS	13.64	14.42	11.92	**13.33**	1.83	2.11	1.71	**1.88**
11 DAS	14.71	15.21	12.63	**14.18**	1.94	2.32	1.82	**2.03**
12 DAS	15.30	16.07	13.15	**14.84**	2.07	2.41	1.93	**2.14**

13 DAS	15.31	16.09	13.10	**14.83**	2.04	2.40	1.90	**2.11**
14 DAS	15.30	16.00	13.11	**14.80**	2.05	2.40	1.91	**2.12**
Mean	**12.23**	**13.04**	**10.79**	**12.02**	**1.67**	**1.94**	**1.55**	**1.72**
SEd	0.55	0.48	0.57		0.04	0.07	0.06	
CD (p=0.05)	1.12	0.97	1.15		0.08	0.14	0.13	

Table 6.25: Effect of temperature on vigour index in Jatropha in CJH12 variety

Days After Sowing	Vigour Index			Mean
	25 ^{0}C	**30 ^{0}C**	**35 ^{0}C**	
4 DAS	194	277	162	**211**
5 DAS	339	462	246	**349**
6 DAS	490	686	393	**523**
7 DAS	755	898	636	**763**
8 DAS	950	1117	857	**975**
9 DAS	1128	1387	1009	**1175**
10 DAS	1327	1654	1184	**1388**
11 DAS	1483	1865	1350	**1566**
12 DAS	1658	2011	1440	**1703**
13 DAS	1664	2007	1438	**1703**
14 DAS	1662	1999	1437	**1699**
Mean	**1059**	**1306**	**923**	**1096**
SEd	34.4	30.5	36.1	
CD (p=0.05)	68.9	61.2	72.2	

Table 6.26. Effect of temperature on mean germination time in different Jatropha variety

Days After Sowing	Mean germination time			Mean
	25 ^{0}C	**30 ^{0}C**	**35 ^{0}C**	
CJH 3	6.2	5.8	6.6	6.2
CJH 5	5.7	5.2	6.0	5.6
CJH 9	6.6	6.2	6.7	6.5
CJH12	7.5	7.3	7.8	7.5
Mean	6.5	6.1	6.8	6.5
SEd	0.06	0.12	0.14	
CD (p=0.05)	0.13	0.25	0.27	

The minimum mean germination time (MGT) was recorded under 30 ^{0}C in CJH 5 lot where as maximum MGT was recorded at 30 ^{0}C (6.0). Irrespective of seed lot maximum mean

germination time (MGT) was recorded at 30 ^{0}C (6.8) than 25 ^{0}C (6.5) and 30 ^{0}C (6.1) (Table 6.26)

Salient findings: The optimum temperature recorded for the maximum germination of jatropha was 30^{0}C and days to take first count was 7th day and final count for jatropha germination (%) was 12th days after germination test.

Highlights: *The optimum temperature for germination is 30 ^{0}C and days for first count and final count is 7th and 12th days respectively. Jatropha seed viability can be evaluated through the pre-moistening treatment of 26 h using whole seeds with seed coat cracked at opposite to the hilum and soaked in water for 24 h using the embryo as tissue for 3.0 h as staining duration.*

C. Seed Pathology

Significant observations:

- Rice bunt has only been observed in samples from OUAT, Bhubaneswar; MPKV Rahuri; CCAU Hisar; PJTSAU, Hyderabad and PAU Ludhiana. The highest bunt infection was 2.6% in samples from PAU, Ludhiana, where 91.7% samples were carrying bunt infection. At PJTSAU, Hyderabad and MPKV, Rahuri, 16.6% and 8.16% samples infected with rice bunt, respectively and maximum infection was up to 0.9%.
- Potato virus Y and Corm rot of saffron are emerging as new seed- borne diseases at Jammu & Kashmir and bacterial panicle blight of rice, bacterial canker and wilt of tomato are emerging as new seed- borne diseases at Uttarakhand.
- Fifty per cent of farmers' saved seed samples evaluated by PAJANCOA & RI, Karaikal, and 36% farmers' saved seed samples evaluated by AAU Jorhat exhibited germination much below IMSCS indicating very poor quality of farmers own saved seeds at respective locations..
- CSKHPKV, Palampur and PAU, Ludhiana reported a very high incidence of karnal bunt in the farmers' saved and unprocessed seed samples. In Himachal Pradesh, Karnal bunt infection of wheat reached maximum up to 6.0% at Mathai in Kangra, whereas in Punjab Karnal bunt infection reached to maximum 12.5% (in samples from Patiala). No loose smut and ear cockle is reported in any of the sample at both the places.
- Standardized the molecular diagnostic method for detection of seed-borne infection of BCMV in mungbean; *Pepper mild mottle virus* (PMMoV) of Capsicum; *Potato Virus Y* in potato tubers, *Burkholderia glumae* in paddy seed.
- Modified standard blotter test by replacing 2-4 D with 0.5% NaOH which is found to be superior for detection of *Fusarium sp*. and *Macrophomina sp.* in mungbean and soybean seed based on studies conducted at TNAU, Coimbatore; PJTSAU, Hyderbad and validated at GBPUA&T, Pantnagar,
- The most effective management of *Alternaria solani* in tomato seed crop was through three foliar sprays of Azoxystrobin (18.2 %) + Difenconazole (11.4 %) @ 0.03% which recorded least incidence and improved fruit and seed yield.

Experiment 01: Monitoring and detection of rice bunt in processed, unprocessed and farmers' seed sample and bacterial leaf blight & bacterial panicle blight at farmer's field.

Centres: AAU, Jorhat; AAU, Anand; CCSHAU, Hisar; CSKHPAU, Palampur; CSAUAT, Kanpur; GBPUAT, Pantnagar; IARI, New Delhi; JNKVV, Jabalpur; KAU, Pattambi; MPKV, Rahuri; NDUAT, Faizabad; OUAT, Bhubaneswar; PAJANCOA&RI, Karaikal; PAU, Ludhiana; PJTSAU, Hyderabad; RPCAU, Pusa; SKNAU, Durgapura; SKUAST, Srinagar; TNAU, Coimbatore ; VNMKV Parbhani

OUAT, Bhubaneswar

A total of 2232 seed samples were collected from farmers of 18 districts. No bunt incidence was found in farmers' seed sample of four districts i.e. Angul, Baragarh, Kandhamal and Rayagada. In remaining districts, 4.7 to 16% of farmers' saved paddy samples were infected with bunt. Whereas, bunt incidence was observed in 9.7 to 24.8% of unprocessed seed samples and 3 to 6.1% of processed seed samples from different districts of Odisha. The range of bunt incidence varied from 0 to 0.9% in unprocessed seed samples and maximum bunt incidence was found in varieties *viz.,* Sanskar, Moti, Swarna sub 1, MTU 1001, MTU 1010, Kalashree, Samalei, CR 1014, Nilambar, IR 36, IR 64, CR 1030 and Uphar.

There was no incidence of panicle blight in farmers' field of 10 different districts *viz.,* Cuttack, Puri, Khurda, Mayurbhanj, Keonjhar, Ganjam, Rayagada, Sundargarh, Baragarh and Sambalpur.

Bunt infection:

Seed Category	Location covered	Sample tested	Sample infected	% Sample infected	% Range infected (bunt)	Remark	Varieties
OUAT, Bhubaneswar							
Farmers' samples	**District**					No bunt	Jagannath, Moti, Swarna Pusa, Murdini, Subarna Kalachampa, Ranidhan Baidyaraj, Pooja, Sarala Mahanadi Prachi Lalat, MTU1001, Pratikhya Bhuban, Soubhagya Ranjit, Sindhu, MTU 1010, MTU 1010 Sahabhagi, Prativa, Prachi Acharmati, Sidhanta, Uphar, Mahanadi, Padmini, Jagabandhu Krushnabhog, Swarna Sub 1, Padmini, Jajati Kalajeera, Masoori, Manaswini Mahanadi, Kranti Ranidhan, Parijat, Mayurakantha, Surendra Anjali, Khandagiri, CR 1009, Bina, PKU 44, Naveen, Hasanta, Asutosh, Mrunalini CR 1018, Gajapati, Acharmati, Indrabati Padmini, Udaygiri Sidhanta,
	Angul	110	None	00.00	00.00	No bunt	
	Rayagada	138	None	00.00	00.00	No bunt	
	Baragarh	148	None	00.00	00.00	No bunt	
	Nayagarh	140	None	00.00	00.00		
	Kandhamal	118	None	00.00	00.00	No bunt	
	Balasore	100	8.0	8.0	00-0.1	Bunt infection within certification limits	
	Dhenkanal	105	5.0	04.70	00.0.1	Bunt incidence was within certification limits	
	Cuttack	165	25.0	15.15	00.015	Bunt was within certification limits	
	Ganjam	125	20.0	16.00	00.00		
	Jharsuguda	115	8.0	6.95	00-0.1		
	Kalahandi	130	11.0	8.46	00-0.1		

	Nuapada	135	12.0	8.80	00-0.3	Very few samples were above certification standards	Juhi, Ranjeet , solari, Badala CR Dhan 506, CR Dhan 801, CR 1018, Satyabhama, Niranjan, Sitabhog, Deradoon, Pratikhya Manaswini, Konark, Barsa Kadambini, Kasturi, Khudrat, Mahalaxmi Basumati, Jeevan, Badal, Tapaswini, Dharitri, Kalasree,
	Mayurbhanj	250	32.0	12.8	00-0.2		
	Khurda	140	15.0	10.71	00-0.1	`	
	Keonjhar	185	20.0	10.81	00- 0.3	Very few samples were above certification standards	
	Puri	128	15.0	11.71	00-0.1		
Unprocessed samples							
	Cuttack	125	31.0	24.8	00-0.6	-	Swarna, CR 1014, MTU1010,Ranidhan,sanskar, lalat, puja bina, Swarana sub-1, Mahanadi, Moti, Naveen Pratikhya , Krushna, Krushna , Mtu 1001, MTU 1010 , sanskar, Padmini, Jajati Kalajeera, Masoori, Manaswini Mahanadi, Kranti Ranidhan, Parijat
	Ganjam	105	14.0	14.0	00-0.7	-	
	Keonjhar	215	20.0	9.7	00-0.9	-	
	Khurda	110	12.0	10.9	00-0.7	-	
	Sundargarh	105	12.0	11.4	00-0.4	-	
Processed seed samples (708)	Cuttack	135	8.00	5.9%		None of the samples has infection above certification standard	Almost all the varieties popularly in demand
	Ganjam	118	6.0	5.08	00-0.05	-	
	Keonjhar	245	15.0	6.1	00-0.05	-	
	Khurda	100	3.0	3.0	00-0.05	-	
	Sundargarh	110	6.0	5.4%	00-0.05		

Bacterial leaf blight

Locations	no. of infected fields	Location/districts	Minimum no. of plants evaluated in each field	Observation on infection as per rating scale 1-9	Remark if any
250 fields	94	Khurda Mayurbhanj Keonjhar Sambalpur khurda	100	1-5	Pooja, Pratikhya and swarna exhibited maximum severity of BLB.

- **No panicle blight was observed in any of the fields surveyed**

CCSHAU, Hisar

Bunt infection:

Type of samples	Location /districts	Total no. of samples	Per cent samples infected	Range of infection	Remark
Farmers samples	Jind, Kurukshetra, Yamuna Nagar, Karnal, Hisar Kaithal, Fatehabad, Sirsa	563	14.56%	0.05-0.25	Pusa-4, Pusa-44 followed by HKR-127, PR 118 and PB-1 exhibited maximum infection. Bunt infection is within certification limit
Unprocessed samples	Kurukshetra, Yamuna Nagar, Hisar, Fatehabad, Sirsa	115	13.24	0.05-0.25	HKR-127, Pusa- 44, PR 118 and PB-1. Bunt infection is within certification limit

Bacterial blight:

Type of sample	Location /districts	Field surveyed /	Infected fields	Disease in Rating scale (0-9)	Remark
Farmers field	Jind, Kurukshetra, Yamuna Nagar, Karnal, Hisar Kaithal, Fatehabad, Sirsa	54	12	1-5	Pusa-44 & PR 118 showed maximum incidence
Seed production plots		52	6	1-5	The variety Pusa-44 & PR 118 showed maximum incidence in seed production plots at all the locations (52) at three districts Yamuna Nagar, Kurukshetra, and Karnal

Panicle blight was not observed in any of the farmers' field and in seed production plots.

PAU, Ludhiana

Out of the total 268 processed seed samples analyzed in lab, 91.7% (246 samples) were found infected with bunt. The incidence of bacterial blight was observed in low intensity on variety Pusa 44 from Jalandhar, Fatehgarh Sahib and Ropar. However, bacterial panicle blight was not observed in any district.

Bunt infection:

District surveyed	Varieties	No. of samples	Infected samples	Percent infected samples	Average bunt incidence (%)	Range of infection (%)	Remark
Processed seed samples							
Amritsar Bathinda Ferozepur Jalandhar, Kapurthala Samrala, Sangrur	PUSA 44, 1121, 1509, PUSA 1121, PR 27, 44, 45, 47,113, 114, 115, 121,122,125, 127, 202, 212, 126, 666,777, HKU5, HK47, P18, IR8, Basmati 4,	268	246	91.7	0.1- 0.39	0.1-1.4	The highest bunt incidence of 1.4% was recorded in var. PR127 from Bathinda and Ferozepur districts on variety PR 122.
Unprocessed seed samples							
Amritsar, Bathinda, Ferozepur Fazilka, Gurdaspur, Hoshiarpur Jalandhar Kapurthanla Moga, Patiala, Roper, S.B.S Nagar, Sangrur, Tarantarn	PUSA 44, 1121, 1509, PUSA 1121, PR 27, 44, 45, 47,113, 114, 115, 121,122,125, 127, 202, 212, 126, 432, 505, 666,777, 1067, 1414, 2731 4042, HKU5, HK47, P18, IR8, Basmati 4, N 53, Kranti, CSR30	1200	1162	96.5	00 - 0.75	0.05-2.6	In district Jalandhar, maximum bunt infection up to 1.78 % in a sample of variety PR 126 and in Patiala, all the samples collected, showed bunt infection above the certification standards and in variety, 127 it was up to 2.26%.

JNKVV, Jabalpur
Bunt infection:

Farmers saved sample :					
District	**Sample tested**	**Sample infected**	**% Sample infected**	**% Range infected**	**Remark**
Balaghat	19	01	05.2	0.01-0.02	IR36, Kranti and Mahamaya are the popularly grown rice varieties. Highest number (03) of infected samples (15.7%) were from Mandla, a tribal dominant belt.
Betul	15	02	13.3	0.01-0.01	
Chhatarpur	11	01	09.0	0.01-0.01	
Chhindwara	13	01	07.6	0.01-0.01	
Damoh	17	00	00.0	0.0	
Dindori	19	02	10.5	0.01-0.01	
H'bad	17	00	00.0	00	
Jabalpur	29	02	06.8	0.01-0.01	
Katni	17	01	05.8	0.01-0.01	
Mandla	19	03	15.7	0.01-0.01	
Narasinghpur	14	00	00.0	00	
Rewa	07	00	00.0	00	
Satna	12	00	00.0	00	
Seoni	11	01	09.0	0.01-0.02	
Shadol	12	00	00.0	00	
Tikamgargh	12	00	00.0	00	
Umaria	11	00	00.0	00	
17	255	14	5.49	0.01-0.02	
Khamaria Processing plant					Seed infection was within the certification standards
Unprocessed	60	02	3.3	0.01-0.02	
Processed	60	00	0.0	0.0	

Bacterial leaf blight and Panicle blight:

District	**Fields visited**	**Field infected**	**% field infected**	
			BLB	**Panicle Blight**
Balaghat	11	2	Trace	No panicle blight incidence was observed in any of the field
Betul	11	1	Trace	
Chhindwara	12	0	0	
Damoh	15	0	0	
Dindori	09	0	Severe	
H'bad	13	0	0	
Jabalpur	23	0	0	
Katni	19	0	0	
Mandla	09	2	Severe	
Narasinghpur	10	0	0	
Rewa	14	0	0	
Seoni	25	0	0	
Shadol	04	0	0	

Tikamgargh	05	0		
Umaria	05	1	Trace	
	168			

PJTSAU, Hyderabad

Bunt infection:

Locations	Type of samples collected	Number of samples collected	Number of samples affected (bunt)	Per cent samples affected (%)	Range of infection (%)	Remark
Karimnagar Nizamabad, Medak, Mahabubnagar Nalgonda, Ranga Reddy, Nirmal, Warangal Khammam	Farmers samples	633	106	16.74	0.00 - 0.97	The maximum infection of 0.9% was in the sample of district Nirmal. At rest of the locations, BPT5204, MTU1010, KNM118, RNR 15048 , BPT 5204, JGL18047, Tellahamsa & JGL 18047, Jai sree Ram, and Siddi
Karimnagar, Nizamabad, Medak, Nalgonda, Warangal	Processed samples	420	43	10.23	0.00 - 0.02	
Nizamabad Karimnagar Medak Mahabubnagar Nalgonda Warangal	Unprocessed samples	195	28	14.35	0.05 - 0.17	
	Total	**1248**	**177**	**14.18**		

Bacterial Leaf Blight and panicle blight:

Across the paddy fields visited for the incidence bacterial leaf blight during the year 2018-19, majority of them were found free from bacterial leaf blight incidence. However, in some fields of Nizamabad and Suryapet districts up to 70% leaf area damage (rating scale 9) was observed. About 1-12% of leaf area damage (rating scale 1-3%) was noticed in Nalgonda district and 1-5% leaf area damage (rating scale 1) was observed in Karimnagar, Mahabubnagar and Khammam districts. No incidence of BLB was observed in farmers' fields of Warangal district.

MPKVV, Rahuri

Bunt infection:

Total Districts covered	Type of samples collected	Number of samples collected	No of Infected samples	Varieties	Remark
	Farmers				

	samples				
04		431	00.0	Indrayani, Phule Radha, Pusa Basmati-1, Chimansal, Phule Samrudhi, Kolam, Karjat-5, Karjat-2, Sahyadri-2, Sahyadri-4, Bhogawati, Ambemohar-157, Basmati-370, Kundalika, Wada kolam, Surati Kolam, Daptari-1008, Om Shriram, LK-248, Raibhog, Kalbhat, D-100, YSR, Ratna, HMT-Sona, Sal and Kolapi	Samples from Konkan Region – Ratnagiri, Dapoli Exhibited bunt infection in the range of 0.10-0.25.
	Un-processed samples	49	19 (8.16%)		
	Processed samples	30	00		

Bacterial Leaf Blight and panicle blight:

No bacterial blight nor panicle blight was observed in seed plots and farmers field

Sher-E-Kashmir University, Srinagar

None of the processed, unprocessed and farmers sample exhibited bunt infection. Bacterial and panicle blight also not observed in any of the seed production fields and farmer's field.

CSKHPKV, Palampur

In Una, Solan, Dhaulakaun and Kangra districts, paddy field were surveyed and samples examined, none of the rice seed sample showed the presence of rice bunt in any of the location nor there has been the incidence of bacterial leaf blight and panicle blight. However, grain discoloration was quite high in various locations. Grain discolouration was recorded in 73 samples with an incidence of 5.0 to 70.0 per cent.

VNMKV, Parbhani

During monitoring of farmers' field and seed production plots, no bacterial leaf blight and panicle blight was observed. Besides, no bunt incidence in processed and unprocessed paddy seed samples of ARS Tuljapur of popularly cultivated varieties (TJP-48 and Terna) was observed in any of the sample collected.

RPCAU, Dholi, Muzaffarpur (Bihar)

Out of 89 samples of farmers, unprocessed samples and processed samples examined, none of the sample of any variety was carrying bunt infection.

A survey of 72 farmers fields, 48 fields were infected with Bacterial leaf blight in the range of 0 – 3 scale. The maximum BLB incidence was in R. Sweta, Hybrid 6444, Prabhat followed by PB 71, Rajshree etc.

Seed production plots are having twenty varieties at Pusa & Dholi farm, around 38% fields carrying BLB infection in the range of 0 – 3 scale.

PAJANCOA, Karaikal

No bunt incidence in any of the farmers' samples and in unprocessed and processed seed samples at Puducherry (UT) in any of the variety.

The observation on BLB incidence in the Farmers' field revealed that the level of percentage field infection was more in Farmers' field (40%) as compared to Seed Production plots (10%) showing BLB at Seed Farm of PAJANCOA & RI, Karaikal.

IARI, New Delhi

Rice bunt (*Tilletia barclayana*)

Seventy-four seed samples of different varieties of paddy were collected from Noida Gurgaon, Baraut and Meerut districts for detection of bunt. Out of the 74 seed samples collected from various places mentioned above, none of the sample showed the incidence of bunt. In Pusa 1121, both in farmers field in different villages of Baraut, Noida, Gurgaon and Meerut as well as in seed production plots of IARI, BLB was observed in moderate severity while, in other varieties it was not so severe.

TNAU, Coimbatore

Seed samples, collected from locations did not exhibit bunt incidence. Bacterial leaf blight was also found in farmers and seed production plots at Coimbatore in the range of 10-12% and no panicle blight was observed in any field surveyed.

AAU, Anand

No bunt, bacterial blight and panicle blight was observed in any of the location and samples tested.

AAU, Jorhat

One Hundred (100) paddy samples of fifteen (15) popular as well as local varieties of different farmers' field of Sonitpur district and one hundred (100) samples of forty three (43) varieties from seed production plots of AAU, Jorhat were analysed for Bunt infection. None of the tested samples showed any infection of bunt disease.

Out of 71 farmers' fields surveyed, BLB was recorded in 1-3 scale in three varieties, while other varieties were free from infection. In seed production plots of AAU, BLB was recorded in a score of 1 in the variety Ranjit, in early growth stage. No panicle blight was observed.

Experiment 2: Monitoring of emerging new diseases of seed-borne nature
Centre: All centres

University	New diseases	Remark
Sher-e-Kashmir University, Srinagar	Potato Virus Y (PVY)	Out of 30 samples collected, 12 samples exhibited PVY positive and hence presence of PVY in potato fields of the valley is observed. The presence of PYV was also confirmed by molecular diagnosis.
	Corm rot of Saffron	Corm rot of Saffron is being observed in valley for the first

		time. The causal agent is found to be a complex of *Fusarium sp., Rhizotonia sp., & Penicillum sp.* Symptoms are observed during the flowering stage, as yellowing and wilting of shoots due to basal stem rot and the development of white rounded spots on the corm.
GBPUA&T, Pantnagar	Bacterial Panicle Blight of paddy (*Burkholderia glumae*)	The pathogen produces wide range of symptoms at different plant growth stages starting from seedling blight and rots in nursery to the dark brown to black coloured rotten grains. The diseased panicle bears light to dark brown, partially or fully discolored glumes. Under severe conditions, grain filling in the diseased panicles is affected, subsequently resulting in chaffy grains.
	Bacterial canker and wilt of tomato *(Clavibacter michiganensis ssp. Michiganensis)*	Symptoms appear as canker formation on the stem region, brown discolouration can be seen in the stem pith. Diseased plants show unilateral wilting of the leaves followed by whole plant wilting. Bird's eye spot formation in both unriped and riped fruits in severely infected plants.



Fig 1: Symptoms of Potato Virus Y (PVY)



Fig 2: Symptoms of saffron corm rot

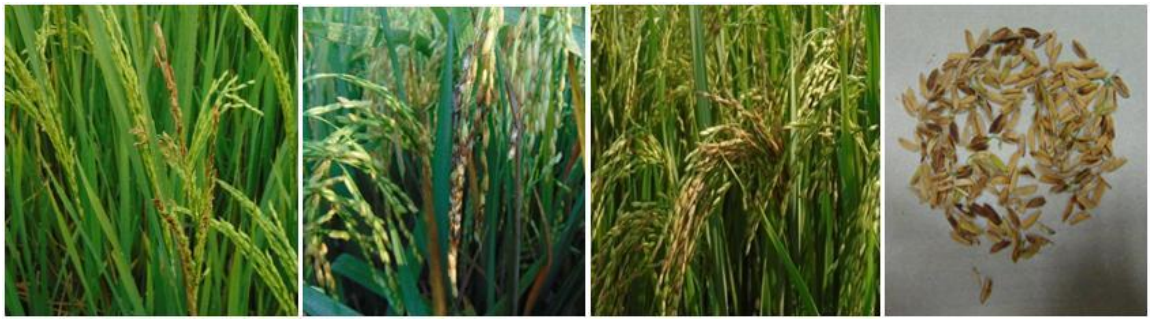


Fig 3. Symptoms of panicle blight in paddy



Fig 4: Symptoms of *Clavibacter michiganensis ssp. michiganensis*

Experiment 03: Studies on seed health status of farmers' own saved seed

Centres:

Crop	Centres
Paddy	AAU, Jorhat; CSKHPAU, Palampur; IARI, New Delhi; MPKV, Rahuri; NDUAT, Faizabad; OUAT, Bhubaneswar; PAJANCOA&RI, Karaikal; PAU, Ludhiana; RPCAU, Pusa; SKUAST, Srinagar; TNAU, Coimbatore
Wheat	AAU, Anand; CSAUAT, Kanpur; CSKHPAU, Palampur; CCSHAU, Hisar; GBPUAT, Pantnagar; MPKV, Rahuri; PAU, Ludhiana; IARI, New Delhi; RPCAU, Pusa
Soybean	SKNAU, Duragapura, JNKVV, Jabalpur; KAU, Pattambi ; MPKV, Rahuri; PJTSAU, Hyderabad
Groundnut	AAU, Anand; MPKV, Rahuri; SKNAU, Duragapura, JNKVV, Jabalpur; PJTSAU, Hyderabad
chickpea	SKNAU, Duragapura, MPKV, Rahuri

Saffron	SKUAST, Srinagar

Crop: Paddy

Centre	District	Varieties	Total No. of samples	Discoloured samples	Per cent discoloured samples	(%) Germination Below IMSCS	Fungi associated	Remark
OUA&T, Bhubneshwar	Keonjhar, Cuttack and Khurda	Popularly grown varieties	490	83.0	16.93	22.85	*Helminthosporium oryzae*, *Curvularia* spp., *Fusarium* spp., *Sarocladium oryzae* and *Aspergilus* spp.	The seed discolouration has not having any correlation with the seed germination.
SKUAS&T, Srinagar	Baramullah Srinagar Pulwama	Jehlum, China-1039, China-988, Shalimar Rice-1, and Shalimar Rice-2	300	-	-	Above IMSCS	*Pyricularia oryzae Bipolaris oryzae Alternaria spp*	The fungi associated with the seed caused discolouration, thereby reducing the seed quality however, the seed germination was not adversely affected
TNAU, Coimbatore	Thanjavur , Nagapattinam, Erode Tirupur, Coimbatore	ADT (R) 45 ADT 43 , TKM 9,ADT 37,BPT 5204, CO 51, TKM 13,IW ponni ,MTV 7029 ,ADT 36	44	35		79.5	-	Observed only brown discolouration.
PAJAN COA&RI, Karaikal	Karaikal Region Puducherry region	-	46		100	50		50% samples showed germination below IMSCS particularly in seed collected from Karaikal Region. The fungi associated were mainly

								Aspergillus and *Helminthosporium*

PAU, Ludhiana	Amritsar, Bathinda Ferozepur Jalandhar, Kapurthala, Samrala, Sangrur, Mansa, Gurdaspur, Hoshiarpur Jalandhar, Kapurthanla, Moga, Patiala , Roper , S.B.S Nagar, Sangrur, Tarantarn	PUSA 44, 1121, 1509, PUSA 1121, PR 27, 44, 45, 47,113 114, 115,121,122,125, 127, 202, 212, 126, 432, 505, 666,777, 1067, 1414,1509 PUSA 1121, PR 27, 44, 45, 47,113, 114, 115,121,122,125, 127, 202, 212, 126, 432, 505, 666,777, 1067, 1414,	1200	1189	99.18	4.5 %	*Drechslera oryzae Fusarium* spp., *C. lunata, Alternaria alternate, Chaetomium globosum, Rhizopus* spp. and *Penicillium* spp.	Highest incidence of discolouration was 11.2% on variety PR 116 and 8% on PR118 in district Faridkot followed by variety PR127 (6.7%) in Tarantaran and Jalandhar 6.5%. It was minimum (0.2%) on PUSA 1121 from Amritsar district (Table 4). Only 48 (4%) samples showed germination below IMSCS.
TCA, Dholi RPCAU, Pusa (Bihar)		20	89	-	13.48		*Aspergillus spp., Penicillium sps., Curvularia spp., Drechslera oryzae, Fusarium spp.,* etc.	
PJTSAU, Hyderabad	Karimnagar, Mahaboobnagar, Medak, Nalgonda, Nizamabad, Ranga Reddy, Nirmal, Warangal and Khammam)	MTU 1010, RNR15048, KNM 118, Tellahamsa & JGL 18047, BPT 5204, Jai sree Ram, and Siddi etc	678	-	10.67	All samples above IMSCS	*Fusarium* sp *Aspergillus Alternaria Drechslera sp.*	Highest per cent seed infection was recorded from Ranga Reddy (2.62%) followed by Medak and Nirmal (1.30%) while the least was recorded from Karimnagar (0.58%)

AAU, Jorhat			100	-	-	36 % samples below IMSCS	*Aspergillus spp, Penicillium Fusarium spp., Alternaria spp., Rhizhopus spp., Drechslera oryzae, Curvularia spp.*	
MPKV, Rahuri	Ahmednagar, Nasik, Pune, Kolhapur,	Indrayani, P. Samrudhi, Ambemohar, Raibhog, Jirvel, Sal, Kolapi, Ratna, Daptari 1008, Omshriram and Kalbhat	340	112	Range of discoloured seed (16.66-57.69)	All samples above IMSCS	*Aspergillus spp., Fusarium spp. Alternaria spp, Drechslera oryzae, Curvularia spp. Phoma*	

Crop: Wheat

Centre	Districts	Samples tested	Varieties	Sample infected	(%) Germination Below IMSCS	KB , Loose smut ear cockle
CSKHPAU , Palampur	Hamirpur, bilaspur , Una	169	HPW-155, 360, HS 562 ,DBW 88, HPW-368, HS 507, HPW-155, HPW-360, VL-892, VL-829, HPW-42, HPW-368,HS 507, HPW-249, HPW-236, HPW-249	00.00	100%	No loose smut and ear cockle observed in any of the sample. However, a high incidence of Karnal bunt was observed both in unprocessed samples from seed production plots and farmer's samples. KB Infection reached up to 6.0% at Mathai in Kangra, followed by 5.6% in Fathapur. At Patehar 1.2%, at Thara 1.4 % in Una. At Rukhari in Dhaulakaun 4.6%
MPKV, Rahurai	Ahamadnagar, Nasik, Pune, Solapur, Sangali & Jalgaon)	447	Phule Samadhan, Netravati, Trimbak and HD-2189		4.25%	No loose smut, KB and ear cockle in farmers samples
TCA, Dholi, RPCAU, Pusa (Bihar)		60	10	81 – 95	6.66 %	Seed discoloration was recorded 0 – 8% & infected seed range from 2 – 11%.
PAU Ludhiana	Amritsar, Bathinda Ferozepur Jalandhar, Kapurthala, Samrala, Sangrur, Mansa,	1100	HD 2667, HD 2967, HD 2932, HD 3086,DBW 17, PBW 621, PBW 677, PBW 550, Sher-e-punjab,Pb.	>85	0	*No loose smut, no ear cockle samples.* 25% samples from Amritsar; 16% samples from Faridkot; 28% samples from

	Gurdaspur, Hoshiarpur Jalandhar, Kapurthanla, Moga, Patiala , Roper, S.B.S Nagar, Sangrur, Tarantarn		Shingara, DBW 17, HD 2894, Berbet, WH711 & WH1105			Kapurthala; 42% samples from Roper; 23% from Jalandhar having an highest percent infection of 7.5% ; 12.5% from Patiala ; 7.14% in Bhatinda ; 6.34 from SBS Nagar ; 8.6% from Hoshiarpur were carrying KB above seed certification standards. Samples from Mukatsar, Sangrur, Ropar, Mansa, Ludhiana, Gurdaspur, Tarantaran were carrying the bunt infection but within the certification limits.
CCSHAU, Hissar	Karnal Kurukshetra Kaithal Jind	160	-	146 samples infected with KB only	0	*no loose smut and ear cockle only karnal bunt*
GBPUA&T., Pantnagar	US Nagar, Haridwar, Nanital	200	UP 2572, VL 892, 907, 802, PBW 154, 343, 226 HS 507,HD 2967	3	All samples above IMSCS	No KB, no ear cockle , only loose smut within CS
RPCAU, Pusa (Bihar)	Dholi	60	10	0.00	6.66%	No KB, no ear cockle, no loose smut
AAU, Anand	Anand Ahmedabad Chhotaudepur Dahod	110	GW 496, GW 497, GW 270, Desi punagari, Arnej 3-13, GW 273, Lok 1	70 to 96		No KB, no ear cockle, no loose smut.

Crop: Soybean

MPKV, Rahuri										
Locations	**No. of samples collected**	**Most popular Varieties**	**Germination (%)**	**Samples showed the germination below MSCS**	**Diseases Visual observations (SMV and purple stain) / Blotter test (Per cent seed infection)**					**Remarks (Other pathogens)**
					Anthracnose	**Charcoal rot**	***Phomopsis* pod blight**	**Purple stain**	**SMV**	***Remark***
Ahmednagar Jalgaon Nandurba Dhule Nashik Solapur Satara Pune Sangali Kolhapur	315	JS-335, Phule Agrani, DS 228, Phule Kalyani	58-89	43	0-3.5	1.5-4.9	0-4.2	0-2.9	0-2.3	*Other fungi associated were F. moniliforme, F. oxysporium, A. alternate.* In shirur tehsil and Jalgaon, no disease was observed. Phomopsis pod blight, Purple stain, SMV were there. Nandurbar Tahsil was with high incidence of phomopsis
VNMKV Parbhani										
Parbhani, Hingoli, Nanded Osmana Bad, latur, beed	108	JS-335 MAUS-71 MAUS-162	68-92	-	2.1	3.0	1.6	1.93	1.07	-
PJTSAU , Hyderabad										
Adilabad, Nirmal, KomaramBheem, Asifabad, Nizamabad, Kamareddy	385	JS335	81.86	-	2.15 (8.28)	0.67 (4.89)		0.22	-	-
JNKVV ,Jabalpur										
Jabalpur, Seoni Chhindwara Betul ,Narasinghpur Katni ,Damoh Rewa ,Satna	-	-	63-78		01-22.0	02-19	01-18		01-10.0	*Macrophomina phaseolina* was 01-19% in seeds from Jabalpur, *Colletotrichum dematium* 01-22 % in seeds from Chhindwara and *Fusarium*

Tikamgargh ,Chhatarpur , Indore, Ujjain Hoshangabad, Sehore, Vidisha										*oxysporum* 02-17%in seeds from Rewa. In Damoh, SMV was not observed

Crop: Groundnut

AAU, Anand					
Locations	**Number of samples collected**	**Varieties**	**Germination (%)**	***Aspergillus* seed rot (%) (Blotter test)**	**Remark**
Rajkot Junagadh Amreli	85	GG 20, GG 11, GG 20, GG 99, GG 10, GG 1, GG 24, GG 21, GG 45	60 to 90	0 to 20	Nil
	64	GG 10, GG 5, GG 38, GG 27, GG 21, GG 20, GG 2, GG 45, GG 22	70 to 90	2 to 20	Nil
	44	GG 10, GG 20, GG 2, GG 48, GG 21		2 to 20	Nil

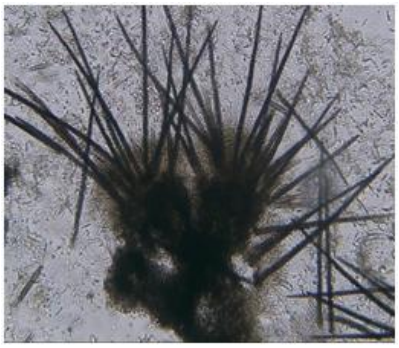
Locations	**No. of samples collected**	**Varieties**	**Germination (%)**	rmination below IMSCS (70%)	*Aspergillus* Seed Rot		ns	
					A. niger	***A. flavus***	***M. phaseolina***	
sik, Pune, Sangli, Jalgaon, Solapur		**JL-24, Phule Warana, Phule Morana and SB- XI**						**il, Sangali exhibited maximum per cent seed infection of *A. niger*.**
Rajkot , Junagadh, Amreli		**G 99, GG 10, GG 1, GG 24, GG 21, GG 45**						
Nagarkurnool , Mahaboobnagar, Wanaparthy, Nizamabad					10.15			
Chhindwara, Sausar, Pandurna, Betul, Seoni, Amarwada								

Crop: chickpea

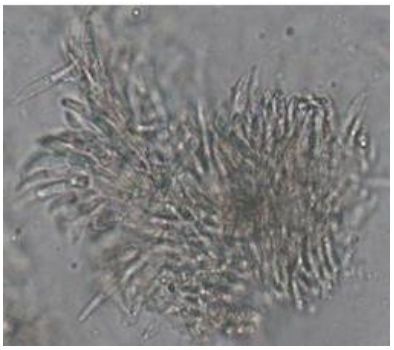
Locations	No. of samples collected	Varieties	Germination (%)	Samples showed the germination below MSCS (85%)	Diseases (Blotter test)			Remark
					B. cinerea	***A. rabiei***	***F.oxysporum***	
MPKV, Rahuri								
Ahmednagar, Nashik, Dhule	271		68-96	9	0-5.3	nil	2.3-6.6	High incidence of *B. cinerea* at Shrigonda Ahmednagar. However, all the samples exhibited high incidence of *Fusarium.*

Crop: Saffron

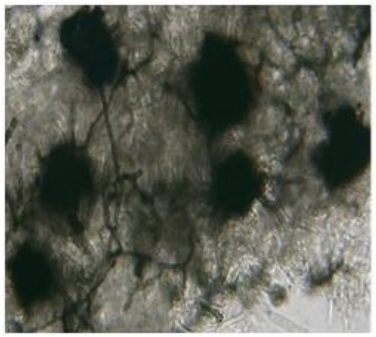
SKUAST., Srinagar				
Total no of faremrs samples	**District Location**	**% corns samples infected**	**fungi associated**	**Remark**
15	Pampora	46.6	*Fusarium sp.* *Rhizotonia sp.* *Penicillum sp.*	The fungi associated with the saffron corms exhibited severe corm rot symptoms on emerging seedlings.
15	Lathpora	33.3		



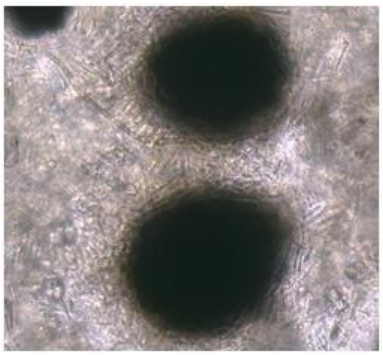
Colletotrichum sp acervulus



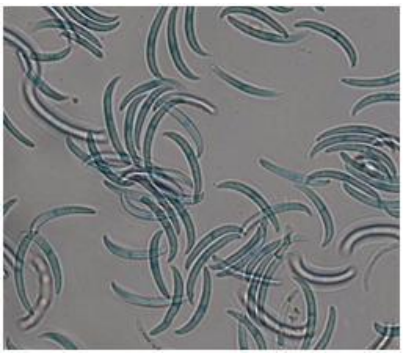
Colletotrichum sp- conidia



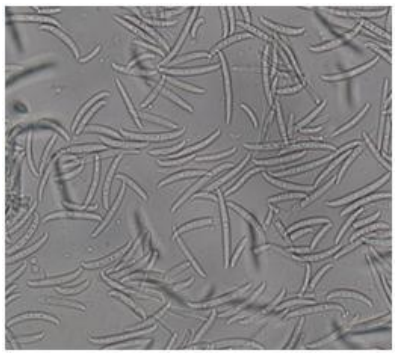
Macrophomina sp



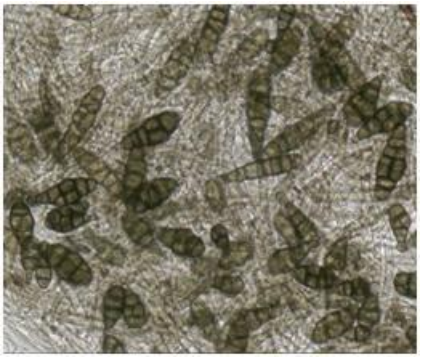
Fusarium sp-conidia



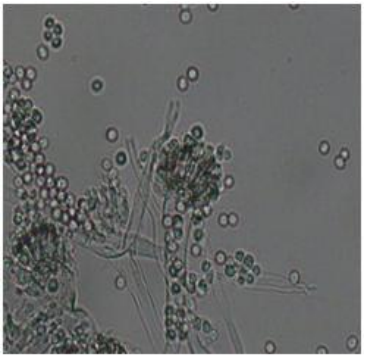
Phomopsis sp-Pycnidia



Fusarium sp- sporodochium



Alternaria sp



Aspergillus sp



Purple stain

Fig. 5. Fungi associated with farmers' own saved soybean seeds

Experiment 04: Standardization of detection methods for seed borne pathogens of significance.

