PROCEEDINGS

JOINT ANNUAL GROUP MEETING OF
AICRP ON NATIONAL SEED PROJECT (CROPS) &
ICAR SEED PROJECT- SEED PRODUCTION IN AGRICULTURAL CROPS

TECHNICAL PROGRAMME
(2021-22)

21-22 April, 2021

VIRTUAL MEETING
HELD THROUGH VIDEO-CONFERENCING

ICAR-Indian Institute of Seed Science
(Indian Council of Agricultural Research)
Mau 275 103 (UP), INDIA
(ISO 9001: 2008 Certified Institute)
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CONTENTS

Session I

Inaugural Session and Action Taken Report, Achievements & Breeder Seed Issues

Date : 21.04.2021 **Time : 10.00 – 12.45**

Chairman	:	**Dr. Trilochan Mohapatra** Secretary, DARE & Director General, ICAR, New Delhi
Co-Chairman	:	**Sh. Ashwani Kumar** Joint Secretary (Seeds), DAC&FW, GoI., New Delhi
Convenors	:	**Dr. D. K. Yadava** ADG (Seed), ICAR, New Delhi **Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	Dr. Vijaykumar A.G., SPO, Seed Unit, UAS, Dharwad Dr. Ramya P., Scientist, ICAR-IISS, RS, Bengaluru

ICAR-Indian Institute of Seed Science, Mau organized the 24th Annual Breeder Seed Review Meeting, 36th AGM of AICRP-NSP (Crops) and 16th ARM of ICAR Seed Project through video conferencing mode on 21st and 22nd April, 2021. The Inaugural Session of the meet was Chaired by Dr. T. Mohapatra, Secretary, DARE and Director General, ICAR, New Delhi. Session was Co-Chaired by Shri. Ashwini Kumar, Joint Secretary (Seed), DAC & FW, GoI. This session was convened by Dr. D. K. Yadava, ADG (Seed), ICAR, New Delhi and Dr. Sanjay Kumar, Director, ICAR-IISS, Mau.

At the outset, Dr. Sanjay Kumar, Director, ICAR-IISS, Mau welcomed all the dignitaries, members of RAC, Chairman and members of QRT, representatives of seed agencies, private industry and Nodal officers and scientists of NSP/ISP centers.

Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi in his opening remarks, emphasized the importance of AICRP – NSP (Crops) as the largest AICRP network of the country making significant contributions in ensuring seed and nutritional security of the country and policy decisions undertaken by ICAR and Government of India. The critical role played by ICAR, SAU's, SSCs, NSC and private sector in shaping Indian seed sector during the COVID-19 pandemic was lauded. The project also encompasses active participation from about 550 private seed companies with almost 100 involved in R & D. The project assumes a greater impact on the food and nutritional sustainability of the country as well as policy-related issues of the seed sector with significant inputs from the Seed Technology Research experiments. The breeder

seed production in the country witnessed an increase to the tune of 25% in spite of pandemic restrictions, however with a slight deficit in soybean. He opined that the performance of the centers could be classified as excellent with respect to Breeder seed production and ICAR Seed Project, while expressing concerns about the implementation of STR component. The challenges put forth by the implementation of the new seed bill particularly regarding compulsory registration, incorporation of transgenics, compensation for poor performance due to sub standard seed material and the possibility of greater competition with the private sector. He stressed on the infrastructural problems faced by most of the centers and the breeder seed quality issues, emphasizing the need to strengthen the maintenance breeding programme at all centers. Dr. D K Yadava, ADG (Seed) also indicated the possibility of ICAR-IARI Regional Station, Karnal being established as a Centre of excellence for maintenance breeding, with some regional zonal centers. He encouraged the seed workers to become better equipped for the export of seed especially to the EU. He opined that the shortcomings of STR component could be addressed by proper discussion as well as the involvement of qualified researchers to lead the program in affected centers.

Dr. Sanjay Kumar, Director, ICAR-IISS, Mau presented the progress report, 2020-21 as well as the Action Taken Report (ATR) on recommendations of previous meeting. Some highlights are as follows;

- Most of the centers have taken initiatives for seed production and promotion of new as well as multiple-stress tolerant varieties. The centers are also carrying out soil health analysis for the assigned experiments and correlating the same with the results.
- Highlighting on the validity issues of the certified seed lots of field crops, he emphasized that the problem could be mitigated by dividing the country into 4 zones namely red, pink, yellow, and green (based on RH and temperature) in the order of difficulty with the red zone requiring urgent priority for infrastructural development for controlled seed storage.
- Other major rectifications include profiling of seed-borne diseases in all crops, large scale demonstrations in millets, the study of seed replacement rates (SRR) in Mau, Ballia and Ghazipur districts of UP.
- Seed brands by almost all participating centers as envisaged by flagship programme of ‘Make in India’ project of GOI was accentuated.
- He also stressed on problems like varietal mismatch and higher breeder seed indents for old released varieties.
- Dr. Sanjay Kumar also described the successful conduct of an online training program in maintenance breeding in collaboration with ICAR-IARI Regional Station, Karnal for the benefit of seed fraternity.

He listed out some of the major recommendations rolled out to the farming community from the previous annual meeting. These include

- Promotion of Integrated Nutrient Management (INM) with *Pseudomonas fluorescence* along with neem and vermicompost incorporation for better yield in proso, foxtail, little, finger and kodo millets.
- The lower seed rates were judged as not beneficial for soybean whereas isolation distance in mustard was finalized as 400m.
- The validity periods of certified seeds of major field crops like wheat, paddy, maize, sunflower, sorghum, cotton, soybean, cowpea, castor and groundnut was established.
- The use of SSR markers for hybridity determination was effective in crops like paddy, maize and sunflower.
- For mitigation of terminal heat stress and for enhancing seed quality, the application of salicylic acid @ of 400 and 800 ppm at vegetative and anthesis state was found beneficial in wheat, paddy and sorghum.
- Information on standard detection methods are available for most of the seed-borne pathogens along with developing new management techniques for purple blotch and *Stemphylium* the blight of onion with fungicides and plant-based products was also shared.
- Pre-harvest fungicidal sprays for seed health and quality of soybean, as well as solarization for management of pulse beetle in farmer saved seeds in cowpea, green gram, pigeon pea and black gram were advocated to the farming community.

Dr. Sanjay Kumar further elucidated the 'challenges' faced by the seed sector including climate change, varietal mismatches, low SRR in few crops or states, non-lifting of breeder seeds, less efficient downstream multiplication of BS/FS/CS, traceability of seed chain, maintenance breeding, disagreement in seed and field standards as well as the implementation of new seed bill. Similarly, he identified the 'prospects' as being quality seed production in farmers' varieties or landraces, a united digital platform for seed availability, creation of seed reserves, mechanization, identification of novel molecules for seed treatment, seed health testing protocols, organic seed production and certification, reaching the unreached as well as the OECD seed scheme.

The Co-Chairman of the session Mr. Ashwini Kumar, Joint Secretary (Seeds), Department of Agriculture Cooperation and Farmer's welfare, GOI in his remarks lauded the efforts of ICAR in varietal development. He further stressed that more focus should be given to oilseeds and pulses particularly for distribution as minikit to farmers. He opined that the problems in seed infrastructure and seed health must be addressed with immediate effect for enhancing seed export. He ascertained traditional varieties, seed validity and seed packaging as areas of crucial concern. Further, he ensured whole-hearted co-operation from the Ministry and acknowledged that the efforts of ICAR and SAU's are reaching farmers as good quality certified seeds and ultimately resulted in the enhanced productivity of the country.