Centres: All centres

For detection of seed-borne infection of important pathogens of significance, methods have been standardized, protocols developed and validated at different centres are mentioned below.

Centre	Method	Pathogen	Crop	Protocol standardized
AAU Anand	Molecular diagnosis	BCMV	Mung bean	Standardized molecular method for detection of seed borne infection of BCMV and nucleotide sequenced.
CSKHPKV, Palampur	Molecular diagnosis	*Pepper mild mottle virus* (PMMoV)	Capsicum	RT- PCR based protocol designed and standardized. To be validated for its authenticity and robustness
PJTSAU, Hyderabad	Standard blotter method		Mung bean	Blotters soaked in 0.5% NaOH solution help in better recovery of saprophytic fungi the fungi over standard blotter test
SKUAS&T, Srinagar	Molecular diagnosis	*Potato Virus Y*	Potato	Universal Primers have been designed for detection of all the strains of PVY. The conserved regions in different PVY strains in coat protein region were used to design oligonucleotides for detection of PVY infection. The primers used are: **Forward-** TATGAATTCCACCATCAAGCAAATGA **Reverse-** ATCGTCCGGCTCGAGACTACATCA
	Agar Plate Method	*Corm rot (Fusarium sp. Rizotonia spp Aspergillus sp. Penicillum sp)*	Saffron	Corms plated on PDA and incubated for 5-7 days at 22± 1^{o}C under alternate cycles of 12 hour light and 12 hour darkness
	Molecular diagnostics	BCMV	Mung bean and Common bean.	The primers for coat protein detection have been designed and its molecular detection is being carried out. CPF5'-TCCATGTCAGGAC/TCTGGACAGCC-3' CP R 5'-CTAGACTGCGAAGGACCCATGCC-3'
MPKV, Rahuri	Standard deep freeze blotter method	*Fusarium oxysporum*	Soybean	Incubation temperature needs validation.
GBPUA&T,	Serological	*Clavibacter*	Tomato	ELISA technique at OD value ranging

Pantnagar	and Molecular diagnosis	*michiganensis* subsp *michiganensis*		from 0.445nm to 0.629nm. Specific primer for *Clavibacter* giving an amplicon of size 1.45kb and also by subsp specific primer giving an amplicon of size 614bp.
	Molecular diagnosis	*Burkholderia glumae*	Paddy	The bacterium has been detected by 16s ribosomal DNA sequencing by universal primer pair 27F (5' AGTTTGATCCTGGCTCAG 3') and 1492R (5' ACCTTGTTACGACTT3').
JNKVV, Jabalpur	Deep Freeze blotter	*Macrophomina phaseolina*	Soybean	Seed dip in antibiotics (200ppm), before plating
OUA&T, Bhubneswar	Blotter method	*Sarocladium oryzae*	Paddy	Blotter paper dipped in sterilized water of pH 6.5
PAU, Ludhiana	Standard blotter method	Fusarium *fujikuroi*	Paddy	Incubation of plates at 28^{0}C at 12 hours darkness and 12 hours light
TNAU, Coimbatore	Standard blotter method	*Fusarium sp*	blackgram	Modified as Blotter sheets soaked in NaOH 0.4% and incubated at 25^{0}C at 12h alternate light and dark period
		Macrophomina sp		Modified as Blotter sheets soaked in KOH 0.2 % and incubated at 25^{0}C at 12h alternate light and dark period

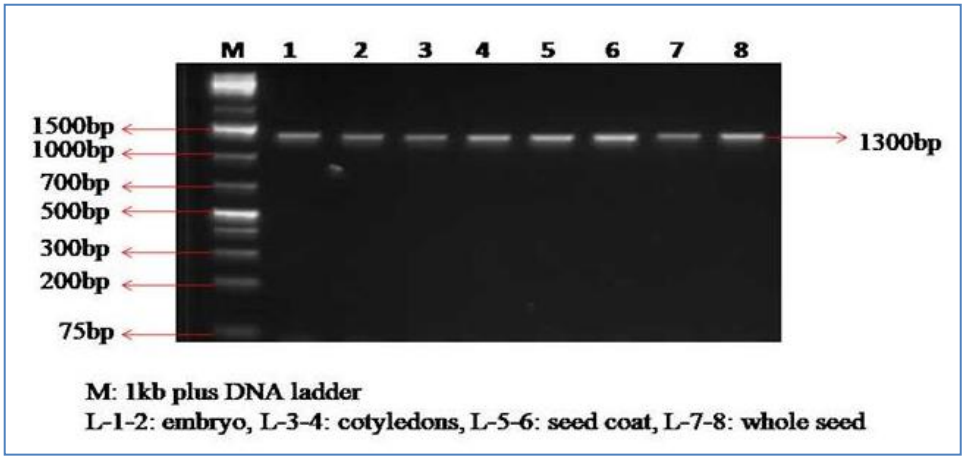


Fig.:6 Bean Common Mosaic Virus (BCMV)- Coat protein specific primer mung bean variety- MEHA

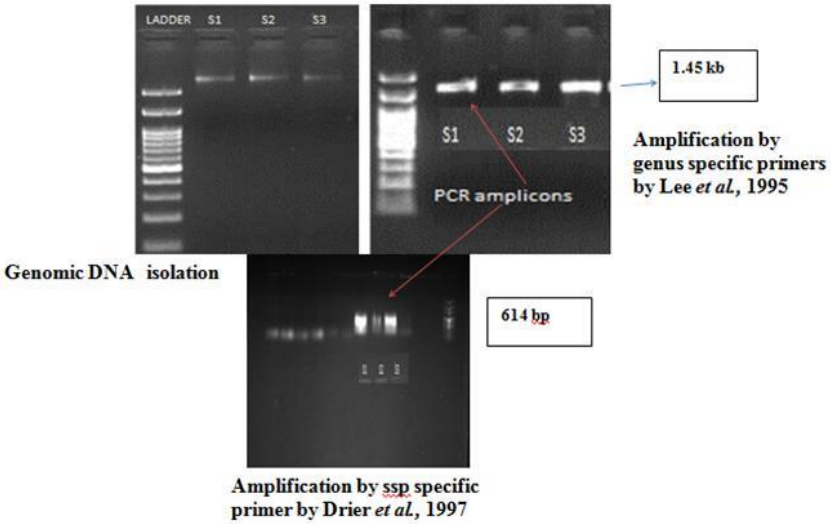
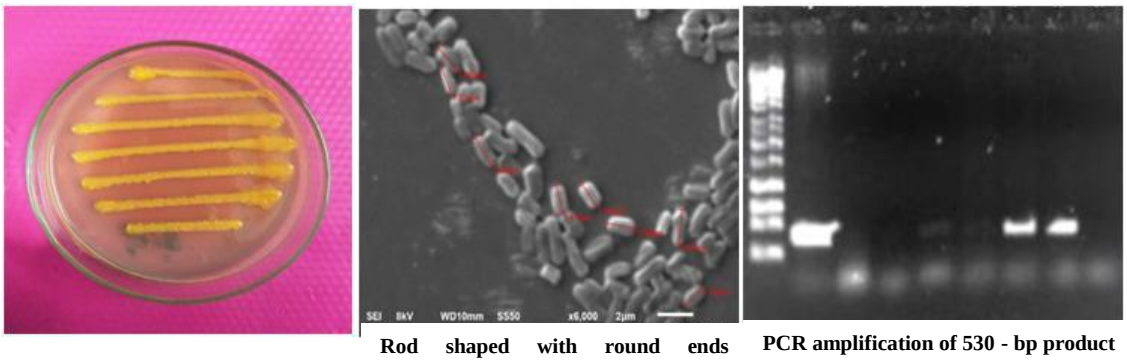


Fig. 7. **Molecular characterization of *Clavibacter michnganense pv. machiganense* from tomato seed**



Isolation of bacterium

Rod shaped with round ends Bacterium under SEM **with average size 0.45-0.65x1.41 to 1.65 µm**

PCR amplification of 530 - bp product for *B. glumae*

Fig. 8. Molecular characterization of *Burkholderia glumoe* from paddy seed



Fig. 9 NaOH blotter soak method compared with Standard blotter method

Experiment 05. Non chemical management of seed borne infection of bean anthracnose

Centres: CSKHPKV, Palampur and SKUAST, Srinagar

Non-chemical management of seed borne infection of bean anthracnose investigated at SKUAST, Srinagar and CSKHPKV, Palampur.

Table 1: Seed quality and disease incidence as affected by non-chemical management practices

S. No.	Treatment	Seed Germination (%)	Seedling Vigour	Disease Incidence (%)	Per cent Disease Control
1	*T. harzianum* (Th)	65.0	2190	72.0	14.3
2	*T. viride* (Tv)	61.6	1735	71.0	20.2
3	*P. fluorescence* (Pf)	65.0	2042	73.6	15.3
4	Th+Tv	67.6	1720	69.0	20.2
5	Th+Pf	69.0	2095	61.0	29.7
6	Tv+Pf	71.0	2035	65.6	24.1
7	Panchgabya alone	77.0	2218	74.3	14.3
8	Panchgabya + Th	80.0	2323	60.0	30.7
9	Panchgabya + Tv	83.2	2500	53.3	38.4
10	Panchgabya + Pf	83.0	2586	60.0	30.7
11	Carbendazim 50 WP (@ .1%	85.6	2776	46.6	46.2
12	Healthly seed alone	100.0	2600	0.0 (0.00)	100.0
13	Infected seed alon	34.03	695	86.6	-
C.D(P=0.05)		4.94	104.59	4.70	

SKUAST, Srinagar

The highest germination percentage and lowest disease incidence was recorded in healthy seeds followed by infected seeds treated with Carbendazim and Panchgabaya in combination with *T.viride*.

CSKHPAU, Palampur

Among all the treatments, *Trichoderma harzianum* (0.00 to 5.00%) followed by Bavistin (0.00 to 4.67 %) and Pachgavya + *Jivamrit* (0.00 to 7.00%) were found to be effective.

Experiment 07: Monitoring of seed borne viruses in soybean and pulses and standardization of methods for detection through biological, serological and molecular techniques

Centres: AAU, Anand and IARI, New Delhi

Soybean varieties *viz.,* JS 9041, JS 1, JS 2, NRC 37 and JS 335 cultivated in certain pockets of Anand, Dahod and Vadodara districts were monitored for the incidence of soybean mosaic virus (SMV) disease. Among the 16 farmers' fields surveyed, the SMV incidence was in the range of 1.0. – 5.35%

Sl. No.	District	Village	GPS location	Crop	Incidence ULCV (%)
1.	Ahmedabad	Juna padhar	72°22'27''E 23°12'42''N	Urdbean	0.0
2.		Dalsana	72°21'47.52''E 23°12'762.63''N	Urdbean	0.0
3.		Endala	72°21'75.62''E 23°16'990.31''N	Mothbean	0.0
4.			72°21'76.22''E 23°16'989.46''N	Mungbean	1-2
5.		Karshanpura	72°31'18.82''E 23°17'1059.32''N	Mungbean	1-2
6.	Mehsana	Modhera	72°74'7''E 23°34'23''N	Urdbean	1
7.			-	Mungbean	0.0
8.	Banaskantha	Juna Deesa	72°95'9''E 24°12'13''N	Urdbean	4-5
9.		S K Nagar	-	Urdbean	<1
10.			-	Mungbean	0.0
11.			-	Mothbean	0.0
12.	Patan	Sabdalpur	71°37'26''E 23°46'18''N	Urdbean	1
13.		Ramgadh	72°23'8''E 24°41'14''N	Urdbean	0.0

Location / District	Variety	No. of fields surveyed	No. of fields infected	Incidence of SMV (%)
Anand, Vadodara & Dahod	JS 9041	2	1	2.35
	JS 2	1	1	4.35
	JS 335	2	1	5.35
	JS 1	1	0	4.65
	NRC 37	3	1	1-2.35
Total		**16**	**4**	**1.0 -5.35**

Serological Characterization:

Direct Antigen Coating – ELISA (DAC-ELISA) was done for the different seed and leaf samples collected from the seed transmission trial. Leaves with symptoms of soybean mosaic virus (SMV) gave strong reaction with DAC- ELISA whereas apparently healthy leaves showed no reaction. The ELISA reaction was assessed at 490 nm. The virus is detected both in seed coat and embryo of the infected seeds.

Experiment 08: Management *Alternaria solani* in tomato through seed treatment and foliar application of newer chemicals

Centres: AAU, Anand; PAU, Ludhiana; SKUAST, Srinagar; MPKV, Rahuri and GBPUAT, Pantnagar

Observations:

At PAU, Ludhiana; MPKV, Rahuri; GBPUA&T, Pantnagar; SKUAST, Srinagar and AAU, Anand, Azoxystrobin (18.2 %) + Difenconazole (11.4 %) @ 0.03% was found as most effective treatment for reducing the diseases and improving the fruit and seed yield. However, at GBPUA&T, the data on fruit yield is awaited.

Table 2: Incidence of early blight and fruit yield as affected by different chemical treatments

T. No.	Name of fungicide	Conc. (%)	PDI before 1st spray	PDI at 7 days after 1st Spray	PDI at 7 days after 2nd spray	PDI at harvest	Fruit Yield kg/ha
T_1	Carbendazim (25 %) + Mancozeb (50 %)	0.15	2.84 (9.66)	5.30 (13.28)	10.29 (18.68)	13.74 (21.72)	28433
T_2	Azoxystrobin (11 %) + Tebuconazole (18.3 %)	0.03	2.53 (9.34)	4.00 (11.51)	7.46 (15.79)	10.86 (19.21)	35155
T_3	Hexaconazole (4 %) + Zineb (68 %)	0.075	2.35 (8.52)	5.83 (13.93)	11.37 (19.65)	14.90 (22.64)	29241
T_4	Azoxystrobin (18.2 %) + Difenconazole (11.4 %)	0. 03	2.35 (8.77)	3.92 (11.34)	6.62 (14.88)	8.66 (17.10)	39433
T_5	Trifloxysytrobin (25 %) + Tebuconazole (50 %)	0.075	2.33 (8.74)	5.56 (13.61)	11.35 (19.61)	14.60 (22.39)	26783
T_6	Metiram (55 %) + Pyraclostrobin (5 %)	0.06	2.58 (8.93)	6.71 (14.95)	10.42 (18.79)	15.38 (23.04)	23207
T_7	Famoxadone (16.6 %) + Cymoxanil (22.1 %)	0.04	3.59 (10.33)	8.97 (17.37)	14.72 (22.49)	17.75 (24.89)	29384
T_8	Pyraclostrobin 20 % SC	0.02	2.03 (8.16)	9.23 (17.68)	13.75 (21.75)	16.64 (24.06)	23780
T_9	Azoxystrobin 23 % SC	0.025	2.34 (8.62)	7.13 (15.46)	11.54 (19.84)	20.28 (26.66)	30999
T_{10}	Control	--	1.98 (7.91)	14.12 (21.97)	20.05 (26.56)	45.12 (42.18)	17823
	C.D. @ 5%		NS	2.35	3.18	3.95	6061.77
	C.V. %		17.22	8.96	9.36	9.44	12.43

Experiment 09: Impact of different storage conditions and longevity on seed associated mycoflora of greengram / blackgram

Centres: AAU, Jorhat; TNAU, Coimbatore; PAJANCOA&RI; MPKV, Rahuri; and OUAT, Bhubaneswar

Table 3: Seed germination as affected by different storage conditions and storage periods

Sn	Treatments	Germination (%)					
		Initial	30 days	60 days	90 days	120 days	150 days
T_1	Treated Farmer's seed stored in Gunny bags	95.00 (77.12)	95.00 (77.05)	91.89 (73.70)	87.93 (69.72)	86.89 68.85)	83.69 (66.18)
T_2	Untreated Farmer's seed stored in Gunny bags	95.00 (77.12)	94.67 (76.63)	87.75 (69.88)	84.22 (66.75)	82.17 (65.14)	80.73 (63.90)
T_3	Treated seed from Seed Production Fields stored in Gunny bags	98.00 (82.05)	97.67 (81.22)	94.67 (76.70)	90.46 (72.28)	89.33 (71.03)	86.67 (68.64)
T_4	Untreated seed from Seed Production Fields stored in Gunny bags	98.00 (82.05)	98.00 (81.84)	92.88 (74.65)	88.86 70.61)	87.46 (69.46)	85.60 (67.47)
T_5	Treated Farmer's seed stored in Polylined gunny bags	95.00 (77.12)	95.00 (77.05)	93.67 (75.46)	90.83 72.57)	90.47 (71.89)	88.23 70.07)
T_6	Untreated Farmer's seed stored in Polylined gunny bags	95.00 (77.12)	94.67 (76.63)	89.70 (71.67)	88.14 (70.14)	88.00 (69.72)	84.67 66.94)
T_7	Treated seed from Seed Production Fields stored in Polylined gunny bags	98.00 (82.05)	97.67 (81.22)	96.53 (79.63)	94.42 (76.70)	95.33 (77.51)	92.19 73.99)
T_8	Untreated seed from Seed Production Fields stored in Polylined gunny bags	98.00 (82.05)	97.33 (80.70)	93.06 (75.12)	90.40 (72.22)	88.30 (69.80)	87.59 69.46)
T_9	Treated Farmer's seed stored in Cloth bags	95.00 (77.12)	95.00 (77.05)	90.44 (72.26)	87.24 (69.21)	84.19 (66.72)	82.93 65.41)
T_{10}	Untreated Farmer's seed stored in Cloth bags	95.00 (77.12)	94.67 (76.63)	85.86 (68.01)	81.67 (64.71)	79.67 (63.23)	73.33 (58.90)
T_{11}	Treated seed from Seed Production Fields stored in Cloth bags	98.00 (82.05)	98.00 (81.84)	92.57 (74.40)	89.50 (71.25)	88.33 (70.07)	85.67 67.76)
T_{12}	Untreated seed from Seed Production Fields stored in Cloth bags	98.00 (82.05)	97.67 (81.22)	89.70 71.59)	86.21 (68.35)	83.83 66.42)	79.33 (62.95)
	C.D. @ 5 %	NS	NS	3.97	3.79	3.27	3.05

Table 4: Seed mycoflora as affected by different storage conditions and storage periods

Treatments	Seed Mycoflora (%)					
	Initial	30 days	60 days	90 days	120 days	150 days
T_1	7.21 (15.58)	9.70 (18.14)	11.80 (20.08)	13.63 (21.66)	15.67 (23.30)	17.03 (24.36)
T_2	7.21	21.17	27.00	31.07	35.67	39.00

	(15.58	(27.38)	(31.29)	(33.86)	(36.65)	(38.63)
T_3	5.32 (13.34)	7.47 (15.85)	9.70 (18.12)	12.07 (20.32)	13.87 (21.85)	15.13 (22.88)
T_4	5.32 (13.34)	17.67 (24.84)	22.50 (28.30)	25.93 (30.60)	29.67 (32.99)	32.47 (34.72)
T_5	7.21 (15.58)	7.83 (16.23)	9.20 (17.65)	10.73 (19.11)	12.27 (20.49)	13.37 (21.43)
T_6	7.21 (15.58)	18.87 (25.73)	24.03 (29.34)	27.60 (31.68)	31.63 (34.21)	34.63 (36.03)
T_7	5.32 (13.34)	6.77 (15.07)	8.20 (16.63)	9.47 (17.91)	10.87 (19.24)	11.90 (20.17)
T_8	5.32 (13.34)	15.67 (23.31)	20.00 (26.55)	23.10 (28.71)	26.47 (30.94)	28.87 (32.48)
T_9	7.21 (15.58)	10.77 (19.15)	13.13 (21.24)	15.20 (22.93)	17.23 (24.51)	18.90 (25.75)
T_{10}	7.21 (15.58)	23.47 (28.96)	30.00 (33.19)	34.53 (35.97)	39.60 (38.98)	43.27 (41.11)
T_{11}	5.32 (13.34)	8.40 (16.84)	10.33 (18.74)	11.90 (20.17)	13.57 (21.60)	14.87 (22.67)
T_{12}	5.32 (13.34)	19.60 (26.27)	24.97 (29.96)	28.83 (32.46)	32.97 (35.02)	36.13 (36.93)
S.E.m	0.13	0.22	0.40	0.41	0.45	0.48
C.D. @ 5 %	NS	0.65	1.17	1.20	1.32	1.41
C.V.	--	1.79	2.84	2.70	2.75	2.80

Experiment is continuing at OUAT, Bhubneshwar; MPKV, Rahuri and TNAU Coimbatore. However, the experiment is not conducted at AAU Jorhat and PAJANCOA&RI, Karaikal

Observations:

OUAT Bhubaneswar

With the increase in storage period, the associated mycoflora increased in all the treatments and maximum being in check. The minimum percent seed mycoflora(11.90), highest seed germination (92.19 %) and field emergence (80.00 %) was in the seed obtained from seed production fields and treated with thiram @0.25% before storage in Polylined gunny bags upto 150 days of storage, followed in treated farmer's seed stored in Polylined gunny bags.

TNAU Coimbatore

The seed borne pathogens like *Fusarium* sp and *Macrophomina sp.* were not observed in any of the storage containers from 11th months to 15 months of storage.

Experiment 10: Detection, location and transmission of seed borne *Macrophomina phaseolina* in sesame

Centres: TNAU, Coimbatore

Findings: Recovery of *M. Phaseolina* was maximum in agar plate method as compared to blotter test. The results need validation at other centres. The experiment is still going on.

Experiment 11: Management of purple blotch and *Stemphylium* blight of onion by fungicides and plant based products.

Centres: PAU, Ludhiana; SKUAST, Srinagar; MPKV, Rahuri

Table 5: Disease incidence, seed germination and vigour of onion as affected by different fungicides and plant based products.

Sl. No	Fungicides/plant based products	SKUAST, Srinagar			PAU, Ludhiana				MPKV, Rahuri		
		Disease incidence	Germination	Vigour index	Disease incidence	Germination	Vigour index	PDI	Reduction over control	Bulb Yield q/ha	Increase over control
1	Mancozeb @0.3% +0.1% Triton	19.7	79	592.5	10.46	81	1.782	58.13	30.13	191.67	12.50
2	Metiram55%+pyaclostrobin 5% @0.3%+0.1% Triton	20.6	78	592.8	17.33	82	1.72	67.20	19.23	187.35	9.96
3	Difenconazole@0.1%+0.1% Triton	17.5	82	631.4	8.4	90	2.25	44.27	46.79	224.07	31.52
4	Propiconazole @0.1%+0.1% Triton	11.5	85	663.0	9.66	88	2.46	39.73	52.25	248.70	45.98
5	Tebuconazole@0.1%+0.1% Triton	21.0	80	592.0	8.73	90	2.34	55.73	33.02	197.47	15.91
6	Kitazine 48% Ec @0.2% +0.1%Triton	20.5	82	598.6	20.16	78	1.79	71.20	14.42	182.72	7.25
7	Lantana camara@0.3%+0.1% Triton	23.5	80	600.0	39.25	67	1.67	74.40	10.58	175.62	3.08
8	Pongamia pinnata @0.3%+0.1% Triton	21.5	79	600.4	44.91	65	1.56	63.47	23.71	189.20	11.05
9	Crude leaf extract of Azadirachtra indica @ 0.5% +0.11% Triton	26.5	81	607.5	39.4	75	1.87	48.53	41.67	211.42	24.09
10	Control (No Spray)	32	70	518.0	51.98	62	1.24	83.20	--	170.37	--
	C.D(P=0.05)	0.8827	3.1162	23.8893	**2.26**	**2.67**	**0.30**	6.18		31.36	

Observations:

Centre	Fungicide sprays	Plant extract
MPKV Rahuri	Three sprays of fungicide Hexaconazole (0.10%) were found to be most effective in management of purple blotch of onion (52.25), thereby enhancing the onion bulb yield (45.98 %). This was followed by Propiconazole (0.10 %).	Crude leaf extract of *Pongamia pinnata* (0.30 %) found to be superior over other plant passed products.
SKUAST, Srinagar	For Management of purple blotch / *Stemphylium* blight of onion through fungicide and plant based products, Propiconazole @ 0.1%+0.1% Triton was best treatment with highest germination (85%) and least disease incidence (11.5%) and highest yield.	Crude extracts of *Lantana camara* , *Pongamia pinnata and neem* have been found superior over check and at par with chemical seed treatment and improved seedling emergence, vigour index of the seedling . However, these extracts have been less effective than fungicides in management of percent disease incidence
PAU, Ludhiana	Minimum percent disease incidence (PDI) of purple blotch and *Stemphylium* blight of onion was recorded in seed crop of onion having either 4 four prophylactic spray of Zineb @ 0.2% at 10 days interval or 2 sprays of difenconazole @ 0.1% at 10 days interval .	Crude leaf extract of neem gave best control of stemphylium blight as compared to *Lantana camara* and *Pongamia pinnata.*

Experiment 12: Detection, location and transmission of seed-borne *Alternaria sesami* in sesame

Centres: PJTSAU, Hyderabad

Infected sesame seeds were collected from experimental plots of RARS, Jagtial, severely affected by *Alternaria sesami* during *Kharif* 2018-19. To determine the association of *A. sesami, the* seeds were subjected to two incubations methods viz., standard blotter method and agar plate method using 400 seeds in each method. Of these two methods evaluated, the per cent seed infection was found to be more with agar plate method (12 %) when compared to the standard blotter method (7.56 %).

The infected seed were sent for validation of results to GBPUA&T, Pantnagar. The pictures of the fungus on the sesame seed are attached. The recovery of the fungus was found in both the methods but on agar plate method, the observations on *A. sesame* obscured because of saprophytic growth of other fungi and *Alternaria sp.*

Centres		PJTSAU, Hyderabad	GBPUA&T., Pantnagar
Sl. No.	Detection method	Per cent seed Infection %	
1.	Standard Blotter Method	7.56	10.0
2.	Agar plate Method	12.00	6.00

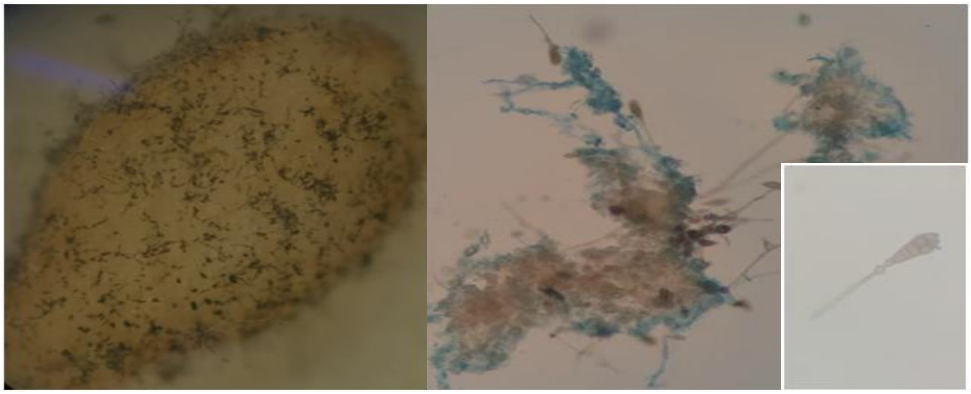


Fig. 10. Growth *of Alternaria sesami* on sesame seed in blotter method at GBPUA&T, Pantnagar

Experiment 13: Effect of pre-harvest fungicidal sprays on seed health and quality of soybean

Centres: PJTSAU, Hyderabad and GBPUAT, Pantnagar

PJTSAU, Hyderabad

There was no incidence of any foliar fungal diseases up at 75% pod maturity stage. However, 0.03 to 8.07 per cent incidence of Anthracnose and 0.10 to 4.83 per cent incidence of *Cercospora* leaf spot were observed at 100% pod maturity.

GBPUA&T, Pantnagar

Very low incidence of *Cercospora* leaf spot was observed but no incidence of anthracnose. The results indicated that, the disease incidence in majority of the treatments was found to be nil or negligible in all the treatment. Subsequent seed health studies are under progress.

D. Seed Entomology

Experiment 1: Survey and evaluation of seed health status of farmers' saved seed with respect to insect infestation (to be combined with pathology / storage).

Objectives:

- To know the type and level of infestation by insects under storage condition
- Impact of insect infestation on seed quality
- Farmer's practice, if any, to store / protect seeds from insect damage

Date of start: 2006

All centers including voluntary NSP centers will do the experiment

Methodology: About 500g of seeds of crop/ variety will be collected from farmers / seed producers before sowing on payment or gratis. While collecting seed a questionnaire will also be filled to know crop / variety, period and conditions of storage, treatments, if any, source of seed, if it is not farmer's saved one. The following observations are to be recorded.

1. Seed moisture content (%)
2. Live insect, its species and storage
3. Damage in 400 seed samples including internal infestation
4. Germination (%)
5. Vigour test

Results: ***(Tables 1.1 – 1.12)***

MPKV, Rahuri;

Total of two hundred and ninety two farmers' saved seed samples of various crops (soybean-59, pearl millet-42, sorghum-58, wheat-69 and chickpea - 64) were collected from Ahmednagar and Pune district for evaluation of seed health status. All soybean seed samples were free from insect damage but only 57.6% soybean seed samples had seed germination above IMSCS (Indian Minimum Seed Certification Standards). About 31% seed samples of both pearlmillet and sorghum were infested with *Rhizopertha dominica*, *Sitophilus oryzae* and *Tribolium castaneum* and insect damage was beyond permissible limit in all infested samples. About 78.6% and 79.3% samples recorded seed germination above IMSCS in pearlmillet and sorghum seed samples respectively. About 48.4% and 30.4% samples had insect damage beyond permissible limit in chickpea and wheat respectively. The moisture content of different seed samples ranged between 7.2 to 9.2% (Table-1.1).

JAU, Jamnagar;

For survey and evaluation of seed health status of farmer's saved seed with respect to insect infestation, total of 100 groundnut seed samples were collected from three districts *viz*.,

Jamnagar (45samples), Rajkot (22 samples) and Devbhoomi Dwarka (33 samples) of Gujrat (Table 1.2).The average storage period was 7-8 months. Average moisture content was 5.59% where as average seed germination was 80.5%. Seed vigor index was observed from 166 to 1679 with an average value of 774. Incidence of groundnut seed beetle, *Caryedon serratus* (Oliver) was observed in 65% samples and 41% samples were having insect damage beyond permissible limit. Average intensity of infestation was 2.23 % and maximum damage was 28%. The life stages *i.e.* larvae, pupae and adults of *Caryedon serratus* and adults of *Tribolium* sp. were observed in infested samples. About 89% seed samples recorded higher seed germination than IMSCS. The farmers usually stored the seed by spraying DDVP or methyl parathion @ 2% on gunny bags, celphos fumigation, mixing of neem leaves with seeds and sun drying once after harvest of the crop.

PDKV, Akola

During survey three hundred and twenty one seed samples (Soybean-87, Pigeonpea-65, Mungbean-38, Udidbean-48, Chickpea-40 and Wheat-43) were collected from Vidarbha region of Maharastra (Table-1.3). Storage period of these samples ranged between 6-8months. About 26.5% seed samples were infested with various storage insects and 16.8% samples were having insect damage beyond permissible limit. The moisture content of seed samples ranged between 7.5 to 14.5%. About 65.4% seed samples recorded seed germination above IMSCS. The insect damage in different samples varied from 0.20 to 26.3%.

Among the collected samples, 21.1% of mungbean, 27.1% of udidbean, 7.7% pigeonpea, 25% of chickpea, 34.9% of wheat and 3.4% of soybean showed insect damage beyond permissible limit. Whereas 71.1% of samples of mungbean, 66.7% sample of udidbean, 83.1% samples of pigeonpea, 22.5% samples of chickpea, 39.5% samples of wheat and 81.6% sample of soybean had seed germination above IMSCS.

AAU, Jorhat

To study the seed health status of farmer's saved seeds with respect to insect infestation, paddy seed samples were collected from Sonitpur district of Assam. Total of one hundred seed samples (17 different varieties) were collected from two Sub-divisions (Sonitpur and Dhekiajuli subdvision) of Sonitpur district (Table 1.4).

Out of hundred samples collected, 65% samples recorded seed germination above IMSCS. Per cent seed germination ranged between 47 to 96. The storage period of most of the samples was 7 to 8 months. Seed moisture content ranged between10.6 to 13.6%. Overall, 35% seed samples were infested by *Sitophilus oryza* and *Sitotroga cerealella*. About 19% collected seed samples had insect damage beyond permissible limit as per IMSCS. The insect damage ranged between 0.25 to 15%. The vigour index of the collected seed samples ranged between 525 to 2121.

OUAT, Bhubaneswar

Paddy seed samples (261 nos.) were collected from farmers belonging to Keonjhar, Puri, Cuttack, Khurda, Bargarh, Kalahandi, Nayagarh, Bhadrak, Dhenkanal, Angul, Ganjam and

Mayurbhanj districts of Odisha. Out of 261 samples,195 seed samples (74.7%) were infested with angoumois grain moth and lesser grain borer and insect damage was beyond permissible limit in 65.5% samples. Insect damage level ranged between 0.5-27%. About 63.2% seed samples were having seed germination above IMSCS (Table-1.5).

NDUAT, Faizabad

Eighty five paddy seed samples were collected from farmers of Ayodhya, Sultanpur, Sarawasti, Gonda, Basti and Maharajganj whereas wheat seed samples (95nos.) were collected from Ayodhya, Sarawasti, Gonda, and Bahariach (Table-1.6). About 98.8% paddy seed samples were infested with various storage insects namely, *Rhyzopertha dominica*, *Sitotroga cerealella* and *Sitophilus oryzae.* About 95.3% samples were having insect damage beyond permissible limit (>0.5% ID). About 87.4% wheat samples were infested with various storage insects (*Rhyzopertha dominica* and *Sitophilus oryzae)* and insect damage was beyond permissible limit (>0.5% ID) in all infested seed samples. Seed germination ranged between 20-98% in paddy and 76-98% in case of wheat. About 28.2% of paddy seed samples and 89.5% of wheat seed samples had seed germination above IMSCS.

TNAU, Coimbatore

A total of 98 farmers saved seed samples were collected from Perukupathi Pudur, Perumpathi, Kunjurpathi and Manguli of Palamalai area (Table 1.7). The seed samples comprised of Indian bean (26), finger millets (21), amaranthus (6), sorghum (9) cowpea (3), foxtail millet (6), little millet (4), pearl millet (3), horse gram (9), greengram (1), coriander (1), sesame (4) and maize (1).

Most of the farmers are using jute and woven poly bags for seed storage. Some farmers also use earthen structures *i.e.,* thombai, kuruthu and pots for storing seeds. Four insect pests *viz*., rice weevil (*Sitophilus oryzae*), pulse beetle (*Callosobruchus maculatus*) red flour beetle (*Tribolium castaneum*) and rice moth (*Corcyra cephalonica*) were recorded in the stored seeds. The farmers practiced protection measures like (i) Solar drying (ii) Red earth treatment for redgram and lablab and (iii) Mixing leaves of *Azadiracta indica*, *Vitex negundo* and *Ocimum*.

Out of 26 Indian bean seed samples, 13 samples had insect infestation. Intensity of seed damage varied from 1.0 to 95% among the samples. About 42% of total collected samples were having seed damage beyond permissible limit. Moisture content of samples ranged between 10.7-23.2%. Seed germination ranged between 0.0 to 97%. About 73% of the seed samples collected had seed germination above minimum seed certification standard.

Out of 34 millet samples (finger millets, foxtail millet, little millet and pearl millet) collected, only 2 samples of pearl millet were infested and about 5.9% of total samples had insect damage >0.5%. Per cent seed germination varied from 0.0-96 and 50% samples had seed germination above IMSCS level.

Out of 32 seed samples of other crops (sorghum, horsegram, bengal gram, greengram, cowpea, coriander, sesame and maize), only 13 samples were infested with various insects and about 37.5% samples were having insect damage beyond permissible limit. Seed germination varied from 0-98% with 37.5% samples above IMSCS level.

UAS, Bangalore

Survey was carried out in villages of Tumkur, Bengaluru rural, Chikkabalapur, Chitradurga, Chamrajnagar, Mysore and Mandya districts of Karnataka. Total of 162 seed samples were collected in seven different crop species *viz*., cowpea (35), field bean (33), chickpea (27), horsegram (14), greengram (10), groundnut (20) and paddy (23). Storage period of collected seed samples ranged between 2 to 12 months and all seed samples were infested with various storage insects (seed damage 0.25 to 6.25%). In cowpea, all the samples had seed damage beyond permissible limit and only 20% samples had seed germination above IMSCS (Table 1.8). Seed moisture content ranged between 9.8-12.8%. In field bean 87.9% samples had insect damage beyond permissible limit whereas only 36.4% samples recorded seed germination above IMSCS. About 85.2% chickpea seed samples had insect damage beyond permissible limit and all samples failed to meet minimum seed germination standard under IMSCS. In horsegram 85.7% seed samples were having >1% insect damage and only 14.3% samples could meet the seed germination standard. In greengram, all the samples had >1% insect damage and 20% samples had seed germination above IMSCS. About 95% groundnut seed samples had insect damage beyond permissible limit whereas 40% seed samples could meet the minimum seed germination standard. All paddy seed samples (23) failed to meet both the standard of seed damage and germination. All the pulse seeds were infested by *Callosobruchus sp*., *Rhyzopertha dominica, Tribolium castaneum* and *Sitophillus oryzae.* About 60% of groundnut pods were infested by *Caryedon serratus* and *Rhyzopertha dominica,* where as all paddy seed was infested with *Corcyra cephalonica*, *Rhyzopertha dominica* and *Sitophilus oryzae*. Only 2 to 5 % of the farmers saved their own seeds. No control measures were taken to save farm seeds from insect infestation.