The Hon'ble Secretary, DARE and Director General, ICAR, Dr. T. Mohapatra announced the various awards as part of the annual meeting. The best Breeder Seed Production Centre award for the year 2020-21 was bestowed upon AICRP, NSP of UAS, Dharwad whereas Sher-e-Kashmir University of Agricultural Sciences & Technology, Srinagar bagged the best STR center award. As for ICAR seed project, Tamil Nadu Agricultural University, Coimbatore was pronounced as the best performing SAU whereas ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora was adjudged best among ICAR centers.

Dr. T. Mohapatra, in his Chairman's address congratulated the seed workers for the fairly good job done during pandemic restrictions. He praised the efforts of participating centers including ICAR institutes, SAU's as well as ICAR-IISS, Mau for their critical roles in allowing the national agricultural system to flourish during difficult times. He opined that an increase in the production of food crops above 300 million tonnes is a crowning glory for the seed sector and hoped that growth will be accelerated here on. He stressed on the need to prioritize the aspects of seed research and production and strongly advocated that varietal mis-match particularly in soybean requires immediate attention and a detailed action plan to address the bottlenecks. The surplus production of breeder seed needs to be set aside as a buffer stock for spells of low production as well as poor crop. He promoted the idea of establishment of an information system on the varietal composition of the country for last 5-10 years by proper sampling. The digital platform must also address all aspects of production from land preparation till harvest and must identify the answers to crop failure precisely. Further, the Hon'ble DG expressed concern that the new varieties are not being promoted in crops like rice where the area of coverage is reduced drastically and urged the researchers to define strategies to allow new varieties to penetrate the seed chain as well as tackle the issue of low SRR. He further elucidated the importance of seed treatment and insisted the researchers to incorporate cutting-edge technologies like cold plasma and nano-materials. A program like 'Seeds for Needs' promoted by Bioversity International and ICAR, is essential to target the adverse effects of climate change. He proposed that such a program must be revived and rejuvenated by addressing bottlenecks and must target difficult areas like North East and Hilly tracts. A functional plan of action on North East is the need of the hour according to him. He urged the researchers to give more focus on GI tagged varieties and biofortified varieties with enhanced promotion from NGOs/ FPO's thereby boosting the monetary benefit to farmers. His apprehension was evident to the low SRR in pulses and oilseeds which he argued must be addressed within 5 years along with an increase in production of 5-6 MT. Further, a self-sustaining seed system must be built as a public sector entity. He encouraged a proper discourse on public-private partnerships other than licensing and stressed the up-gradation of infrastructure in partnering centers. He stressed on the need for harmonization of seed production and research programmes with international standards, to identify relevant areas of

seed research and registration of varieties based on traits of importance as well as for climate resilience so that such varieties can be promoted through seed production.

The session ended with a formal vote of thanks by Dr. Govind Pal, Principal Scientist, ICAR-IISS, Mau.

During the detailed deliberations, following action points were emerged from the discussions:

- In order to address the varietal mis-matches in breeder seed production particularly in soybean crop, there is a need to work out the detailed action plan to address the bottlenecks at national and regional level also. **[Action: All Nodal Officers of Soybean BSP Centres & Director, ICAR-IISS, Mau]**
- The new varieties are penetrating variably at different zones, penetration is high in the states like Punjab & Haryana while poor in states like Odisha, Jharkhand etc. The reason behind this needs to be studied and bottlenecks need to be addressed. **[Action: All Nodal Officers of BSP/ ISP Centres & Director, ICAR-IISS, Mau]**
- In order to augment the net returns from crop husbandry, it is necessary to diversify the crop as well as varietal spectrum to couple with niche consumer segments. In this regard, all centres have to have an action plan to promote the GI tagged and bio-fortified varieties through NGOs/ FPO's thereby boosting the monetary benefits to farmers. **[Action: All Nodal Officers of BSP/ ISP Centres & Director, ICAR-IISS, Mau]**
- With view of strengthening maintenance breeding programme in the country, few centres of excellence need to be identified for the purpose of capacity building. In this regard, ICAR-IARI Regional Station, Karnal may be further strengthened along with few other centres in each zone. **[Action: ADG (Seed), ICAR & Director, ICAR-IISS, Mau]**

Glimpses of Session I

Session II

Presentation of Seed Technology Research Achievements during 2020-21 by Principal Investigators and Finalization of Technical Programme for 2021-22

Date : 21.04.2021 **Time : 2.00 – 6.00**

Chairman	:	**Dr. S.A. Patil** Former Chairman, Farmers Commission of Karnataka & Former Director, ICAR-IARI, New Delhi
Co-Chairman	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi
External Experts	:	**Dr. R.R. Hanchinal,** Former Chairperson, PPV&FRA, New Delhi **Dr. S.K. Rao,** Vice-Chancellor, RVSKVV, Gwalior **Dr. J.S. Chauhan,** Former ADG (Seed), ICAR, New Delhi **Dr. Malavika Dadlani,** Former Joint Director (Research), ICAR-IARI, New Delhi
Convener	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	Dr. Vijay R. Shelar, PS & SRO, MPKV, Rahuri Dr. Sripathy K.V., Scientist, ICAR-IISS, RS, Bengaluru

Session was Chaired by Dr. S.A. Patil, Former Director, ICAR-IARI, New Delhi and Co-Chaired by Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi. Dr. Sanjay Kumar, Director, ICAR-IISS, Mau convened the meeting as host. The session was graced by external experts' viz. Dr. R.R. Hanchinal, Former Chairperson, PPV&FRA, New Delhi, Dr. S.K. Rao, Vice Chancellor, RVSKVV, Gwalior, Dr. Malavika Dadlani, Former Joint Director (Research), ICAR-IARI, New Delhi and Dr. J.S. Chauhan, Former ADG (Seed), ICAR, New Delhi. Dr. M. Bhaskaran, Chairman and esteemed Members of RAC, ICAR-IISS, Mau also presented their views during the deliberations.

The discipline wise presentation of progress report for the year 2020-21 was made by respective Principal Investigators.

S. No.	Discipline	Principal Investigator
1	Seed Production & Certification	Dr. Sandeep K. Lal
2	Seed Physiology, Storage and Testing	Dr. Shiv K. Yadav
3	Seed Pathology	Dr. Atul Kumar
4	Seed Entomology	Dr. Amit Bera

5	Seed Processing	Dr. Ashwani Kumar

Some of the important issues deliberated in the Session are:

Seed physiology, Storage & Testing: Dr. Shiv Kumar Yadav, PS, ICAR-IARI, New Delhi & PI presented the highlights pertinent to 2020-21. In the experiment on validity periods for certified seed lots, based upon the weather data (duration of prevalence of RH > 70% & temperature > 35^{o}C in a year), country has been divided into four zones viz. green, yellow, pink & red zones. Based upon three years' experimentation following conclusions were being arrived, in crops viz. wheat, paddy, maize, cotton, pigeonpea, chickpea & castor after the first validity period of 9 months, first revalidation shall be for 6 months & second revalidation may be provided by SSCAs as special case only. While in crops viz. groundnut & soybean, initial validity period shall be for 6 months and first revalidation for only 3 months' period and there will not be any second revalidation for these crops. In experiment for identification of molecular markers for genetic purity assessment of crop cultivars, two markers (RM 228 & RM 570) have been validated for paddy hybrids viz. JRH 19 & CORH 4, respectively. In experiment, mitigation of terminal heat stress, spraying of 800 ppm & 400 ppm of salicylic acid at vegetative and flowering stage have been found to be effective in crops viz. paddy, sorghum and mustard. It was decided to continue experiment on validity periods for rest of field crops which are not included in first phase.