PJTSAU, Hyderabad

During survey, a total of 123 seed samples of three major crops *viz.,* paddy (85), bengalgram (10) and redgram (28) were collected from Rangareddy, Nizamabad, Mehabubnagar, Medak, Medchal- Malkajgiri, Warangal and Miryalguda districts of the Telangana state (Table 1.9). Most of the farmers were using gunny bags for storing seeds, However, few farmers are using different packaging materials *viz*., polylined bags, non-woven bags for storing seeds. Storage period of these samples ranged between 6-18 months. Out of 85 paddy seed samples, 52 samples (61.2%) showed insect infestation, mainly by Anguomois grain moth, lesser grain borer and red flour beetle. Seed damage varied from 0-19.9%. About 50.6% samples were having insect damage beyond the permissible limit (> 0.5%). Moisture content of seed samples ranged between 9.1-13.2%. About 90.6% seed samples recorded seed germination above IMSCS *i.e*., >80 %.

All the chickpea seed samples were infested with *Callosobruchus* sp and seed damage ranged from 2.86-14.2%. However, 90% samples maintained germination (85-97%) above IMSCS. Out of 28 redgram seed samples collected, 42.9% samples were infested with *Callasobruchus* sp.

and 28.6% samples had insect damage beyond permissible limit. All the samples maintained seed germination percentage (91.33-97.33%) above IMSCS.

PAJANCOA & RI, Karaikal

Forty six samples of paddy (14 varieties) were collected from two different regions of Puducherry (UT) *viz.,* Puducherry and Karaikal, out of which 41 samples were infested with various insects. All infested samples had seed damage ranging between 0.25 and 10.8%. About 80.4% of the samples had insect damage beyond permissible limit under IMSCS. Similarly, only 54.3% of the samples fulfilled IMSCS for germination (80%). *Rhyzopertha dominica* was the insect predominantly found in the seed samples (42 samples) followed by *Sitotroga cerealella* (19 samples). Seed moisture content ranged between 9.6-14.5% (Table 1.10).

CSAUAT, Kanpur

Two hundred two (202) farmers saved seed samples of paddy (97) and wheat (105) were collected from Kannauj, Kanpur, Mainpuri, Unnao and Hardoi district of U.P (Table 1.11).

Out of 97 samples of paddy, 37.1% (36) samples were infested with *Rhizopertha dominica* and *Oryzaephilus surinamensis*. Seed damage ranged between 0.25 to 3.75% in these samples. About 8.2% paddy seed samples had >0.5% insect damage. In all these samples, germination ranged between 69 to 92% whereas, seed moisture content and vigour index ranged between 13.1-14.6% and 869-1548 respectively. About 66% seed samples had seed germination above IMSCS.

About 32.4% wheat seed samples were infested with various storage insects (*Rhizopertha dominica* and *Sitophilus oryzae*) and 18.1% samples had insect damage beyond permissible limit. However, 45.7% seed samples recorded seed germination above IMSCS. Seed moisture content ranged between 9.4 to 12.8%. Storage period of wheat seed samples was 6 months. Whereas, paddy seed samples were collected after 7 months of storage.

UAS, Dharwad

One hundred sixty nine seed samples of various crops (groundnut-53, wheat-59 and soybean-57) were collected from the farmers before sowing (Table 1.12). All the collected seed samples were infested with various storage insects like *Caryedon serratus*, *Tribolium castaneum*, *Plodia interpunctella* and *Sitophilus granarius*. In soybean about 94.7% seed samples failed to meet the standard for insect damage. Seed moisture content ranged between 10-12.0%. Seed germination ranged between 58-87% and 73.7% samples had seed germination above IMSC standard. All the wheat seed samples were infested with various insects and 96.6% seed samples had insect damage beyond permissible limit. Moisture content ranged between 10-14.0%, while seed germination ranged between 58-92%. Only 15.3% samples had seed germination above IMSCS. All the groundnut seed samples failed to meet the standard of insect damage, while 81.1% samples recorded seed germination above IMSCS.

IISS, Mau

During survey one hundred wheat seed samples were collected from eleven villages of different districts (Kushmaur, Onhaich, Rahjaniya, Fattepur, Gokulpura, Sadipur, Gopalpur, Gahna, Belaunjha, Badhauna and Meuri kala) of Uttar Pradesh (Table-1.13). Storage period of these samples was 6 months. About 27% seed samples were infested with various storage insects and 17% samples were having insect damage beyond permissible limit. The moisture content of seed samples ranged between 9.6 to 14.3%. About 74% seed samples recorded seed germination above IMSCS. The insect damage in different samples ranged between 0.25 to 6.25 %. Most of the farmers used ITKs like mixing of cowdung cake ash (@50g/Kg Seed), mixing with dry chilly @ 20 gm + garlic @ 100 gm/40 kg seeds, mixing with salt @ 200 gm + garlic @ 100 gm/40 kg seeds and stacked bags on straw for protecting wheat seed from storage insects.

Conclusion

The survey has been conducted in ten states and one union territory across the country and about 2154 nos. of farmers' saved seed samples have been collected and analysed for seed quality. The survey revealed that about 37.1% seed samples had germination bellow IMSCS and about 55.8% seed samples were infested with various storage pests. About, 47.1% samples had insect damage beyond permissible limit. The intensity of damaged seed usually varied from 0.25-5.0%. Therefore, there is ample scope of improvement of seed health status of farmers' saved seed.

Table 1.1. Survey and evaluation of seed health status of farmers saved seed (MPKV, Rahuri)

Sr. No.	Location	Crop/ variety	Storage period	Number of samples collected	Number of samples infected	Name of insects present	Per cent seed damage (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Seed sample with germination above IMSCS (%)
1	A.Nagar &pune	Soybean	Oct-June	59	0	Nil	Nil	Nil	7.4-8.9	70 (62-78)	57.6
2	A.Nagar &pune	Pearl millet	Oct-June	42	13	*R. dominica, S. oryzae, T. castaneum*	0-9	31.0	7.4-8.9	78(70-90)	78.6
3	A.Nagar &pune	Sorghum	Oct-June	58	18	*R. dominica, S. oryzae, T. castaneum*	0-14	31.0	7.4-8.9	78 (68-90)	79.3
4	A.Nagar &pune	Wheat	March-Nov	69	21	*R. dominica, S. oryzae, T. castaneum*	0-13	30.4	7.2-9.2	86(75-92)	71
5	A.Nagar &pune	Chickpea	March-Nov	64	19	*Callosobruchus* spp	0-18	48.4	7.5-9.2	86(70-92)	76.6

Table 1.2. Survey and evaluation of seed health status of farmers saved seed of groundnut with respect to insect infestation (JAU, Jamnagar)

Sr. no.	Districts	No. of samples collected	No. of samples infested	Crop & variety	Storage period in months (range)	Insect-pests observed	Per cent Seed damage (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Germination (%) in Lab. (range)	Per cent seed sample with germination above IMSCS	Vigour index (range)	Seed trt. Given by farmers
1	Jamnagar	45	18	Groundnut GG -20 GJG-22 TG-45 TG-37 GJG-31 GG-24	7-8	*Caryedon* & *Tribolium*	0.0-5.0	24.4%	3.11-7.09	63.0-97.0	86.7	242-1679	2% M. parathion on gunny bags, Celphos , and Sun drying once after storage, DDVP on gunny bags.
3	Devbhumi Dwarka	33	29	Groundnut GG-20 GJG-22 GG-20 Kranti Bombaysona TG-37	7-8	*Caryedon* & *Tribolium*	1.0-28.0	51.5%	3.56-9.91	60.0-95.0	97.0	166-1336	2% M. parathion on gunny bags, Celphos, Sun drying once after storage, DDVP,neem leaves
4	Rajkot	22	18	Groundnut GG-20, TG-45 GJG-22	7-8	*Caryedon*	1.0-6.0	59.1%	4.92-7.11	59.0-96.0	81.8	279-1602	Sun drying once after storage. 2% M. parathion on gunny bags, Celphos
			Overall range	**Minimum**	-	--	0.00	--	3.11	59.0		166	--
				Maximum	-	--	28.0	--	9.91	97.0		1679	
				Average	-	--	2.23	--	5.59	80.5		774	

Table 1.3. Survey report of seed health status of farmer's saved seed with respect to insect infestation (PDKV, Akola)

Sr. No.	Location	Crop/ Variety	Storage period	Number of samples collected	Number of samples infected	Name of insects present	Per cent seed damage (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Per cent seed sample with germination above IMSCS	Mean vigour index (with range)
1	Vidarbha region of Maharashtra	Mungbean	8 month	38	12	*C. chinensis*	0.66-2.9	21.1	7.9-8.1	75 (70-80)	71.1	1698 (1645-1800)
2		Udidbean	7 month	48	16	*C. chinensis*	0.45-2.85	27.1	8.3-8.5	74.5 (70-79)	66.7	1695 (1605-1690)
3		Pigeonpea	6 month	65	9	*C. chinensis*	0.51-2.50	7.7	8.0-9.5	76.5 (71-82)	83.1	1710 (1495-1820)
4		Soybean	7 month	87	7	-	0.2-2.4	3.4	7.5-8.4	70.5 (62-79)	81.6	1723 (1625-1792)
5		Chickpea	8 month	40	21	*C. chinensis*	0.25-26.3	25	8.4-14.5	72 (48-96)	22.5	2417 (1734-2517)
6		Wheat	7 month	43	20	*R. dominica*	0.5-5.25	34.9	7.6-11.8	70 (44-96)	39.5	2685 (2054-2878)

Table 1.4. Survey and evaluation of seed health status of farmer's saved paddy seed with respect to insect infestation (AAU, Jorhat)

Sl.	Paddy variety	Storage period (months)	Number of samples collected	Number of samples infested	Name of insects present	Per cent seed damage (range)	Seed sample with seed damage beyond permissible limit (%)	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Per cent seed sample with germination above IMSCS	Mean vigour index (with range)
	Sonitpur Subdivision										
1	Swarna Mashuri	8	4	2	SC	(0-5.00)	50.0	11.6-12.3	78.0 (65 - 84)	75.0	1424 (1060-1688)
2	15 No.	7 to 8	10	6	SC,SO	(0-15.0)	30.0	11.6 -13.1	77.7 (63 - 87)	60.0	1435 (1012-1870)
3	Bora	8	1	Nil	Nil	Nil	Nil	11.80	82.0	100	1525
4	Ranjit	7 to 8	9	3	SC	(0-0.50)	Nil	10.6-12.6	83.0 (75-96)	77.8	1445(840-2064)
5	Kola Joha	7	1	1	SC,SO	4.50	100	13.0	76.0	Nil	1110
6	Mashuri	7	1	Nil	Nil	Nil	Nil	12.5	80.0	100	1448
7	Kalamdani	7	1	Nil	Nil	Nil	Nil	12.2	78.0	Nil	1287
8	Joha Bora	7	3	1	SC	(0-0.25)	Nil	11.2-12.1	83.3 (80-88)	100	1735(1517-2121)
9	Jalparia	8	6	2	SC	(0-12.0)	33.3	11.4-12.8	80.0 (72-87)	66.7	1275(806-1618)
10	Kon Joha	8	3	Nil	Nil	Nil	Nil	11.9-12.2	81.3 (80-82)	100	1553(1328-1730)
11	Aijong	8	3	Nil	Nil	Nil	Nil	11.0-11.6	84.0 (82-86)	100	1745(1277-2073)
12	Swarna Sap	8	1	Nil	Nil	Nil	Nil	12.10	85.0	100	1232
13	Lucky	8	2	Nil	Nil	Nil	Nil	12.2-12.6	80.0 (79-81)	50.0	1137(1043-1231)
14	Bogi Aijong	8	1	Nil	Nil	Nil	Nil	11.80	85.0	100	1403
	Dhekiajuli Subdivision										
15	Swarna Mashuri	8	14	5	SC,SO	(0-7.00)	14.3	11.2-13.1	77.1 (62-88)	50.0	1121(670-1725)
16	Ranjit	7 to 8	22	8	SC,SO	(0-12.5)	22.7	11.3-13.4	78.4 (55-86)	63.6	1263(594-1677)
17	Bahadur	8	7	3	SC	(0-0.50)	Nil	11.6-13.6	78.4 (72-83)	57.1	1171(795-1760)
18	15 No.	8	3	3	SC,SO	(2.50-11.6)	100	12.9-13.4	58.0 (47-75)	Nil	653(525-907)
19	Joha	7	4	Nil	Nil	Nil	Nil	11.6-12.8	79.5 (78-80)	75.0	1311(1096-1560)
20	Bora	8	3	1	SC,SO	(0-2.50)	33.3	11.7-12.2	79.7 (76-82)	66.7	1160(1003-1255)

21	Jalparia	8	1	Nil	Nil	Nil	Nil	12.40	80.0	100	1168.0

**SC- Sitotroga cerealella; SO-Sitophilus oryzae;*

Table 1.5. Evaluation of seed health status of farmers saved paddy seeds with respect to insect infestation (OUAT, Bhubaneswar)

Sr. No.	Location	Storage period (Months)	Number of samples collected	Number of samples infected	Name of insects present	Per cent seed damage (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Per cent seed sample with germination above IMSCS
1	Keonjhar	6-7	36	21	R.d, S.c	0.5-6.5	22.2	10.0-13.5	89.4(80-98)	97.2
2	Puri	6	15	14	R.d, S.c	1.5-29.0	100	10.5-14.5	59.9(42-93)	26.7
3	Cuttack	6	44	32	R.d, S.c	0.5-25.0	47.7	9.5-15.0	82.2(38-98)	77.3
4	Khurda	6	13	12	R.d	1.0-27.0	100	10.5-13.5	76.1 (36-91)	61.5
5	Bargarh	6-7	9	8	R.d, S.c	2.0-14.5	100	11.5-15.0	71.7 (50-96)	33.3
6	Kalahandi	6-7	20	15	R.d	0.5-5.5	60.0	10.0-14.0	82.3(68-95)	55.0
7	Nayagarh	7	11	8	S.c	1.0-18.5	100	11.0-15.5	78.4(47-95)	63.6
8	Mayurbhanj	6	52	40	R.d	0.5-24.5	69.2	9.5-16.0	74.2(20-99)	53.8
9	Bhadrak	6	15	10	R.d, S.c	1.0-10.5	100	10.0-16.5	81.5(55-94)	66.7
10	Dhenkanal	7	15	13	R.d	0.5-14.0	60.0	11.0-15.5	77.1(50-92)	53.3
11	Angul	7	13	9	R.d	1.5-9.5	100	10.5-14.5	78.9(58-94)	53.8
12	Ganjam	6	18	13	R.d, S.c	1.0-13.5	100	11.0-14.5	76.8(50-95)	55.5

**R.d-R. dominica, S.c-S. cerealella,*

Table 1.6. Seed health status of farmer's saved seed with respect to insect infestation in eastern UP (NDUAT, Faizabad)

Sr. No.	Location	Crop/ variety	Storage period	Number of samples collected	Number of samples infected	Name of insects present	Per cent seed damage (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Per cent seed sample with seed germination above IMSCS	Mean vigour index (with range)
1	Ayodhya	Paddy	5-6 months	12	11	SC,RD,SO	2.16 (0.00-4.3)	91.7	11.6(11.1-12.2)	86.7(79-92)	58.3	1615(1280-1993)
2	Sultanpur	Paddy	5-6 months	8	8	SC,RD,SO	1.45(0.3-2.60)	75	11.7(10.5-12.7)	78.5(51-90)	50.0	1273(792-1490)
3	Sarawasti	Paddy	5-6 months	15	15	SC,RD,SO	5.58(2.3-10.00)	100	11.8 (10.9-14.1)	63.3(30-84)	26.7	1151 (308-1620)
4	Gonda	Paddy	5-6 months	18	18	SC,RD,SO	7.53(1.30-8.60)	100	11.5(10.9-12.8)	48.9(23-88)	5.6	711(167-1316)
5	Basti	Paddy	5-6 months	14	14	SC,RD,SO	5.03(1.60-8.0)	100	11.5(10.9-12.0)	78.2(20-98)	28.6	1360 (280-1762)
6	Maharajganj	Paddy	5-6 months	18	18	SC,RD,SO	3.07(0,3-9.3)	94.4	11.4(10.5-11.8)	71.7(20-93)	44.4	1463 (920-1845)
7	Ayodhya	wheat	8-9 months	22	14	RD,SO	1.90(0-8.00)	63.6	9.77(9.1-0.4)	94.0(78-98)	90.9	1263(990-1690)
8	Gonda	wheat	8-9 months	26	23	RD,SO	4.30(0-10.0)	88.5	9.93(9.7-10.3)	90.2 (76-97)	88.6	1212(980-1610)
9	Sarawasti	wheat	8-9 months	24	23	RD,SO	5.41(0.0-12.0)	95.8	11.0(10.1-11.4)	90.3 (80- 97)	87.6	1192 (779-1476)
10	Bahariach	wheat	8-9 months	23	23	RD,SO	3.56(1.0-8.0)	100	10.3(9.9-10.7)	89.7 (80-96)	91.3	1142(865-1339)

*R.d- *R. dominica*; S.c- *S. cerealella; S.o – Sitophilus oryzae*

Table 1.7. Survey and evaluation of seed health status of farmer's saved seed in Tamilnadu (TNAU, Coimbatore)

Sr. No.	Location	Crop/ variety	Storage period	Number of samples collected	Number of samples infected	Name of insects present	Seed damage (%) (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Seed sample with germination (%)above IMSCS	Mean vigour index (with range)
1	Perukupathi, Kunjurpathi, Perukupathi Pudur, Manguli of Palamalai	Indian bean (Lab lab)	2 to 8 months	26	13	C.c	1.0 to 95.0	42	10.7- 23.2	76 (0.0-97)	73	2348 (0-3501)
2	Perukupathi Pudur and Manguli of Palamalai	Finger millet	2 to 24 months	21	0	---	0	0	12.4-14.6	71 (0.0-98)	62	1015 (0-1764)
3	Perukupathi Pudur, Perumpathi, Kunjurpathi and Manguli, Palamalai	Amaranthus	2 to 12 months	6	0	---	0	0	12.1 (11.4 - 13)	69 (0.0-90)	67	586 (0-864)
4	Perumpathi, Kunjurpa-thi, Manguli	Sorghum	3 to 12 months	9	9	S.o	2.0 to 63.0	100	13.9 (10.8 - 18.2)	49 (0.0-84)	22	1096 (0-1982)
5	Kunjurpathi and Manguli of Palamalai	Horsegram	3 to 36 months	9	2	C.sp	1.0 to 6.0	11	12.5 (10.5 - 15.7)	58 (0.0-98)	44	1357 (0-2491)
6	Kunjurpathi and Manguli of Palamalai	Pearl millet	4 to 12 months	3	2	S.o, T.c, C.c	11.0 to 23.0	67	12.8 (12.6 - 12.9)	65 (42-80)	33	1422 (697-2008)
7	Kunjurpathi and Manguli of Palamalai	Little millet	14 to 24 months	4	0	---	0	0	11.5 (10.9 - 12.2)	0	0	0
8	Manguli of Palamalai	Cowpea	3 to 5 months	3	0	---	0	0	13.3 (12.7 - 14.2)	89 (80-96)	100	2987 (2336- 3561)
9	Manguli of Palamalai	Sesame	8 to 18 months	4	0	---	0	0	5.0 (4.9-5.1)	0	0	0
10	Manguli of Palamalai	Bengalgram	4 to 7 months	4	0	---	0	0	10.5 (9.6-11.0)	88 (68-96)	75	1815 (1366- 2304)
11	Manguli of Palamalai	Foxtail millet	5 months	6	0	---	0	0	11.2 (10.8 - 11.6)	85 (0.0-92)	50	1264 (775-1564)

12	Manguli of Palamalai	Corriander	15 months	1	0	---	0	0	9.2	0	0	0
13	Manguli of Palamalai	Greengram	9 months	1	1	C.c	66	100	22.4	0	0	0
14	Perukupathi of Palamalai	Maize	14 months	1	1	S.o	68	100	21.3	10	0	192

C.c - Corcyra cephalonica (Rice moth); Csp. – Callosobruchus sp*; S.o – Sitophilus oryzae; T.c - Tribolium castaneum*

Table 1.8. Survey and evaluation of seed health status of farmer's saved seed with respect to insect infestation (UAS, Bangalore)

Sr. No.	Location	Crop/ variety	Storage period	Number of samples collected	Number of samples infected	Name of insects present	Per cent seed damage (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Per cent seed sample with seed germination above IMSCS	Vigour index (range)
1	Tumkur, Bangalore Rural, Chitradurga	Cowpea	2-12 Months	35	35	Cal, R.d,S.o	1.25-6.20	100	9.8-12.8	66 (50-78)	20.0	1958-2852
2	Tumkur, Bangalore Rural, Chikkabalapur	Field bean	2-10 Months	33	33	Cal, R.d	0.25-5.75	87.9	10.1-11.9	71 (55-82)	36.4	2015-2655
3	Bangalore Rural	Chikpea	2-8 Months	27	27	Cal. R.d, T.c	0.50-6.25	85.2	10.1-12.5	70 (58-81)	0.0	2005-2501
4	Mandya, Tumkur	Horsegram	2-12 Months	14	14	Cal, R.d	0.50-4.50	85.7	10.2-12.1	73 (64-81)	14.3	2004-2231
5	Chamrajnagar	Greengram	4-10 Months	10	10	Cal. R.d	2.5-5.5	100	10.2-12.8	66 (52-78)	20.0	2045-2142
6	Tumkur, Chitradurga	Groundnut	4-12 Months	20	20	R.d, C.s	1.00-4.00	95.0	8.9-10.2	66 (65-79)	40.0	2002-2654
7	Chamrajnagar, Mysore, Mandya	Paddy	4-12 Months	23	23	C.c, R.d, S.o	2.25-4.75	100	10.2-14.5	67 (52-79)	0.0	1892-2210

T.c - *Tribolium castaneum* (Red flour beetle)	Cal - *Callosobruchus Sp.* (Pulse beetle)	R.d - *Rhyzopertha domoinica* (Lesser grain borer)
S.o-*Sitophillus oryzae (Rice weevil)*	C.c - *Corcyra cephalonica* (Rice moth)	C.s- *Caryedon serratus* (Olivier) (Tamarind beetle)

Table1.9. Survey and evaluation of seed health status of farmer's saved seed with respect to insect infestation (PJTSAU, Hyderabad)

Sr. No.	Location	Crop/ variety	Storage period	No: of samples collected	No: of samples infected	Name of insects present	Per cent seed damage (range)	Seed sample with seed damage beyond permissible limit (%)	Seed Moisture (%) (range)	Mean Seed Germination (%) with (range)	Per cent Seed sample with seed germination above IMSCS	Vigour index (range)
1	Ranga reddy	Paddy	12 M	23	12	A,R,T	0-6.4	43.5	10.5-13.4	82.6-100	100	1177-1853
2	Ranga reddy	Paddy	18 M	4	4	A,R,T	0.23-10.62	50	11.5-13.2	15-100	100	352-1782
3	Nizamabad	Paddy	6 M	8	2	A,R	0.0-3.35	25	9.2-9.6	98-100	100	1626-1862
4	Mahbubnagar	Paddy	6 M	10	1	A,R,	0.0-2.15	10	9.1-9.6	83-100	100	1294-1509
5	Mahbubnagar	Paddy	18 M	1	1	A,R,T	0.43	0	9.5	88.3	100	1530
6	Medak	Paddy	18 M	5	5	A,R,T	0.4-0.91	80	11.2-11.6	94-96	100	1423-1521
8	Medchal-Malkajgiri	Paddy	12 M	3	1	A,R,T	0.0-0.15	0	10.2-10.5	98-100	100	1437-1542
9	Medchal-Malkajgiri	Paddy	18 M	7	4	A,R,T,RW, STB	0.0-5.33	28.6	10.00-11.5	97-100	100	1437-1542
10	Warangal	Paddy	6 M	7	5	R,STB	0.0-19.86	71.4	11.25-12.35	24-100	71.4	-
11	Miryalaguda	Paddy	6 M	17	17	A,R,T	0.51-16.36	100		40-100	76.5	-
1	Nizamabad	Bengalgram	6 M	10	10	PB	2.86-14.2	100	9.5-10.5	84-97	90	1658-2179
1	Nizamabad	Redgram	6 M	15	8	PB	0.0-4.23	46.7	9-9.7	92-97.3	100	2045-2705
2	Sidhipet	Redgram	6 M	13	4	PB	0.0-0.99	0	9.1-9.7	91.33-97	100	2015-2705

A= Angoumois grain moth; RW=Rice weevil R=*Rhyzopertha dominica*

T= *Tribolium* PB=Pulse beetle STB=Saw toothed grain beetle

Table 1.10. Survey and evaluation of seed health status of farmer's saved paddy seed with respect to insect infestation (PAJANCOA, Karaikal)

Sl.No.	Location	No. of samples collected	Storage period (Month)	Moisture Content (%) Range	No. of samples infested	Insects present	Insect infestation (%) (Range)	Percentage of sample with seed damage beyond permissible limit	Mean germination with range (%)	Percentage of Samples with germination above IMSCS (%)	Mean Vigour index I (with range)
1	Puducherry	26		9.6-14.5	25	R, S	0-10.75	88.5	89.1 (78-99)	88.5	2380 (1518-3050)
2	Karaikal	20		10.2-11.8	16	R, S	0-3.00	70.0	64.7 (47-85)	10.0	1433 (945-1934)
	Total	**46**		**9.6-14.5**	**41**		**0-10.75**	80.4	**-**	**54.3**	-

*R- *Rhyzopertha dominica;* S- *Sitotroga cerealella*

Table 1.11. Survey and evaluation of seed health status of farmer's saved seed with respect to insect infestation in UP (CSAUAT, Kanpur)

S. No.	Location	Crop/ varieties	Storage Period	No. of samples collected	No. of samples infested	Live insect present	Seed moisture (%) range	Seed Damage (%) range	Seed sample with seed damage beyond permissible limit (%)	Seed germination % (range)	Seed sample with seed germination above IMSCS (%)	Seedling Vigour (range)
1.	Mainpuri	Paddy	Nov., 17 to May 18	30	11	*Rhizopertha dominica* *Oryzaephilussurinamensis*	13.2-14.2	0.25-1.0	3.3	69-92	90.0	869-1796
2.	Kanauj	Paddy	Nov., 17 to May 18	27	9		13.1-14.6	0.25-1.5	14.8	70-86	59.3	1050-1548
3.	Hardoi	Paddy	Nov., 17 to May 18	40	16		13.1-14.2	0.25-1.5	7.5	70-91	52.5	924-1476
4.	Kanpur	Wheat	May 18 to Nov. 18	30	9	*Rhizopertha dominica* *Sitophilus oryzae*	11-12.6	0.25-2.0	13.3	71-88	36.7	1228-1728
5.	Unnao	Wheat	May 18 to Nov. 18	40	11		11.0-12.8	0.25-2.0	17.5	80-90	52.5	1173-1836
6.	Kanauj	Wheat	May 18 to Nov. 18	35	14		9.4-12.5	0.25-3.75	22.9	15-96	45.7	127-2319

Table 1.12. Survey and evaluation of seed health status of farmer's saved seed with respect to insect infestation (UAS, Dharwad)

Sl. No.	Location	Crop/ variety	Storage period	Number of samples collected	Number of samples infected	Name of insects present	Per cent seed damage (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Per cent seed sample with seed germination above IMSCS	Mean vigour index (with range)
1	Belgaum, Dharwad and Haveri districts	Groundnut GPBD-4 G2-52 GPBD-5 TAG-24	3-6 months	53	53	*Caryedon serratus* *Tribolium castaneum*	1.2-4.2	100	9.0-12.0 %	73.0 (54-86)	81.1	1067 (596-1320)
2	Belgaum, Dharwad and Haveri districts	Wheat DWR-304 DDK-1029 DWR-162 Mace-6222	4-8 months	54	54	*Plodia interpunctella* *Sitophilus granarius*	0.5-3.2	96.6 %	10.0-14.0 %	76.0 % (58-92)	15.3	1214 (724-1674)
3	Belgaum, Dharwad and Haveri districts	Soybean. JS-335 DSB-21 JS-9305	4-7 months	57	57	No insects observed	0.9-3.0	94.7 %	10.0 -12.0 %	74.0 (58-87)	73.7	1623 (821-2225)

Table 1.13. Survey and evaluation of seed health status of farmers saved seed of wheat seed with respect to insect infestation at IISS, MAU

S No	Location	Crop/ variety	Storage period	Number of samples collected	Storage structure used	Number of samples infected	Name of insects present	Per cent seed damage (range)	Per cent seed sample with seed damage beyond permissible limit	Seed Moisture (%) (range)	Mean Seed Germination (%) with range in parenthesis	Per cent seed sample with seed germination within permissible limit	Mean vigour index (with range)
1	Kushmaur	Wheat	6 Months	14	Seed bin; HDPE bag	4	R, S	0.25-1.75	7.14	11.85 (9.6-14.3)	86.9 (82-97)	71.4	1937 (1573-2189)
2	Badhauna	Wheat	6 Months	4	Seed bin	1	R	0.25-0.5	-	12.02 (10.2-13.1)	82.8 (75-88)	50.0	2014 (1803-2240)
3	Onaiach	Wheat	6 Months	3	Seed bin	1	R	0.25-0.5	-	11.9 (11.2-12.6)	76 (62-83)	0.00	1422 (602-2019)
4	Sadipur	Wheat	6 Months	8	Seed bin' HDPE bag	1	R	0-0.25	-	11.58 (10.2-13.1)	84.4 (79-86)	75.00	1935 (1752-2163)
5	Rahajaniya	Wheat	6 Months	6	HDPE bag	Nil	Nil	Nil	-	11.86 (10.2-13.2)	84.8 (84-87)	66.7	1755 (1319-1976)
6	Gokulpura	Wheat	6 Months	26	Seed bin; HDPE bag	2	R, S	0.0-0.5	-	11.83 (9.8-14.2)	86.1 (75-95)	69.2	1992 (1504-2329)
7	Belaunjha	Wheat	6 Months	8	Seed bin	5	R, S, T	1.0-6.25	50.0	12.7 (11.4-14.2)	87.9 (84-95)	87.5	1852 (1743-1908)
8	Fatepur	Wheat	6 Months	10	Seed bin; HDPE bag	1	R	0.0-3.75	10.0	11.97 (10.2-13.9)	88.2 (82-93)	90.0	1987 (1820-2098)
9	Meuri kala	Wheat	6 Months	4	Seed bin	3	T, R	0.5-3.25	75.0	11.5 (10.2-13.6)	90.0 (87-91)	100.0	1958 (1813-2266)
10	Gopalpur	Wheat	6 Months	6	HDPE bag	4	R	1.5-6	66.7	12.13 (10.1-13.6)	86.3 (61-95)	83.3	1912 (1342-2407)
11	Gahna	Wheat	6 Months	11	Seed bin; HDPE bag	5	R, S, T	0.75-4.75	36.4	12.26 (10.1-14.2)	86.6 (77-92)	81.8	1775 (1450-2052)

S-Sitophilus oryzae; R- Rhizopertha dominica; T- Tribolium sp

Experiment 2. Effect of carbon dioxide (CO_2) treatment on the control of storage insect pests and the seed quality attributes under ambient conditions

Year of start: 2010

Objectives:

- To assess the effect of carbon dioxide (CO_2) treatment on the mortality/survival of storage insect pest under ambient conditions
- To monitor effect of carbon dioxide (CO_2) treatment on seed quality attributes particularly seed viability and vigour after 3, 6, 9 and 12 months of storage under carbon dioxide (CO_2) atmosphere

Crop seed	Centre
Pearl millet	JAU, Jamnagar; (*Rhyzopertha* sp.)
Sorghum	TNAU, Coimbatore; (*Sitophilus* sp.)

A. Treatment:

T_1 Normal air treatment (untreated control)

T_2 Carbon dioxide (CO_2) @ 30% of the volume

T_3 Carbon dioxide (CO_2) @ 40% of the volume

T_4 Carbon dioxide (CO_2) @ 50% of the volume

B. Exposure period (P) in months:

P_1 03

P_2 06

P_3 09

P_4 12

Replication: 3 **Design:** FCRD

Observations to be recorded at the end of each storage period

- Percent damaged seed (insect infestation)
- Germination of undamaged seed
- Seed moisture content
- Number of live/dead insects in the representative sample

Results:

Sorghum

TNAU, Coimbatore

Results after twelve months of storage revealed that, there was no insect damage in 40 and 50% CO_2 treatments whereas 30% CO_2 treatment also resulted very low insect damage (1.7%). Control recorded 100% insect damage after nine months of storage. All the

treatments maintained seed germination above IMSCS up to three months, but failed to meet the seed germination standard after six months of storage (seed germination 69-74%). Control recoded 20% seed germination after six months of storage. It may be noted that initial seed germination was 77% only. Control recorded nil seed germination after nine months of storage. Whereas, CO_2 treatments recorded 65-66% seed germination (Table 2.1).

Pearl millet

JAU, Jamnagar

All CO_2 treatments (ID 0.44-1.3%) reduced insect damage significantly compared to normal air treatment (ID 2.31%) but only 50% CO_2 treatments restricted insect damage (0.44%) within permissible limit up to three months of storage. All the treatments maintained seed germination above IMSCS up to nine months of storage, but none of the CO_2 treatments restricted insect damage within permissible limit. However, 50% CO_2 treatments recorded significantly lowest insect damage (0.69%) after nine months of storage. Whereas, normal air treatment recorded 9.31% insect damage (Table 2.2).

Conclusion:

The results indicated that 50% CO_2 treatment can provide effective protection against lesser grain borer in pearlmillet and rice weevil in sorghum seed without affecting seed quality up to 6-9 months storage. Thus CO_2 can be a good alternative to use of chemical insecticides including fumigants for management of storage pests in pearlmillet and sorghum.

Table 2.1. Effect of carbon dioxide (CO_2) treatment on storage insect pests and seed quality attributes of Sorghum under ambient conditions prevailing at TNAU, Coimbatore

Storage duration	3 months		6 months		9 months		12 months	
Treatments	**G (%)**	**ID (%)**	**G (%)**	**ID (%)**	**G (%)**	**ID (%)**	**G (%)**	**ID (%)**
Control	**65.0 (53.53)**	4.7 (12.46)	**20.0 (26.55)**	39.7 (39.04)	**0.0 (2.87)**	100.0 (87.13)	**0.0 (2.87)**	100.0 (87.13)
30% CO_2	**75.0 (59.78)**	0.7 (4.78)	**69.0 (55.96)**	1.0 (5.74)	**65.0 (53.53)**	1.3 (6.54)	**46.0 (42.51)**	1.7 (7.33)
40% CO_2	**76.0 (60.44)**	0.0 (2.87)	**74.0 (59.12)**	0.0 (2.87)	**66.0 (54.53)**	0.0 (2.87)	**49.0 (44.62)**	0.0 (2.87)
50% CO_2	**76.0 (60.44)**	0.0 (2.87)	**73.0 (58.91)**	0.0 (2.87)	**66.0 (54.13)**	0.0 (2.87)	**50.0 (45.00)**	0.0 (2.87)
$CD_{0.05}$	**1.31**	2.52	2.15	1.23	**1.42**	1.89	1.51	1.89

Table 2.2. Effect of carbon dioxide (CO_2) treatment on storage insect pests and seed quality attributes of pearl millet under ambient conditions prevailing at JAU, Jamnagar

Storage duration	Seed Germination (%)					Insect Damage (%)				
Treatments	**3 M**	**6 M**	**9 M**	**12 M**	**Mean**	**3 M**	**6 M**	**9 M**	**12 M**	**Mean**
Control	87.67	84.33	77.67	70.33	80.00	2.31 (8.74)	6.98 (15.32)	9.31 (17.77)	12.31 (20.54)	7.22 (15.59)
30% CO_2	88.33	86	79.67	73.33	81.83	1.30 (6.54)	1.63 (7.33)	1.63 (7.33)	7.95 (1.91)	1.61 (7.29)
40% CO_2	89	86.67	81	74.33	82.75	0.69 (4.78)	1.30 (6.54)	1.30 (6.54)	1.63 (7.33)	1.20 (6.30)
50% CO_2	89.67	87.67	81.33	74.67	83.33	0.44 (3.82)	0.69 (4.78)	0.69 (4.78)	1.00 (5.74)	0.69 (4.78)
$CD_{0.05}$	NS				**0.94**	2.37				1.18

Experiment 3:Efficacy of insecticides and botanicals against storage insects of seeds and their influence on seed viability during storage under ambient condition

Crop	Centre
Wheat	SKNAU, Jobner; ICAR-IISS, Mau; NSRTC, Varanasi
Maize	TNAU, Coimbatore
Paddy	OUAT, Bhubaneswar; AAU, Jorhat, PJTSAU, Hyderabad, PAJANCOA,Karaikal
Pigeonpea	NDUAT, Faizabad, PDKV, Akola
Cowpea	UAS, Bangalore
Chickpea	PJTSAU, Hyderabad; JAU, Jamnagar;
Black gram	TNAU, Coimbatore, PAJANCOA,Karaikal
Field pea	CSAUAT, Kanpur

Objectives:

- To evaluate insecticides/ botanicals against major storage insect-pests damaging seeds
- Study of the storability of treated seeds

Year of Start: 2015

Treatment:

A. Insecticides/botanicals

1. Emamectin benzoate @ 2ppm (40.0mg/kg seed)
2. Deltamethrin @ 1ppm (0.04 ml/kg seed)
3. NeemAzal 10000ppm @ 1.5ml/kg seed (15 mg Azadirachtin/kg seed)
4. Karanj (Pongamia pinnata) oil @5ml/kg seed
5. Citronella oil @ 5 ml/kg of seed
6. *Acorus calamus* TNAU Formulation @10ml/kg
7. Untreated control

B. Packaging Material: Gunny bag-lets of 2 kg capacity

Replications: 3 **Design:** CRD

Results- (Tables 3.1 to 3.4)

A. Maize

TNAU, Coimbatore

After three months of storage all the treatments including control had insect damage (0.01-0.12%) within permissible limit but none of the treatments maintained seed

germination above IMSCS. After six months storage, *Acorus calamus* formulation recorded least insect damage (1.17%) among the botanicals and was significantly better than other botanical as well as control (ID 11.7%) in terms of insect damage (Table 3.2).

B. Paddy

PAJANCOA, Karaikal

All the botanical treatments except neemazal were significantly better than control and maintained seed germination above IMSCS upto 3 months of storage. Among the botanicals *Karanj* oil (ID 0.49%) and *Acorus Calamus* TNAU formulation (ID 0.5%) were on par with respect to insect damage after 3 months of storage. Control recorded 1.41% insect damage after 3 months of storage (Table 3.2). After 6 months of storage, all the botanicals failed to meet both the standard of seed germination and insect damage.

AAU, Jorhat

All the treatments except control maintained seed germination (80-81.7%) above IMSCS after nine months of storage. Among the botanicals neemazal (ID 0.25%) and *Acorus calamus* TNAU formulation (0.33%) restricted insect damage within permissible limit and was significantly better than control (ID 1.08%) up to 9 months of storage. Among the botanicals only these two treatments maintained seed germination above IMSCS. Control recorded 68.7% seed germination and 1.08% insect damage after nine months of storage. After 12 months of storage although neemazal (ID 0.42%) and *Acorus calamus* TNAU formulation (ID 0.50%) recorded insect damage within permissible limit but failed to maintain seed germination above IMSCS. Control recorded 61% seed germination and 2.48% insect damage after twelve months of storage (Table 3.2).