Seed Production & Certification: Dr. Sandeep Kumar Lal, PS, ICAR-IARI, New Delhi and PI presented the significant findings of 2020-21. Demonstration of validated priming technology in kodomillet, fingermillet & littlemillet was conducted at various centres. Based upon first year's observation, isolation distance of 400 m was found to be best for producing genetically pure seeds. In experiment on optimization of seed rate in soybean, no conclusive/ economically significant differences were observed w.r.t. reduced seed rate of 60 kg/ha in place of recommended seed rate of 70 kg/ha. PI also highlighted that, under TERI sponsored experiment the results are withheld due to non-payment of testing fee by TERI, Gurugram during 2020-21.

Seed Pathology: Dr. Atul Kumar, PS, ICAR-IARI, New Delhi and PI presented the salient achievements for 2020-21. Atlas of seed borne pathogens across the country were depicted highlighting the prevalence of rice bunt, BLB, BPB etc. Seed borne diseases viz. sheath rot of rice, false smut of paddy, wheat spot blotch and head blight has been regarded as emerging in few pockets in the country. Molecular diagnostic kits have been developed by SKUAST, Srinagar for PVX & PVY. Further, it was mentioned that, bean common mosaic virus has been reported for the first time in north hilly region by SKUAST, Srinagar.

Seed Entomology: Dr. Amit Bera, Senior Scientist, ICAR-CRIJAF, Barrackpore and PI presented the achievements for 2020-21. Solarization of seed for 6 days for 4h duration per day found to be best for management of pulse beetle in all pulse crops. Botanicals like neemazol TS @ 7.5

ml/ kg of seed provided safe storage period for paddy seeds upto 9 months of storage (except at OUAT, Bhubaneshwar- 3 months only).

Seed Processing: Dr. Ashwani Kumar, PS, ICAR-IARI, RS, Karnal and PI presented the progress report for 2020-21. Grading sieve size was standardized for 12 crop varieties during 2020-21. The proposal for revision of grading sieve sizes submitted to CSCB during the year 2020-21 was also highlighted. PI requested the Director, ICAR-IISS, Mau to make provision for purchase of sieve shaker at all centres involved in carrying out the referred experiment.

Dr. Bhaskaran, in light of non-uniformity in the reporting of data/ non-interpretation of results in proper way across the centres, suggested PIs to make periodic review to provide necessary instructions to centres. He opined that experiment on evaluation of seed quality in farmers saved seeds in entomology and pathology group need to combined together for better correlation and to provide consolidated advisory recommendations. He suggested that those centers which are not conducting the experiment and not reporting the data should be viewed seriously. Similarly, the action may be initiated against the centres which are not reporting the data on time and lapses in data reporting. He also opined that *Pseudomonas fluorescens* is now not available in India. Instead of *Pseudomonas fluorescens*, *Bacillus subtilis* may be promoted for seed treatment which are having equal beneficial effects. It is further added that all the SAU scientist may be made aware of this things.

Dr. Hanchinal, suggested that as groundnut is poor storer and decline in seed vigour is faster asked PI (SPST) to include groundnut in experiment on quantification of vigour. He also pointed out that there is a need to identify the centres with better performance under STR and accordingly means for strengthening these centres may be brought out. He also suggested to consider location specific control for calculating the B: C ratio instead of taking national average yield.

Dr. Dadlani opined that under experiments viz. nano particles for seed quality enhancement and TERI sponsored programme, there is need for both the groups i.e. seed production & certification and seed physiology group to work in tandem. She opined that while giving recommendations of validity periods experiment, the seed quality data need to be linked with climatological data and recommendations based on prevalent RH and temperature may be made. She urged for integration between seed entomology and physiology group for storage studies. She also requested PIs (entomology & pathology) to go for recommending botanicals when results are on par with chemical molecules in pest management experiments. She also opined that under standardization of sieve sizes experiment, recommendations should be given in range rather than giving single size for particular crop/ variety.

Dr. Chauhan suggested to compile the technologies generated under STR component of AICRP-NSP (Crops) during last 10 years for further upscaling. He also urged to include only new varieties in standardization of sieve sizes experiment. He also asked to work out the benefit

cost ratio for all the experiments and survey experiments of seed pathology should be carried out jointly with seed entomology group.

Dr. Sinha, asked the PI (SPC) to include pollinator activity and variability analysis w.r.t. pollinators at various location under isolation distance experiments.

Dr. Yadava, opined that considering the weather parameters, recommendations pertinent to validity periods experiment may be made zone-wise. Further, it was suggested that Indian Institute of Seed Science should provide the data sheet to all the centres for all the experiments and formulate a system for 100% conduct of experiments and data reporting. It is also suggested that the third party monitoring of all the experiments/trials at all the centres may be done.

Dr. Rahul Chaturvedhi requested the Director, ICAR-IISS, Mau to evaluate the technologies generated out of STR experiments in farmer's field associated with seed production programmes at various location for fast tracking of technology adoption.

Dr. Sanjay, opined that the information deduced out of experiments viz. quality of farmers saved seeds and emerging seed borne diseases, should go as appropriate advisory to state governments in this regard.

Dr. Patil suggested to bring out the recommendations in the form of interdisciplinary manner and also these recommendations need to be integrated with package of practices of state agricultural universities and state department of agriculture. He also urged to validate the internationally proven seed technologies related to packaging, seed treatment, seed storage under Indian conditions through network mode. He asked to conduct the experiments on standardization of seed rate, spacing in collaboration with the progressive farmers. Further, the demonstration of different recommendations or validation may be conducted on farmer's field. Further he also suggested to include farm mechanization experiments under seed processing.

The session came to an end with formal vote of thanks by Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi.

During the detailed deliberations, following action points were emerged from the discussions:

1. In order to ensure the uniformity in implementation of experiment and in reporting/ interpretation of data from STR centres, all Principal Investigators shall hold periodic review of STR centres and provide uniform set of data sheet for all experiments. **[Action: All concerned PIs & Director, ICAR-IISS, Mau]**
2. The experiments on quality evaluation of farm saved seeds under two theme areas viz. Seed Pathology & Seed Entomology need to be combined in order to have better correlation of results and to provide suitable advisory recommendations to the concerned states. **[Action: PIs (Seed Pathology & Seed Entomology) & Director, ICAR-IISS, Mau]**

3. In the course of deliberation, many experts are of opinion that pure formulations of *Pseudomonas fluorescens* is now not available in India for purpose of agricultural use and suggested that Instead of *Pseudomonas fluorescens*, *Bacillus subtilis* may be promoted for seed treatment, which is having equal beneficial effect. In this regard, to establish this fact, SKUAST, Srinagar will analyze (molecular level) the samples of *Pseudomonas fluorescens* from all STR centres involved under Seed Pathology with species specific primers. **[Action: PI (Seed Pathology), Dr. Aflaq Hamid (SKUAST, Srinagar) & Nodal Officers of STR centres]**
4. In order to have first-hand information on developed technology and to enhance the visibility of the project, the Directorate shall publish the details of technologies generated out of the project during last 10 years. **[Action: Director, ICAR-IISS, Mau & All PIs]**
5. In order to study the pollinator activity & variability of pollinators in isolation distance experiment, an entomologist may be involved for taking the observations on insect pollinators and nectar collectors and PI shall provide the pollinators' data collected under isolation studies to Dr. S. N. Sinha for necessary suggestions. **[Action: Concerned STR centres & PI (Seed Production & Certification)]**
6. In order to fast track technology dissemination and adoption by target groups, ICAR-IISS, Mau to evaluate the technologies generated out of STR experiments in farmer's field associated with seed production programmes at various location. **[Action: Director, ICAR-IISS, Mau & Nodal Officers of BSP/ISP]**
7. To know the feasibility of adopting globally available seed technologies, ICAR-IISS, Mau may validate the proven seed technologies available at global level related to packaging, seed treatment, seed storage under Indian conditions through network mode. **[Action: Director, ICAR-IISS, Mau & All PIs]**