PJTSAU, Hyderabad

All the treatments maintained seed germination above IMSCS and restricted insect damage (0.0-0.43%) within permissible limit after three months of storage. Control recorded 0.88% insect damage after 3 months of storage. Among the botanicals, only *Acorus calamus* TNAU formulation (ID 0.46%) and Karanj oil (0.45%) restricted insect damage after six months of storage and maintained seed germination (93-95%) above IMSCS. Control recorded 87.7% seed germination and 3.64% insect damage after six months of storage (Table 3.2).

C. Black gram

TNAU, Coimbatore

All the treatments maintained seed germination (95-99%) above IMSCS and restricted insect damage (ID 0.0-0.02%) within permissible limit after three months of storage while, control recorded 0.17% insect damage. After six months of storage, all the seed treatments except neemazal maintained seed germination above IMSCS (G 82-94%) but none of the treatments was capable of restricting insect damage (ID 1.07-6.93%) within permissible limit. Control recorded 70% seed germination and 11.7% insect damage after six months of storage. *Acorus calamus* formulation (ID 1.5%) was significantly better than other botanicals in terms of insect control.

Cumulative mortality data of adults released on six months stored treated seeds revealed that, among the botanicals, *Acorus calamus* formulation recorded 56.7% insect mortality within 7 days of release while other botanicals recorded 33.3-40.0% insect mortality (Table 3.3).

PAJANCOA, Karaikal

All the treatments maintained seed germination (85-93%) above IMSCS up to 9 months of storage while control recorded only 72% seed germination. All the botanicals except neemazal restricted insect damage within permissible limit (ID 0.29-0.36%) up to 9 months of storage. After 12 months of storage all the treatments failed to meet the standard of seed germination (G 53-70%). All botanicals except neemazal were effective in reducing insect damage (0.18-1.12%) even after 12 months of storage (Table 3.3). Control recorded 54% seed germination and 33.8% insect damage after 12 months of storage.

D. Greengram

OUA&T, Bhubaneswar

All the seed treatments maintained seed germination (G 89.0-93.3%) above IMSCS and restricted insect damage within permissible limit up to three months of storage. Among the botanicals *Acorus calamus* formulation recorded least insect damage (0.67%) followed by neemazal and *karanj* oil (ID 0.83 and 1.0%) while, control recorded 78.3% seed germination and 4.17% insect damage after three months of storage. Among the botanicals, seed treatment with *Acorus calamus* formulation maintained seed germination above IMSCS after six months of storage and recorded least insect damage (1.33%) significantly better than the control (ID 11.3%).

Cumulative mortality of adults released on 6 months of stored treated seeds was 63.7% in case of *Acorus calamus* formulation and 53.3-56.7% in other botanicals within 7 days of release (Table 3.3).

E. Chickpea

JAU, Jamnagar

All the treatments maintained seed germination above IMSCS up to nine months of storage. All insecticidal treatments were free from insect damage while, control recorded 9.67 % insect damage after nine months of storage. Among the botanicals, only *Acorus calamus* TNAU formulation restricted insect damage (0.67%) within permissible limit and was significantly better compared to other botanicals (1.67-2.33%). After 12 months of storage all the treatments failed to maintain seed germination above IMSCS (G 82-84%) and all treatments recorded insect damage beyond permissible limit except emamectin benzoate. However, *Acorus calamus* TNAU formulation recorded least insect damage (1.67%) among the botanicals. Control recorded 79% seed germination and 13.3% insect damage after twelve months of storage (Table 3.4).

PJTSAU, Hyderabad

All the treatments maintained seed germination above IMSCS after three months of storage. All the seed treatments except citronella oil restricted insect damage (0.0-0.60%)

within permissible limit while control recorded 3.0% insect damage after 3 months of storage. Among the botanicals, only *Acorus calamus* TNAU formulation restricted insect damage (0.79%) after six months of storage and maintained seed germination (96%) above IMSCS. All other botanicals failed to meet both the standards of insect damage and seed germination after 6 months of storage (Table 3.4). Control recorded 80.7% seed germination and 9.22% insect damage after six months of storage.

F. Pigeonpea

NDUAT, Faizabad

The results obtained after three months of storage revealed that, all the seed treatments were significantly better than control with respect to insect damage up to six months of storage. However, apart from insecticides, only neem formulation restricted insect damage (0.88%) within permissible limit and maintained seed germination above IMSCS (89%) while control recorded 84% seed germination and 3.66% insect damage after three months of storage. *Acorus calamus* formulation recorded 1.44% insect damage while, karanj oil recorded 1.22% insect damage after three months of storage. After six months of storage, all the botanicals maintained seed germination above IMSCS but none could restrict insect damage (1.33-2.22%) within permissible limit. Neem formulation (ID 1.33%) and *Acorus calamus* formulation (ID 1.66%) were at par with respect to insect damage after six months of storage. Control recorded 80.7% seed germination and 5.66% insect damage after six months of storage (Table 3.4).

PDKV, Akola

All the seed treatments restricted insect damage (0.43-0.83%) within permissible limit and maintained seed germination (76-83%) above IMSCS after 12 months of storage. Among the botanicals, *Acorus calamus* formulation recorded lowest insect damage (0.63%) and was at par with neemazal (ID 0.70%) and karanj oil (ID 0.83%) after 12 months of storage. (Table 3.4) Control recorded 71% seed germination and 1.4% insect damage after 12 months of storage.

G. Fieldpea

CSAUA&T, Kanpur

All treatments maintained seed germination above IMSCS and insect damage was not observed in any of the treatments up to 3 months of storage. All the treatments maintained seed germination above IMSCS (G 82-92%) up to six months of storage. Among the botanicals, only *Acorus calamus* formulation restricted insect damage (ID 1.0%) within permissible limit and was at par with karanj oil (ID 1.67%). Control recorded 80% seed germination and 3.33% insect damage (Table 3.4).

Conclusion: Various botanicals like *Karanj* oil, citronella oil and neem formulation (neemazal 10000ppm) were tested along with *Acorus calamus* TNAU formulation. Although there were variations in results from centre to centre, in most of the crops *Acorus calamus* formulation recorded least insect damage among the botanicals and at par with neem formulation.

Acorus calamus formulation @ 10 ml/kg seed and neemazal 10000ppm @ 1.5ml/kg seed can be used for management of storage insects up to 3-6 months in most of the crops without affecting seed germination.

Table 3.1. Effective seed treatment botanicals and storage periods for different crops at various centres

Crop	Centre	Safe period of storage (months)	Effective botanicals
Maize	TNAU, Coimbatore	-	None of the botanicals
Paddy	AAU, Jorhat	9	Neemazal, *Acorus calamus* TNAU formulation
	PJTSAU, Hyderabad	6	*Karanj* oil, *Acorus calamus* TNAU formulation
	PAJANCOA,Karaikal	3	*Karanj oil, Acorus calamus* TNAU formulation
Pigeon pea	NDUA&T, Faizabad	3	Neemazal
	PDKV, Akola;	12	All treatments
Mung bean	OUA&T, Bhubaneswar	3	All botanicals
Chick pea	PJTSAU, Hyderabad	6	*Acorus calamus* formulation
	JAU, Jamnagar	6	*Acorus calamus* formulation
Black gram	TNAU, Coimbatore	3	All treatments
	PAJANCOA,Karaikal	9	All botanicals except neemazal
Field pea	CSAUA&T, Kanpur	6	*Acorus calamus* formulation

Table 3.2. Effect of insecticides and botanicals against storage insects of seeds and their influence on seed viability during storage under ambient condition

Symbol	Crop	Maize				Paddy											
	Centres	TNAU, Coimbatore				PAJANCOA, Karaikal				AAU, Assam				PJTSAU, Hyderabad			
	Storage duration	3 months		6 months		3 months		6 months		9 months		12 months		3 months		6 months	
	Treatments	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID
T_1	Emamectin benzoate 5 SG @ 2 ppm (40.0 mg/kg seed)	83.0 (65.39)	0.01 (0.71)	88.0 (70.15)	1.07 (1.25)	88.7 (70.60)	0.14 (0.80)	83.3 (65.94)	0.73 (1.10)	82.7	0.00 (0.71)	78.3	0.08 (0.76)	96.7 (79.57)	0.00 (0.71)	95.3 (77.61)	0.21 (0.84)
T_2	Deltamethrin 2.8 EC @ 1.0 ppm (0.04 ml/kg seed)	85.0 (67.22)	0.00 (0.71)	85.0 (66.97)	0.93 (1.19)	86.7 (68.65)	1.08 (1.24)	69.3 (56.64)	7.06 (2.74)	84.7	0.00 (0.71)	79.7	0.17 (0.80)	97.3 (80.61)	0.00 (0.71)	98.3 (83.93)	0.44 (0.97)
T_3	Neem Azal 10000ppm @ 1.5ml/kg seed	86.0 (67.76)	0.03 (0.73)	76.0 (60.79)	4.07 (2.14)	80.0 (63.53)	1.29 (1.33)	56.0 (48.44)	5.71 (2.48)	83.7	0.25 (0.86)	79.0	0.42 (0.94)	95.0 (77.22)	0.43 (0.96)	96.7 (79.47)	0.91 (1.19)
T_4	Pongamia pinnata oil @5ml/kg seed	85.0 (66.95)	0.00 (0.71)	77.0 (61.35)	3.47 (1.99)	92.0 (73.62)	0.49 (0.99)	68.7 (56.91)	5.82 (2.41)	79.0	0.50 (0.98)	72.0	1.00 (1.20)	94.3 (76.28)	0.23 (0.85)	93.0 (74.79)	0.45 (0.97)
T_5	Citronella oil @ 5 ml/kg of seed	84.0 (66.43)	0.01 (0.71)	77.0 (61.12)	3.70 (2.05)	62.0 (51.95)	0.76 (1.11)	29.3 (32.40)	10.12 (3.18)	78.7	0.58 (1.01)	74.0	0.67 (1.07)	86.3 (68.30)	0.43 (0.97)	87.3 (69.19)	0.80 (1.14)
T_6	Acorus calamus TNAU Formulation @10ml/kg	85.0 (67.22)	0.01 (0.71)	85.0 (67.25)	1.17 (1.29)	88.0 (69.78)	0.50 (1.02)	60.0 (50.97)	4.98 (2.20)	82.0	0.33 (0.90)	78.3	0.50 (0.98)	97.7 (81.22)	0.00 (0.71)	95.0 (77.09)	0.46 (0.98)
T_7	Untreated control	88.0 (69.74)	0.12 (0.79)	69.0 (56.17)	11.73 (3.50)	86.7 (68.65)	1.41 (1.38)	80.0 (63.43)	8.20 (2.94)	68.7	1.08 (1.25)	61.0	2.48 (1.72)	96.7 (79.57)	0.88 (1.17)	87.7 (69.41)	3.64 (2.04)
	$CD_{0.05}$	1.20	0.02	4.1	0.15	5.44	0.29	13.21	1.07	5.12	0.33	4.21	0.35	3.15	0.014	4.62	0.063

**G- per cent seed germination and ID- per cent insect damage*

Table 3.3. Effect of insecticides and botanicals against storage insects of seeds and their influence on seed viability during storage under ambient condition

Treatments	Black gram										Green gram			
	TNAU, Coimbatore						PAJANCOA, Karaikal				OUAT, Bhubaneswar			
	3 months		6 months		9 months		9 months		12 months		3 months		6 months	
	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID
T_1=Emamectin benzoate (Proclaim 5 SG) @ 2 ppm (40.0 mg/kg seed)	90.0 (71.62)	0.01 (0.71)	93.0 (74.32)	1.07 (1.25)	80.3 (63.68)	3.07 (1.89)	84.7 (67.70)	0.22 (2.60)	70.0 (56.77)	0.18 (2.40)	93(9.70)	0.17(1.07)	82.0(64.9)	0.5(1.22)
T_2=Deltamethrin 2. 8 EC @ 1.0 ppm (0.04 ml/kg seed)	90.0 (71.94)	0.00 (0.71)	89.0 (71.01)	1.37 (1.37)	80.7 (63.92)	3.40 (1.97)	91.3 (73.32)	0.29 (3.03)	67.3 (55.18)	0.14 (2.14)	93.33(9.71)	0.17(1.07)	83.7(66.2)	0.83(1.35)
T_3=Neem formulation 10000 ppm @1.5ml/kg seed (=15mg azadirachtin/kg seed)	85.0 (67.88)	0.02 (0.72)	73.0 (60.88)	5.90 (2.53)	65.3 (53.93)	10.40 (3.30)	92.7 (74.29)	5.12 (12.77)	52.7 (46.52)	13.8 (21.37)	93(9.70)	0.33(1.15)	80.3(63.7)	0.83(1.35)
T_4=Karanja (Pongamia pinnata) oil @ 5 ml/kg seed	88.0 (69.88)	0.00 (0.71)	82.0 (65.27)	4.73 (2.29)	65.7 (54.13)	9.10 (3.10)	91.3 (72.87)	0.29 (3.03)	69.3 (56.40)	0.18 (2.40)	89(9.49)	0.83(1.35)	74.7(59.8)	1.50(1.57)
T_5=Citronella oil @ 5 ml/kg of seed	83.0 (64.61)	0.00 (0.71	85.0 (67.63)	6.93 (2.73)	55.0 (47.87)	14.53 (3.88)	81.3 (64.47)	0.29 (3.03)	64.7 (53.53)	0.43 (3.68)	90.3(9.56)	1.0(1.33)	72.3(58.3)	2.00(1.73)
T_6= Acorus calamus TNAU formulation @10 ml/kg	91.0 (72.47)	0.00 (0.71)	94.0 (76.17)	1.50 (1.41)	76.0 (60.67)	3.83 (2.08)	86.0 (68.14)	0.36 (3.25)	68.0 (55.58)	1.12 (5.55)	91.7(9.63)	0.67(1.28)	78.0(62.0)	1.33(1.52)
T_7= Untreated control	88.0 (70.47)	0.17 (0.82)	70.0 (56.79)	11.73 (3.49)	45.3 (42.32)	40.00 (6.36)	72.0 (58.16)	29.6 (32.92)	54.0 (47.29)	33.8 (35.52)	78.3(8.91)	4.17(2.27)	65.7(54.1)	11.33(3.51)
$CD_{0.05}$	8.47	0.03	13.43	0.20	1.82	0.14	7.87	3.22	5.18	4.54	0.11	0.24	1.6	0.22

**G- per cent seed germination* and *ID- per cent insect damage*

Table 3.4. Effect of insecticides and botanicals against storage insects of seeds and their influence on seed viability during storage under ambient condition

Treatments	Chick pea								Pigeon pea								Field pea			
	JAU, Jamnagar				PJTSAU, Hyderabad				NDUAT, Faizabad				PDKV, Akola				CSAUAT			
	9 months		12 months		3 months		6 months		3 months		6 months		9 months		12 months		3 months		6 months	
	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID	G	ID		
T_1=Emamectin benzoate (Proclaim 5 SG) @ 2 ppm (40.0 mg/kg seed)	90.3	0.00 (0.71)	84.3	0.67 (1.05)	98.0 (83.41)	0.00 (0.71)	96.0 (78.43)	0.88 (1.17)	92.3	0.44 (1.14)	88.3	0.67 (1.38)	84.0 (66.40)	0.30 (0.89)	82.7 (65.37)	0.43 (0.97)	93.0 (74.65)	0.0	84.3 (66.75)	1.67 (1.46)
T_2=Deltamethrin 2.8 EC @ 1.0 ppm (0.04 ml/kg seed)	90.7	0.00 (0.71)	83.7	1.33 (1.34)	96.7 (79.57)	0.00 (0.71)	95.3 (77.55)	0.38 (0.94)	91.0	0.55 (1.28)	86.7	1.00 (1.67)	83.3 (65.91)	0.43 (0.97)	81.0 (64.15)	0.57 (1.03)	90.7 (72.19)	0.0	90.3 (71.86)	1.33 (1.34)
T_3=Neem formulation 10000 ppm @1.5ml/kg seed (=15mg azadirachtin/kg seed)	88.3	2.33 (1.68)	81.7	3.67 (2.04)	90.3 (71.86)	0.60 (1.05)	82.7 (65.40)	2.41 (1.70)	89.0	0.88 (1.63)	85.3	1.33 (2.00)	81.0 (64.14)	0.63 (1.06)	79.0 (62.70)	0.70 (1.09)	86.7 (68.56)	0.0	87.3 (69.13)	2.00 (1.58)
T_4=Karanja (*Pongamia pinnata*) oil @ 5 ml/kg seed	89.0	1.67 (1.46)	82.3	3.00 (1.86)	91.3 (72.87)	0.52 (1.01)	81.3 (64.41)	1.88 (1.54)	88.3	1.22 (1.88)	84.7	1.89 (2.44)	77.7 (61.78)	0.73 (1.11)	76.3 (60.87)	0.83 (1.15)	87.7 (69.41)	0.0	84.7 (66.93)	1.67 (1.46)
T_5=Citronella oil @ 5 ml/kg of seed	89.3	2.33 (1.68)	82.7	4.67 (2.27)	88.3 (70.03)	2.57 (1.75)	76.7 (61.12)	4.27 (2.18)	85.7	1.88 (2.37)	83.0	2.22 (2.57)	78.7 (62.47)	0.70 (1.09)	78.7 (62.47)	0.93 (1.20)	81.3 (64.38)	0.0	82.0 (64.87)	2.33 (1.68)
T_6= *Acorus calamus* TNAU formulation @10 ml/kg	88.0	0.67 (1.05)	83.3	1.67 (1.46)	97.3 (80.70)	0.00 (0.71)	96.0 (80.64)	0.79 (1.13)	86.0	1.44 (2.08)	84.0	1.66 (2.23)	82.0 (64.89)	0.47 (0.98)	80.7 (63.90)	0.63 (1.06)	94.0 (75.79)	0.0	92.7 (74.29)	1.00 (1.22)
T_7= Untreated control	85.3	9.67 (3.18)	79.0	13.3 (3.72)	96.7 (79.57)	3.0 (1.98)	80.7 (63.9)	9.22 (3.12)	84.3	3.66 (3.31)	80.7	5.66 (4.12)	74.3 (59.58)	1.17 (1.29)	71.3 (57.63)	1.40 (1.38)	82.3 (65.12)	0.0	80.0 (63.43)	3.33 (1.95)

$CD_{0.05}$	2.26	0.36	2.89	0.38	4.69	0.067	3.62	0.078	2.51	0.43	2.65	0.57	2.53	0.08	2.17	0.10	1.03	-	2.44	0.28

**G- per cent seed germination and ID- per cent insect damage*

Experiment-4: Evaluation of pre-harvest spraying of insecticides for management of pulse beetle (*Callosobruchus* sp)

Objective:

- To evaluate efficacy of pre-harvest spray of insecticides for management of field infestation of pulse beetle
- **Year of Start:** 2015

Crop	Centre
Pigeonpea	UAS, Bangalore;PJTSAU, Hyderabad; PDKV, Akola
Green gram	OUAT, Bhubaneswar; JAU, Jamnagar;
Chickpea	MPKV,Rahuri; SKNAU, Jobner; NDUAT, Faizabad
Black gram	TNAU, Coimbatore; PAJANCOA,Karaikal; AAU,Assam

Treatments:

A. Insecticides/Botanicals

1. Emamectin benzoate @0.3ml/L
2. Malathion dust @10kg/acre
3. Profenofos 50EC @1ml/L
4. Neemazal 10000ppm @1ml/L
5. Control

B. Spraying schedule

1. Spraying at 50% pod maturity
2. Spraying at Maturity
3. Spraying at 50% pod maturity and maturity

Replication:3 **Design: Strip plot**

Results:

A.Green gram

JAU, Jamnagar:

Among the insecticides, profenofos was the best treatment followed by emamectin benzoate, malathion dust and neemazal. There was no adult emergence within two months of storage in three treatments *viz*., one time spraying of profenofos at pod maturity (I_3S_2), twice spraying of profenofos at 50% pod maturity and maturity (I_3S_3) and twice spraying of emamectin benzoate at 50% pod maturity and maturity (I_1S_3). However these spraying schedules were at par with spraying of emamectin benzoate at 50% pod maturity (ID-0.04%), dusting of malathion at 50% pod maturity and maturity(ID -0.06%) and dusting of malathion at 50% pod maturity (ID- 0.21%). Control recorded 4.26% seed damage after two months of storage period (Table 4.2).

OUAT, Bhubaneswar

Spraying of emamectin benzoate twice at 50% pod maturity and maturity was the best treatment with 0.67% seed damage on 6th week of storage of green gram seed and was at par with twice spraying of neemazal (1.0% seed damage) and profenofos (1.17% seed

damage) at 50% pod maturity and maturity (Table 4.3). However, spraying of emamectin benzoate and neemazal at 50% pod maturity and maturity could restrict the insect damage within permissible limit. Control recorded 7.8% seed damage after 6 weeks of storage.

B. Black gram

AAU,Assam

All the treatment schedules were significantly effective in reducing insect damage (0.0-2.77%) compared to control (ID 10.5%) after 8 weeks of storage. There was no adult emergence in spraying of profenofos and emamectin benzoate twice at 50% maturity and maturity (S3) up to 8 weeks of storage. Spraying of profenofos once at maturity also remained insect damage free up to 8 weeks of storage. However, all these treatments were at par with spraying of emamectin benzoate at maturity (ID 0.08%), twice dusting of malathion (ID 0.08%) and twice spraying of neemazal (ID 0.17) (Table 4.4).

B. Chickpea

MPKV,Rahuri

All spraying schedules of profenofos and nemmazal provided insect damage free seed up to 6 weeks of storage. However, twice spraying of profenofos at 50% pod maturity and maturity was the best treatment with 0.67% insect damage after 8 weeks of storage. Other spraying schedules of profenofos also reduced insect damage (1.33-1.67%) while spraying schedules of neemazal recorded 2.67-3.33% insect damage after 8 weeks of storage (Table 4.5).

NDUAT, Faizabad

Twice spraying of emamectin benzoate at 50% pod maturity and maturity recorded significantly low insect damage (2.67% mean adult emergence) than all other spraying schedules except spraying of emamectin benzoate once at pod maturity (3.3% mean adult emergence) which was at par with twice spraying. Among other spraying schedules twice spraying of profenofos (3.67% mean adult emergence), neemazal (4.0% mean adult emergence), spraying of profenofos once at maturity (4.0%), dusting of malathion at 50% pod maturity and maturity (4.33% mean adult emergence), also reduced adult emergence significantly compared to control and were at par. There was 5.89% adult emergence in control within two months of storage (Table 4.6).

C. Pigeonpea

UAS, Bangalore

The results obtained after 6 weeks of storage indicated that twice spraying (at 50% pod maturity and maturity) of emamectin benzoate provided significantly lowest insect damage (1.75%) compared to other treatments followed by spraying of emamectin benzoate at maturity (2.33%) and 50% pod maturity (2.50%) (Table 4.7). Dusting of malathion at 50% pod maturity and maturity also reduced insect damage (2.42%)

significantly compared to control (7.11%) while, spraying of profenofos and neemazal at 50% pod maturity and maturity recorded 4.08% and 4.33% insect damage after 6 weeks of storage.

PDKV, Akola

Spraying of emamectin benzoate at 50% pod maturity and maturity was the best treatment with 0.33% adult emergence within 8 weeks of storage of pigeon pea seed. Control recorded 0.73% insect damage after 8 weeks storage (Table 4.8).

PJTSAU, Hyderabad

All spraying schedules of insecticides were significantly better than control with respect to adult emergence of pulse bruchid. Among the spraying schedules S3 (Spraying at 50% pod maturity and maturity) was the best schedule with significantly lowest mean adult emergence/Kg of seed (24.27). However, spraying of profenofos at 50% pod maturity and maturity recorded significantly lowest adult emergence (5.67 mean adult emergence/kg seed) after two months of storage of pigeon pea seed. All other insecticides including neemazal with same spraying schedule (S3) were at par with 15.67 mean adult emergence/kg seed after two months of storage. Control recorded 66.8 mean adult emergence/Kg of seed after 2 months of storage

Conclusion*:*There were variation in results due to difference in level of field infestation at various centres. However, in most of the centres spraying of profenofos and emamectin benzoate at 50% pod maturity and maturity were effective in controlling insect population during storage of pulses.

Table 4.1. Effective pre-harvest spraying schedule of insecticides/botanicals for different crops at various centres

Crop	Centre	Insecticide/ Botanical	Spraying schedule	Remarks
Green gram	JAU, Jamnagar	Profenofos, Emamectin benzoate	Profenofos spraying at maturity, Profenofos/ Emamectin benzoate spraying at 50% pod maturity and maturity (S3)	No adult emergence
	OUAT, Bhubaneswar	Emamectin benzoate, neemazal	Spraying at 50% pod maturity and maturity	Insect damage within permissible limit
Black gram	AAU,Assam	Profenofos/ Emamectin benzoate	Profenofos spraying at maturity, Profenofos/ Emamectin benzoate spraying at 50% pod maturity and maturity (S3)	No adult emergence
Chickpea	MPK,Rahuri	Profenofos	Spraying at 50% pod maturity and maturity	Insect damage within permissible limit
	NDUAT, Faizabad	Emamectin benzoate	Spraying at 50% pod maturity and maturity	Lowest insect damage
Pigeon pea	UAS, Bangalore	Emamectin benzoate	Spraying at 50% pod maturity and maturity	Lowest insect damage
	PDKV, Akola	Emamectin benzoate	Spraying at 50% pod maturity and maturity	Lowest insect damage

Table-4.2. Effect of pre-harvest spraying of insecticides and botanicals on seed damage (%) of pulse beetle during 2 month of storage period in green gram at JAU, Jamnagar

Treatment		Seed damage (%)					
		Observation recorded after week of storage					
		3	4	5	6	7	8
I_1 (Emamectin benzoate)S_1 (Spraying at 50% pod maturity)		0.00 (0.71)	0.00 (0.71)	0.01 (0.71)	0.01 (0.71)	0.02 (0.72)	0.04 (0.74)
I_1 (Emamectin benzoate)S_2 (Spraying at Maturity)		0.00 (0.71)	0.00 (0.71)	0.21 (0.84)	0.31 (0.90)	0.39 (0.94)	0.63 (1.06)
I_1(Emamectin benzoate)S_3 (Spraying at 50% pod maturity and maturity)		0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
I_2 (Malathion dust) S_1		0.00 (0.71)	0.00 (0.71)	0.05 (0.74)	0.11 (0.78)	0.16 (0.81)	0.21 (0.84)
I_2 S_2		0.00 (0.71)	0.00 (0.71)	0.08 (0.76)	0.17 (0.82)	0.28 (0.88)	0.48 0.99)
I_2 S_3		0.00 (0.71)	0.00 (0.71)	0.01 (0.71)	0.02 (0.72)	0.04 (0.74)	0.06 (0.75)
I_3 (Profenofos)S_1		0.00 (0.71)	0.36 (0.92)	0.68 (1.09)	0.97 (1.21)	1.75 (1.50)	2.67 (1.77)
I_3S_2		0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
I_3S_3		0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
I_4 (Neemazal) S_1		0.00 (0.71)	0.09 (0.77)	0.17 (0.82)	0.26 (0.87)	0.32 (0.91)	0.54 (1.02)
I_4S_2		0.00 (0.71)	0.04 (0.74)	0.13 (0.79)	0.23 (0.85)	0.32 (0.90)	0.52 (1.00)
I_4S_3		0.00 (0.71)	0.02 (0.72)	0.07 (0.75)	0.17 (0.82)	0.27 (0.88)	0.38 (0.94)
I_5 (Control)S_1		0.15 (0.81)	0.37 (0.93)	0.89 (1.17)	1.38 (1.36)	2.10 (1.60)	4.13 (2.14)
I_5 S_2		0.16 (0.81)	0.33 (0.91)	0.75 (1.12)	1.46 (1.40)	2.48 (1.72)	3.83 (2.07)
I_5 S_3		0.16 (0.81)	0.42 (0.96)	1.05 (1.23)	1.65 (1.45)	2.81 (1.81)	4.81 (2.30)
$CD_{0.05}$	**I**	0.01	0.03	0.08	0.07	0.08	0.01
	S	NS	0.03	0.06	0.05	0.06	0.08
	I*S	NS	0.06	0.14	0.12	0.13	0.18

N.B: figures in parentheses are Square root transformed values.

Table-4.3. Effect of pre-harvest spraying of insecticides and botanicals on infestation of pulse beetle during 6 weeks of storage period in mungbean at OUA&T, Bhubaneswar

Treatment		Seed damage (%)					
		Observation recorded after week of storage					
		1	2	3	4	5	6
I_1 (Emamectin benzoate)S_1 (Spraying at 50% pod maturity)		0.33(1.15)	0.5(1.21)	1.17(1.47)	2.17(1.78)	3.33(2.08)	4.83(2.42)
I_1 (Emamectin benzoate)S_2 (Spraying at Maturity)		0.00(1.0)	0.17(1.07)	0.33(1.15)	0.67(1.28)	1.33(1.52)	2.33(1.83)
I_1(Emamectin benzoate)S_3 (Spraying at 50% pod maturity and maturity)		0.00(1.0)	0.00(0.17)	0.17(1.07)	0.33(1.15)	0.5(1.22)	0.67(1.28)
I_2 (Malathion dust) S_1		0.33(1.14)	0.67(1.28)	1.33(1.52)	2.67(1.91)	3.83(2.20)	5.0(2.45)
I_2 S_2		0.17(1.07)	0.33(1.15)	0.83(1.35)	1.67(1.63)	2.33(1.91)	4.33(2.31)
I_2 S_3		0.00(1.0)	0.17(1.07)	0.33(1.15)	0.67(1.28)	1.17(1.47)	1.67(1.62)
I_3 (Profenofos) S_1		0.33(1.15)	0.33(1.14)	1.0(1.40)	1.83(1.67)	3.0(2.0)	4.67(2.38)
I_3S_2		0.00(1.0)	0.17(1.07)	0.5(1.21)	1.0(1.39)	2.0(1.73)	3.17(2.04)
I_3S_3		0.001.0)	0(1.0)	0.17(1.07)	0.5(1.22)	0.83(1.35)	1.17(1.47)
I_4 (Neemazal) S_1		0.33(1.15)	1.17(1.47)	2.0(1.73)	2.67(1.92)	4.17(2.27)	5.33(2.51)
I_4S_2		0.17(1.07)	0.33(1.15)	0.5(1.22)	1.33(1.52)	2.50(1.87)	3.50(2.12)
I_4S_3		0.00(1.0)	0.00(1.0)	0.17(1.07)	0.33(1.14)	0.67(1.28)	1.0(1.40)
I_5 (Control)S_1		1.33(1.52)	1.83(1.68)	2.83(1.95)	4.50(2.35)	6.0(2.64)	8.0(3.0)
I_5 S_2		1.33(1.52)	2.00(1.88)	3.0(2.0)	4.0(2.23)	5.50(2.55)	7.50(2.92)
I_5 S_3		1.17(1.47)	1.67(1.63)	3.17(2.04)	4.33(2.31)	5.83(2.62)	7.83(2.97)
$CD_{0.05}$	**I**	0.09	0.11	0.12	0.24	0.18	0.14
	S	NS	0.11	0.14	0.09	0.04	0.17
	I*S	NS	NS	0.26	0.31	0.25	0.22

Table-4.4. Effect of pre-harvest spraying of insecticides and botanicals on infestation of pulse beetle in blackgram during storage at AAU, Assam

		Seed damage (%)					
Treatment		3rd week	4th week	5th week	6th week	7th week	8th Week
T1	Emamectin benzoate at 50% pod maturity	0.00	0.00	0.0 (0.71)	0.0 (0.71)	0.25 (0.86)	0.42 (0.93)
T2	E. benzoate at maturity	0.00	0.00	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.08 (0.76)
T3	E. benzoate at 50% pod maturity & maturity	0.00	0.00	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)
T4	Malathion 5% dust @ 10kg/acre at 50% pod maturity	0.00	0.08	0.17 (0.80)	0.75 (1.10)	1.33 (1.31)	1.92 (1.50)
T5	Malathion at maturity	0.00	0.00	0.0 (0.71)	0.17 (0.81)	0.43 (0.95)	0.92 (1.17)
T6	Malathion at 50% pod maturity & maturity	0.00	0.00	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.08 (0.76)
T7	Profenofos at 50% pod maturity	0.00	0.00	0.0 (0.71)	0.08 (0.76)	0.25 (0.86)	0.42 (0.94)
T8	Profenofos at maturity	0.00	0.00	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)
T9	Profenofos 50% pod maturity & maturity	0.00	0.00	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)	0.0 (0.71)
T10	Neemazal at 50% pod maturity	0.25	0.43	0.60 (1.02)	1.17 (1.25)	2.00 (1.53)	2.77 (1.76)
T11	Neemazal at maturity	0.00	0.00	0.08 (0.76)	0.25 (0.86)	0.43 (0.95)	1.25 (1.27)
T12	Neemazal at 50% pod maturity & maturity	0.00	0.00	0.00 (0.71)	0.0 (0.71)	0.0 (0.71)	0.17 (0.80)
T13	Control	0.33	0.68	1.67 (1.47)	3.17 (1.90)	7.17 (2.75)	10.5 (3.30)
	SE	-	-	0.061	0.088	0.135	0.165
	CD 5 % =	-	-	0.18	0.26	0.39	0.48
	CD 1 % =	-	-	0.24	0.35	0.53	0.65

Table 4.5. Effect of pre-harvest spraying of insecticides and botanicals on infestation of pulse beetle during 6 weeks of storage period in Chickpea at MPKV, Rahuri

Treatment	Seed damage (%)					
	Observation recorded after week of storage					
	3	4	5	6	7	8
I_1 (Emamectin benzoate)S_1 (Spraying at 50% pod maturity)	0.00 (0.71)*	2.00 (1.56)	3.67 (2.04)	4.33 (2.16)	5.00 (2.32)	6.33 (2.60)
I_1 (Emamectin benzoate)S_2 (Spraying at Maturity)	0.00 (0.71)	1.33 (1.34)	2.67 (1.77)	4.00 (2.09)	4.67 (2.24)	5.00 (2.34)
I_1(Emamectin benzoate)S_3 (Spraying at 50% pod maturity and maturity)	0.00 (0.71)	0.67 (1.05)	2.33 (1.68)	3.67 (2.04)	4.33 (2.18)	4.67 (2.26)
I_2 (Malathion dust) S_1	0.00 (0.71)	2.33 (1.64)	3.33 (1.95)	4.33 (2.18)	4.33 (2.20)	4.33 (2.19)
I_2 S_2	0.00 (0.71)	1.33 (1.34)	2.00 (1.43)	3.00 (1.72)	4.00 (2.10)	5.33 (2.41)
I_2 S_3	0.00 (0.71)	1.00 (1.17)	1.33 (1.27)	3.33 (1.95)	3.67 (2.02)	4.00 (2.11)
I_3 (Profenofos)S_1	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.00 (1.17)	1.33 (1.34)
I_3S_2	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.67 (1.05)	1.67 (1.39)
I_3S_3	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.33 (0.88)	0.67 (1.05)
I_4 (Neemazal) S_1	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	2.67 (1.77)	3.33 (1.95)
I_4S_2	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	1.33 (1.29)	2.67 (1.77)
I_4S_3	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	2.00 (1.56)	3.00 (1.86)
I_5 (Control)S_1	2.00 (1.58)	2.67 (1.77)	4.67 (2.26)	6.00 (2.54)	5.67 (2.48)	7.33 (2.79)
I_5 S_2	2.33 (1.68)	2.33 (1.68)	4.00 (2.08)	5.33 (2.41)	5.33 (2.41)	7.00 (2.73)
I_5 S_3	1.66 (1.46)	2.67 (1.76)	3.67 (2.03)	4.67 (2.26)	4.33 (2.18)	6.67 (2.67)
	0.1	0.08	0.1	0.16	0.08	0.1
$CD_{0.05}$ I	**0.08**	**0.26**	**0.24**	**0.16**	**0.20**	**0.28**
$CD_{0.05}$ S	NS	NS	NS	NS	NS	NS
$CD_{0.05}$I*S	NS	NS	NS	NS	NS	NS

Table 4.6. Effect of pre-harvest spraying of insecticides and botanicals on infestation of pulse beetle during storage in chickpea at NDUA&T, Faizabad

Treatment	Seed damage (%)					
	Observation recorded after week of storage					
	3	4	5	6	7	8
I_1 (Emamectin benzoate)S_1 (Spraying at 50% pod maturity)	0.00 (0.71)	0.67 (1.05)	1.33 (1.34)	2.67 (1.77)	3.33 (1.82)	4.33 (2.08)
I_1 (Emamectin benzoate)S_2 (Spraying at Maturity)	0.00 (0.71)	0.33 (0.88)	0.67 (1.05)	2.00 (1.56)	3.00 (1.73)	3.33 (1.82)
I_1(Emamectin benzoate)S_3 (Spraying at 50% pod maturity and maturity)	0.00 (0.71)	0.00 (0.71)	0.33 (0.88)	1.33 (1.33)	2.33 (1.63)	2.67 (1.63)
I_2 (Malathion dust) S_1	0.67 (1.05)	1.67 (1.46)	2.33 (1.74)	3.67 (2.04)	4.33 (2.08)	5.33 (2.31)
I_2 S_2	0.00 (0.71)	1.33 (1.34)	1.00 (1.17)	3.00 (1.86)	4.00 (1.91)	5.00 (2.23)
I_2 S_3	0.00 (0.71)	1.00 (1.225)	1.67 (1.46)	2.67 (1.77)	3.33 (1.82)	4.33 (2.08)
I_3 (Profenofos)S_1	0.33 (0.88)	1.33 (1.34)	2.00 (1.58)	3.33 (1.59)	3.67 (1.91)	4.67 (2.16)
I_3S_2	0.00 (0.71)	1.00 (1.23)	1.33 (1.34)	2.67 (1.77)	3.33 (1.82)	4.00 (2.0)
I_3S_3	0.00 (0.71)	0.33 (0.88)	1.00 (1.23)	1.67 (1.29)	2.67 (1.63)	3.67 (1.91)
I_4 (Neemazal) S_1	0.33 (0.88)	1.67 (1.46)	2.33 (1.68)	3.33 (1.95)	4.33 (2.08)	5.00 (2.24)
I_4S_2	0.00 (0.71)	1.33 (1.34)	1.67 (1.46)	3.00 (1.86)	3.67 (2.16)	4.67 (2.16)
I_4S_3	0.00 (0.71)	0.67 (1.05)	1.33 (1.34)	2.33 (1.68)	3.33 (1.82)	4.00 (1.99)
I_5 (Control)S_1	1.00 (1.17)	2.00 (1.58)	3.00 (1.86)	4.00 (2.11)	4.67 (2.15)	5.67 (2.38)
I_5 S_2	1.33 (1.29)	2.33 (1.68)	2.67 (1.77)	3.67 (2.04)	4.33 (2.08)	6.00 (2.45)
I_5 S_3	1.33 (1.34)	2.00 (1.56)	3.00 (1.86)	4.33 (2.20)	5.00 (2.24)	6.00 (2.44)
$CD_{0.05}$Insecticides	0.25	0.22	0.25	0.29	0.16	0.13
Time of Spray	0.22	0.10	0.19	0.23	0.14	0.18
Insecticides x Time of Spray	0.39	0.43	0.43	0.92	0.23	0.27

Table 4.7. Effect of pre-harvest spraying of insecticides and botanicals on infestation of pulse beetle during storage in pigeonpea at UAS, Bangalore

Treatment	Seed damage (%)					
	Observation recorded after week of storage					
	1	2	3	4	5	6
I_1 (Emamectin benzoate)S_1 (Spraying at 50% pod maturity)	0.00 (0.00)	0.00 (0.00)	0.58 (4.36)	1.00 (5.71)	1.58 (7.19)	2.50 (9.06)
I_1 (Emamectin benzoate)S_2 (Spraying at Maturity)	0.00 (0.00)	0.00 (0.00)	0.25 (2.86)	0.83 (5.22)	1.50 (7.02)	2.33 (8.76)
I_1(Emamectin benzoate)S_3 (Spraying at 50% pod maturity and maturity)	0.00 (0.00)	0.00 (0.00)	0.08 (0.95)	0.67 (4.66)	1.08 (5.93)	1.75 (7.59)
I_2 (Malathion dust) S_1	0.00 (0.00)	0.00 (0.00)	1.00 (5.71)	2.08 (8.27)	3.92 (11.40)	4.58 (12.35)
I_2 S_2	0.00 (0.00)	0.08 (0.95)	0.75 (4.92)	1.67 (7.40)	3.17 (10.23)	4.25 (11.89)
I_2 S_3	0.00 (0.00)	0.00 (0.00)	0.33 (3.26)	1.50 (7.02)	2.42 (8.92)	3.67 (11.03)
I_3 (Profenofos)S_1	0.00 (0.00)	0.25 (2.31)	1.42 (6.81)	3.00 (9.96)	5.17 (13.13)	5.92 (14.07)
I_3S_2	0.00 (0.00)	0.08 (0.95)	1.17 (6.14)	2.67 (9.35)	4.92 (12.80)	5.50 (13.54)
I_3S_3	0.00 (0.00)	0.00 (0.00)	0.75 (4.92)	2.08 (8.29)	4.08 (11.65)	5.00 (12.91)
I_4 (Neemazal) S_1	0.00 (0.00)	0.17 (1.91)	1.58 (7.19)	3.42 (10.62)	5.67 (13.77)	6.92 (15.22)
I_4S_2	0.00 (0.00)	0.33 (3.26)	1.33 (6.58)	2.33 (8.76)	4.58 (12.34)	6.42 (14.66)
I_4S_3	0.00 (0.00)	0.08 (0.95)	1.25 (6.40)	2.25 (8.61)	4.33 (11.98)	5.92 (14.07)
I_5 (Control)S_1	0.42 (3.57)	1.00 (5.71)	2.08 (8.23)	4.67 (12.44)	7.25 (15.61)	9.08 (17.53)
I_5 S_2	0.50 (3.96)	1.08 (5.96)	2.42 (8.87)	4.25 (11.86)	6.75 (15.05)	8.67 (17.11)
I_5 S_3	0.58 (4.22)	1.00 (5.71)	2.25 (8.57	4.83 (12.69)	7.33 (15.71)	9.00 (17.45)
S.Em±	-	-	0.56	0.42	0.36	0.34
CD at 5%	**-**	**-**	1.62	1.20	1.03	0.97
CV (%)	-	-	17.01	8.42	5.51	4.51

Table 4.8. Effect of pre-harvest spraying of insecticides and botanicals on infestation of pulse beetle during 2 month of storage period in pigeonpea at PDKV, Akola

Treatment	Seed damage (%)					
	Observation recorded after week of storage					
	3	4	5	6	7	8
I_1 (Emamectin benzoate)S_1 (Spraying at 50% pod maturity)	0.17 (0.82)	0.20 (0.84)	0.23 (0.86)	0.30 (0.89)	0.37 (0.93)	0.43 (0.97)
I_1 (Emamectin benzoate)S_2 (Spraying at Maturity)	0.13 (0.80)	0.20 (0.84)	0.23 (0.86)	0.33 (0.91)	0.42 (0.96)	0.53 (1.01)
I_1(Emamectin benzoate)S_3 (Spraying at 50% pod maturity and maturity)	0.10 (0.77)	0.13 (0.80)	0.17 (0.82)	0.27 (0.88)	0.30 (0.89)	**0.33** (0.91)
I_2 (Malathion dust) S_1	0.23 (0.86)	0.27 (0.88)	0.30 (0.89)	0.40 (0.95)	0.47 0.98)	0.53 (1.02)
I_2 S_2	0.23 (0.86)	0.23 (0.86)	0.27 (0.88)	0.30 (0.89)	0.37 (0.93)	0.47 (0.98)
I_2 S_3	0.13 (0.80)	0.20 (0.84)	0.27 (0.88)	0.33 (0.91)	0.40 (0.95)	0.50 (1.00)
I_3 (Profenofos) S_1	0.23 (0.86)	0.27 (0.88)	0.30 (0.89)	0.43 (0.97)	0.50 (1.00)	0.57 (1.03)
I_3S_2	0.10 (0.77)	0.17 (0.82)	0.17 (0.82)	0.27 (0.88)	0.33 (0.91)	**0.37** (0.93)
I_3S_3	0.20 (0.84)	0.20 (0.84)	0.30 (0.89)	0.37 (0.93	0.48 (0.99)	0.59 (1.04)
I_4 (Neemazal) S_1	0.23 (0.86)	0.23 (0.86)	0.30 (0.89)	0.40 (0.95)	0.50 (1.00)	0.57 (1.03)
I_4S_2	0.20 (0.84)	0.23 (0.86)	0.33 (0.91)	0.39 (0.94)	0.44 (0.97)	0.50 (1.00)
I_4S_3	0.17 (0.82)	0.27 (0.88)	0.33 (0.91)	0.37 (0.93)	0.43 (0.97)	0.53 (1.02)
I_5 (Control)	0.30 (0.89)	0.33 (0.91)	0.40 (0.95)	0.53 (1.02)	0.63 (1.06)	0.73 (1.11)
S.E	0.021	0.021	0.025	0.019	0.017	0.020
$CD_{0.05}$	0.06	0.06	0.07	0.06	0.05	0.06
$CD_{0.01}$	0.08	0.08	0.10	0.08	0.07	0.08

Table-4.9: Effect of pre-harvest spraying of insecticides and botanicals on infestation of pulse beetle during 2 month of storage period in pigeonpea at PJTSAU, Hyderabad

Treatments	Number of exit hole/kg of seed after 8 weeks of storage					
	Emamectin benzoate (I1)	Malathion (I2)	Profenophos (I3)	Neemazal (I4)	Control (I5)	Mean
S1(Spraying at 50% pod maturity)	25.67	28.33	14.33	14.67	68.00	30.20
S2 (Spraying at Maturity)	38	42.33	21.67	32.67	63.67	39.67
S3 (Spraying at 50% pod maturity and maturity)	15.67	15.67	5.67	15.67	68.67	24.27
Mean	26.44	28.78	13.89	21.00	66.78	
	T	S	T at S	S at T		
S.Ed.	4.61	1.12	2.5	5.04		
CD (0.05)	10.64	2.34	5.23	11.45		

Experiment 5: Effect of solarization on bruchids (pulse beetle) infestation and quality of pulse seeds

Crop	Centre
Pigeon pea	NDUAT, Faizabad, PDKV, Akola
Cowpea	UAS, Bangalore; SKNAU,Jobner; ICAR-IISR, Mau,
Chickpea	JAU, Jamnagar; UAS, Dharwad; MPKV, Rahuri
Blackgram	TNAU, Coimbatore; PAJANCOA, Karaikal; AAU, Assam
Greengram	OUA&T, Bhubaneswar; PJTSAU, Hyderabad; CSAUAT, Kanpur

Objectives:

- To develop effective eco-friendly, low cost techniques for the control of bruchids infesting pulse seed
- To study the effect of solarization on seed quality attributes of treated seeds

Treatment:

1. Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days
2. Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days
3. Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days
4. Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days
5. Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days
6. Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days
7. Control (Fresh seed)
8. Control (inoculated seed)

Packaging Material: Clear polyethylene (700 gauge) packets (30X20 cm) of 2 kg capacity

Replications: 3 **Design:** CRD

Results:

A.Greengram

OUA&T, Bhubaneswar

All solarization treatments were significantly better than control with respect to insect damage. Solarization of fresh seeds for 3h for 4 days and 3h for 6 days remained free from insect damage up to 3 months of storage. These treatments were at par after six months of storage and recorded 0.33% insect damage in fresh seeds. However, in inoculated seeds 6 days solarization for 3h recorded least insect damage (0.67%) but was at par with 4 days' solarization for 3h (ID 0.83%) after 6 months of storage. All the treatments maintained seed germination above IMSCS (79-92%) while control failed to maintained seed germination standard (71% and 38% in fresh and inoculated seeds respectively). Most effective cumulative heat (Sum of maximum inside temperature acquired on each day during solarization period) was 288^{o}C over 6 days duration (5.2).

PJTSAU, Hyderabad

All the treatments were significantly better than control with inoculated seeds with respect to insect damage. Solarization of fresh seeds for 6 days (3h on each day) recorded significantly lowest insect damage (0.49%) up to 6 months of storage. However, in inoculated seeds only solarization for 6 days (3h on each day) was significantly better treatment (ID 2.12%) compared to control with fresh seeds (ID 4.23%) after 6 months of storage. All treatments maintained seed germination (81-91%) above IMSCS after 6 months of storage (Table 5.3). Most effective cumulative heat was 397.6^{o}C over 6 days duration.

B.Cowpea

UAS, Bangalore

All solarization treatments maintained seed germination (78-85% above IMSCS up to 6 months of storage while control with inoculated seeds (74%) failed to meet the standard. Solarization treatment for 6 days (3 h on each day) was significantly better treatment compared to all other treatments in reducing insect damage (ID 0.08%) of fresh seeds while, all solarization treatments in inoculated seeds were at par after six months of storage. However, all solarization treatments in inoculated seeds were significantly better than control with both fresh and inoculated seeds after 6 months of storage. Most effective cumulative temperature was 240^{o}C over six days duration (Table 5.4).

C.Blackgram

AAU, Assam

All solarization treatments maintained seed germination (79-86% above IMSCS up to 3 months of storage while control with inoculated seeds (73%) failed to meet the seed germination standard. Solarization treatments were at par with respect to insect damage (0.0-0.33%) after three months of storage and significantly differed from control with inoculated seed (3.37%). However, solarization of fresh seeds for 6 days (3h) remained insect damage free up to 3 months of storage. Most effective cumulative temperature was 288^{o}C over six days duration (Table 5.5).

PAJANCOA, Karaikal

After 3 months of storage, all solarization treatments in both fresh and inoculated seeds remained free from insect damage except T6 (Solarization of inoculated-seeds for 6 days) which recorded 0.1% insect damage. Control with fresh seeds also remained free from insect damage after three months of storage. However, control with inoculated recorded 87% seed germination and 2.4% insect damage after 3 months of storage (Table 5.6).

TNAU, Coimbatore

Solarization treatments in fresh seeds remained free from insect damage up to 6 months of storage while control with fresh seeds recorded 3.57% insect damage after 6 months of storage. Solarization treatments in inoculated seeds for 6 days (3h on each day with cumulative temperature 340.4^{o}C) showed 0.90% insect damage whereas, control with inoculated seeds recorded 7.6% insect damage after 6 months of storage (Table 5.7).

D.Chick pea

MPKV, Rahuri

All the treatments in fresh seeds remained free from insect damage up to 3 months of storage. However, solarization treatments for 6 days (3h on each day with cumulative temperature 274.4^{o}C) only remained insect damage free up to 6 months of storage. All solarization treatments (ID 0.0-1.0%) were significantly better than control with inoculated seeds (ID 7.0%) after 6 months of storage. All treatments maintained seed germination above IMSCS after 6 months of storage but, solarization in fresh seeds maintained significantly better seed germination compared to both the control (fresh as well as inoculated seeds) (Table 5.8).

JAU, Jamnagar

All solarization treatments in fresh and inoculated seeds remained free from insect damage and insect population build up to 6 months of storage. Lowest effective cumulative heat was 73^{o}C over 2 days duration. All treatments maintained seed germination (93-95%) above IMSCS up to 6 months of treatments. Control with fresh seed and inoculated seeds showed 5.0% and 12.0% insect damage respectively after 6 months of storage (Table 5.9).

UAS, Dharwad

Solarization treatments in fresh seeds for different duration were not significantly different from control with fresh seeds (T7) with respect to insect damage and seed germination after 3 months of storage (Table 5.10). However, solarization treatments in inoculated seeds were at par with each other but significantly different from control with inoculated seeds (T8) with respect to insect damage after 3 months of storage.

Conclusion: There were variations in insect damage due to differences in seed materials, prevailing climate and population density insect pests from centre to centre. However preliminary studies revealed that Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day) was highly effective treatment for reducing insect damage in most of the centres and maintained higher seed germination compared to control during storage. Thus, solarization can be used for management of insect infestation and maintenance of seed germination in chickpea, cowpea, greengram and blackgram seeds.

Table 5.1. Effective solarization schedule for different crops at various centres

Crop	Centre	Solarization schedule	Remarks
Chickpea	JAU, Jamnagar	Solarization of seeds in clear polythene (700 gauge) packet for 2 days (3 h on each day)	No adult both fresh seeds and inoculated seeds
	MPKV,Rahuri	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	No adult emergence in fresh seeds and least insect damage in inoculated seeds
	UAS, Dharwad	All solarization treatments of seeds in clear polythene (700 gauge) packet	Requires validation
Green gram	OUAT, Bhubaneswar	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	Lowest insect damage in both fresh seeds and inoculated seeds
	PJTSAU, Hyderabad	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	Lowest insect damage in both fresh seeds and inoculated seeds
Black gram	TNAU, Coimbatore	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	No adult emergence in fresh seeds and least insect damage in inoculated seeds
	AAU,Assam	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	No adult emergence in fresh seeds and least insect damage in inoculated seeds
	PAJANCOA,Karaikal	All solarization treatments of seeds in clear polythene (700 gauge) packet	Requires validation
Cowpea	UAS, Bangalore	Solarization of seeds in clear polythene (700 gauge) packet for 6 days (3 h on each day)	Lowest insect damage in both fresh seeds and inoculated seeds

Table 5.2. Effect of solarization treatments in green gramseedsduring storage at OUAT, Bhubaneswar

Treatments		Germination (%)		Seed damage(%)		Moisture (%)		Cumulative heat (°C)
		3 months	6 months	3 months	6 months	3 months	6 months	
T_1	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days	93.3 (75.05)	90.7 (72.21)	0.17 (1.07)	0.67 (4.62)	9.7	10.1	93.2
T_2	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days	94 (75.82)	91.6 (73.27)	0.0 (1.0)	0.33 (2.90)	9.6	9.9	191.3
T_3	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days	94.7 (76.66)	92.3 (73.93)	0.0 (1.0)	0.33 (2.90)	9.6	9.8	288.1
T_4	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days	86.7 (68.60)	79.0 (66.07)	0.67 (1.28)	1.50 (6.97)	9.9	10.4	93.2
T_5	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days	89.0 (70.64)	81.3 (64.42)	0.33 (1.14)	0.83 (5.18)	9.8	10.2	191.3
T_6	Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days	91.3 (72.88)	84.0 (66.43)	0.33 (1.15)	0.67 (4.62)	9.7	10.1	288.1
T_7	Control (Fresh seed)	81.7 (64.65)	71.3 (57.64)	2.33 (1.82)	9.17 (17.61)	10.3	10.8	
T_8	Control (inoculated seed)	65.3 (53.93)	38.3 (38.25)	11.5 (3.54)	30.67 (33.62)	10.8	13.4	
SEm		0.38	0.49	0.07	0.76	0.05	0.07	
C.D. at 5 %		1.13	1.47	0.21	2.26	0.16	0.22	

Table 5.3. Effect of solarization treatments in greengram seeds during storage at PJTSAU, Hyderabad

Treatments		Germination (%)		Seed damage(%)		Moisture (%)		Cumulative heat (°C)
		3 months	6 months	3 months	6 months	3 months	6 months	
T_1	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days	93.0 (74.65)	86.0 (68.05)	0.83 (1.15)	3.34 (1.96)	10.6 (18.99)	10.5 (18.89)	133.5
T_2	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days	95.7 (78.30)	86.7 (68.58)	0.47 (0.98)	2.23 (1.65)	10.5 (18.87)	10.3 (18.73)	265.8
T_3	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days	97.3 (80.70)	90.7 (72.21)	0.13 (0.80)	0.49 (0.99)	9.9 (18.37)	9.8 (18.27)	397.6
T_4	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days	91.7 (73.22)	85.7 (67.73)	1.34 (1.35)	5.41 (2.43)	11.4 (19.75)	12.4 (20.61)	133.5
T_5	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days	92.3 (73.90)	86.7 (68.56)	0.78 (1.13)	4.41 (2.22)	10.9 (19.27)	10.4 (18.84)	265.8
T_6	Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days	95.3 (77.55)	87.7 (69.43)	0.55 (1.02)	2.12 (1.62)	10.1 (18.49)	10.2 (18.61)	397.6
T_7	Control (Fresh seed)	90.3 (71.87)	83.3 (65.89)	1.14 (1.28)	4.23 (2.17)	11.9 (20.20)	12.6 (20.81)	
T_8	Control (inoculated seed)	83.0 (65.67)	81.3 (64.38)	4.23 (2.18)	8.17 (2.94)	12.7 (20.84)	13.7 (21.69)	
SE		1.076	0.704	0.043	0.052	0.123	0.277	
C.D. at 5 %		3.23	2.11	0.13	0.16	**0.37**	**0.83**	

Table 5.4. Effect of solarization treatments in cowpea seeds during storage at UAS, Bengaluru

Treatments		Germination (%)		Seed damage(%)		Moisture (%)		Cumulative heat (°C)
		3 months	6 months	3 months	6 months	3 months	6 months	
T_1	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days	84.7	82.7	0.08 (0.76)	0.83 (1.15)	8.90	9.37^{ab}	76.4
T_2	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days	85.0	84.0	0.00 (0.71)	0.50 (1.00)	8.83	9.30^{ab}	156.1
T_3	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days	86.0	85.3	0.00 (0.71)	0.08 (0.76)	8.70	9.13^{a}	239.9
T_4	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days	82.3	78.3	1.00 (1.22)	1.58 (1.44)	9.00	9.63^{b}	76.4
T_5	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days	83.7	80.0	0.83 (1.15)	1.33 (1.35)	9.03	9.57^{b}	156.1
T_6	Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days	84.3	81.3	0.67 (1.08)	1.25 (1.32)	8.93	9.53^{ab}	239.9
T_7	Control (Fresh seed)	81.0	77.3	1.67 (1.47)	2.42 (1.70)	9.33	10.50^{c}	
T_8	Control (inoculated seed)	79.0	73.7	1.75 (1.50)	3.00 (1.87)	9.37	10.57^{c}	
SEm		0.51	0.71	0.039	0.043	0.18	0.13	
C.D. at 5 %		1.54	2.12	0.12	0.13	NS	0.40	

Table 5.5. Effect of solarization treatments in blackgram seeds during storage at AAU, Assam

Treatments		Moisture Content (%)	Germination (%)	Seed damage(%)	Cumulative heat (°C)
		3 months	3 months	3 months	
T_1	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days	9.90	86.3 (68.4)	0.00 (0.71)	92.2
T_2	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days	10.17	82.5 (65.3)	0.08 (0.76)	175.9
T_3	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days	10.17	85.0 (67.3)	0.00 (0.71)	266.3
T_4	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days	10.03	83.3 (65.9)	0.33 (0.90)	92.2
T_5	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days	10.10	81.0 (64.2)	0.25 (0.86)	175.9
T_6	Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days	10.30	79.0 (62.7)	0.25 (0.86)	266.3
T_7	Control (Fresh seed)	10.20	80.0 (63.4)	0.33 (0.88)	
T_8	Control (inoculated seed)	10.13	73.3 (58.9)	3.37 (1.95)	
SE		-	1.38	0.106	
C.D. at 5 %		NS	4.13	0.32	

Table 5.6. Effect of solarization treatments in blackgram seeds during storage at PAJANCOA, Karaikal

Treatments		Germination (%)	Seed damage(%)	Moisture (%)	Cumulative heat (°C)
		3 months	3 months	3 months	
T_1	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days	90 (71.56)	0.0(0.71)	10.0 (18.43)	72.4
T_2	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days	95 (77.08)	0.0(0.71)	9.8 (18.24)	143.9
T_3	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days	83 (65.65)	0.0(0.71)	9.4 (17.85)	215.6
T_4	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days	93 (74.66)	0.0(0.71)	9.6 (18.05)	72.4
T_5	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days	90 (71.56)	0.0(0.71)	9.4 (17.85)	143.9
T_6	Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days	91 (72.54)	0.10 (0.75)	9.2 (17.65)	215.6
T_7	Control (Fresh seed)	91 (72.54)	0.0(0.71)	9.7 (18.14)	
T_8	Control (inoculated seed)	87 (68.86)	2.40 (1.71)	9.6 (18.05)	
C.D. at 1 %		2.45	0.10	0.28	

Table-5.7: Effect of solarization treatments in blackgram seeds during storage at TNAU, Coimbatore.

Treatments		Germination (%)		Seed damage (%)		Moisture (%)		Cumulative heat (°C)
		3 months	6 months	3 months	6 months	3 months	6 months	
T_1	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days	89.3	87.3 (69.21)	0.00 (0.71)	0.00 (0.71)	8.8 (17.26)	8.8 (17.24)	113.0
T_2	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days	87.3	86.7 (68.65)	0.00 (0.71)	0.00 (0.71)	8.8 (17.29)	8.1 (16.53)	225.0
T_3	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days	87.3	82.7 (65.40)	0.00 (0.71)	0.00 (0.71)	8.8 (17.29)	9.3 (17.70)	339.3
T_4	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days	86.0	76.3 (60.87)	0.17 (0.81)	3.73 (2.05)	9.6 (18.02)	10.4 (18.83)	113.0
T_5	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days	85.7	76.7 (61.11)	0.80 (1.14)	2.03 (1.59)	9.2 (17.69)	8.4 (16.80)	225.4
T_6	Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days	87.7	76.3 (60.87)	0.17 (0.80)	0.90 (1.18)	9.2 (17.72)	7.3 (15.67)	340.4
T_7	Control (Fresh seed)	83.7	85.7 (67.75)	0.03 (0.73)	3.57 (2.01)	9.5 (17.95)	8.6 (17.09)	
T_8	Control (inoculated seed)	79.3	71.3 (57.61)	1.23 (1.23)	7.57 (2.84)	10.1 (18.51)	9.4 (17.85)	
SEm		2.27	1.00	0.125	0.054	0.36	0.98	
C.D. at 5 %		NS	3.01	0.37	0.16	1.08	2.88	

Table 5.8. Effect of solarization treatments in chickpea seeds during storage at MPKV, Rahuri

Treatments		Germination (%)		Seed damage(%)		Moisture (%)		Cumulative heat (°C)
		3 months	6 months	3 months	6 months	3 months	6 months	
T_1	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days	91.33 (72.88)	89.66 (71.25)	0.00 (0.71)	0.67 (1.05)	8.40	8.2	77.3
T_2	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days	92.33 (73.93)	91.00 (72.54)	0.00 (0.71)	0.33 (0.88)	8.27	8.2	161.3
T_3	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days	96.67 (79.48)	93.00 (74.66)	0.00 (0.71)	0.00 (0.71)	8.27	8.4	247.4
T_4	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days	89.00 (70.63)	87.66 (69.44)	0.66 (1.05)	1.00 (1.17)	8.30	8.2	87.3
T_5	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days	90.00 (71.57)	88.00 (69.73)	0.33 (0.88)	0.67 (1.05)	8.25	8.2	175.0
T_6	Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days	89.00 (70.63)	87.33 (69.15)	0.00 (0.71)	0.33 (0.88)	8.43	8.3	264.7
T_7	Control (Fresh seed)	88.67 (70.33)	86.00 (68.03)	0.66 (1.05)	1.00 (1.17)	8.23	8.3	
T_8	Control (inoculated seed)	87.67 (69.44)	85.00 (67.21)	3.66 (2.04)	7.00 (2.72)	8.16	8.3	
SEm		1.36	0.90	0.11	0.191	-	-	
C.D. at 5 %		4.13	2.72	0.33	0.57	NS	NS	

Table 5.9. Effect of solarization treatments in chickpea seeds during storage at JAU, Jamnagar

Treatments		Moisture (%)		Germination (%)		Seed damage (%)		Cumulative heat (°C)
		3 months	6 months	3 months	6 months	3 months	6 months	
T_1	Solarization of fresh seeds for 3 h for 2 days	4.39	4.45	95.0	93.0	0.0 (2.87)	0.0 (2.87)	73.0
T_2	Solarization of fresh seeds for 3 h for 4 days	4.36	4.43	95.3	93.3	0.0 (2.87)	0.0 (2.87)	148.0
T_3	Solarization of fresh seeds for 3 h for 6 days	4.36	4.42	95.7	94.0	0.0 (2.87)	0.0 (2.87)	220.8
T_4	Solarization of inoculated-seeds for 3 h for 2 days	4.42	4.41	96.3	94.3	0.0 (2.87)	0.0 (2.87)	75.0
T_5	Solarization of inoculated-seeds 3 h for 4 days	4.41	4.42	96.7	94.7	0.0 (2.87)	0.0 (2.87)	152.0
T_6	Solarization of inoculated-seeds for 3 h for 6 days	4.40	4.41	97.0	95.0	0.0 (2.87)	0.0 (2.87)	225.0
T_7	Control (Fresh seed)	4.38	4.51	94.0	92.0	1.00(5.74)	12.9 (5.0)	
T_8	Control (inoculated seed)	4.42	4.63	92.0	89.0	3.0 (9.88)	12.0 (20.3)	
S. Em +/-		0.02	0.03	0.31	0.03	0.35	0.32	
C.D. at 5 %		NS	0.08	0.93	0.08	1.04	0.97	
C.V. %		0.61	1.06	0.57	1.06	14.70	8.93	

Table 5.10. Effect of solarization treatments in chickpea seeds during storage at UAS, Dharwad

Treatments		Germination (%)	Seed damage (%)	Moisture (%)	Cumulative Heat (°C)
		3 months	3 months	3 months	
T_1	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 2 days	94.7 (77.06)	0.01 (0.711)	8.97 (3.00)	113.4
T_2	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 4 days	95.0 (77.09)	0.01 (0.712)	9.23 (3.04)	222.3
T_3	Solarization of fresh seeds in clear polythene (700 gauge) packet for 3 h for 6 days	96.0 (78.82)	0.01 (0.712)	8.57 (2.93)	327.7
T_4	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 2 days	83.0 (65.72)	0.08 (0.762)	9.17 (3.03)	113.4
T_5	Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 3 h for 4 days	84.3 (66.78)	0.07 (0.754)	9.87 (3.14)	222.3
T_6	Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3 h for 6 days	82.7 (65.58)	0.10 (0.772)	9.33 (3.05)	327.7
T_7	Control (Fresh seed)	96.0 (78.49)	0.01 (0.715)	11.63 (3.41)	
T_8	Control (inoculated seed)	80.3 (63.69)	0.19 (0.832)	14.77 (3.84)	
	SE	1.85	0.008	0.068	
	$CD_{0.05}$	5.54	0.025	0.20	

Experiment 6: Survey and monitoring of insecticide resistance in storage insect pests infesting seeds in storage godowns

Centres

TNAU, Coimbatore; UAS, Bengaluru; PDKV, Akola;
SKNAU, Jobner; PJTSAU, Hyderabad; MPKV, Rahuri;
UAS, Dharwad; OUA&T, Bhubaneswar; AAU, Assam

Objective: To estimate level of resistance to commonly used insecticides in storage godowns

Target insects:

Rhyzopertha dominica
Sitophilus oryzae
Tribolium castaneum
Callosobruchus maculatus

Insecticides:

Deltamethrin
Malathion

Results:

Insects were collected from storage godowns by various centres further multiplied in the laboratory to assess relative susceptibility of these insects against commonly used contact insecticides (Malathion and Deltamethrin). Mainly four insects *viz.Rhyzopertha dominica, Sitophilus oryzae, Tribolium castaneum* and *Callosobruchus maculatus* were collected by various centrs. TNAU, Coimbatore collected insects from NSC godown located at Coimbatore, PJTSAU collected from Ranga Reddy district of Telengana, OUA&T collected from Jagatsingpur district of Odisha and UAS, Bengaluru collected insects from UAS, GKVK, Bengaluru godowns.

1. **Relative susceptibility of *Rhyzopertha dominica* towards malathion and deltamethrin**

The results (Table-6.1) revealed that *R. dominica* strains collected from Ranga Reddy district showed highest degree of resistance (x3) towards malathion compared to susceptible Delhi strain followed by Rahuri (x2.71) and Bengaluru (x1.02). Similarly, *R. dominica* strains collected from Ranga Reddy district also recorded highest degree of resistance (x4.2) towards deltamethrin compared to susceptible Delhi strain followed by Rahuri (1.25).

2. Relative susceptibility of *Tribolium castaneum* towards malathion and deltamethrin

The results presented in the Table 6.2 indicated that, *Tribolium castaneum* strain collected by PJTSAU from Ranga Reddy district showed high degree of resistance towards malathion (x31.5) compared to susceptible Delhi strain followed by Coimbatore (x17.2) and Rahuri (x3.75). In case of deltamethrin also PJTSAU strain recorded maximum degree of resistance (x5.98) followed by Rahuri strain (x1.08).

3. Relative susceptibility of *Sitophilus oryzae* towards malathion and deltamethrin

Among the collected strains, *Sitophilus oryzae* collected by PJTSAU showed highest degree of resistance (x36.1) towards malathion (Table 6.3) compared to susceptible Delhi strain followed by Bengaluru (x15.7), Rahuri (x4.68) and Coimbatore (x4.5). *Sitophilus oryzae* strains collected by Coimbatore showed higher degree of resistance (x97.3) towards deltamethrin compared to susceptible Delhi strain followed by PJTSAU (x13.67), Rahuri (x4.59) and Bengaluru (x1.39).

4.Relative susceptibility of *Callosobruchus maculatus* towards malathion and deltamethrin:

Results given in the Table- 6.4 revealed that, *Callosobruchus maculatus* strain collected by UAS, Bengaluru recorded highest degree of resistance (x104.7) towards malathion compared to susceptible Delhi strain followed by PJTSAU (x6.25), Rahuri (x2.5) and OUA&T (x2.2). *C. maculatus* strains collected by Rahuri recorded highest degree of resistance towards deltamethrin (x9.33) compared to Delhi strain followed by OUA&T (x3.82), Bengaluru (x2.69) and PJTSAU (x2).

Conclusion: Preliminary results obtained at various centres indicated that, degree of resistance varied from among the insects collected from different locations and also among the strains. Degree of resistance ranged from x1.02 to x104.7 compared to susceptible strains. Highest degree of resistance was observed in *C. maculatus* strains collected by UAS, Bengaluru towards malathion (x104.7) followed by *Sitophilus oryzae* strains collected by Coimbatore (97.3) towards deltamethrin. However, large number of strains need to be collected and evaluated at all cooperating centres. Moreover, these toxicity data need to be validated further.

Table 6.1. Toxicity of some contact insecticides to different strains of *Rhyzopertha dominica* collected from various locations

SL No.	Name of Insect	Insecticide	Strain name/location	Heterogeneity		Regression coefficient/equation	LC_{50}	Fiducial limits		Resistance compared to susceptible strain
				df	χ^2			Min.	Max.	
1	*Rhyzopertha dominica*	Malathion	Rahuri	3	0.2798	4.1084+19.722	0.0452	0.031	0.0594	2.71
2			Bengaluru	3	0.995	1.3726x+1.9405	0.016941	0.009384	0.030581	1.02
3			PJTSAU	4	5.246	2.73709+2.105x	0.05006	0.04388	0.05952	3.01
4			S (Delhi strain)	4	2.991	1.204+0.05	0.01665	0.01289	0.0215	-
5		Deltamethrin	Rahuri	3	0.5993	3.433+283.26	0.0055	0.0045	0.0065	1.25
6			PJTSAU	4	8.129	2.098+1.21x	0.01841	0.00632	0.0291	4.193
7			S (Delhi strain)	3	2.952	1.353+0.08	0.00439	0.00296	0.00651	-

Table 6.2. Toxicity of some contact insecticides to different strains of *Tribolium castaneum* collected from various locations

SL No.	Name of Insect	Insecticide	Strain name/location	Heterogeneity		Regression coefficient/equation	LC_{50}	Fiducial limits		Resistance compared to susceptible strain
				df	χ^2			Min.	Max	
1	*Tribolium castaneum*	Malathion	Rahuri	3	2.975	3.526+20.755	0.071	0.0575	0.0845	3.75
2			Coimbatore	10	3.44	3.36x - 6.773	0.3255	0.2959	0.3579	17.2
3			PJTSAU	8	15.879	0.834+3.70649x	0.59551	0.53215	0.7152	31.51
4			S (Delhi strain)	4	0.8963	9.900+3.507x	0.0189	0.0159	0.0226	-
5		Deltamethrin	Rahuri	3	0.527	12.667+2.294	0.0005	0.0003	0.0006	1.08
6			PJTSAU	6	1.316	10.167+3.97 x	0.00275	0.0026	0.00291	5.98
7			S (Delhi strain)	4	6.5939	7.792+0.836x	0.00046	0.00026	0.00078	-

Table 6.3. Toxicity of some contact insecticides to different strains of *Sitophilus oryzae* collected from various locations

SL No.	Name of Insect	Insecticide	Strain name/ location	Heterogeneity		Regression coefficient/equation	LC_{50}	Fiducial limits		Resistance compared to susceptible strain
				df	χ^2			Min.	Max	
1	*Sitophilus oryzae*	Malathion	Rahuri	3	1.609	3.615+206.78	0.0067	0.0053	0.0081	4.68
2			Bengaluru	3	0.926	4.995x+6.7494	0.02249	0.01892	0.02674	15.7
3			PJTSAU	8	22.612	3.95828+3.077x	0.05169	0.04513	0.05905	36.1
4			Coimbatore	10	0.47	1.708x + 1.9	0.0065	0.0053	0.0081	4.5
5			S (Delhi strain)	3	4.3897	10.802+2.4005x	0.001432	0.00111	0.00185	-
6		Deltamethrin	Rahuri	3	0.4007	12.158+2.140	0.0005	0.0003	0.0006	4.59
7			Bengaluru	3	0.992	2.6356x+4.5238	0.000152	0.00011	0.00011	1.39
8			PJTSAU	4	8.858	4.81025+1.702x	0.00149	0.00115	0.00179	13.67
9			Coimbatore	14	2.67	1.423x + 2.114	0.0106	0.0084	0.0134	97.3
10			S (Delhi strain)	5	5.3579	7.6606+0.6712x	0.000109	0.000056	0.00021	-

Table 6.4. Toxicity of some contact insecticides to different strains of *Callosobruchus maculatus* collected from various locations

SL No.	Name of Insect	Insecticide	Strain name/ location	Heterogeneity		Regression coefficient/equation	LC_{50}	Fiducial limits		Resistance compared to susceptible strain
				df	χ^2			Min.	Max.	
1	*Callosobruchus maculatus*	Malathion	Rahuri	3	0.20	3.5451+2320.57	0.0006	0.0005	0.0007	2.5
2			Bengaluru	3	0.979	3.2328x+2.7553	0.025126	0.01946	0.03244	104.7
3			PJTSAU	5	8.213	8.213+2.909x	0.0015	0.00127	0.0021	6.25
4			OUA&T	4	10.00	2.0258x + 1.5097	0.0005283	0.000166	0.001789	2.2
5			S (Delhi strain)	4	5.101	3.233+0.711x	0.00024	0.000031	0.00045	-
6		Deltamethrin	Rahuri	3	0.7481	3.598+1948.51	0.0007	0.006	0.0009	9.33
7			Bengaluru	3	0.958	3.5467x+3.9184	0.0002016	0.000159	0.000255	2.69
8			PJTSAU	5	8.23	11.12245+2.909x	0.00015	0.00013	0.00021	2.00
9			OUA&T	4	3.00	1.4385x + 2.9032	0.0002868	0.000136	0.001556	3.82
10			S (Delhi strain)	3	1.046	3.315+1.920x	0.000075	0.000001	0.000098	-

E. Seed Processing

Experiment 1: Optimum sieve size and type of screen for grading seeds of different crop varieties and hybrids including their parents.

Objectives:

1. Crop-wise classification of varieties in seed chain with respect to their seed size.
2. To standardize the size and type of grading sieve.

Crop	Centres
Chickpea	CSAUAT, Kanpur; MPKV, Rahuri; UAS Dharwad and UAS, Raichur
Pigeonpea	UAS, Bengaluru and UAS, Raichur
Soybean	UAS, Dharwad; UAS, Raichur and MPKV, Rahuri
Paddy	ICAR-IARI RS, Karnal; UAS, Raichur; NDUAT, Faizabad and TNAU, Coimbatore
Maize	TNAU, Coimbatore and UAS, Bangalore
Mustard	CSAUA&T, Kanpur
Field bean	UAS, Bengaluru
Finger millet	UAS, Bengaluru
Sunflower	UAS, Bengaluru

Treatment details:

i. Crop : as above
ii. Machine : Standard sieve shaker
iii. Sieve size : Grading sieve:
   a. Recommended sieve (as per IMSCS)
   b. Two sieves above the recommended sieve
   c. Two sieves below the recommended sieve

Results:

Paddy

ICAR- IARI-RS, Karnal

Seeds of three paddy varieties *viz.*, Pusa 44, PB 1121 and PB 1509 were sieved by sieve shaker using five slotted sieve sizes i.e. 2.2, 2.1, 1.9, 1.8 and 1.6mm. It was found that maximum seed was retained by the 1.9mm sieve but the rejection percentage was high. Therefore, 1.8mm may be recommended which gave highest cumulative recovery efficiency of physically pure seed *i.e.* 90.88, 91.26 and 94.31% for Pusa 44, PB 1121 and PB 1509, respectively. The sieve sizes upto 1.8mm was also meeting the IMSC standards (Table 1) for the seed quality parameters of physical purity (98%) and germination (80%). Hence the sieve size of 1.8mm is recommended for grading seeds of Pusa 44, PB 1121 and PB 1509 varieties. The moisture content of seed was around 13 %.

TNAU, Coimbatore

The seeds retained over BSS 8 (3.17mm) recorded 15.9% of seed recovery and BSS 9 (2.82mm) recorded 72.0% of seed recovery. Both the sieves put together recorded 87.9%

seed recovery which predominantly represented the processed seed lot of paddy *cv.* CO 52. The length (10.1mm), breadth (2.2mm) and thickness (2.4mm) of seeds retained on BSS 9 are optimum in size which contributed 72% of the whole seed lot. The seeds from BSS 8 and BSS 9 also recorded the maximum physical purity of 97.9% and 99.3%, with the germination of 98% and 97%, respectively. The seeds retained over BSS 8 recorded the maximum vigour index II (150) which was at par with seeds retained over BSS 9. But the seed retained on BSS 9 showed significantly higher value for vigour index I (3554) (Table 2). Hence for mechanized seed processing of rice variety CO 52 with two screen machine, BSS 9 (2.82mm) sieve can be recommended as grading sieve.