Session III

Panel Discussion on Strengthening of Pubic Private Partnership in Seed Production & Research

Date : 22.04.2021 **Time : 10.00 – 12.00**

Chairman	:	**Dr. K.V. Prabhu** Chairperson, PPV&FRA, New Delhi
Co-Chairman	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi
Panelists	:	**Dr. D.K. Yadava,** ADG (Seed), ICAR, New Delhi **Dr. Vilas A. Tonapi,** Director, ICAR-IIMR, Hyderabad **Dr. M. Prabhakar Rao,** President, NSAI, New Delhi **Dr. Ram Kaundinya,** Director General, FSII, New Delhi **Sh. Gubba Kiran,** CEO, Gubba Cold Storage, Hyderabad
Convener	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	Dr. Udaya Bhaskar K. Senior Scientist, ICAR-IISS, RS, Bengaluru Dr. Kalyani Kumari, Scientist, ICAR-IISS, Mau

The event was Chaired by Dr. K.V. Prabhu, Chairperson, PPV&FRA, New Delhi and Co-Chaired by Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi. Dr. Vilas A. Tonapi, Director, ICAR-IIMR, Hyderabad; Dr. M. Prabhakara Rao, President, NSAI, New Delhi; Dr. Ram Kaundinya, Director General, FSII, New Delhi; Sh. Gubba Kiran, CEO, Gubba Cold Storage, Hyderabad were some of the prominent panelists presented their viewpoints during the discussion.

At the outset, Dr. Sanjay Kumar, Director, ICAR-IISS, Mau welcomed the dignitaries and set the tenor for igniting lively deliberations pertinent to public private partnership in seed sector.

Dr. D. K. Yadava outlined the status, strength, weakness and prospects of public seed sector, in his remarks, emphasized the contribution of ICAR in making robust seed system. Insights pertinent to role of public sector in varietal development, augmentation of seed indices (VRR & SRR), productivity maximization through improved seed, challenges posed by changing climate, need for strengthening of seed system in horticultural crops, minimizing the share of informal seed sector, working in conjunction with private seed sector for augmenting the seed availability, ISTA accreditation of seed laboratories vis-à-vis seed trade, preparedness for new

seed bill, assumption of novel seed coating & pelleting technologies, revision of field & seed standards and need for revision of SMR were adeptly narrated.

Dr. Vilas A. Tonapi in his deliberations on framework for public private partnership in seed production pondered upon issues such as trust deficit, goal commonality & strength complementarity and specified perspective for leveraging partnership in Indian seed domain. Need for sharing of research material, joint R&D ventures and potential areas of collaborations viz. varietal licensing, sharing of infrastructure, exchange & deployment of manpower, technology demonstration & commercialization through FPOs etc. were adroitly accentuated.

Dr. M. Prabhakara Rao skillfully articulated about success stories and way forward for public private partnership in seed production. He reiterated on trust building and healthy partnering is the only way to tread ahead. He stressed on economically feasible-output oriented research programmes that can be easily adopted by farmers and also highlighted the critical role of government policies in facilitating strategic environment for public private complementarity in seed sector.

Dr. Ram Kaundinya briefed about challenges of public and private seed sectors and focused on collaborations with respect to joint research projects for contemporary technologies development, enhancing seed export potential and sharing of facilities should be given utmost priority. He opined that, trust deficit and silo approach & no major cross sharing has been the principal reasons contributing for non-sustainability of public-private partnership ventures in agriculture sector. He also pointed out the need for more integrated approach in product oriented research, market survey, research collaboration in open pollinated crops, development of GM & non-GM traits. Need for setting up regulatory agencies on PPP mode, involvement of food industry with seed industry for promotion of bio-fortified crop varieties and sharing of infrastructure facilities were also highlighted.

Sh. Gubba Kiran deliberated on importance of core competency and how state of art storage technologies of Gubba can aid in strengthening of seed sector and rendered views on fumigation, pest free seed storage and how seed storage sector can contribute for growth *per se*.

Dr. A. K. Singh, Director, ICAR-IARI, New Delhi deliberated to have structured partnership in seed domain for better product delivery to the farmers.

Dr. K.V. Prabhu in his Chairman's remarks suggested for both public and private sectors should venture into strength complementation thereby enabling an operable regime. He pointed out that fragmented approach, climate irregularities, seed traceability, commercialization of varieties, lack of trust and sharing of research materials are some of the major issues that needs to be addressed in short time scale. He also stressed the need for clustered approach with the creation of common facility through both public and private investment in seed sector along with the framework of clearly defined parameters for sharing of research outputs. He underlined the need for more and more licensing of products from

public sector, creation of state of art seed quality assurance labs involving both public & private sector and collaborative projects in the areas of seed production, testing of new varieties and seed export.

Dr. S.A. Patil, Former Director, ICAR-IARI, New Delhi & Chairman, QRT, ICAR-IISS, Mau; Dr. R.R. Hanchinal, Former Chairperson, PPV&FRA, New Delhi; Dr. M. Bhaskaran, Former VC, TNOU, Chennai & Chairman, RAC, ICAR-IISS, Mau; Dr. S.K. Rao, VC, RVSKVV, Gwalior; Dr. Vishnuvardhan Reddy, VC, ANGRAU, Guntur, Dr. J.S. Chauhan, Former ADG (Seed), ICAR; Dr. Malavika Dadlani, Former JD (Research), ICAR-IARI, New Delhi and Dr. Rahul Chaturvedhi, Associate Director (Seed Programmes), PepsiCO, Bengaluru were some of the other notable dignitaries expressed their views during deliberations. Over 215 participants including the leading seed scientists, Nodal Officers of AICRP-NSP (Crops) & ICAR Seed Projects from ICAR institutes & SAUs and representatives from the NSC, SSCs, SDAs, private seed industry etc. joined the event.

The session ended on a positive note with having an action plan and measures to enable a successful PPP in this endeavor and concluded with vote of thanks by Dr. Udaya Bhaskar K., Sr. Scientist, ICAR-IISS, RS Bengaluru.

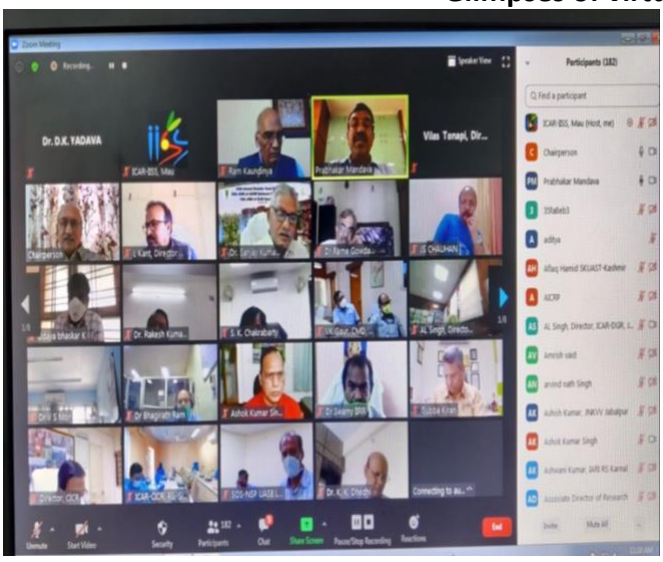
Following are some of the major recommendations emanated during the deliberations

1. In a bid to strengthen the seed production and supply system in horticultural crops especially vegetable segment, the framework (breeder seed indentation, commercialization of crop varieties etc.) to be drawn in a way similar to field crops by ICAR in consultation with other stakeholders viz. DAC&FW, NSC, SSCs and private sector.
2. Development of collaborative research projects with well-defined framework for sharing of outputs in the areas viz. development of climate resilient, bio-fortified, multiple stress resistant/tolerant crop varieties, GM traits etc. and in the areas of seed production, testing of new varieties and seed trade.
3. Need was felt to have clustered approach rather than fragmented approach through joint investments of public private collaborators in creation of research facilities, market surveys, product development, quality assurance laboratories, promotion, branding and marketing.
4. Establishment of national and state level market consulting group/ platform involving both the sectors for clear understanding of problems at grass root level and they may also aid in the development of programmes in order to address the identified issues.
5. In order to build enabling environment in seed sector, an independent regulatory agency may be established on PPP basis to look after the issues related with testing of crop varieties, its commercialization, seed production, quality assurance and marketing. Furthermore, lack of market orientation in research was also felt, hence, same agency

may also be entrusted with the responsibility of bridging gaps between the market requirement and defining research objectives.

6. In order to popularize the bio-fortified crop varieties bred by public/ private sector, need was felt to link seed industry with food industry. In this regard, ICAR and its collaborators shall develop a roadmap involving partners from food industry.
7. Both public and private seed sector are investing heavily on development of research infrastructure. Hence in a bid to reduce capital expenditure and maximize capacity utilization, both sector need to develop some sort of strategies for effective sharing of available infrastructures with clear benefit sharing estimations.
8. Need for creation of state of art seed quality assurance laboratories through joint venture in major seed hubs was felt. These seed laboratories shall function as a hub of seed quality assurance for both public and private sector. Similarly, they shall also work on development/ testing of farmers friendly, economically feasible seed production and quality enhancement technologies.

Glimpses of virtual meeting



SEED TECHNOLOGY RESEARCH TECHNICAL PROGRAMME, 2021-22

A. Seed Production & Certification

Date: 21.04.2021

Chairman	:	**Dr. S. A. Patil** Former Chairman, Farmers Commission of Karnataka & Former Director, ICAR-IARI, New Delhi
Co-chairman	:	**Dr. D. K. Yadava** ADG (Seed), ICAR, New Delhi
External Experts	:	**Dr. R. R. Hanchinal**, Former Chairperson, PPV&FRA, New Delhi **Dr. S.K. Rao**, Vice-Chancellor, RVSKVV, Gwalior **Dr. J. S. Chauhan**, Former ADG (Seed), ICAR, New Delhi **Dr. Malavika Dadlani**, Former Joint Director (Research), ICAR-IARI, New Delhi
Convener	:	**Dr. Sandeep Kumar Lal,** Principal Investigator/ Principal Scientist, ICAR-IARI, New Delhi

General Observations

- It was suggested that those centers which are not conducting the experiment and/ or not reporting the data should be viewed seriously. Similarly, action may be initiated against the centres for delay/ lapses in data reporting.
- The data should be reported timely and uniformly in the prescribed format. The deviation/s in conduct of experiments, including constraints should be communicated well in advance to the concerned PI and Director, ICAR-IISS, Mau. Further, it was suggested that the mechanism for third-party monitoring of all the experiments/trials at all the centres may be explored.
- The benefit cost ratio may be worked out for all the experiments to assess the economic feasibility of the developed technologies.

Specific suggestions

- The reduced seed rates may affect yield under unirrigated conditions, which may be taken care of.
- For organic seed production, locally adopted varieties may be included which may be effective under low input conditions.
- The experiments of use of nano fertilizers and molecules undertaken by Seed Production and Certification group in collaboration with Seed Physiology, Storage and Testing.
- The entomologist should be involved in the isolation distance studies for taking the

observations on insect pollinators and nectar collectors. PI may provide the pollinators' data collected under isolation studies to Dr. S. N. Sinha for necessary suggestions.

- The experiments on standardization of seed rate, spacing may be conducted in collaboration with the progressive farmers. Further, the demonstrations of finalized recommendations or validation may be conducted on the farmers' fields.

Important points for the submission of results:

- The centers should follow the technical programme strictly, without any deviation/s and conduct the experiment accordingly.
- The deadline for the submission of reports should be strictly adhered to (June and December for rabi and kharif experiments, respectively)
- The centers should furnish meteorological data (monthly mean) and soil test report and interpret the results the data to analyze the environmental variations between the centers, failing which the results will not be considered valid.
- The report should be sent in a proper format with brief experimental lay out details about net and gross plot area, name of variety/ hybrid/ parental lines, date of sowing, relevant figures and tables (properly numbered and formatted, along with MS Excel tables), salient findings, interpretation of the results and conclusion.
- The data should be reported after subjecting to appropriate statistical analysis, and mention CV and CD data for the experiments conducted as standard error is not sufficient to analyze the precision of the experiment.

Salient findings 2020-21:

1. **Standardization of isolation distance in pigeon pea and mustard hybrids:** There was no seed setting observed in the female parent beyond a distance 350 m from the male line. Hence, an isolation distance of 400 m may be considered for the production of genetically pure seed in pigeon pea hybrids.
2. **Optimization of organic seed production systems in Paddy:** Among the nutrient management treatments, State Recommended Dose of Fertilizer (N2) recorded highest plant growth, seed yield and seed quality attributes, including net monetary returns and BC ratio as compared to organic treatment and control, irrespective of the varieties. However, the treatment T3 (RDN through Green manure/ FYM/ Vermicompost/ Neem Cake/ Azospirillum, as either sole application or combination of different sources + 10kg PSB/ ha + 10kg KSB/ ha) performed better as compared to control. Hence, the seed yield, net monetary returns and benefit cost ratio was high in inorganic nutrient management with all the varietal combinations as compared to organic management (due to high input costs) and control.

Recommendations:

1. **Integrated approach for enhancing seed yield and quality in millets (Finger millet, Foxtail millet, Proso millet, Kodo millet and Little millet):** The treatment combination, N4P4 (Seed priming with 20% liquid Pseudomonas fluorescens in combination of nutrient management with 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 spray at flowering) led to a significant increase in field emergence, seed yield, overall seed quality and net monetary returns. The combination of organic and inorganic fertilizers can be beneficial in improving production potential and seed quality attributes of little millet, but the input costs need to be optimized for better profits.

2. **Optimization of seed rate in Soybean (*Glycine max* L.):** Based on three years of experimentation and one year validation study, it can be concluded that the seed yield, net monetary returns and BC ratio were calculated as 1.94, 6.56 and 4.94 % higher in case of 70 kg/ha (22.5 q/hac, Rs. 56240 and 1.7) as compared to 60 kg/ha (22.12 q/hac, Rs. 52779 and 1.62), respectively. Therefore, reduction in recommended seed rate was associated with seed yield as well as monetary losses. Hence, lower seed rates of 60 kg/ha cannot be recommended for quality seed production in soybean.

Technical Programme for 2021-22

Experiment 1. Standardisation of isolation distance in Pigeon pea and Mustard hybrids

Rationale: The development of CGMS based hybrids in pigeon pea and Indian mustard has prompted for undertaking experimentation for working out isolation distance standards and recommend for inclusion in IMSCS, 2013

Objective: To recommend isolation distance in certified seed production of Pigeon pea and mustard hybrids

Year of start: 2018-19

CROP	CENTRES
Pigeon pea (5)	PJTSAU, Hyderabad; MPKV, Rahuri; PDKV, Akola, JNKVV, Jabalpur and GBPUAT, Pantnagar
Mustard (7)	IARI, New Delhi; PAU, Ludhiana; GBPUAT, Pantnagar; JNKVV, Jabalpur; NDUAT, Faizabad; SKNAU, Durgapura and ICAR- IISS, Mau

Methodology:

- **Pigeon pea**: A plot size of 3.75 m (width) x 30 m (length) with a spacing of 75 x 30 cm (minimum of 4 rows) will be maintained for the pollen parent (Fig. 1.1). Three rows of female parent (CMS line) will be planted (6 m row length) at different distances i.e. 200, 250, 300, 350 and 400 m from the pollen parent (R line). Precaution should be taken that no other pigeon pea crop variety should be grown within a periphery of 400 m.