Table 1: Grading screen size on seed quality parameters in paddy at ICAR-IARI, Karnal

Sieve Size (mm)	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
Pusa 44 (Non Basmati)										
2.2s	1.15 e	8.81	2.58 a	1.96 a	97.4 c	83.3 bc	2898 ab	10985 b	23.57 a	13.1
2.1s	4.43 c	8.72	2.56 ab	1.95 b	98.1 b	81.5 c	2840 b	11190 b	23.50 a	13.2
1.9s	82.93 a	8.82	2.52 bc	1.93 c	98.8 a	87.5 a	2981 a	12633 a	23.30 ab	13.1
1.8s	7.95 b	8.80	2.49 c	1.92 d	98.5 ab	84.3 b	2874 ab	11141 b	23.06 b	13.2
1.6s	2.75 d	8.78	2.43 d	1.92 d	97.5 c	79.5 d	2545 c	9576 c	22.18 c	13.2
Raw seed*		*8.80*	*2.49*	*1.93*	*93.9*	*76.8*	*2467*	*9497*	*22.46*	*13.4*
CD (0.01)	**0.93**	**NS**	**0.06**	**0.01**	**0.62**	**2.7**	**159**	**1449**	**0.52**	**NS**
CV (%)	**2.2**	**0.9**	**1.2**	**0.3**	**0.3**	**1.5**	**2.6**	**6**	**1.0**	**0.5**
PB 1121 (Basmati)										
2.2s	0.55 e	11.78	2.51 a	1.99 a	97.8 bc	84.3 ab	2898 ab	10065 a	29.87 a	13.5
2.1s	3.53 d	11.76	2.52 a	1.97 b	98.1 abc	83.3b	2840 b	9760 a	29.72 a	13.5
1.9s	81.98 a	11.75	2.38 ab	1.93 c	98.6 a	86.8 a	2981 a	9767 a	28.89 b	13.5
1.8s	9.28 b	11.77	2.29 b	1.92 cd	98.4 ab	84.8 ab	2874 ab	9603 a	28.85 b	13.5
1.6s	5.63 c	11.75	2.33 b	1.91 d	97.4 c	79.3 c	2545 c	8396 b	28.01 c	13.6
Raw seed*		*11.74*	*2.36*	*1.93*	*93.2*	*78.0*	*2605*	*9068*	*28.75*	*13.4*
CD (0.01)	**1.24**	**NS**	**0.22**	**0.02**	**1.0**	**4.0**	**159**	**820**	**0.96**	**NS**
CV (%)	**2.9**	**0.4**	**4.2**	**0.4**	**0.5**	**2.2**	**2.6**	**4**	**1.5**	**1.5**
PB 1509 (Basmati)										
2.2s	0.43 e	12.43	2.51 a	1.90 a	97.7 b	82.8abc	2450 a	10282 a	31.66 a	13.4
2.1s	2.78 c	12.42	2.49 a	1.90 a	97.9 b	81.8 bc	2419 ab	10364 a	31.61 a	13.5
1.9s	88.93 a	12.44	2.44 b	1.86 b	98.5 a	85.0 a	2522 a	10990 a	31.20 b	13.5
1.8s	5.38 b	12.43	2.41 bc	1.84 c	98.5 a	83.8 ab	2459 a	10533 a	30.90 b	13.5
1.6s	1.80 d	12.43	2.38 c	1.81 d	97.6 b	80.0 c	2320 b	9046 b	30.30 c	13.6
Raw seed*		*12.43*	*2.44*	*1.84*	*94.9*	*77.8*	*2267*	*9349*	*30.80*	*13.6*
CD (0.01)	**1.1**	**NS**	**0.05**	**0.02**	**0.9**	**4.2**	**169**	**1121**	**0.53**	**NS**
CV (%)	**2.6**	**0.3**	**0.9**	**0.5**	**0.4**	**2.4**	**3.2**	**5.1**	**0.8**	**1.2**

** Not included for statistical analysis*

Table 2: Grading screen size on seed quality parameters in paddy *cv.* Co 52 at TNAU, Coimbatore

Sieve Size* (mm)	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
2.54 (BSS 10) passed	2.6	8.40	1.80	1.50	61.8	39 (37)	1519	37	10.1	11.4
2.54 (BSS 10) retained	7.0	9.40	1.90	1.90	78.2	75 (61)	2815	89	12.5	11.4
2.82 (BSS 9)	72.0	10.01	2.20	2.40	99.3	97 (79)	3554	141	16.1	11.7
3.17 (BSS 8)	15.9	11.00	2.80	2.70	97.9	98 (82)	3214	150	16.6	11.8
3.65 (BSS 7)	2.6	12.30	3.10	3.00	89.6	90 (70)	1956	140	17.0	11.9
CD (0.05)	**1.1**	**0.07**	**0.02**	**0.02**	**1.5**	**4**	**142**	**10**	**0.5**	**NS**
CV (%)	**3.5**	**4.8**	**4.4**	**3.9**	**1.2**	**3.4**	**3.7**	**5.8**	**2.2**	**1.7**

* Square mesh size; *(Figures in the parentheses are arc sine values)*

Chickpea

UAS, Raichur

Seeds of chickpea variety BGD 103 were graded with five round sieves *i.e.* 6.75, 7.00, 7.25, 7.50 and 7.75mm. The data revealed that the optimum sieve size 6.75mm registered highest recovery (96.31%), physical purity (98.15%), germination (97.00%), 1000 seed weight (351.84g), Seedling vigour Index I (2514), Seedling vigour Index II (38.15) and these quality parameters were above the minimum seed certification standards. Hence the bengal gram/ BGD103 can be processed using 6.75mm round grading sieve for better seed recovery and quality (Table 3).

UAS, Dharwad

Seeds of chickpea variety JG 11 were graded with five round sieves *viz:*, 5.00, 5.50, 6.00, 7.00 and 8.00mm. The sieve size 6.00mm registered higher seed recovery at par with 5.50 and 5.00mm sieves but physical purity (98.18%) was found superior to both the below recommended sizes of 5.50 and 5.00mm sieves. Seed quality parameters such as seedling vigour index-II (183.68), 1000 seed weight (298.44g) were also significantly higher compare to below recommended sieve sizes (5.0 and 5.50mm) and at par with above recommended sieve sizes (7.00 and 8.00mm). When seed recovery and seed quality parameters were compared, 6.00mm round shape sieve was found significantly superior over rest of the sieves tested (Table 4).

CSAUA&T, Kanpur

Seeds of two chickpea varieties *viz.*, Pragti and Radhey were graded with three round sieves *i.e.* 5.0, 5.5 and 6.0mm. Results revealed that grading screen size of 5.0mm was optimum for grading of these two varieties with respect to seed recovery and meeting IMSC standards of seed quality (Table 5).

Dr. PDKV, Akola

Two chickpea varieties, Jaki 9218 and AKS 1109 were graded with five round sieves *viz:*, 5.0, 5.5, 6.0, 6.5 and 7.0mm. Results revealed that grading screen size of 6.0mm and 6.5mm was optimum for grading of the varieties Jaki 9218 and AKS 1109, respectively, as these sieve sizes gave the best results with respect to seed recovery (%), physical purity (%), germination (%), vigour Index I and vigour Index II (Table 6 & 7).

MPKV, Rahuri

Seeds of three chickpea varieties *viz.*, Digvijay, Vishal and Virat were selected along with two round sieves i.e. 6.5 mm and 7.0 mm. Results revealed that grading screen size 6.5r mm and 7.0r mm was optimum for *desi* varieties i.e. Digvijay and Vishal and Kabuli variety i.e. Virat, respectively (Table 8).

Table 3: Effect of grading screen size on seed quality and processing parameters in chickpea *cv.* BGD 103 at UAS, Raichur

Sieve Size (mm) Round	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
6.75	96.31	9.80	7.20	7.11	98.15	97	2514	38.15	351.84	9.15
7.00	94.75	10.09	7.97	7.75	98.30	98	2520	39.72	352.69	9.14
7.25	91.67	9.82	7.47	7.42	98.55	98	2621	41.39	357.00	9.24
7.50	83.80	10.08	7.93	7.84	99.07	99	2882	42.00	359.79	9.23
7.75	67.72	10.38	7.80	7.77	0.43	2.67	3101	3.92	368.33	9.24
CD (0.01)	**3.22**	**0.49**	**0.65**	**0.67**	**0.43**	**2.67**	**325**	**3.92**	**4.75**	**NS**

Table 4: Effect of grading screen size on seed quality and processing parameters in chickpea *cv.* JG 11 at UAS, Dharwad

Sieve Size (mm) Round	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
5.00	91.01	7.38	5.13	4.38	97.05	95.50	2099	180.1	295.25	10.9
5.50	87.71	8.50	5.63	4.63	97.56	94.75	2201	173.0	297.71	10.0
6.00	86.92	8.50	6.00	5.00	98.18	93.25	2159	183.7	298.44	8.9
7.00	81.77	8.88	6.13	5.13	98.73	90.00	2221	194.0	299.20	8.6
8.00	67.53	9.63	6.50	5.50	99.22	94.75	2695	195.5	309.00	8.5
CD (0.05)	**5.68**	**0.51**	**0.32**	**0.25**	**0.89**	**3.51**	**399**	**24.2**	**2.89**	**0.8**
CV (%)	**4.44**	**0.72**	**0.45**	**0.36**	**0.59**	**2.43**	**11.00**	**8.49**	**0.63**	**5.78**

Table 5: Effect of grading screen size on seed quality and processing parameters in chickpea cv. Pragti and Radhey at CSAUA&T, Kanpur

Sieve Size (mm) Round	Recovery (%)	Physical Purity (%)	1000 Seed wt. (g)	Germination (%)	Vigour Index I	Vigour Index II	MC (%)
Pragti							
5.00	95.30	99.31	189.00	94	1504.00	43.24	12.62
5.50	92.00	99.50	190.24	94	1522.80	41.36	

6.00	80.20	99.30	193.34	92	1380.00	39.56	
Radhey							
5.00	94.60	99.74	185.60	92	1499.60	43.24	12.50
5.50	87.80	99.72	190.43	90	1494.40	42.30	
6.00	80.00	99.65	188.00	90	1440.00	44.10	
CD Var.	**1.68**	**0.21**	**NS**	**1.26**	**NS**	**NS**	**NS**
CD Sieve	**2.05**	**NS**	**2.89**	**1.54**	**20.54**	**NS**	**NS**
CD V x S	**NS**	**NS**	**4.07**	**NS**	**29.05**	**2.18**	**NS**
CV (%)	**1.45**	**0.20**	**1.22**	**1.66**	**1.11**	**2.92**	**0.563**

Table 6: Effect of grading screen size on seed quality and processing parameters in chickpea *cv.* Jaki 9218 at Dr. PDKV, Akola

Sieve Size (mm) Round	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
7.00	11.30	7.24	6.66	6.59	98.88	91.23	1898.7	79.11	243.13	8.73
6.50	10.05	6.69	6.58	6.62	98.95	90.03	1829.4	71.23	238.45	8.83
6.00	72.05	6.27	6.14	6.26	99.45	89.98	2000.8	83.37	228.75	8.68
5.50	3.43	5.76	5.56	5.82	97.20	79.15	1534.8	63.95	224.35	8.75
5.00	3.175	5.28	4.92	5.57	96.75	77.55	1350.8	56.29	213.10	8.78
CD (0.05)	**2.04**	**0.23**	**0.37**	**0.59**	**0.72**	**1.73**	**79.8**	**5.49**	**6.43**	**NS**
CV (%)	**6.53**	**2.31**	**3.98**	**6.16**	**0.47**	**1.29**	**2.97**	**4.98**	**1.84**	**1.25**

Table 7: Effect of grading screen size on seed quality and processing parameters in chickpea *cv.* AKS 1109 at Dr. PDKV, Akola

Sieve Size (mm) Round	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
7.00	10.55	7.76	6.73	6.86	99.03	88.35	2128.2	85.13	251.28	8.85
6.50	72.18	6.75	6.64	6.65	99.40	88.18	2214.3	84.27	245.33	8.88
6.00	12.43	6.30	6.25	6.30	97.60	87.60	2078.6	85.65	244.13	8.87
5.50	2.98	5.84	5.29	5.22	96.70	78.13	1673.4	66.94	237.76	8.82
5.00	1.88	5.20	4.94	4.86	96.00	76.75	1609.3	64.37	225.20	8.87
CD (0.05)	**2.02**	**0.27**	**0.39**	**0.42**	**0.82**	**1.30**	**66.2**	**3.26**	**2.93**	**NS**
CV (%)	**6.47**	**2.71**	**4.23**	**4.54**	**0.54**	**0.99**	**2.19**	**2.71**	**0.78**	**1.11**

Table 8: Effect of grading screen size on seed quality and processing parameters in chickpea seed at MPKV, Rahuri

Treatment	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
Variety										
Digvijay (*Desi*)	91.43 (73.54)	9.18	6.37	6.62	98.89 (84.01)	98.50 (82.72)	2452	64.18	263.41	9.06 (17.51)
Vishal (*Desi*)	92.72 (75.01)	9.73	6.96	7.18	98.86 (83.95)	98.16 (82.32)	2427	63.43	279.50	8.96 (17.40)
Virat	92.74	9.82	7.15	7.56	98.23	97.66	2164	54.24	296.80	9.23

(*Kabuli*)	(75.04)				(82.45)	(81.43)				(17.68)
CD (0.05)	**0.78**	**0.24**	**0.14**	**0.28**	**1.26**	**NS**	**85**	**1.93**	**7.85**	**NS**
Grading Sieves (mm) Round										
6.50	96.55 (79.30)	9.28	6.71	6.97	98.32 (82.62)	97.55 (81.16)	2278	59.40	269.13	9.06 (17.51)
7.00	88.05 (69.76)	9.88	6.94	7.27	99.00 (84.32)	98.66 (83.16)	2417	61.83	290.67	9.11 (17.55)
CD (0.05)	**0.64**	**0.19**	**0.11**	**0.23**	**1.03**	**1.848**	**70**	**1.57**	**6.41**	**NS**

(Figures in the parentheses are arc sine values)

Soybean

UAS, Raichur

Seeds of soybean cv. DSB-21 were graded with five oblong sieves 3.75, 4.0, 4.2, 4.5, and 4.75mm. Grading sieve of 3.75mm registered highest Seed recovery (81.16%) and seed quality parameters *viz.,* Physical purity (98.33%), Germination (88.00 %), 1000 seed weight (110.00 gm), Seedling vigour Index I (2970) and Seedling vigour Index II (41.95) are above the minimum seed certification standards. Hence the Soybean *cv.* DSB-21 can be processed using 3.75mm oblong grading sieve for better seed recovery and quality (Table 9).

UAS, Dharwad

Seeds of soybean variety DSb-21 were subjected for grading with five different size sieves *viz:*, 4.40, 4.30, 4.00, 3.75 and 3.50mm. The optimum sieve size was found to be 4.00mm oblong type for grading of soybean variety DSb-21 which recorded significantly higher seed recovery (88.34%), physical purity (98.16%), seed germination (88.00%), Seedling vigour index –II (68) which were at par with sieve sizes above the recommended (4.30and 4.40mm), even though the highest seed recovery was recorded with 3.50mm sieve size (below recommended) but the physical purity of seed was significantly less, hence 4.00mm oblong sieve size was found to be optimum for grading soybean variety DSb 21 (Table 10).

MPKV, Rahuri

Seeds of four soybean varieties *viz.,* JS 335, P. Agrani, JS 93-05 and P. Kalyani were selected along with three oblong sieves i.e. 3.25 mm, 3.75 mm and 4.0 mm. The moisture content of seed was observed to be about 15 %. The results revealed that optimum grading sieve size should be 3.75 mm oblong (Table 11). The grading sieve size has shown significant interaction with cultivar for seed quality traits.

Table 9: Effect of grading screen size on seed quality and processing parameters in soybean *cv.* DSb 21 at UAS, Raichur

Sieve Size (mm) Oblong	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
3.75	81.16	6.70	5.67	4.06	98.33	88	2970	38.15	110.00	8.14
4.00	72.39	6.53	5.67	4.56	98.42	91	3102	39.72	114.32	8.19

4.20	65.76	7.07	6.06	4.65	98.46	92	3140	41.39	125.07	8.16
4.50	51.62	7.18	5.99	4.60	98.87	91	3168	42.00	128.69	8.33
4.75	38.93	7.39	6.60	5.78	99.14	90	3266	3.92	133.15	9.00
CD (0.01)	**1.39**	**0.49**	**0.56**	**0.72**	**0.37**	**2.18**	**166.69**	**3.92**	**2.05**	**0.55**

Table 10: Effect of grading screen size on seed quality and processing parameters in soybean *cv.* DSb 21 at UAS, Dharwad

Sieve Size (mm) Oblong	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
3.50	88.90	7.75	6.25	4.75	97.24	88.25	2751	67.57	154.36	12.81
3.75	89.14	7.88	6.25	4.75	96.85	88.75	2564	65.83	153.31	13.68
4.00	88.34	8.63	6.75	5.25	98.16	88.00	2853	68.44	155.43	11.63
4.30	82.29	8.75	6.63	5.13	98.66	83.00	3011	75.61	158.05	11.38
4.40	78.81	8.88	7.25	5.75	98.54	82.75	2799	74.08	156.41	11.74
CD (0.01)	**2.66**	**0.38**	**0.43**	**0.43**	**0.77**	**3.40**	**399**	**8.63**	**2.33**	**1.59**
	2.02	**2.93**	**4.25**	**5.49**	**0.51**	**2.56**	**9.26**	**7.97**	**0.97**	**8.42**

Table 11: Effect of grading screen size on seed quality and processing parameters in soybean at MPKV, Rahuri

Treatment	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
Variety										
JS-335	94.97 (77.04)	6.99	5.87	4.64	98.90 (84.02)	85.88 (68.04)	2721	102.2	114.38	6.72 (15.02)
P. Agrani	96.44 (79.24)	7.32	6.18	4.90	98.75 (83.78)	87.33 (69.30)	3021	108.3	118.78	6.97 (15.29)
JS -93-05	94.82 (76.87)	7.23	6.15	4.85	98.47 (83.68)	84.33 (66.75)	2691	96.8	118.72	6.77 (15.08)
P. Kalyani	95.80 (78.21)	7.35	6.19	4.99	98.80 (83.80)	86.00 (68.16)	2748	105.4	123.31	7.25 (15.62)
CD (0.05)	**0.002**	**0.13**	**0.11**	**0.08**	**1.04**	**1.58**	**59**	**1.0**	**0.54**	**0.23**
Grading Sieves (mm) oblong										
3.25	95.81 (78.33)	7.37	6.18	4.91	98.42 (83.14)	86.50 (68.55)	2837	105.2	117.46	6.92 (15.24)
3.75	95.40 (77.69)	7.15	6.08	4.81	99.00 (84.01)	85.91 (68.03)	2829	103.3	118.73	6.87 (15.19)
4.00	95.31 (77.51)	7.14	6.04	4.81	98.60 (83.27)	85.25 (67.61)	2719	101.1	120.20	7.00 (15.33)
CD (0.05)	**0.002**	**0.11**	**0.10**	**0.07**	**1.01**	**1.36**	**51**	**0.9**	**0.47**	**0.20**

(Figures in the parentheses are arc sine values)

Maize

UAS, Bengaluru

Among the sieve sizes studied, seeds retained on 6.40mm (R) showed optimum seed recovery (93.93%), which was at par with sieve size 6.25mm (R) (94.90%). Seed quality *viz*.,

physical purity (98.75%), seed length (7.95mm), seed breadth (6.48mm), seed thickness (5.10mm), 100 seed weight (31.17g), germination (92.75%), seed vigour index-I (2644) recorded in sieve size 6.40mm (R) were at par with the observation in sieve size of 6.75mm (R) (99.06%, 8.10mm, 6.53mm, 5.18mm, 31.49g, 93.25% and 2700, respectively) (Table 6). Hence, presently recommended sieve size for grading with 6.40 mm (R) can be employed to obtain better seed quality parameters of hybrid maize MAH 14-5 with better seed recovery with optimum seed quality parameters (Table 12).

TNAU, Coimbatore

Male parent (UMI 1230) of maize hybrid COH (M) 8

The seeds retained over 6.3mm recorded 77.4% of seed recovery with maximum physical purity of 99.3%. The sieve size of 8.0 mm recorded the seed recovery of 10.0% with physical purity of 99.9%. So both the sieves together registered the seed recovery of 87.4% (77.4% + 10.0%) which represented the processed seed lot of the male parent (UMI 1230). The length (7.8mm), breadth (6.3mm) and thickness (6.0mm) of the seeds retained on 6.3mm sieve are optimum in size which contributed 77.4 % of the whole seed lot.

The seeds from 8.0mm and 6.3mm recorded significantly higher germination of 99% and 93% with 100 seed weight of 23.0g and 21.1g, respectively. The seeds retained over 8.0mm and 6.3mm also recorded the maximum vigour index II (189 and 163, respectively) (Table 13). Hence for mechanized seed processing of male parent (UMI 1230) of COH (M), 8.0mm and 6.3 mm sieve can be recommended as grading sieve (Table 13).

Female parent (UMI 1201) and hybrid seeds of COH (M) 8

The sieve size of 8.0mm retained the larger quantity of seeds of female parent (72.5%) and maize hybrid seed (73.3%) of COH (M) 8. The seeds retained on 10.0mm sieves are bold in size which reflected in the higher 100 seed weight of 31.9g with the seed recovery of only 5.8% in female parent (UMI 1201) and 30.9g with 5.3% seed recovery in hybrid seeds. The seeds retained over 8.0mm size registered the physical purity of 98.9% for female parent and 99.6% for hybrid seeds (Table 14 and Table 15)

The maximum seed sizes with higher length (11.3mm), breadth (8.3mm) and thickness (6.5mm) were noticed in the seeds retained over sieve size of 10.0mm but the recovery is only 5.8% in female parent (UMI 1201) and the same trend was also observed in hybrid seeds. The optimum seed sizes with length (9.3mm), breadth (7.5mm) and thickness (6.2mm) with the seed recovery of 72.5% in female parent and seed sizes with length (9.6mm), breadth (8.3mm) and thickness (6.0mm) with the seed recovery of 73.3% in hybrid seeds were recorded in the seeds retained on 8.0 mm sieve. The seeds retained on 10.0 mm and 8.0mm recorded the maximum seed germination in both female parent (98% and 97%, respectively) and hybrid seeds (99% and 98%, respectively). The same trend was also reflected in vigour index. In female parent, the seeds retained on 10.0mm recorded the maximum value for vigour index I (4977) and vigour index II (191) followed by 8.0mm (4544, 178, respectively). The same results were also observed in hybrid seeds. The seeds retained on 10.0mm recorded the maximum value for vigour index I (5151) and vigour index II (193)

followed by 8.0mm (4910 and 181, respectively). Hence for mechanized seed processing of female parent seeds (UMI 1201) and hybrid seeds of COH (M) 8, 8.0mm sieve can be recommended as grading sieve (Table 14 & 15).

Table 12: Effect of sieve size on seed recovery and seed quality in maize hybrid MAH 14-5 at UAS, Bengaluru

Sieve Size (mm) Round	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	100 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness					
6.00	96.44	7.58	5.82	4.55	97.48	92.25	2567	30.32	11.84
6.25	94.90	7.68	6.13	4.85	97.93	92.75	2581	30.23	11.94
6.40	93.93	7.95	6.48	5.10	98.75	92.75	2644	31.17	11.89
6.75	92.48	8.10	6.53	5.18	99.06	93.25	2700	31.49	12.06
7.00	90.98	8.20	6.40	5.28	99.14	93.00	2714	31.82	12.04
CD (0.05)	**1.38**	**0.14**	**0.55**	**0.22**	**0.46**	**NS**	**102**	**0.95**	**NS**
CV (%)	**1.00**	**1.10**	**5.80**	**2.90**	**0.30**	**1.60**	**2.50**	**2.10**	**1.10**

Table 13. Effect of different sieve sizes on seed quality characteristics of male parent (UMI 1230) of maize hybrid COH (M) 8 at TNAU, Coimbatore

Sieve Size (mm) Round	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	100 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
5.5 passed	2.3	5.8	4.2	4.4	62.9	51 (48)	1534	57	17.1	10.4
5.5 retained	9.1	6.1	5.4	5.2	87.6	74 (61)	2839	95	19.8	10.6
6.3	77.4	7.8	6.3	6.0	99.3	93 (72)	4357	163	21.1	10.7
8.0	10.0	9.8	7.0	6.3	99.9	99 (83)	4876	189	23.0	10.9
10.0	1.3	11.0	7.4	6.5	97.2	96 (80)	4898	183	24.4	10.9
CD (0.05)	**1.24**	**0.27**	**0.21**	**0.23**	**1.00**	**1.89**	**151**	**12.0**	**0.44**	**0.59**
CV (%)	**4.12**	**1.83**	**2.46**	**2.56**	**0.74**	**1.52**	**2.71**	**5.81**	**1.40**	**3.71**

Table 14. Effect of different sieve sizes on seed quality characteristics of female parent (UMI 1201) of maize hybrid COH (M) 8

Sieve Size (mm) Round	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
6.3 passed	2.8	6.2	5.4	5.0	66.5	59 (50)	1775	69	16.1	10.6
6.3 retained	17.6	7.5	6.8	5.8	77.1	81 (63)	3230	109	22.7	10.5
8.0	72.5	9.3	7.5	6.2	98.9	97 (80)	4544	178	27.9	10.8
10.0	5.8	11.3	8.3	6.5	99.8	98 (84)	4977	191	31.9	10.7
12.0	1.3	12.3	8.8	6.7	95.6	92 (73)	4666	175	33.9	11.0
CD (0.05)	**0.63**	**0.519**	**0.377**	**0.298**	**1.300**	**3.7**	**182**	**13.5**	**0.70**	**NS**
CV (%)	**1.82**	**4.10**	**4.36**	**3.30**	**0.99**	**3.5**	**3.2**	**6.3**	**1.77**	**4.6**

Table 15. Effect of different sieve sizes on seed quality characteristics of hybrid seeds of maize COH (M) 8 at TNAU, Coimbatore

Sieve Size (mm) Round	Rec. (%)	Seed Size (mm)			Phy. Purity (%)	Germ. (%)	Vigour index I	Vigour index II	1000 Seed Wt. (g)	MC (%)
		Length	Breadth	Thickness						
6.3 passed	3.5	6.2	5.9	4.9	66.0	57 (49)	1865	69	18.4	10.5
6.3 retained	16.6	7.5	6.8	5.6	80.9	82 (65)	3459	113	23.8	10.8
8.0	73.3	9.6	8.3	6.0	99.6	98 (82)	4910	181	30.7	10.9
10.0	5.3	11.2	9.1	6.2	99.8	99 (83)	5151	193	30.9	11.1
12.0	1.3	12.1	9.3	6.8	96.3	95 (76)	5055	190	32.5	11.2
CD (0.05)	**0.49**	**0.262**	**0.386**	**0.253**	**1.302**	**3.5**	**142**	**11.3**	**0.71**	**0.44**
CV (%)	**1.69**	**1.87**	**3.21**	**2.86**	**0.98**	**3.2**	**3.73**	**5.0**	**1.74**	**2.66**

Pigeonpea

UAS, Bengaluru

Seeds of pigeonpea variety BRG-5 was subjected for grading using air screen cleaner with five different round sieves viz. 4.0, 4.5, 4.75, 5.0 and 5.5mm. Among the sieve sizes studied in the experiment, seeds processed with 5.00mm recommended sieve size recorded optimum seed recovery (93.38%) and seed moisture (10.04%), which was at par with sieve size 4.75mm (93.93% and 9.95%, respectively), whereas, seed quality parameters *viz.,* physical purity (98.70%), seed length (4.70mm), seed breadth (4.38mm), seed thickness (3.38mm), 100 seed weight (14.14g), germination (95.00%), SVI-I (3349) in seed processed with sieve size of 5.00mm were at par with sieve size of 5.50mm (98.74%, 4.98mm, 4.70mm, 3.70mm, 14.26g, 95.25%, 35.80cm and 3409, respectively) (Table 16). Hence, Pigeon pea variety BRG-5 could be processed satisfactorily by using grading sieve size of 5.00mm (Round) in order to get satisfactory seed recovery and quality parameters.

Table 16: Effect of grading screen size on seed quality and processing parameters in Pigeonpea *cv.* BRG-5 at UAS, Bangalore

Sieve size (mm) Round	Seed recovery (%)	Seed Size (mm)			Physical purity (%)	Seed germi. (%)	Seedling vigour index	100 seed weight (g)	MC (%)
		Length	Breadth	Thickness					
4.50	95.22	4.15	3.95	2.98	97.61	93.25	2934	13.54	9.92
4.75	93.93	4.35	4.05	3.10	97.83	93.75	3020	13.59	9.95
5.00	93.38	4.70	4.38	3.38	98.70	95.00	3349	14.14	10.04
5.50	88.35	4.98	4.70	3.70	98.74	95.25	3409	14.26	10.09
6.00	52.17	5.08	4.98	3.78	99.07	95.75	3514	14.90	10.12
CD (0.05)	**1.32**	**0.33**	**0.32**	**0.19**	**0.35**	**1.95**	**225**	**0.18**	**0.13**
CV (%)	**1.03**	**4.76**	**4.81**	**3.91**	**1.23**	**1.36**	**4.60**	**0.82**	**0.86**

Mustard

CSAUAT, Kanpur

Seeds of four varieties of mustard *viz.*, Basanti, Peetambri, Vardan and Urvashi were graded using two round sieves *i.e.* 1.2 and 1.7mm. The seed recovery was more (93.75 to 96.32%)

with 1.2 mm sieve size than that of 1.7 mm sieve size (81.3 to 85%), exhibiting an average difference of 11.32 to 12.45% and meeting the IMSC standards (Table 17). Hence, 1.2mm sieve size was found to be optimum for grading of these mustard varieties.

Table 17: Effect of grading screen size on seed quality and processing parameters in mustard at CSAUA&T, Kanpur

Sieve Size (mm)	Recovery (%)	Physical purity (%)	Germination (%)	Seed vigour Index I	Seed vigour Index II	1000 Seed- wt. (g)	Moisture content (%)
Basanti							
1.2	96.26	98.20	90	990.00	1.80	4.31	12.10
1.7	82.00	98.40	87	913.50	1.74	4.30	
Peetambri							
1.2	93.75	98.60	86	860.00	1.72	4.30	11.70
1.7	82.00	97.90	90	873.00	0.90	4.00	
Vardan							
1.2	95.24	99.00	88	968.00	1.76	4.35	12.00
1.7	81.30	98.60	87	955.26	1.74	4.00	
Urvashi							
1.2	96.32	97.80	90	1012.50	1.78	4.48	12.00
1.7	85.00	97.60	88	968.00	1.76	4.41	
CD Var.	**1.90**	**NS**	**NS**	**21.64**	**0.04**	**0.21**	**NS**
CD Sieve	**1.34**	**NS**	**NS**	**15.30**	**0.03**	**0.15**	**NS**
CD VxS	**NS**	**NS**	**1.84**	**30.60**	**0.06**	**NS**	**NS**
CV %	**1.75**	**0.72**	**5.70**	**1.88**	**7.0**	**3.99**	**1.3**

Field bean

The seeds of field bean cv. HA-4 were graded with air screen cleaner using five different round sieves viz. 5.0, 5.5, 6.0, 6.5 and 7.0. It was found that, the sieve size of 6.5mm (recommended sieve size) recorded optimum seed recovery (91.80%) and seed moisture (10.11%), which was at par with sieve size 6.00mm (92.60% and 9.84%, respectively). While, the seed quality parameters *viz*., physical purity (98.68%), seed length (6.96mm), seed breadth (5.27mm), seed thickness (3.20mm), 100 seed weight (16.97g), germination (93.50%), seedling length (40.85cm), SVI-I (3818) with 6.50mm sieve were at par with sieve size of 7.00mm (98.98%, 7.06mm, 5.34mm, 3.32mm, 17.07g, 94.75%, 42.28cm and 4005, respectively) (Table 18). Hence, field bean variety HA-4 could be processed by using grading sieve size of 6.50mm (Round) in order to get satisfactory seed recovery and quality parameters.

Table 18: Effect of grading screen size on seed quality and processing parameters in field bean cv. HA-4 at UAS, Bengaluru

Sieve size (mm) Round	Seed recovery (%)	Seed Size(mm)			Physical purity (%)	Seed germi. (%)	Seedling vigour index	100 seed weight (g)	MC (%)
		Length	Breadth	Thickness					

5.50	96.03	6.69	5.05	3.09	97.08	92.75	3473	16.13	9.43
6.00	92.60	6.78	5.14	3.09	97.75	92.75	3690	16.24	9.86
6.50	91.80	6.96	5.27	3.20	98.68	93.50	3818	16.97	10.11
7.00	76.23	7.06	5.34	3.32	98.98	94.75	4005	17.07	10.21
7.25	60.83	7.19	5.39	3.42	99.25	95.25	4083	17.12	10.23
CD (0.05)	**2.18**	**0.17**	**0.17**	**0.31**	**0.63**	**NS**	**240**	**0.18**	**0.23**
CV (%)	**1.7**	**1.7**	**2.1**	**6.5**	**0.4**	**2.2**	**4.2**	**1.0**	**1.60**

Finger millet

Among the five sieve sizes used for seed processing of finger millet *cv.* GPU 67, seeds graded with 1.20mm (Round) (Recommended sieve size) recorded optimum seed recovery (90.00%) and seed moisture (11.80%), which was at par with sieve size 1.10mm (90.46% and 11.85%, respectively). Whereas, the seed quality parameters *viz.,* physical purity (98.55%), 1000 seed weight (3.49g), seed germination (93.0%), seedling length (16.18 cm), SVI-I (1504) recorded with 1.20mm (Round) (Recommended sieve size) were at par with higher sieve size of 1.30 mm (R) (99.07%, 3.55g, 93.25%, 16.08cm and 1545, respectively) (Table 19). Hence, seeds of finger millet *cv.* GPU 67 could be processed by using grading sieve size of 1.20 mm (Round) (Recommended sieve size) in order to get satisfactory seed recovery and quality parameters.

Table 19: Effect of grading screen size on seed quality and processing parameters in finger millet cv. GPU-67 at UAS, Bengaluru

Sieve size (mm) Round	Seed recovery (%)	Physical purity (%)	Seed germination (%)	Seedling vigour index	1000 seed weight (g)	MC (%)
1.00	93.16	96.04	91.75	1403	3.40	11.75
1.10	90.46	96.19	93.00	1451	3.44	11.76
1.20	90.00	98.55	93.00	1504	3.49	11.80
1.30	86.76	99.07	93.25	1545	3.55	11.85
1.60	30.73	99.56	94.00	1600	3.62	11.78
CD (0.05)	**1.33**	**0.34**	**NS**	**66**	**0.07**	**NS**
CV (%)	**1.1**	**0.2**	**1.8**	**3**	**1.2**	**1.0**

Sunflower

Among the five sieve sizes used for the seed processing of sunflower hybrid KBSH-53, seeds graded with 2.40mm (s) (Recommended sieve) recorded optimum seed recovery (90.88%) and seed moisture (8.28%), which is at par with sieve size 1.85mm (s) (92.33% and 8.30%, respectively). While, the seed quality parameters *viz*., physical purity (98.97%), seed length (8.31mm), seed breadth (3.68mm), seed thickness (2.14mm), 100 seed weight (3.82g), germination (92.50%), seedling length (25.55 cm), SVI-I (2363) recorded with 2.40mm (s) (Recommended sieve), were at par with higher sieve size of 2.80 x 20mm (s) (99.12%, 8.44mm, 3.92mm, 2.30mm, 3.86g, 93.25%, 25.88cm and 2413, respectively) (Table 20).

Hence, sunflower hybrid KBSH-53 could be processed by using grading sieve size of 2.40mm (s) in order to get satisfactory seed recovery and quality parameters.

Table 20: Effect of grading screen size on seed quality and processing parameters in Sunflower hybrid KBSH-53 at UAS, Bengaluru

Sieve size (mm) Round	Seed recovery (%)	Seed Size (mm)			Physical purity (%)	Seed Germi. (%)	Seedling vigour index	100 seed weight (g)	MC (%)
		Length	Breadth	Thickness					
1.80	93.23	8.05	3.20	2.05	96.99	91.50	2126	3.72	8.26
1.85	92.33	8.15	3.30	2.09	97.19	91.50	2159	3.76	8.30
2.40	90.88	8.31	3.68	2.14	98.97	92.50	2363	3.82	8.28
2.80	81.53	8.44	3.92	2.30	99.12	93.25	2413	3.86	8.30
3.00	26.81	8.51	3.96	2.44	99.20	93.50	2479	3.91	8.32
CD (0.05)	**3.68**	**0.36**	**0.28**	**0.28**	**0.24**	**NS**	**81.2**	**0.06**	**0.09**
CV (%)	**3.2**	**2.9**	**5.1**	**8.4**	**0.2**	**1.2**	**2.3**	**1.0**	**0.7**

Experiment 2: Management of Karnal Bunt through mechanical seed processing.

Objective : Elimination of bunted seed to maximum the processing efficiency

Crop		**Centres**
Wheat	:	ICAR-IARI RS Karnal, PAU Ludhiana, UAS Dharwad, GBPUA& T Pantnagar, JNKVV Jabalpur

Treatments

Machine: Specific Gravity Separator
Slope of deck: S_1-2.0^0 and S_2-2.5^0
Feeding: F_1-10 and F_2-15 Kg/minute
Replications: 3

Procedure

Unprocessed seed of the each crop variety will be procured from reliable source. Specified quantity of unprocessed seed material will be sieved using pre-cleaner and seed cleaner cum grader using optimum sieve size. After that material will be processed at the specific gravity separator by using four combinations *viz*.S_1F_1, S_1F_2, S_2F_1, S_2F_2.

Representative samples from unprocessed seed and after the pre- cleaner, seed cleaner cum grader and specific gravity separator will be analyzed for Karnal bunt infested seed by NaOH soaking method.

Observations

1. Karnal bunt infection (%) in feed (unprocessed seed)
2. Karnal bunt infection (%) in seed after pre- cleaner
3. Karnal bunt infection (%) in seed after seed cleaner cum grader
4. Karnal bunt infection (%) in final output
5. Recovery Kg/minute
6. Germination (%)
7. Vigour index
8. Physical purity (%)
9. 1000 seed weight (g)
10. Processing efficiency (%)

$$\text{Processing efficiency (\%)} = \frac{\text{Final output (100 – KB infection (\%) in final output)}}{\text{Feeding (100 – KB infection (\%) in feeding)}} \text{ X100}$$

Results

There was hardly any infestation of Karnal bunt disease this season. This lack of appearance of the disease at the Seed Farms was also confirmed personally. Therefore, this experiment could not be conducted by any of the centres which have chosen this experiment and thus remained inconclusive.