  Seed Source: 100 g seed each of pollen parent (R line) and female parent (CMS line) will be procured and supplied to the concerned centres by the Coordination Unit, ICAR-IISS, Mau.
- **Mustard**: A plot size of 2.25 m (width) x 18 m (length) with a spacing of 45 x 15 cm (minimum of 4 rows) will be maintained for the pollen parent. Three rows of female parent (CMS line) will be planted (3 m row length) at different distances viz., 100, 200, 300, 400, 500, and 600 m. Precaution should be taken that no other pigeon pea crop variety should be grown within a periphery of 600 m.

  Seed Source: 200 g seed each of pollen parent (R line) and female parent (CMS line) will be supplied by Dr. Bhagirath Ram, Principal Scientist, Bharatpur, Rajasthan (Mob. No. 9660114965).

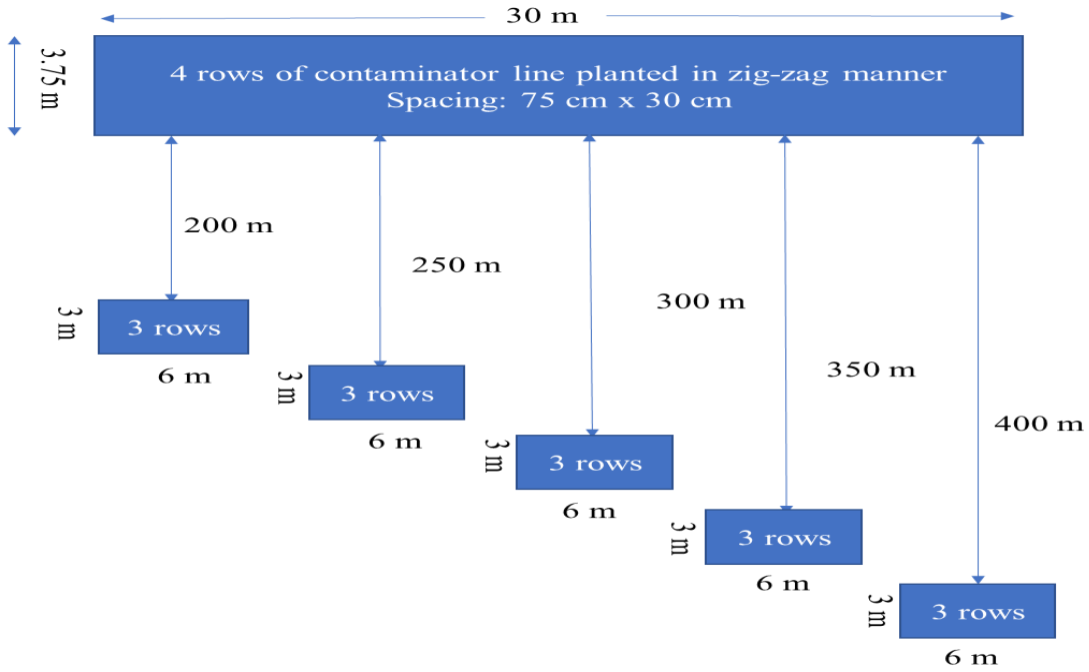


Fig.1.1: Schematic field layout for standardization of Isolation distance for hybrid Pigeon pea

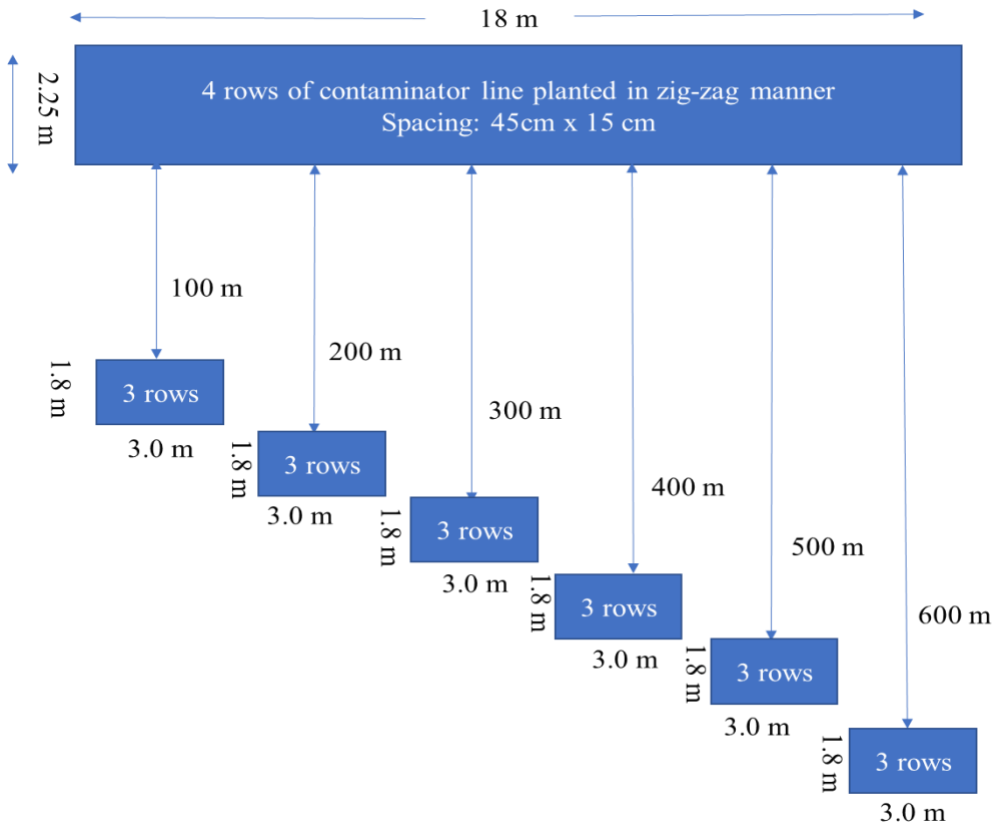


Fig.1.2: Schematic field layout for standardization of Isolation distance in hybrid Mustard

Observation to be recorded (Table 1.1):

- Days to flower initiation in parental lines
- Day to 50% flowering in parental lines
- Duration of flowering in parental lines (days)
- Extent of selfing in female line by bagging
- Plant height at harvest
- Seed setting percentage in the female parent
- Seed yield / plant (gm) – The data may be recorded on 10 plants each in three rows, constituting three replications
- Test weight (gm)

Note:

- Pigeon pea is a kharif/rainy season crop; it is essential to undertake adequate measures to drain excess water. The sowing should be done on ridges made along the slope at a spacing of 75 cm.
- A basal dose of 100 kg/ha DAP is recommended and the sowing should be undertaken, when the soil moisture is adequate for germination.