Monitoring Team Report 2018-19

North Zone Group – I

Monitoring Team:

1	Dr. K. Madhusudhan, UAS, Bengaluru	Convener
2	Dr. N.K. Gupta, SKNAU, Jobner	Member
3	Dr. Bhojaraja Naik K., ICAR-IISS, Mau	Member

Date of monitoring: 09-19th October, 2018

Centres monitored: SKUAST, Jammu; SKUAST, Kashmir; CSKHPKV, Palampur & PAU, Ludhiana

PAU, Ludhiana

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Total Breeder seed production during the year 2017-18 was 4244.75q as against the indent of 3161.56q. Short fall was observed in the production of fodder oat seeds.
2	Status of STR experiments	STR experiments were conducted as per the approved technical programme.
3	Progress of ICAR Seed Project	Foundation seed of 8652.80 q of various crops was produced during 2017-18. Certified seed of 28043.60 q of various crops was produced during 2017-18.
4	Participatory seed production programme	Produced 756.88 q of Certified/TL seeds of sorghum, maize, wheat and berseem.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	-
6	Tribal Sub Plan (TSP) implementation	NA
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Satisfactory. Expenditure is more than the allotted in STR (Rs. 20.64 lakh) and BSP (21.67 lakh)
9	New infrastructures developed during previous year	Nil
10	No. of training conducted	5 trainings were organized for 340 participants (1 two days & 4 one day Training programme) Women participation was comparatively less.
11	Constraints faced by centres (if any)	Require more funds in contingencies for smooth functioning of the programmes.

		Expressed difficulty in conducting experiment on redefining the isolation distance of IMSCS 2013 in maize.
12	No. of trainings attended by staffs	5 trainings were attended.
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP Unit: Excellent STR Unit: Good ICAR Seed Project Unit: Excellent TSP: NA
14	Special remarks of monitoring team (if any)	-
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed	No. of Districts/ farmers surveyed- Survey will be conducted during *Rabi/ summer* 2018

CSKHPKV, Palampur

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Total Breeder seed production during the year 2017-18 was 210.32 q against the GOI indent of 207.48 q.
2	Status of STR experiments	STR experiments were conducted as per the approved technical programme, except the experiment under Seed Production & Certification: Seed Priming of Lentil with commercial formulation of Sodium molybdate @ 0.5 g/lt + T. harzianum @ 15 g/kg.
3	Progress of ICAR Seed Project	Foundation seed of 258.82 q and TL seeds of 4303.07 q of various crops was produced as against the indent of 238.65 q and 3734.3 q respectively. Planting material (Horticulture & Fodder root slips) of 18.93 lakhs was produced as against the indent of 16.25 lakhs.
4	Participatory seed production programme	Produced 1250 q of TL seeds and 25 lakh of planting material.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	The entire sanctioned amount was refunded. AICRP-NSP: Available balance for the year 2017-18 was Rs. 46,66,823. Spent Rs. 2.60 lakh on repair and purchase of farm equipment's.
6	Tribal Sub Plan (TSP) implementation	Planned to conduct 3 trainings under TSP during 2018-19.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Rs. 18.0 lakh is pending with the university.
8	Status of fund utilization	Not satisfactory.
9	New infrastructures developed during previous year	Nil
10	No. of training conducted (indicate	5 training programs were organized for 344

	the participation of farm women)	participants. 5 field days were organized and have plan for conduct of 5 more trainings. Woman participation was satisfactory.
11	Constraints faced by centres (if any)	Require more contingency grants.
12	No. of trainings attended by staffs	Nil
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP Unit : Good STR Unit : Good ICAR Seed Project Unit: Good TSP : Satisfactory
14	Special remarks of monitoring team (if any)	-

SKUAST, Jammu

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	NA
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project	No shortfall was observed in breeder and foundation seed production against the targets. Fail to meet the target in production of certified seeds of rice.
4	Participatory seed production programme	Nil
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	The remaining 5 lakhs sanctioned amount was refunded. The available balance for the year 2017-18 was 146.82 lakh.
6	Tribal Sub Plan (TSP) implementation	6 trainings have been organized for tribal people of Poonch and Rajouri benefiting 169 tribal farmers.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted.
8	Status of fund utilization	Not fully utilized. Refunded balance amount of Rs. 22,93,227.0 on 17.07.18.
9	New infrastructures developed during previous year	Nil
10	No. of training conducted (indicate the participation of farm women)	6 training programs have been conducted for 315 participants.
11	Constraints faced by centres (if any)	-
12	No. of trainings attended by staffs	One training attended.
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP Unit: - STR Unit: - ICAR Seed Project Unit: Good TSP : Good
14	Special remarks of monitoring team	Genetic purity in breeder seed production plot of

	(if any)	rice hybrid B-370 at RS Pura farm was not maintained.
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey will be conducted during *Rabi/ summer* 2018

SKUAST, Srinagar

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Total Breeder seed production of 129.96 q against the indent of 79.25 q.
2	Status of STR experiments	STR experiments were conducted as per the approved technical programme.
3	Progress of ICAR Seed Project	Foundation seed of 1357.05 q of various crops was produced as against the target of 1294.75 q. Certified/ TL seed of 3419.5 q was produced as against target of 3315 q.
4	Participatory seed production programme	Nil.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	ICAR-Seed Project: The sanctioned amount of 25 lakh was fully refunded and profit earned for the year 2017-18 was 25.90 lakh. Out of which Rs. 25 lakh has been utilized by the university. Breeder Seed Production: Refunded the sanctioned amount of 4 lakh and 13.99 lakh of revenue generated.
6	Tribal Sub Plan (TSP) implementation	6 q seeds of paddy and maize were distributed to the tribal farmers. Farm inputs and seed bins were distributed to 362 beneficiaries.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Satisfactory
9	New infrastructures developed during previous year	Nil
10	No. of training conducted (indicate the participation of farm women)	8 trainings conducted for 335 participants. 3 seed/ Field days were organized. Women participation has been taken care.
11	Constraints faced by centres (if any)	-
12	No. of trainings attended by staffs	Nil
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP Unit : Excellent STR Unit : Very good ICAR Seed Project Unit: Excellent TSP : Excellent
14	Special remarks of monitoring team (if any)	Breeder seed production plots of maize was excellent and maintained the genetic purity.

15	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey will be conducted during *Rabi/ summer* 2018



Nucleus seed production of rice at PAU, Ludhiana



Breeder seed production of maize at SKUAST, Srinagar

North Zone Group – II

Monitoring Team:

1	Dr. G.K. Koutu, JNKVV, Jabalpur	Convener
2	Dr. J.B. Patel, JAU, Junagadh	Member
3	Dr. Aflaq Hamid, SKUAST, Srinagar	Member
3	Dr. S.P. Jeevan Kumar, ICAR-IISS, Mau	Member

Date of monitoring: 27 Sept. to 03 Oct., 2018

Centres monitored: CCSHAU, Hisar; GBPUAT, Pantnagar; ICAR-IIWBR, Karnal; ICAR-IARI, New Delhi/Karnal; ICAR-VPKAS, Almora; SVPUAT, Meerut

CCSHAU, Hisar

S. No.	Item of Monitoring	Remarks
1	Breeder seed production against GOI indents	Expected breeder seed production is about 157.25q as against the target as per BSP 1 i.e. 144.74q. However, the high rainfall of about 76.2 mm during September 22-25, 2018, resulted in some shortfall in BSP especially in mungbean and guar.
2	Status of STR experiments	All the experiments of *kharif* season were conducted. Experiment on redefining isolation distance in cotton had poor growth of the crop, as it was sown very late. The experiments of *Rabi* will be initiated in ensuing *Rabi* season.

3	Progress of ICAR Seed Project	Targeted seed production under ICAR seed production was achieved during 2017-18.
4	Participatory Seed Production Programme	Nil
5	Status of Revolving Fund under AICRP -NSP (Crops) and ICAR Seed Project	BSP net profit: 30,99,882/- ICAR Seed Project Net Profit: 89,25,996/- The committee asked to reimburse the initial revolving fund to the ICAR under ICAR seed project
6	Tribal Sub Plan (TSP) implementation	Nil
7	Status of AUCs & SOEs of AICRP -NSP (Crops), ICAR Seed Project and TSP	Statement of Expenditures (SOEs) of AICRP -NSP (Crops), STR and ICAR Seed Project were sent. The committee also informed the concerned scientists to return the unspent money of 12th five year plan.
8	Status of Fund utilization	During 2017-18, unspent balance is about 281540/-, 616615/- and 708262/- under BSP, STR and ICAR seed project, respectively.
9	New Infrastructure developed during previous year	Nil
10	No. of trainings conducted (indicate participation of Farm women)	Nil
11	Constraints faced by centers (if any)	Nil
12	No. of training attended by staffs	01
13	Special remarks of monitoring team (if any)	Weed control is the problem in spite of sufficient fund available under recurring contingency. Centre has to reimburse / return the unspent balance of 12th plan, 2017-18 and initial revolving fund of ICAR seed project**.**
14	Status of survey work related to formal and informal sector w.r.t use of quality seed (allotted to all centers)	Not done
15	Grading	BSP: Good; STR: Good; ICAR Seed Project: Good

ICAR-IARI, RS, Karnal

S. No.	**Item of Monitoring**	**Remarks**
1	Breeder seed production against GOI indents	Sufficient Breeder seed was produced during *Kharif* 2017 and *Rabi* 2017-18. Planning is made to fulfill the target as per indent for the ensuing *Rabi* 2018-19.

2	Status of STR experiments	Optimization of sieve size for Paddy will be done after receipt of produce to processing plant. Elimination of bunted seed with maximum processing efficiency: This Experiment is not feasible this year because the wheat produce of *Rabi* 2017-18 is not infested with bunted seeds.
3	Progress of ICAR Seed Project (targeted production of Foundation, Certified and TLS)	Nil
4	Participatory Seed Production Programme	TL seed of about 1582.60 q and 251.98 q was produced with Farmers participation under ICAR mega seed project RF scheme during *kharif* 2017-18 and *Rabi* 2017-18, respectively. In *kharif* 2018, participatory seed production was undertaken in 104 ha area.
5	Status of Revolving Fund under AICRP -NSP (Crops) and ICAR Seed Project	Total money available at the end of financial year 2017-18 under ICAR seed project : Rs. 4406224/-
6	Tribal Sub Plan (TSP) implementation	Nil
7	Status of AUCs & SOEs of AICRP - NSP (Crops), ICAR Seed Project and TSP	AUC and SOEs Submitted to IISS, Mau
8	Status of Fund utilization	-
9	New Infrastructure developed during previous year	Nil
10	No. of trainings conducted (indicate participation of Farm women)	One training programme during 2017-18
11	Constraints faced by centers (if any)	Nil
12	No. of training attended by staffs	Nil
13	Grading of Centre	
	BSP Unit	Excellent
	STR	Good
	ICAR Seed Project	Excellent
	TSP	-
14	Special remarks of monitoring team (if any)	Nil
15	Status of survey work related to formal and informal sector w.r.t use of quality seed (allotted to all centers)	Not done

ICAR- IIWBR, Karnal

S. No.	Item of Monitoring	Remarks
1	Breeder seed production against GOI indents	Breeder seed of 2034.94 q and 276.20 q was produced against the target of 683.40 q and 136.0 q in wheat and barley, respectively during 2017-18.
2	Status of STR experiments (No. of experiments conducted, its status, reason for non-conduct of any experiments, problems faced, etc).	No STR
3	Progress of ICAR Seed Project (targeted production of Foundation, Certified and TLS)	No production of Foundation, Certified and TLS
4	Participatory Seed Production Programme	Nil
5	Status of Revolving Fund under AICRP -NSP (Crops) and ICAR Seed Project	Total money available at the end of financial year 2017-18 under ICAR seed project : Rs. 1,19,02,959/-
6	Tribal Sub Plan (TSP) implementation	Nil
7	Status of AUCs & SOEs of AICRP -NSP (Crops), ICAR Seed Project and TSP	AUC Submitted to IISS, Mau
8	Status of Fund utilization	The unspent balance of 997464/- was refunded to IISS, Mau.
9	New Infrastructure developed during previous year	Nil
10	No. of trainings conducted (indicate participation of Farm women)	Five trainings were conducted during 2017-18, wherein total beneficiaries were 240 farmers. During 2018-19, till date, there is no training programme
11	Constraints faced by centers (if any)	Nil
12	No. of training attended by staffs	Nil
13	Special remarks of monitoring team (if any)	Nil
14	Status of survey work related to formal and informal sector w.r.t use of quality seed (allotted to all centers)	Not done
15	Grading	ICAR Seed Project: Very Good

GBPUA&T, Pantnagar

S. No.	Item of Monitoring	Remarks
1	Breeder seed production against GOI indents	Sufficient breeder seed was produced in *Kharif* - 2018 and proper planning was made to fulfill the target as per indent for the ensuing *Rabi* 2018-19.
2	Status of STR experiments	Experiments are conducted as per the guidelines enumerated in the AICRP (NSP)
3	Progress of ICAR Seed Project (targeted production of Foundation, Certified and TLS)	Under ICAR-Seed project 8887.82 q was produced against 10510.15 q including breeder, foundation, certified, TFL and Planting material. Planting material of 30,000 has been achieved against 30,000 target.
4	Participatory Seed Production Programme	Nil
5	Status of Revolving Fund under AICRP -NSP (Crops) and ICAR Seed Project	Total money available at the end of financial year 2017-18 under ICAR seed project : Rs. 1,19,02,959/-
6	Tribal Sub Plan (TSP) implementation	Two training programs have done for tribal farmers benefiting 269 farmers and also distributed seeds to the farmers
7	Status of AUCs & SOEs of AICRP - NSP (Crops), ICAR Seed Project and TSP	AUC Submitted to IISS, Mau
8	Status of Fund utilization	Unspent balance of Rs. 5,26,892/- are yet to be remitted
9	New Infrastructure developed during previous year	Seed godown under pulse seed hub is under construction
10	No. of trainings conducted (indicate participation of Farm women)	Two trainings were conducted during 2017-18, wherein total beneficiaries were 240 farmers. During 2018-19, till date, there is no training programme
11	Constraints faced by centers (if any)	Nil
12	No. of training attended by staffs	01
13	Special remarks of monitoring team (if any)	Team suggested precautionary measures to curb green mosaic virus problem in soybean.
14	Status of survey work related to formal and informal sector w.r.t use of quality seed (allotted to all centers)	No
15	Grading	BSP: Very Good STR: Very Good ICAR Seed Project: Very Good

ICAR- VPKAS, Almora

S. No.	Item of Monitoring	Remarks
1	Breeder seed production against GOI indents	Expected breeder seed production for kharif is about 12.20 q as against the target 7.55 Q and for Rabi is about 117.00 q as against the target 84.4 q
2	Status of STR experiments	No experiment of STR was allotted to the centre.
3	Progress of ICAR Seed Project (targeted production of Foundation, Certified and TLS)	TL seed produced was 4.14 q of nine crops, Nucleus seed produced was 7.83 q of seven crops.
4	Participatory Seed Production Programme	In kharif 2018, achieved the target of 2.80 q set under ICAR seed project and in Rabi 2017 achieved the target of 200 q.
5	Status of Revolving Fund under AICRP -NSP (Crops) and ICAR Seed Project	At the end of the financial year the closing balance of AICRP- NSP (Crops) is 18.68 lakhs and in ICAR Seed Project is 17.11 lakhs.
6	Tribal Sub Plan (TSP) implementation	Three trainings were conducted during 2018-19, wherein total beneficiaries were 84 farmers.
7	Status of AUCs & SOEs of AICRP -NSP (Crops), ICAR Seed Project and TSP	Statement of Expenditures (SOEs) of AICRP -NSP (Crops), STR and ICAR Seed Project were sent and submitted well in time.
8	Status of Fund utilization	During 2017-18, unspent balance under AICRP-NSP (Crops) is about 605/- and in ICAR Seed Project unspent balance is about 43/- rupees. In TSP 1230/- rupees is the unspent balance.
9	New Infrastructure developed during previous year	Nil
10	No. of trainings conducted (indicate participation of Farm women)	NIL
11	Constraints faced by centers (if any)	Nil
12	No. of training attended by staffs	Nil
13	Special remarks of monitoring team (if any)	They have been suggested to reorganize maintenance breeding programme in a systematic way, as it is lacking in the centre.
14	Status of survey work related to formal and informal sector w.r.t use of quality seed (allotted to all centers)	Not done
15	Grading	ICAR Seed Project: Very Good TSP : Very good

SVPUAT, Meerut

S. No.	Item of Monitoring	Remarks
1	Breeder seed production against GOI indents	Sufficient breeder seed was produced in *Kharif* - 2018 and proper planning was made to fulfill the target as per indent for the ensuing *Rabi* 2018-19.
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project (targeted production of Foundation, Certified and TLS)	They have taken the seed production of Basmati Rice Varieties, it was organized systematically.
4	Participatory Seed Production Programme	Nil
5	Status of Revolving Fund under AICRP -NSP (Crops) and ICAR Seed Project	Total money available at the end of financial year 2017-18 under ICAR seed project: Rs. 7.01 crores. They have refunded the entire seed money.
6	Tribal Sub Plan (TSP) implementation	-
7	Status of AUCs & SOEs of AICRP - NSP (Crops), ICAR Seed Project and TSP	AUC Submitted to IISS, Mau
8	Status of Fund utilization	Unspent balance of Rs. 49.25/- refunded to IISS, Mau.
9	New Infrastructure developed during previous year	Nil
10	No. of trainings conducted (indicate participation of Farm women)	Two trainings were conducted during 2017-18, wherein total beneficiaries were 150 farmers.
11	Constraints faced by centers (if any)	Nil
12	No. of training attended by staffs	01
13	Special remarks of monitoring team (if any)	Maintenance breeding programme is lacking and human resource involved in project needs training.
14	Status of survey work related to formal and informal sector w.r.t use of quality seed (allotted to all centers)	No
15	Grading	ICAR Seed Project: Very good

	
Seed production of mungbean at CCSHAU, Hisar	**Seed production of paddy at IARI, RS, Karnal**

Western Zone I

Monitoring Team:

1 Dr. P.K. Singh, BHU, Varanasi — Convener
2 Dr. Godavari S. Pawar, VNMKV, Parbhani — Member

Date of monitoring: 20-24 September, 2018
Centres monitored: SKRAU, Bikaner; SKNAU, Jobner; ICAR- CAZRI, Jodhpur

SKNAU, Jobner

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	NA
2	Status of STR experiments	Experiments were conducted as per technical programme
3	Progress of ICAR Seed Project	NA
4	Participatory seed production programme	NA
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	NA
6	Tribal Sub Plan (TSP) implementation	NA
7	Status of AUCs & SOEs of AICRP-NSP (Crops)	Submitted.
8	Status of fund utilization	NA
9	New infrastructures developed during previous year	Nil
10	No. of training conducted (indicate the participation of farm women)	03
11	Constraints faced by centres (if any)	-
12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	STR Unit: Good
14	Special remarks of monitoring team	-

	(if any)	
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed	-

ICAR- CAZRI, Jodhpur

S. No.	Items	Remarks
1.	Breeder seed production against GoI indents	Produced BS of 6.0 q against indent of 5.6 q in CAZRI moth -2
2.	Status of STR experiments	02 experiment allotted and only one has been conducted.
3.	Status of revolving fund in AICRP – NSP (Crops) and ICAR seed project- profit generated, problem in utilization if any	Rs. 23.30 lakhs /-(revenue generated)
4.	Progress of ICAR seed project – breeder seed. Foundation seed, Certified and truthfully labeled seed	-
5.	Participatory seed production programme especially under ICAR seed project (Quantity /quality/class)	NA
6.	Status of fund utilization	Fully utilized
7.	Land and infrastructure development	-
8.	Transfer of technology- No. of training organized, farm women participation	Not taken up
9.	Capacity building, No. of training attended etc.	Nil
10.	Status of submission of AUC and SOE	Submitted
11.	Grading of each centre based on the performance	
	Unit	**Performance of centre**
	BSP unit	Satisfactory
	STR unit	Poor
	ICAR seed project	Satisfactory
	TSP	Poor
12.	Any other remarks by the committee	-

SKRAU, Bikaner

S. No.	Items	Remarks
1.	Breeder seed production against GoI indents	Produced breeder seed more than GOI Indent for moth, guar, pearlmillet & groundnut.
2.	Status of STR experiments	Not allotted
3.	Status of revolving fund in AICRP – NSP (Crops) and ICAR seed project- profit generated, problem in utilization if any	Balance as on 01.04.2018 Rs. 3033239.95/- (NSP) Balance as on 01.04.2018 Rs. 5898396.95/- (ISP) Rs. 2000000/- refunded to ICAR
4.	Progress of ICAR seed project – breeder seed. Foundation seed, Certified and truthfully labelled seed	-
5.	Participatory seed production programme especially under ICAR seed project (Quantity/quality/class)	NA
6.	Status of fund utilization	Satisfactory
7.	Land and infrastructure development	NA
8.	Transfer of technology- No. of training organized, farm women participation	-
9.	Capacity building, No. of training attended etc.	-
10.	Status of submission of AUC and SOE	Submitted
11.	Grading of each centre based on the performance	
	Unit	**Performance of centre**
	BSP unit	Good
	STR unit	-
	ICAR seed project	Good
	TSP	-
12.	Any other remarks by the committee	-

Western Zone – II

Monitoring Team:

1	Dr. Govind Pal, ICAR-IISS, Mau	Convener
2	Dr. Sharmila D. Deka, AAU, Jorhat	Member
3	Dr. Pushpavathi, PJTSAU, Hyderabad	Member
4	Dr. Nitin Rastogi, IGKV, Raipur	Member

Date of monitoring: 23-29 September, 2018 and 06-07 March, 2019

Centres monitored: AAU, Anand; JAU, Junagadh; ICAR-DGR, Junagadh; SDAU, SK Nagar; AU, Kota; NAU, Navsari; MPUAT, Udaipur

NAU, Navsari

S. No.	Items	Remarks	
1	Breeder seed production against GoI indents	NA	
2	Status of STR experiments	One STR experiments have been conducted as per approved technical programme.	
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Breeder seed of 155.91 q, foundation seed of 401.56q, certified seed of 2128.97 q and TFL seed of 1813.14 q of various crops was produced during 2017-18. About 1433.96 q and 106644 number planting materials and tissue culture plantlets also produced.	
4	Participatory seed production programme	Nil	
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	RFS under ICAR Seed project- the available balance on 31st March, 2018 was Rs. 2,02,47,075.00	
6	Tribal Sub Plan (TSP) implementation	Training / capacity building, Front line demonstration and field day have been organized.	
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	AUC & SOE of all components have been submitted.	
8	Status of fund utilization	Under ICAR Seed project, the unspent balance on 31st March, 2018 was Rs. 2,19,576.00 including Rs. 40,650.00 unspent balance under TSP component.	
9	New infrastructures developed during previous year	Nil	
10	No. of training conducted (indicate the participation of farm women)	Training conducted - 7 (685 participants including 115 women participants)	
11	Constraints faced by center (if any)	Nil	
12	No. of trainings attended by staffs	Nil	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – Nil Seed sample collected - Nil	
14	Special remarks of monitoring team	Survey work to be completed on priority basis.	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	-
		STR unit	-
		ICAR Seed project	Very Good
		TSP	Very Good

AAU, Anand

S. No.	Items	Remarks	
1	Breeder seed production against GoI indents	Not applicable	
2	Status of STR experiments	STR experiments have been conducted as per approved technical programme. One experiment of seed physiology and storage (1A) not conducted.	
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Total targeted production of 966.6 q for foundation seed, 1918.00 q of certified seed and 1608 q of TFL seed of various crops for the year 2018-19.	
4	Participatory seed production programme	Nil	
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	RFS under AICRP NSP (crops)- the available balance on 31st March, 2018 was Rs. 59.72 lakhs (all sub centers). RFS under ICAR Seed project- the available balance on 31st March, 2018 was Rs. 146.31 lakhs (Field and horticultural crops).	
6	Tribal Sub Plan (TSP) implementation	Training / capacity building have been organized and quality inputs have been distributed.	
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	AUC & SOE of all components have been submitted	
8	Status of fund utilization	Under AICRP- NSP (Crops)- STR, the unspent balance on 31st March, 2018 was Rs. 41,01,995.00 Under ICAR Seed project, the unspent balance on 31st March, 2018 was Rs. 2,69,671.00 Under TSP, the unspent balance on 31st March, 2018 was Rs. 5,45,360.00	
9	New infrastructures developed during previous year	Nil	
10	No. of training conducted (indicate the participation of farm women)	Training conducted - 1	
11	Constraints faced by center (if any)	More funds required in capital and contingencies.	
12	No. of trainings attended by staffs	Nil	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – 220 farmers Seed sample collected - 162	
14	Special remarks of monitoring team	More focus may be given on STR and TSP component.	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	-
		STR unit	Very Good

		ICAR Seed project	Very Good
		TSP	Good

SDAU, SK Nagar

S. No.	Items	Remarks	
1	Breeder seed production against GoI indents	The total breeder seed production was 3515.70 q against indent of 3156.11 q of various crops during the year 2017-18.	
2	Status of STR experiments	Not applicable	
3	Progress of ICAR Seed Project	Total quality seed production was 1191.20 q of various class and crops during the year 2017-18.	
4	Participatory seed production programme	Nil	
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	RFS under AICRP NSP (crops)- the available balance on 31st March, 2018 was Rs. 243.98 lakhs. RFS under ICAR Seed project- the available balance on 31st March, 2018 was Rs. 318.93 lakhs.	
6	Tribal Sub Plan (TSP) implementation	Quality seeds of castor has been distributed.	
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	AUC & SOE of all components have been submitted.	
8	Status of fund utilization	• Under AICRP- NSP (Crops)- BSP, the unspent balance on 31st March, 2018 was Rs. 59,12,905.65 • Under ICAR Seed project, the unspent balance on 31st March, 2018 was Rs. 33,59,646.00 • Under TSP, the unspent balance on 31st March, 2018 was Rs. 18,57,395.00	
9	New infrastructures developed during previous year	Farm pond, Micro irrigation system and mini godown	
10	No. of training conducted (indicate the participation of farm women)	Training conducted - 1	
11	Constraints faced by center (if any)	Lack of irrigation facilities in plots.	
12	No. of trainings attended by staffs	Nil	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – Nil Seed sample collected - Nil	
14	Special remarks of monitoring team	Very poor utilization of budget. More focus may be given on TSP component.	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	Good
		STR unit	-
		ICAR Seed project	Very Good

		TSP	Satisfactory

JAU, Jamnagar

S. No.	Items	Remarks	
1	Breeder seed production against GoI indents	Not applicable	
2	Status of STR experiments	All STR experiments have been conducted as per approved technical programme.	
3	Progress of ICAR Seed Project	Breeder seed of 2369.50 q, foundation seed of 230.18 q and TFL seed of 3113.82 q of various crops was produced during 2017-18. About 797 q and 1.79 lakh (number) planting materials and tissue culture plantlets also produced.	
4	Participatory seed production programme	Certified seed of 1036.00 q and TFL seed of 4208.32 q of various crops was produced at farmers' field during 2017-18.	
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	RFS under AICRP NSP (crops)- the available balance on 16.09.2018 was Rs. 34.74 lakhs. RFS under ICAR Seed project- the available balance on 31st March, 2018 was Rs. 202.85 lakhs (all components).	
6	Tribal Sub Plan (TSP) implementation	Not applicable	
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	AUC & SOE of all components have been submitted.	
8	Status of fund utilization	• Under AICRP- NSP (Crops)- STR, the unspent balance on 31st March, 2018 was Rs. 11,47,816.00 • Under ICAR Seed project, the unspent balance on 31st March, 2018 was Rs. 64,016.00	
9	New infrastructures developed during previous year	Nil	
10	No. of training conducted (indicate the participation of farm women)	Training conducted - 2 Training through high tech museum- 76 National Seed Day- 1	
11	Constraints faced by center (if any)	More funds required in capital and contingencies.	
12	No. of trainings attended by staffs	1	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – 250 Seed sample collected - 89	
14	Special remarks of monitoring team	Concentrated efforts are required for conducting STR experiments.	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	-

		STR unit	Good
		ICAR Seed project	Very Good
		TSP	-

ICAR-DGR, Junagadh

S. No.	Items	Remarks	
1	Breeder seed production against GoI indents	Not applicable	
2	Status of STR experiments	Not applicable	
3	Progress of ICAR Seed Project	Total targeted production for kharif 2018 (90 q of Girnar- 2 and 105 q of Girnar-3 variety (Nucleus and breeder seed) of Groundnut.	
4	Participatory seed production programme	Nil	
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	RFS under ICAR Seed project- the available balance on 31st March, 2018 was Rs. 33.50 lakhs.	
6	Tribal Sub Plan (TSP) implementation	Not applicable	
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	AUC & SOE has been submitted	
8	Status of fund utilization	Under ICAR Seed project, the unspent balance on 31st March, 2018 was Rs. 1,37,270.00	
9	New infrastructures developed during previous year	Nil	
10	No. of training conducted (indicate the participation of farm women)	Nil	
11	Constraints faced by center (if any)	Non-lifting of seed and lack of seed storage facility.	
12	No. of trainings attended by staffs	2	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – 300 Seed sample collected - Nil	
14	Special remarks of monitoring team	More effort is required for weed control management and development of irrigation facilities in seed production plots.	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	-
		STR unit	-
		ICAR Seed project	Very Good
		TSP	-

AU, Kota

S. No.	Items	Remarks	
1	Breeder seed production against GoI indents	The total breeder seed production was 2044 q against indent of 1673 q of various crops during *Rabi* 2017-18 and during kharif 2018 the production was 935 q against indent of 1541 q of various crops.	
2	Status of STR experiments	Not applicable	
3	Progress of ICAR Seed Project	Not applicable	
4	Participatory seed production programme	Nil	
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Not applicable	
6	Tribal Sub Plan (TSP) implementation	To be implemented	
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	AUC & SOE of all components have been submitted	
8	Status of fund utilization	Under AICRP- NSP (Crops)- BSP, the unspent balance on 31st March, 2018 was Rs. 53,09,019.00 and under TSP it was Rs. 12,04,051.00.	
9	New infrastructures developed during previous year	Nil	
10	No. of training conducted (indicate the participation of farm women)	Nil	
11	Constraints faced by center (if any)	More funds required in capital and contingencies.	
12	No. of trainings attended by staffs	03	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – Nil Seed sample collected - Nil	
14	Special remarks of monitoring team	More emphasis should be given for genetic purity. Survey work to be completed on priority basis. Unspent balance amount of 12th plan period is to be refunded to ICAR-IISS, Mau immediately.	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	Good
		STR unit	-
		ICAR Seed project	-
		TSP	Poor

	
Breeder seed production of groundnut at DGR, Junagadh	**Seed production of wheat at MPUAT, Udaipur**

Central Zone – I

Monitoring Team:

1	Dr. M.V. Nagesh Kumar, PJTSAU, Hyderabad	Convener
2	Dr. Ashwani Kumar, IARI RS, Karnal	Member
3	Dr. Ramanadane, PAJANCOA&RI, Karaikal	Member
4	Dr. B.V. Patoliya, JAU, Junagadh	Member

Date of monitoring: 27 Sept. to 2 Oct., 2018

Centres monitored: PDKV, Akola; MAU, Parbhani; MPKV, Rahuri; ICAR-IISR, Indore; VSI, Pune; KKV, Dapoli

DBSKKV, Dapoli

S. No.	Monitoring Indicator	Remarks
1.	Achievements of Breeder Seed Production under AICRP-NSP (Crops) especially GOI indents	The targets of the breeder seed production will be fully achieved during 2018-19 under both AICRP-NSP (Crops) and ICAR Seed Project.
2.	Implementation of STR experiments, their status and problems if any,	Three experiments were conducted during *Kharif* 2018 and one experiment will be executed in *Rabi* 2018. *The survey work related to formal and informal seed sector w.r.t. use of quality seed was conducted in 22 villages by interviewing 220 farmers.*
3.	Status of revolving fund-AICRP NSP (Crops) and ICAR Seed Project	The base amount of revolving fund was refunded to ICAR. A cumulative profit of Rs.65,02,707; Rs.50,48,714 and Rs.1,67,298 in field crops, horticulture crops and fisheries components under ICAR Seed Project was earned during the year 2017-18.
4.	Progress of ICAR Seed Project-Breeder Seed, Foundation, Certified and truthfully labelled seed	Production would be achieved more than the targets in all classes of seed under ICAR Seed Project.
5.	Participatory Seed production	Participatory seed production was taken up in an

	programme (Quantity/Quality/Class)	area of 35.41 ha in groundnut, paddy and finger millet crops with anticipated production of 1022.70 q during 2018-19
6.	Tribal sub plan	The tribal sub plan was implemented in four villages by including 205 beneficiary tribal farmers.
7.	Utilization of funds, infrastructure development, Transfer of Technology and capacity building.	`One scientist attended training at NSAI
8.	Audit Utilization certificate	Submitted all AUC's in stipulated time
9.	Constraints and needs	• Limited land availability for seed production in university farms • Lack of irrigation facilities during *Rabi* season at various centres • Renovation of seed testing laboratory • Funds required for purchase of tractors and farm machinery at various centres for seed production • Lack of man power under AICRP-NSP and STR voluntary centre
10.	Grading based on the performance	BSP: 8.5 STR: 8.0 ICAR Seed Project: 8.0

VSI, Pune

S. No.	**Monitoring indicator**	**Remarks**
1	Achievements of Breeder Seed Production under AICRP-NSP (Crops) especially GOI indents	NA
2	Implementation of STR experiments, their status and problem	NA
3	Status of revolving fund - AICRP-NSP (Crops) and ICAR Seed Project	Refunded entire revolving fund of Rs. 20,00,000 to the ICAR-IISS, Mau. The profit generated during the year 2017-18 was Rs.7.43 lakh.
4	Progress of ICAR Seed Project – Breeder Seed, Foundation, Certified and truthfully labeled seed	A total of 19.66 lakh two eye budded setts and 2.48 lakh single bud seedlings were distributed to the farmers and sugar mills in the MS.
5	Participatory Seed Production programme (Quantity/quality/class)	The seed production programme is confined to within the centre farm only.
6	Tribal Sub Plan	The TSP is implemented in two locations viz., Agsti SSK Ltd., Ahmednagar dist. and Kadwa SSK Ltd., Nasik dist. With targeted 15 tribal farmers in an area of 4 ha.
7	Utilization of funds, Infrastructure	Organized training programmes at Oos Sheti

	development, Transfer of Technology and capacity building	Dyanyag and Oos Sheti Dyanlaxmi during 2018-19
8	Audit utilization certificate (AUC)	The AUC's were submitted till 2017-18 for BSP and STR schemes.
9	Constraints and Needs	-
8	Grading of each centre based on the performance	ICAR Seed Project: 7.5 TSP: 7.5 Though the single bud seedling multiplication under greenhouse conditions was well maintained but the crop management in breeder seed plots need to be improved to get good crop expression.

MPKV, Rahuri

S. No.	Monitoring Indicator	Remarks
1.	Achievements of Breeder Seed Production under AICRP-NSP (Crops) especially GOI indents	The targets for Breeder seed production during *Kharif* 2018 is 865.38 q against which the anticipated achievement is 2485.30 q.
2.	Implementation of STR experiments, their status and problems if any,	The total number of experiments conducted under STR programme are 37, of which 26 were executed during *Kharif* and 11 are planned in *Rabi*.
3.	Status of revolving fund-AICRP NSP (Crops) and ICAR Seed Project	Amount sanctioned as revolving fund under BSP NSP (Crops) is Rs.14,00,000/- and was refunded in by 2008. During 2017-18 the profits earned are Rs.3,43,479/-. Amount sanctioned as revolving fund under ICAR seed project is Rs.73.00 lakhs and was returned by 2017-18. Profits earned by 2017-18 is Rs.1,02,99,040/-
4.	Progress of ICAR Seed Project-Breeder Seed, Foundation, Certified and truthfully labelled seed	The targets of breeder seed is 15.66 q and expected production is 133.15 q The foundation seed production expected achievement is 2561.50q
5.	Participatory Seed production programme (Quantity/Quality/Class)	Since the large cultivable area is under university farms, the participatory seed production was not executed at the centre.
6.	Tribal sub plan	Certified seed of chickpea variety Vijay for 20 ha and wheat variety P. Samadhan for 50 ha was distributed under TSP
7.	Utilization of funds, infrastructure development, Transfer of Technology and capacity building	Two popularization programmes were conducted during 2018
8.	Audit Utilization certificate	Submitted the AUC's of STR and BSP
9.	Constraints and needs	Lack of sufficient funds to conduct research under STRP Vehicle requirement to monitor seed production

		plots from time to time
10.	Grading based on the performance	BSP: 8.0 STR: 8.5 ICAR Seed Project: 8.0 TSP: 8.0

Dr. PDKV, Akola

S. No.	Monitoring Indicator	Remarks
1.	Achievements of Breeder Seed Production under AICRP-NSP (Crops) especially GOI indents and problems faced if any	The targets of breeder seed production during Kharif and Rabi 2018 are 1158.84 q and 301.84 and expected to achieve without any shortfall.
2.	Implementation of STR experiments, their status and problems if any,	In total 14 experiments were executed during the year and all have been conducted efficiently.
3.	Status of revolving fund-AICRP NSP (Crops) and ICAR Seed Project	The amount Rs. 55,00,000/- given as base amount had been reimbursed to ICAR with cumulative profit is Rs. 80,161.00.
4.	Progress of ICAR Seed Project-Breeder Seed, Foundation, Certified and truthfully labelled seed	Under ICAR seed project, 72.00 q Foundation seed, 107.50 q Certified seed, and 780.40 q truthfully labelled seed had been produced by the centre.
5.	Participatory Seed production programme (Quantity/Quality/Class)	Seed production through participatory mode was executed in 14 ha in crops like paddy and groundnut with expected production of 240 q
6.	Tribal sub plan	The training programmes and field days under TSP are planned during November 2018
7.	Utilization of funds, infrastructure development, Transfer of Technology and capacity building	Irrigation facilities were improved at CDF Wani Rambhapur. Training programmes on seed production aspects were conducted and 175 no. farmers have been trained from the centre during 2018.
8.	Audit Utilization certificate	Submitted AUC's of all the schemes to ICAR.
9.	Constraints and needs	Requirement of facilities for irrigation, mechanization and protection from grazing animals in various seed production farms
10.	Grading based on the performance	BSP: 8.0 STR: 8.0 ICAR Seed Project: 8.0 TSP: 8.0

ICAR- IISR, Indore

S. No.	Monitoring Indicator	Remarks
1.	Achievements of Breeder Seed Production under AICRP-NSP	The targets of breeder seed production of different soybean varieties (620 q) will be

	(Crops) especially GOI indents	achieved (650 q) except in case of JS 20-34 and JS 20-29.
2.	Implementation of STR experiments, their status and problems if any,	Experiment on 'Optimization of seed rate in Soybean' is in progress.
3.	Status of revolving fund-AICRP NSP (Crops) and ICAR Seed Project	NA
4.	Progress of ICAR Seed Project-Breeder Seed, Foundation, Certified and truthfully labelled seed	The details were not provided by the centre.
5.	Participatory Seed production programme	The details were not provided by the centre.
6.	Tribal sub plan	NA
7.	Utilization of funds, infrastructure development, Transfer of Technology and capacity building	The details were not provided by the centre.
8.	Audit Utilization certificate	Submitted
9.	Constraints and needs	-
10.	Grading based on the performance	ICAR Seed Project: 7.5



Monitoring at PDKV, Akola



Breeder Seed production of soybean at IISR, Indore

Central Zone - II

Monitoring Team:

1	Dr. Basave Gowda, UAS, Raichur	Convener
2	Dr. D.P. Saini, MPUAT, Udaipur	Member
3	Dr. Meghachandra Singh, ICAR RC NEH, Manipur	Member

Date of monitoring: 28 Oct. to 03 Nov., 2018

Centres monitored: JNKVV, Jabalpur; ICAR-CICR, Nagpur; IGKV, Raipur; OUAT, Bhubaneswar; ICAR-NRRI, Cuttack.