- Pre-emergence herbicide such as Fluchloralin (Basalin) @ 2.0 - 3.0 l/ ha should be sprayed for weed management.
- For controlling pod borers, spraying of Indoxacarb (15.8% EC @ 400-500 ml /ha) or Spinosad 45 % SC (200-250 ml/ ha) is recommended. The most important consideration in spraying is that the insecticide should not kill the pollinating insects; and hence, spraying should be done either before 9 AM or after 4 PM. The activity of pollinators is minimum at above timings.
- The meteorological data should be recorded for the respective centre. Further, the observations on the activity of pollinators visiting the parental lines will be studied as per the given table and correlated with the seed setting (along with relevant and good quality photographs).
- The timings for recording pollinator related observations can be adjusted depending upon visit of honeybee/ pollinators. Five random plants (around 10 min. /plant) should be observed for about one hour (8-10 AM for FN and 2-3 PM for AN) for the visit of insect pollinators during peak flowering stage (>50% flowering). Honeybees carrying pollen from contaminator plots should be recorded as pollen gatherers. The nectar collectors will be devoid of pollen in their pollen basket. The pollen gatherers and nectar collectors should be identified in consultation with the entomologist. The observations should be repeated for three days and reported (Table 1.2).

Expected output: The revised isolation distance will be worked out for maintaining genetic purity of seed and enhancing seed quality

Experiment 2: Optimization of organic seed production systems in selected crops

Objective:

1. Evaluation of crop varieties for their suitability under organic seed production systems
2. To study the influence of organic nutrient sources on seed yield and quality attributes under organic production systems

Year of start: 2018-19

CROP	CENTRE
Paddy (8)	ICAR RC NEHR, Sikkim Centre (NOFRI); ICAR RC Meghalaya; ICAR RC NEHR Manipur Centre (Black rice); AAU, Jorhat; IGKV, Raipur; IISS, Mau; PJTSAU, Hyderabad and UAS, Bangalore
Maize (5)	ICAR RC Meghalaya; ICAR RC NEHR Manipur Centre; GBPUAT, Pantnagar, PJTSAU, Hyderabad and UAS, Dharwad
Ragi (3)	ICAR RC NEHR, Sikkim Centre (NOFRI), GBPUAT, Pantnagar; and

	UAS, Bangalore

TREATMENT DETAILS		
No. of treatments: 03		**Replications:** 04
Sowing method		
Direct sowing - 20 x 10 cm (Paddy and Ragi) and 60 x 20 cm (Maize – sown at 3-4 cm depth)		
Treatment details		
T1 - Control **(**No Fertilizer & Manure)		
T2 - State Recommended Dose of NPK Fertilizer (Inorganic): Not applicable in case of NOFRI, Sikkim		
T3 - RDN through Green manure/ FYM/ Vermicompost/ Neem Cake/ / *Azospirillum* as either sole application or combination of different sources + 10kg PSB/ ha + 10kg KSB/ ha		
Note: *The doses of organic sources have to be calculated as per the N requirements of respective crop prescribed equivalent to State RDN* ***(Recommended dose of Nitrogen)***		
Design		Randomized block design (Fixed plot)
Plot size	**Gross plot size**	3 m × 5.0 m =15.0 m^2
Spacing between plots (Plot Border)		One metre
Cultivar		A set of 3 local/ traditional/ Organic varieties (minimum). The seed of 4 paddy varieties will be supplied by Dr. Umesh Kalita, AAU, Jorhat (Mob. No.: 8822613718)
Seed treatment		Seed treatment with biocontrol agents *viz., Trichoderma harzianum* or *Pseudomonas fluorescens* @10g/ kg of seed;
Plant protection (As prophylactic measure)		Uniform application of botanicals i.e., Neem oil (@ 5 ml/ litre of water) to all the plots. Spray of commercially available *T. harzianum* Emulsifiable concentrate @ 2 ml/ litre *or P. fluorescens* Emulsifiable concentrate @ 5 ml/ litre or Combination of *P. fluorescens* + *Bacillus subtilis* @ 5 gm/ litre water as a prophylactic measure. **Application schedule of *P. fluorescens* (Paddy)** i. Boot emergence stage ii. 50% panicle emergence stage iii. Pre-harvest stage (15 days prior to harvest)

	Application schedule of combination of *P. fluorescens* + *B. subtilis* (Maize and Ragi) i. 45 DAS ii. 60 DAS iii. 90 DAS
Source of Fertilizer and nutrient composition	Farm Yard Manure: 0.5% N, 0.2 % P & 0.5% K Neem Cake: 5 % N, 1% P and 2 % K) Vermicompost: 2 % N, 1.5% P and 0.6 % K *Azospirillum*@ 10 kg/ha = 20 kg N PSB @ 10 kg/ha = 20 kg P KSB @ 10 kg/ha = 20 kg K

Observations to be recorded

Paddy and Ragi	**Maize**
i. Field emergence	i. Field emergence
ii. Plant stand establishment	ii. Plant stand establishment
iii. Plant height at 30 days and at harvest	iii. Plant height at 30 days and at harvest
iv. Days to first flowering	iv. Days to first flowering
v. Days to 50% flowering	v. Days to 50% flowering
vi. No. of tillers/ m^2	vi. No. of cobs/ plant
vii. Seed yield/ plant	vii. Seed yield/ plant
viii. Seed yield (q/ha)	viii. Seed yield (q/ha)
ix. 1000 seed weight (g)	ix. 1000 seed weight (g)
x. Seed recovery per cent – manual basis	x. Seed recovery per cent – manual basis
xi. Seed quality - Seed germination and Vigour index I	xi. Seed quality - Seed germination and Vigour index I
xii. Net monetary returns (Rs.)	xii. Net monetary returns (Rs.)
xiii. Benefit Cost ratio (BCR) – proforma attached	xiii. Benefit Cost ratio - proforma attached

Guidelines

1. This experiment should be conducted only in organically maintained plots. The organic treatment plots have to be laid out in separate block (organically converted field) and inorganic treatments (RDF) are to be laid out in the adjacent inorganic/regular field having almost similar conditions to avoid the heterogeneity.

2. The soil fertility status of the experimental plot in all the three treatments should be estimated for parameters like texture, bulk density, pH, EC, organic carbon content, available N, P, K, Zn at pre- and post-experiment stages.
3. The nutrient composition of the organic nutrient sources (in case of T3 - for N, P, K, Zn and other nutrients, if any) and the spore concentration (cfu/g) of bio-agents (Rhizobium, PSB, KSB, *T. harzianum, P. fluorescens, B, subtilis* etc.) should be analyzed/ furnished before use/ field application.
4. The organic sources of NPK *viz.,* Neem cake, FYM/Vermicompost should be applied to experimental plots as per treatment schedule, at least 20 days prior to sowing and the nitrogen supplied through these sources should be calculated. Alternatively, the biofertilizers *viz.,* Azospirillum, PSB and KSB should be mixed with FYM/ Vermicompost at the time of last ploughing.
5. Adequate care should be taken to avoid the flow of water from inorganic field to organic experimental site /plots
6. No other crop should be grown in subsequent season in the experimental site/plots of organic seed production technology.

Expected output: The organic seed production technology will be optimised in different field crops**.**

Experiment 3: Seed quality assessment of breeder seed samples

Objective:

- To assess the seed quality of the breeder seed produced (to be done in collaboration with BSP unit of the respective Centre).
- To explore the possibility of formulation of seed standards for breeder seed

Rationale: It is mentioned in the IMSCS that "Breeder seed shall be genetically so pure as to guarantee that in the subsequent generation i.e. certified Foundation seed class shall conform to the prescribed standards of genetic purity. The other quality factors of Breeder seed such as physical purity, inert matter, germination etc. shall be indicated on the label on actual basis". However, the minimum standards have not been fixed for the breeder seed though it is assumed that the standards should be higher that the Foundation/ Certified class of seed.