OUAT, Bhubaneshwar

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Achieving the breeder seed production target of 903.1 q against the indented quantity of 886.6 q.
2	Status of STR experiments	Conducted 15 trials during *Kharif*-2018 and planned to two trials during Rabi/Summer and trials are satisfactory and advised to fill the vacant post of SRO in Seed physiology and Pathology.
3	Progress of ICAR Seed Project	Targeted to produce 4701 q during 2018-19 and planting material of 4.42 lakh. Satisfactory and; advised to promote new varieties from the university.
4	Participatory seed production programme	Advised to involve in farmers participatory programme to promote new varieties.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Returned seed money and advised to utilize the profit of revolving fund for strengthening seed infrastructure.
6	Tribal Sub Plan (TSP) implementation	Rs.3.0 lakhs provided under the project, programme yet to be initiated.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Utilized and balance amount for 2nd half year has to be released by the IISS
9	New infrastructures developed during previous year	Advised to utilize the profit of revolving fund for strengthening seed infrastructure like irrigation, farm ponds and repair of seed godown etc.,.
10	No. of training conducted	Yet to be organised
11	Constraints faced by centres (if any)	• Rain and hailstorm during *Rabi* season causes severe losses to *Rabi* pulse crops and groundnut. • Cyclonic weather during harvest season is a regular phenomenon in coastal Odisha which affect seed production and quality significantly. • Disposal problem of foundation, certified and TL seeds. • No man power in the project to maintain stock and disposal.
12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	Breeder Seed Production - Very good ICAR Seed Project - Good STR - Good TSP – Satisfactory
14	Special remarks of monitoring team (if any)	Advised to fill the vacant post under STR project immediately.
15	Status of survey work related to	Under progress

	formal and informal sector w.r.t. use of quality seed	

ICAR- NRRI, Cuttack

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Achieving the breeder seed production target of 478.90 q against the indent quantity of 563.90 q and there is shortfall of Swarnaa sub-1 due to cyclone.
2	Status of STR experiments	No STR programme
3	Progress of ICAR Seed Project	Expected 990.45 q as against 1000 q of target.
4	Participatory seed production programme	Undertaking seed production of truthfully labelled seed under farmer participatory programme.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Generated 71.17 lakh profit by utilize initiated seed money of Rs.15.0 lakh.
6	Tribal Sub Plan (TSP) implementation	Yet to be initiated and advised to implement the same.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Satisfactory
9	New infrastructures developed during previous year	Covered of threshing floor & Irrigation channel.
10	No. of training conducted	-
11	Constraints faced by centres (if any)	Cyclone *Titili* on 11.10.2018 along with heavy rains severely affected paddy seed production plots during *Kharif*-2018.
12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	Breeder Seed Production - Very good ICAR Seed Project - Good TSP – Satisfactory
14	Special remarks of monitoring team (if any)	Advised to undertake seed production of new varieties under farmer participatory programme
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Under progress

IGKV, Raipur

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Expecting 1537.2 q of breeder seed against indent of 1256.6 q during *Kharif*-2018 and planned to produce 502 q against the indent of 374.4 q during

		Rabi/Summer-2018-19.
2	Status of STR experiments	Conducted two STR experiments in finger millet and little millet i.e., integrated approaches for maximizing seed yield.
3	Progress of ICAR Seed Project	Expecting 5596 q of quality seeds
4	Participatory seed production programme	Expecting 4026 q of quality seeds during *Kharif*-2018.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Satisfactory
6	Tribal Sub Plan (TSP) implementation	Implementation in 17 villages covering 202 farmers and conducted two training programmes.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Utilized 33.5 lakh against 56.39 lakh upto Sept 2018 under NSP (Crops) 3.81 lakh against 9.51 lakh and TSP 5.58 lakh against 12.25 lakh under ICAR Seed Project as on September, 2018.
9	New infrastructures developed during previous year	-
10	No. of training conducted	-
11	Constraints faced by centres (if any)	Non lifting of breeder seed of different crop varieties by MP State
12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	Breeder Seed Production - Very good ICAR Seed Project – Very good STR - Good TSP – Satisfactory
14	Special remarks of monitoring team (if any)	Advised to utilize the profit generated under seed revolving fund for strengthening seed infrastructure.
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Under Progress

ICAR-CICR, Nagpur

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	As per state indent, four varieties and parents of CICR -2 hybrid breeder seed production was taken at Sirsa centre and anticipating 4.5 q .
2	Status of STR experiments	Four experiments were allotted and one experiment on redefining of pigeonpea cotton, maize is implemented at Coimbatore centre and

		one experiment on hybrid purity testing by molecular markers in public sector of hybrid crop is yet to be initiated.
3	Progress of ICAR Seed Project	Under ICAR seed project B/S of variety Suvi, four BT varieties and five non BT varieties were taken and expecting seed yield of 40.0 q.
4	Participatory seed production programme	Under farmer participatory programme was taken in 16 acres and expecting 32.0 q.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Under ICAR seed project about 3.7 lakh receipt was generated and having the closing balance of 9.87 lakh as on 4th Oct, 2018.
6	Tribal Sub Plan (TSP) implementation	Out of Rs. 8.31 lakh available an amount of Rs.0.73 lakh was utilized as on 21.9.2018 and organised five training programmes covering 1588 farmers.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	HRD is yet to be utilized
9	New infrastructures developed during previous year	-
10	No. of training conducted	Three training programmes was organised involving 500 farmers.
11	Constraints faced by centres (if any)	Requesting to enhance the contingency budget.
12	No. of trainings attended by staffs	Two
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	Breeder Seed Production - Good ICAR Seed Project - Good STR - Good TSP – Satisfactory
14	Special remarks of monitoring team (if any)	Advised to have MOU with private companies to promote BT varieties of Cotton.
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Not carried out due to non-supply of certified seeds in cotton.

JNKVV, Jabalpur

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Targeted to produce 19347.4 q against indent of 3206.5 q (GOI indent) and 15410 q (State indent) during *Kharif* 2018
2	Status of STR experiments	Conducted five experiments under seed production and certification and five experiments under seed pathology during *Kharif* and remaining five experiments will be implemented during *Rabi/Summer*
3	Progress of ICAR Seed Project	Targeted to produce 22665 q against the target of

		19025 q.
4	Participatory seed production programme	Participatory programme of seed production in Paddy, Pigeonpea, Wheat, Gram and linseed.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Under profit
6	Tribal Sub Plan (TSP) implementation	Rs.7.87 lakh as on 1.4.2018 and programme yet to be initiated.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	HRD amount yet to utilized
9	New infrastructures developed during previous year	-
10	No. of training conducted	-
11	Constraints faced by centres (if any)	Due to old age farm machineries and irrigation system, quality seed production of different crop varieties are affected.
12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	Breeder Seed Production – Excellent ICAR Seed Project – Very good STR – Very good TSP – Good
14	Special remarks of monitoring team (if any)	Suggested to retain the senior pathologist working in the STR unit to utilize his expertise for effective implementation of the programme.
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Under progress



Breeder seed production of rice at JNKVV, Jabalpur



Breeder Seed production of rice at ICAR- NRRI, Cuttack

North Eastern Zone

Monitoring Team:

1	Dr. Sharad Tiwari, JNKVV, Jabalpur	Convener
2	Dr. Rakesh Kapila, CSKHPKV, Palampur	Member
3	Dr. D.T. Deshmukh, PDKV, Akola	Member
4	Dr. Ramesh K.V., ICAR-IISS, Mau	Member

Date of monitoring: 15-26 October, 2018
Centres monitored: AAU, Jorhat; ICAR RC NEH Region Centres; and CAU, Imphal.

ICAR RC NEH Region (Tripura, Manipur, Sikkim, Meghalaya and Nagaland centers)

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Targeted breeder seed production is 450q. Other than in Tripura there was no indent.
2	Status of STR experiments	Manipur centre: Two experiments conducted but one experiment was not initiated due to non-availability of hybrid rice seed parents. In Meghalaya centre: Two experiments were conducted as per technical programme.
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Targeted production of foundation, certified and truthfully labeled seed are 600 q, 800 q and 1500 q respectively.
4	Participatory seed production programme	Seed production of paddy, maize, soybean, black gram, Lentil, green gram, rajmash, mustard and linseed are taken up.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	No revolving fund has been sanctioned
6	Tribal Sub Plan (TSP) implementation	Funds received and implemented as plan of action during current year
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Satisfactory
9	New infrastructures developed during previous year	No funds released under works. *Seed graders purchased during previous year are lying in open in Sikkim and Nagaland due to lack of funds for construction of sheds.*
10	No. of training conducted (indicate the participation of farm women)	Field/seed days: 13 Trainings: 28 Kisan melas: 9 Field demonstration: 65 No. of farm women attended: 362
11	Constraints faced by centres (if any)	No revolving fund sanctioned: lack of fund for seed buy back Delay in release of funds from Umaim centre

		Lack of manpower
12	No. of trainings attended by staffs	01
13	Special remarks of monitoring team (if any)	Provision of revolving fund for ICAR RC NEH Manpower (R.A.) may be provided as special case for the north east Sikkim centre: Local varieties are to be selected and promoted Maintenance breeding needs to be strengthened at the centres NEH states do not have seed certification agency. Manipur has initiated seed certification cell and is performing well. The same needs to be upgraded to seed certification agency which will ultimately promote quality seed production in the NEH region.
14	Status of survey work related to formal and informal sector w.r.t. use of quality seed (allotted to all centres)	Survey work was not initiated. Monitoring team has suggested for execution of the same at the earliest.

Activity	**Performance of the centre**				
	Tripura	**Nagaland**	**Manipur**	**Sikkim**	**Meghalaya**
BSP	Good	NA	Excellent	NA	Very Good
STR	NA	NA	Very Good	NA	Good
ICAR Seed Project	Good	Good	Excellent	Good	Very Good
TSP	Good	Good	Good	Good	Good

CAU, Imphal

S. No.	**Items for monitoring**	**Remarks**
1	Breeder seed production against GoI indents	Targeted breeder seed production is 19.00q. under ICAR Seed Project
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Targeted truthfully labeled seed production is 1652 q (Paddy-1590 q; Groundnut-18 and Soybean-44 q)
4	Participatory seed production programme	Seed production of paddy, groundnut and soybean is taken up.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Rs. 18.2393 lakh available under ICAR Seed Project as on October, 2018. Refunded corpus provide by ICAR.
6	Tribal Sub Plan (TSP) implementation	Satisfactory, an amount of Rs. 10.00 lakh was received during FY 2018-19 and expenditure up to October, 2018 was of Rs. 1.31328 lakh.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and	Submitted

	TSP	
8	Status of fund utilization	Funds have been utilized efficiently under ISP
9	New infrastructures developed during previous year	Nil
10	No. of training conducted (indicate the participation of farm women)	Trainings: 06 (Total farmers: 328 and No. of farm women: 157)
11	Constraints faced by centres (if any)	Wear and tear of decade old seed processing plant needs to be addressed
12	No. of trainings attended by staffs	Nil
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	ICAR Seed Project Unit: Very Good TSP: Very Good
14	Special remarks of monitoring team (if any)	-
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed (allotted to all centres)	Survey work was not initiated. Monitoring team has suggested for execution of the same at the earliest.

AAU, Jorhat

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Targeted breeder seed production is 503.20 q. No shortfalls in BSP
2	Status of STR experiments	16 STR experiments are conducted. *Experiments under Seed Production & Certification are not conducted as per technical programme.*
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Targeted production Breeder seed: 477.4 q Foundation Seed: 1856.86 q Certified seed: 359.4 q Truthfully labeled seed: 232.7 q
4	Participatory seed production programme	Seed production of paddy, black gram, green gram and sesame are taken up. Foundation Seed: 1041 q Certified seed: 1210 q Truthfully labeled seed: 9824 q
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Seed money yet to be reimbursed under ICAR Seed Project
6	Tribal Sub Plan (TSP) implementation	Nil
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Funds have been utilized efficiently under BSP, STR

		and ISP. However, no fund utilization was reported under TSP
9	New infrastructures developed during previous year	Nil
10	No. of training conducted (indicate the participation of farm women)	Nil
11	Constraints faced by centres (if any)	-
12	No. of trainings attended by staffs	Nil
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP Unit: Very Good STR Unit: Satisfactory ICAR Seed Project Unit: Good TSP: Satisfactory
14	Special remarks of monitoring team (if any)	*Single window system needs to be sorted at the university level.* Survey work on disease and insect pests need to be streamlined so as to represent the whole of Assam.
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed (allotted to all centres)	Survey work was not initiated. Monitoring team has suggested for execution of the same at the earliest.



Participatory seed production in rice at CAU, Imphal

Southern Zone I

Monitoring Team:

1	Dr. Karuna Vishnuvat, GBPUAT, Pantnagar	Convener
2	Dr. R.S. Shukla, JNKVV, Jabalpur	Member
3	Dr. R. Siddaraju, UAS, Bengaluru	Member
4	Dr. Sripathy K.V., ICAR-IISS, Mau	Member

Date of monitoring: 10 - 15 February, 2019

Centres monitored: ICAR-CCARI, Goa; UAS, Dharwad; UAS, Raichur; PJTSAU, Hyderabad; ICAR-IIRR, Hyderabad; ICAR-IIMR, Hyderabad; ICAR- IIOR, Hyderabad

ICAR-CCARI, Goa

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Targeted breeder seed production in paddy- 24.0q; cowpea- 20.0q.
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Targeted truthfully labeled seed production in paddy, mungbean and cowpea
4	Participatory seed production programme	Seed production of paddy to tune of 80.0q is being taken up.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Rs. 2.0 lakhs has been refunded to ICAR and Rs. 0.73 lakhs is left as profits.
6	Tribal Sub Plan (TSP) implementation	-
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Funds have been utilized efficiently under ISP
9	New infrastructures developed during previous year	Operational field laboratory for characterization of varieties has been established
10	No. of training conducted (indicate the participation of farm women)	Trainings: 02 (No. of farm women: 80) FLDs: 25 to popularize paddy variety Shabhagi Dhan
11	Constraints faced by centres (if any)	Needs covered threshing floor; storage facilities
12	No. of trainings attended by staffs	Nil
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	ICAR Seed Project Unit: Good
14	Special remarks of monitoring team (if any)	-
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed (allotted to all centres)	Survey work was not initiated. Monitoring team has suggested for execution of the same at the earliest.

UAS, Dharwad

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Produced 4525.0q of BS against indent of 4189.0q in Kh-18. Rabi 2018-19, planned to produce 573.0q against 500.0q target.
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project	Produced 847.0q of foundation seed in groundnut

	(targeted production of foundation, certified and TLS)	during Kh-18.
4	Participatory seed production programme	Seed production of groundnut, soybean are taken up
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Under profits and returned entire seed money to ICAR
6	Tribal Sub Plan (TSP) implementation	Conducted one training programme at Deriya village and distributed seedlings, bee hive boxes etc.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Funds have been utilized efficiently
9	New infrastructures developed during previous year	Aluminum partition of seed godown
10	No. of training conducted (indicate the participation of farm women)	-
11	Constraints faced by centres (if any)	Seed infrastructures viz. threshing floor, irrigation need to be strengthened at satellite centres
12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP: Excellent ICAR Seed Project Unit: Excellent TSP: Good
14	Special remarks of monitoring team (if any)	-
15	Status of survey work related to formal and informal sector w.r.t. use of quality seed (allotted to all centres)	Survey work was not initiated. Monitoring team has suggested for execution of the same at the earliest.

UAS, Raichur

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Produced 372.0q of breeder seed against target of 340.0q during Kh-18.
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Targeted production of foundation seed in chickpea and groundnut is 1795.0q.
4	Participatory seed production programme	University is undertaking quality seed production under participatory mode
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Under profits and returned entire seed money to ICAR
6	Tribal Sub Plan (TSP)	Conducted one training programme and

	implementation	distributed quality seeds of chickpea and foxtail millet to 36 farmers
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Funds have been utilized efficiently
9	New infrastructures developed during previous year	-
10	No. of training conducted (indicate the participation of farm women)	8 trainings conducted for seed growing farmers
11	Constraints faced by centres (if any)	UASR has only one TA position under BSP. Vehicle is required for lifing of seeds from production sites.
12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP: Excellent ICAR Seed Project Unit: Very good TSP: very good
14	Special remarks of monitoring team (if any)	Looking at potential, contribution and work load centre may be considered for a full pledged BSP centre with atleast one scientific staff.

ICAR-IIMR, Hyderabad

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Production as per DAC indents
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Targeted production of quality seed in sorghum and fodder sorghum varieties
4	Participatory seed production programme	-
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Under profits and returned entire seed money to ICAR
6	Tribal Sub Plan (TSP) implementation	-
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Funds have been utilized efficiently
9	New infrastructures developed during previous year	-
10	No. of training conducted (indicate the participation of farm women)	-
11	Constraints faced by centres (if any)	Lifting of breeder seed in fodder sorghum

12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP: Good ICAR Seed Project Unit: Good TSP: Good
14	Special remarks of monitoring team (if any)	Centre made request for early release of funds under TSP

ICAR-IIRR, Hyderabad

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Produced 462.8q of breeder against target of 245.0q during Kh-18.
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	-
4	Participatory seed production programme	147.0 q of TL seed are produced under participatory mode during Kh-8 and target for Rabi is 14.0q.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	-
6	Tribal Sub Plan (TSP) implementation	New drought tolerant rice varieties (DRR 42 & DRR 44) were distributed to farmers among eight districts of AP.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Funds have been utilized efficiently
9	New infrastructures developed during previous year	-
10	No. of training conducted (indicate the participation of farm women)	-
11	Constraints faced by centres (if any)	Due to non-availability of NS, BS targets were not achieved
12	No. of trainings attended by staffs	-
13	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP: Good ICAR Seed Project Unit: Good TSP: Good
14	Special remarks of monitoring team (if any)	-

ICAR-IIOR, Hyderabad

S. No.	Items for monitoring	Remarks
1	Breeder seed production against	Produced breeder seeds of castor, sunflower and

	GoI indents	safflower as per GOI indents during Kh-18.
2	Status of STR experiments	NA
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	TL seeds were produced Sunflower: 12 q Safflower: 6 q
4	Participatory seed production programme	147.0 q of TL seed are produced under participatory mode during Kh-8 and target for Rabi is 14.0q.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Under ISP, generated a revenue of Rs. 56.95 lakhs
6	Tribal Sub Plan (TSP) implementation	Around 30 farmers were benefited from Niger field day. Organized training programmes on seed production technologies of oilseed crops.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted
8	Status of fund utilization	Funds have been utilized efficiently
9	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	ICAR Seed Project Unit: Very good TSP: Good
10	Special remarks of monitoring team (if any)	-

PJTSAU, Hyderabad

S. No.	Items for monitoring	Remarks
1	Breeder seed production against GoI indents	Produced 1139.5 q of breeder seed against indent of 1119.3 q during Kh-18.
2	Status of STR experiments	All experiment has been carried out as per technical programme.
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	The total seed production, during 2018-19, including breeder seed, foundation, certified and TLS had been 6482 q against the targeted quantity of 5943.10 q.
4	Participatory seed production programme	Two promising varieties KNNM-118 and JGL 18047, a replacement of MTU 1010 of old paddy variety, is getting prominence in Telangana State.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Returned to ICAR
6	Tribal Sub Plan (TSP) implementation	New drought tolerant rice varieties (DRR 42 & DRR 44) were distributed to farmers among eight districts of AP.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and	Submitted

	TSP	
8	Status of fund utilization	Funds have been utilized efficiently
9	Constraints faced by centres (if any)	Lifting of certain paddy varieties is problem
10	No. of trainings attended by staffs	-
11	Grading of centre (i) Excellent, (ii) Very good, (iii) Good, (iv) Satisfactory, (v) Poor	BSP: Excellent ICAR Seed Project Unit: Excellent TSP: Good
12	Special remarks of monitoring team (if any)	-

Southern Zone–II

Monitoring Team:

1	Dr. S.K. Yadav, ICAR-IARI, New Delhi	Convener
2	Dr. Vinay K. Choudhary, RPCAU, Pusa	Member
3	Dr. R.K. Sahu, ICAR-NRRI, Cuttack	Member
4	Dr. Vijayakumar H.P., ICAR-IISS, Mau	Member

Date of monitoring: 27 Sept. to 06 Oct., 2018

Centres monitored: UAS, Bengaluru; TNAU, Coimbatore; KAU, Thrissur; PAJANCOA & RI, Karaikal.

UAS, Bengaluru

S. No.	Items	Remarks
1	Breeder seed production against GoI indents	The centre will be meeting the indents in all the crops except soybean and groundnut during *kharif* 2018. Anticipated total breeder seed production is 688.5 q against the target of 1809.5 q.
2	Status of STR experiments	The centre has conducted totally 12 experiments and yet to conduct one experiment under seed processing in want of fresh seed.
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Anticipated 1256 q of foundation seed against the target of 1987 q. Anticipated 7738 q of certified seed against the target of 2942 q during *kharif* 2018.
4	Participatory seed production programme	Anticipated 17082 quintals of certified seed during kharif 2018 against the target of 24955 q.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Rs. 146.77 lakhs of RF available under ICAR Seed project and Rs.6.35 lakh under BSP as on 31st March, 2018.
6	Tribal Sub Plan (TSP) implementation	Three training/ and field days have been organized and farm inputs have been distributed to the tribal farmers.
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and	AUC & SOE of all components have been submitted

	TSP		
8	Status of fund utilization	Amount sanctioned under all the projects has been completely utilized.	
	New infrastructures developed during previous year	Infrastructure to the tune of Rs. 301 lakhs was created during 2017-18. (surface tank, bore wells, seed storage godown, processing plant, threshing and drying yard)	
10	No. of training conducted	Three training/field days were conducted during 2017-18.	
11	Constraints faced by center (if any)	Contingency is not sufficient for STR as more number of experiments are being undertaken	
12	No. of trainings attended by staffs	-	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – 2 districts already covered Seed sample collected – 35no.	
14	Special remarks of monitoring team	Experiment on effect of terminal heat stress may be better dropped as there are neither naturally elevated temperatures conditions occur at Bengaluru nor the centre has the facilities.	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	Very good
		STR unit	Excellent
		ICAR Seed project	Very good
		TSP	Very good

TNAU, Coimbatore

S. No.	Items	Remarks
1	Breeder seed production against GoI indents	The total breeder seed production was 1801 quintals against the target of 1745 quintals.
2	Status of STR experiments (No. of experiments conducted, its status, reason for non-conduct of any experiments, problems faced, etc.)	STR experiments have been conducted as per approved technical programme.
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	The centre has targeted 2536 q of foundation seed, 13618 q of certified seed and 873 q of TFL seed during 2018-19.
4	Participatory seed production programme	Targeted production of 4500 quintals of quality seed during 2018-19.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	The centre has earned cumulative profit of 359 lakhs from BSP up to 2017-18. Under ICAR Seed project, earned gross income of 214.27 lakh during 2017-18.
6	Tribal Sub Plan (TSP) implementation	Three trainings have been organized and farm inputs have been distributed.
7	Status of AUCs & SOEs of AICRP-NSP	Submitted

	(Crops), ICAR Seed Project and TSP		
8	Status of fund utilization	Amount sanctioned under both schemes has been completely utilized.	
9	New infrastructures developed during previous year	Strengthened the infrastructure facilities viz., farm implements, drip irrigation facility and borewell through ICAR Seed Project (RF)	
10	No. of training conducted (indicate the participation of farm women)	8 trainings, 9 field/seed days and 1 field demonstration were conducted during 2017-18	
11	Constraints faced by center (if any)	Contingency for STR is not sufficient as labour wages are revised.	
12	No. of trainings attended by staffs	-	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – Two Districts (200 farmers)	
14	Special remarks of monitoring team	Good efforts are being made by the scientists involved to carry out the allotted experiments	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	Very good
		STR unit	Excellent
		ICAR Seed project	Very good
		TSP	Very good

ICAR- SBI, Coimbatore

S. No.	Items	Remarks
1	Breeder seed production against GoI indents	Not applicable
2	Status of STR experiments	Not applicable
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	53435 no.s of tissue culture seedlings were supplied to sugar factories during 2017-18 and 31365 no.s of tissue culture seedlings were supplied till now during 2018.
4	Participatory seed production programme	About 620 and 600 tonnes of quality setts have been produced during 2017 phase I and 2017 phase II, respectively and distributed to sugar factories.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	RFS under ICAR Seed project- the available balance on 31st March, 2018 was Rs. 30.20 lakhs
6	Tribal Sub Plan (TSP) implementation	Not applicable
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	Submitted.
8	Status of fund utilization	The centre has made full utilization of fund allocated.

9	New infrastructures developed during previous year	-	
10	No. of training conducted	Three trainings, one farmer's mela, one interaction meeting	
11	Constraints faced by center (if any)	-	
12	No. of trainings attended by staffs	Nil	
13	Special remarks of monitoring team	Excellent work by the centre in producing sugarcane quality planting material.	
14	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	-
		STR unit	-
		ICAR Seed project	Excellent
		TSP	-

ICAR- CICR, RS, Coimbatore

S. No.	Items	Remarks	
1	Breeder seed production against GoI indents	One acre of breeder seed production of cotton variety Suvin was undertaken during kharif 2018.	
2	Status of STR experiments (No. of experiments conducted, its status, reason for non-conduct of any experiments, problems faced, etc.)	STR experiments were at initial stage/yet to be initiated.	
3	Special remarks of monitoring team	The competent authorities may decide to delete such centers.	
4	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	Very Poor
		STR unit	Poor
		ICAR Seed project	-
		TSP	-

KAU, RARS, Pattambi

S. No.	Items	Remarks
1	Breeder seed production against GoI indents	The expected breeder seed production was 54.6 q against the indent of 20.61 q
2	Status of STR experiments	The centre has voluntarily conducted two *kharif* STR experiments and planned two experiments for *Rabi*.
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Taken up under participatory programme
4	Participatory seed production programme	The centre has targeted 850 q of quality seed of paddy
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed	RF available as on 31.03.2018 is Rs. 15.81 lakhs under AICRP-NSP (Crops) and Rs. 4.15 lakhs under

	Project	ICAR Seed Project	
6	Tribal Sub Plan (TSP) implementation	Not applicable	
7	Status of AUCs & SOEs of AICRP-NSP (Crops), ICAR Seed Project and TSP	AUC & SOE has been submitted	
8	Status of fund utilization	Utilized entire amount allocated to centre	
9	New infrastructures developed during previous year	Nil	
10	No. of training conducted (indicate the participation of farm women)	One front line demonstration for farmers and 2 training programmes for tribal farmers were conducted.	
11	Constraints faced by center	Low recurring contingency is the major constraint.	
12	No. of trainings attended by staffs	Nil	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted – one district covered (100 farmers)	
14	Special remarks of monitoring team	*The center is conducting STR experiments since 1998 and may be considered for regular center.*	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	Very Good
		STR unit	-
		ICAR Seed project	Good
		TSP	-

PAJANCOA&RI, Karaikal

S. No.	Items	Remarks
1	Breeder seed production against GoI indents	Not Applicable
2	Status of STR experiments	All the kharif STR experiments have been conducted as per approved technical programme. Another two experiments are planned for Rabi
3	Progress of ICAR Seed Project (targeted production of foundation, certified and TLS)	Breeder seed production of paddy varieties is planned in 3 acres and targeted 5 q of foundation seed and 420 q of labelled seed production.
4	Participatory seed production programme	Produced 10 q of TL seeds of short duration rice variety. Targeted 290 q of foundation seed and 250 q of TL seed of medium and long duration rice varieties.
5	Status of revolving fund under AICRP-NSP (Crops) & ICAR Seed Project	Revolving fund was not allocated to this centre.
6	Tribal Sub Plan (TSP) implementation	One training/field day was conducted. Seeds and other farm inputs; farm implements were supplied to tribal farmers.
7	Status of AUCs & SOEs of AICRP-NSP	Submitted

	(Crops), ICAR Seed Project and TSP		
8	Status of fund utilization	Entire amount allocated for STR component and ICAR Seed Project was utilized except TSP amount during 2017-18.	
9	New infrastructures developed during previous year	Filter point bore well (60' depth)	
10	No. of training conducted (indicate the participation of farm women)	Three trainings and seed distribution was done for farmers (Two women participants)	
11	Constraints faced by center	Required one deep borewell for irrigation; need scientific staff; vehicle for field visit.	
12	No. of trainings attended by staffs	Nil	
13	Status of survey work related to formal and informal sector w.r.t. use of quality seed	Survey conducted, but no data was presented.	
14	Special remarks of monitoring team	There is no tribal area in the State (UT), therefore TSP at this centre may be discontinued.	
15	Grading of each centre based on the performance	Unit	Performance of centre
		BSP unit	-
		STR unit	Excellent
		ICAR Seed project	Very Good
		TSP	Very Good



Breeder seed production plot of Sunflower at UAS, Bangalore



Sugarcane breeder seed production by ICAR-SBI, Coimbatore

Tribal Sub Plan (TSP)

With the objective of improving the livelihood of tribal farmers and, as per the direction received from ICAR for formulation, implementation and monitoring of TSP, the following cooperating centres of AICRP-NSP (Crops) were provided with funds under TSP as detailed below for the year 2018-19.

(Rs. in lakhs)

S. No.	Centre	AICRP –NSP (Crops)
		Tribal Sub Plan
1	SKUA& T, Srinagar	5.00
2	HPKVV, Palampur	6.00
3	AU, Kota	3.00
4	AAU, Anand	3.00
5	MPKV, Rahuri	8.00
6	PDKV, Akola	6.00
7	UAS, Bangalore	10.00
8	TNAU, Coimbatore	10.00
9	CRIJAF, Barrackpore	5.00
10	CAZRI, Jodhpur	1.00
11	NRRI, Cuttack	1.00
12	IIRR, Hyderabad	7.00
13	IIMR, Hyderabad	9.00
14	CICR, Nagpur	3.00
	Total	**77.00**

Summary of physical achievements under Tribal Sub Plan of AICRP-NSP (Crops): 2018-19

Centres	Seed distributed (kg.)	Seed storage bins; sprayers, small farm implements (No's)	Training (No's)	FLDs (No's)	Exposure visit (No's)	Beneficiary (No's)
SKUA&T, Srinagar	1068	250	16	-	-	734
CSHPKV, Palampur	-	50	01	-	-	50
AAU, Anand	2250	-	04	-	-	150
MPKV, Rahuri	12600	-	02	-	-	210
UAS, Bengaluru	7169.15	-	02	-	-	361
TNAU, Coimbatore	250	252	01	-	-	252
PDKV, Akola	15100	-	10	-	-	106
JNKVV, Jabalpur	3580	-	11	-	-	312
CAZRI, Jodhpur	700	-	01	-	-	175
IIMR, Hyderabad	4980	-	05	-	-	1960
CICR, Nagpur	70	50	15	40	1	1310
Total	**47767.15**	**602**	**58**	**40**	**1**	**5620**

Note: In addition to above 750 kg of *Trichoderma* culture and 150 bottles of *Rhizobium* consortia was distributed by AAU, Anand to tribal farmers

Various activities carried for implementation of TSP program by selected centres of AICRP-NSP (Crops) along with details of the inputs provided to tribal farmers for taking up quality seed production, improving seed health & storage and other related activities in domain of seed were detailed below.

Sher-e-Kashmir University of Agricultural Sciences & Technology, Srinagar

Training programme conducted: 16 training programmes were conducted on the various aspects of seed *viz*. Quality seed production in oats, maize and paddy; Quality seed production and strategies for utilizing farmers saved seeds. Programme was implemented for the benefit of 392 tribal farmers in various districts of Jammu & Kashmir *viz*. village Suriender, Sumbler of district Bandipora; village Hajinar, Karnah, Baghi Bala, Karnah, Baderhar (Nabedzeb), Handwara of district Kupwara; village Nagbal, Shoplain of district Budgam and Kamalkote Uri of district Baramulla of Kashmir region.

Input distribution: 1068 kg of quality seed were distributed among 92 tribal farmers during training (oats- 568 kg, paddy- 500 kg). 250 implements and seed storage structures were also distributed (Shalimar plough- 130 Nos, seed bin- 120 Nos).

Field demonstrations/ field day/ seed day conducted: Four front line demonstration was organized, one each at Nagbal, Shopian, Baderhar and Handwara covering an area of 14.03 ha for popularization of oats variety Sabzar and paddy variety K 332.



Training and distribution of farm implements under Tribal Sub Plan by SKUAST, Srinagar

Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya, Palampur

Training programme conducted: One training programme was conducted on Quality seed production technology and testing benefiting 50 tribal farmers in Kinnaur district (Chitkul, Sangla, Raarang, Baturi, Kamru villages) of Himachal Pradesh. The farmers were made aware of various aspects of quality seed viz. genetic purity testing, maintenance of cultivars, basic principles of quality seed production and seed certification, importance of disease management in seed production.

Input distribution: All 50 beneficiaries were provided with Knapsack sprayer and also trained them about handling of the sprayer in crop protection activities.




Training and distribution of sprayer under Tribal Sub Plan by CSKHPKVV, Palampur

Anand Agricultural University, Anand

Training programme conducted: Four training programmes were organized on Fungi and insect pests damaging seeds/ food grains during storage and their management benefiting 150 tribal famers from Devgadh Baria and Dahod districts of Gujarat. Methods of seed biopriming, techniques for enrichment of FYM through *Trichoderma* and mushroom production were also demonstrated to farmers.

Input distribution: All beneficiaries were provided with *Trichoderma* culture (750 kg), AgriMedia VCDs on cultivation of maize and soybean (150 Nos), chickpea seed (2250 kg) and *Rhizobium* consortia (150 bottles).




Training and input distribution under Tribal Sub Plan by AAU, Anand

Mahatma Phule Krishi Vidyapeeth, Rahuri

Training programme conducted: Two training programmes on quality seed production in wheat and chickpea and one awareness programme on importance of seed treatment were organized at Nandurbar district (Navapur), benefitting 210 tribal farmers.

Participatory seed production in tribal villages: Four villages of Navapur (Nandurbar district) were selected for seed production programme. 210 tribal farmers were selected and foundation seed of wheat (8400 kg) and chickpea (4200 kg) were distributed to farmers along with bio-agents for covering one acre each.



Training and input distribution under Tribal Sub Plan by MPKV, Rahuri

University of Agricultural Sciences, Bengaluru

Training programme conducted: Two training programmes were organized on various aspects of general crop husbandry at Chamarajanagar district (Ganigamangala & Budipadaga villages), benefitting 361 tribal famers.
Input distribution: 7169.15 kg of quality seed (redgram- 322 kg, ragi- 1000 kg, groundnut- 5796 kg, amaranthus – 54.15 kg) was distributed to tribal farmers.



Training and input distribution under Tribal Sub Plan by UAS, Bengaluru

Tamil Nadu Agricultural University, Coimbatore

Training programme conducted: One training programme on 'Seed production in millets, pulses and vegetable crops' was organized at Mavanatham village, Erode district.
Input distribution: Quality seeds of fingermillet cv. Paiyur 2, blackgram cv. VBN 6, frenchbean cv. Ooty 1 were distributed to tribal farmers along with bio-control agents and implements (spade, hand fork and tarpaulin) at Mavanatham village, Erode district, benefiting 102 farmers. Another input distribution programme was organized at Palamalai village, Coimbatore district, quality seeds of blackgram cv. VBN 8 and farm implements viz. spade, crowbar, pickaxe and tarpaulins were distributed benefiting 150 famers. Total number of beneficiaries were 252 tribal farmers.




Training and input distribution under Tribal Sub Plan by TNAU, Coimbatore

Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola

Training programme conducted: 10 training programmes were organized on importance of quality seed and Seed production technology at various blocks of Amaravathi district viz. Chikhaldhara, Chilati, Simori, Hatru, Aadnadi, Bhulori, Aaamzari, Khatkali benefitting 199 tribal famers.

Input distribution: 15100 kg of quality seed of wheat and chickpea cv. JAKI 9218 was distributed among tribal farmers.




Training and input distribution under Tribal Sub Plan by PDKV, Akola

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

Training programme conducted: Nine training programmes with live demonstration on 'seed production technology in rabi crops' and 'management of diseases in rabi crops' were organized in villages *viz*. Barbaspur, Kaccharwar, Ghoghari, Tali, Baderi, Dabroha, Chandiya, Pali and Chada of Umariya district benefiting 156 tribal farmers. Further 2 training programme were alos organized on quality seed production of wheat, chickpea and peas to the selected farmers of above mentioned villages to engage them in participatory seed production programme of JNKVV, Jabalpur.

Input distribution: Source seed for seed production programme were distributed free of cost to farmers viz. wheat- 1920 kg, chickpea- 360 kg, peas- 1600 kg among 156 tribal farmers in the Karkeli, Manpur blocks of Umaria district.

Participatory seed production in tribal villages: JNKVV, Jabalpur organized seed production in tribal villages under participatory mode during *Rabi* 2018-19. *In toto*, 64 farmers (wheat- JW

3288), 79 farmers (peas- JM 6 & JP 885) and 13 farmers (chickpea- JG 11) were participated in quality seed production programme at Karkeli, Manpur blocks of Umaria district. The crop is in good condition and will be harvested during first week of April, 2019.




Training and seed production programme under Tribal Sub Plan by JNKVV, Jabalpur

ICAR- Indian Institute of Millets Research, Hyderabad

Training programme conducted: Five training programmes were organized on standard cultivation practices of millets at Vikarabad district (Godamguda), Vizianagaram district (Kothavalasa), Bidar district (Bidar), Prakasam district (Kanigiri) and Ibrahimpatnam district (Andugula), benefiting 1960 tribal farmers.
Input distribution: *In toto*, 4980 kg of quality seed of various millet crops were distributed at all five locations mentioned above.




Training and input distribution under Tribal Sub Plan by ICAR-IIMR, Hyderabad

ICAR- Central Institute of Cotton Research, Nagpur

Training programme conducted: *In toto*, 15 training programmes were organized on various aspects of Quality seed production and crop management in the districts of Nagpur and Vellore (Beed Borgaon, Narhar, Kolimatra, Dhwalapur, Ambhazari, Saleghat, Ghatpendri, Jolarpettai), benefitting more than 1000 tribal farmers.

Input distribution: *In toto*, 70 kg of quality seed of cotton and 50 seed bins, sprayers, traps and cotton picking bags were also distributed, benefiting 120 farmers.

Participatory seed production in tribal villages: Six tribal farmers were involved in participatory seed production programme of non-Bt cotton varieties viz. Suraj, LRK 516, Nh 615, AKH 081, Phule Dhanwantry and AKA 7. Red gram seeds were also given to maintain barrier isolation and thereby additional income. Seeds were bought back at 10% higher rate than market price.

Other activities: Apart from above mentioned activities, one awareness camp (150 beneficiaries) and 40 front line demonstrations were also organized.





Input distribution and seed production programme under Tribal Sub Plan by ICAR-CICR, Nagpur

Central Arid Zone Research Institute, Jodhpur

Training programme conducted: One training programme cum input distribution programme was organized on Livelihood improvement of Scheduled Tribe farmers through improved agricultural interventions at Banswara district (Narptonkigoj & Charla village).

Input distribution: 700 kg of quality seed of mungbean cv. IPM 2-3 was distributed among 175 tribal farmers in the training programme organized at Banswara district.




Training programme and input distribution under Tribal Sub Plan by ICAR-CAZRI, Jodhpur



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