Year of start: 2019-20

CENTRE	CROP (s)
CSKHPKV, Palampur	Wheat, Blackgram and Mustard
PAU, Ludhiana	Paddy, Wheat, Greengram and Mustard
ICAR-IARI, New Delhi	Paddy, Wheat, Chickpea and Greengram

GBPUAT, Pantnagar	Paddy and Soybean
JNKVV, Jabalpur	Paddy, Wheat, Chickpea and Soybean
MPKV, Rahuri	Sorghum, Chickpea, Soybean and Greengram
PDKV, Akola	Sorghum, Chickpea, Soybean and Cotton
UAS, Bengaluru	Paddy Hybrid (parental lines), Sunflower Hybrid (parental lines) and Groundnut
TNAU, Coimbatore	Paddy, Greengram, Groundnut and Cotton
OUAT, Bhubaneshwar	Paddy and Groundnut
PAJANCOA & RI, Karaikal	Paddy
VNMKV, Parbhani	Chickpea and Soybean
PJTSAU, Hyderabad	Paddy and Pigeonpea
CCSHAU, Hisar	Wheat and Mustard

Methodology:

- The Seed Technology Research Unit (Seed Production and Certification group) will procure the samples of breeder seed produced during the kharif and Rabi season. The seed produced during the kharif and rabi season will be supplied by the BSP unit by the end of December and May, respectively.
- The background information on crop variety, area sown, location details (including GPS coordinates), meteorological data, date of sowing, date of harvest, pest and disease infestation during crop growth, seed yield (q/ha) and any other relevant information shall be furnished along with the breeder seed samples.
- The grow out test for *kharif* breeder seed samples may be conducted during January-February.
- At many places, off season grow out test for *rabi* crops may not be possible. Hence, the GOT may be conducted 30 - 40 days before the onset of rabi season in such cases
- Since the genetic purity of the breeder seed is expected to be 100%, the number of plants to be observed should be fixed at 8000.
- The observation on the off types may be recorded on the basis of morphological characters of the variety.
- These observations may be confirmed by involving the concerned breeder for the inspection.
- The number of crops will be capped at 2 per season and number of varieties will be restricted to a maximum of eight (all the crops included) during a calendar year.

Observations to be recorded: Plant population, percent off types, percent genetic purity (GOT) and other seed quality parameters (Seed Moisture content, Physical purity including ODVs, Germination per cent and Seed Health test, including the names and per cent infection by

different seed borne fungi/ insect-pest infestation, if any), accompanied by high quality photographs.

All Nodal Officers of BSP/ ICAR Seed Project / STR/ will be responsible for conduct and reporting of results in this regard.

Expected Outcome: It will help in assessment and documentation of seed quality status of breeder seed produced at SAUs and ICAR Institutes, which can facilitate the setting up benchmark levels for breeder seed quality.

Experiment 4: Preparation of Atlas for breeder seed production pockets of different crops in India

Objectives:

- Delineation of for breeder seed production areas in India
- To ensure production and supply of better quality seed in domestic and export markets

Year of start: 2019-20

CROP (s)	CENTRE
Paddy (48)	UAHS, Shivamogga; IGKV, Raipur; AAU, Anand; UAS, Raichur; OUA&T, Bhubaneshwar; CSKHPKV, Palampur; PJTSAU, Hyderabad; TNAU, Coimbatore; SKUAS&T, Srinagar; DRPCAU, Pusa; NAU, Navsari; SVPUA&T, Meerut; BCKVV, West Bengal; NDUA&T, Ayodhya; AAU, Jorhat; ICAR-IARI, New Delhi; ICAR-IARI RS, Karnal; GBPUA&T, Pantnagar; UAS, Dharwad; CCSHAU, Hisar; ICAR-VPKAS, Almora; RARS (KAU), Pattambi; BAU, Sabour; JNKVV, Jabalpur; ICAR-NRRI, Cuttack; ICAR-IIRR, Hyderabad; UAS, Bengaluru; BHU, Varanasi; PAU, Ludhiana; MPKV, Rahuri; PDKV, Akola; BAU, Ranchi; BSKKV, Dapoli; ICAR-CCARI, Goa; SKUAST, Jammu; ANGRAU, Guntur; PAJANCOA &RI, Karaikal; CAU, Imphal; ICAR NEH Region Tripura; ICAR NEH Region, Manipur; ICAR NEH Region, Meghalaya and ICAR- CIARI, Port Blair

Methodology: It is a survey type integrated and multi-disciplinary experiment, which will be done in line with soil maps and whole crop production environment. It will encompass technical collaboration among all STR disciplines *viz.,* Seed Production and Certification (including Seed Processing), Seed Physiology, Storage and Testing, Seed Pathology and Seed Entomology. It may be noted that one sample will be drawn from all satellite stations, where breeder seed is

produced under the jurisdiction of concerned University/ Institute. The different seed production units will be represented by dot points on the map, along with seed quality attributes. Dr. R. N. Sahoo, Principal Scientist, Division of Agricultural Physics, Indian Agricultural Research. Institute, New Delhi 110012 (Email: rnsahoo.iari@gmail.com) will provide technical guidance for this experiment.

The seed production and certification group will procure the breeder seed samples of seed produced within the jurisdiction of their University/ Institute along with the information on different seed production points (including satellite stations) during *kharif, rabi* and *summer* season (atleast two varieties per location/season). The seed produced during the kharif and rabi season will be supplied by the BSP unit by the end of December and May, respectively. **All Nodal Officers/ Controlling authority of BSP/ ICAR Seed Project / STR/ will be responsible for conduct and reporting of results in this regard.**

Observations to be recorded:

Seed Production and Certification (including seed processing component): All the breeder seed samples from producing centers of ICAR Institutes/ SAUs jurisdiction will be collected during *kharif, rabi* and *summer* season along with following observations:

- Location details of seed production plots (including GPS coordinates)
- Crop and Variety
- Date of sowing
- Date of harvest
- Soil test report
- Meteorological data during crop growth
- Pest and disease infestation during crop growth
- Seed recovery %
- Seed yield (q/ha)
- Cost benefit ratio - proforma attached
- Any other relevant observation/ remarks

Seed Physiology Storage and Testing

- Seed quality parameters (Germination, Seed moisture content, Vigour Index I and II) - Initial and quarterly observations till next planting season
- Any other relevant observation/ remarks

Seed Pathology:

- Seed mycoflora observed during storage, including the names and per cent infection by different seed borne fungi, if any
- Seed health (% infection) - Initial and quarterly observations till next planting season
- Any other relevant observation/ remarks

Seed Entomology:

- Storage pests observed during storage, including the names and % infestation by insect-pests, if any
- Storage pest infestation (%) - Initial and quarterly observations till next planting season
- Any other relevant observation/ remarks

Expected Outcome: Based on 3 to 4 years data, the seed production pockets across the country will be identified and documented through preparation/ publication of Seed Production Atlas. It will depict the breeder seed production pockets of different crops in India during *kharif, rabi and summer seasons*.

Experiment 5: Nutrient management through nano fertilizers (in collaboration with TERI, Gurugram)

Year of start: 2020-21

Crops - Maize, Groundnut, Wheat and Chickpea

S. No.	Crop	Centres
1.	Maize (5)	PAU, Ludhiana; GBPUAT, Pantnagar and JNKVV, Jabalpur; ICAR-IARI, New Delhi and RPCAU, Pusa
2.	Groundnut (6)	JAU Jamnagar; UAS, Bangalore, PJTSAU, Hyderabad; UAS, Dharwad, PDKV, Akola and SKNAU, Durgapura
3.	Chickpea (8)	ICAR-IARI, New Delhi; MPKV, Rahuri; PDKV, Akola, IISS, Mau; CCS HAU, Hisar; JNKVV, Jabalpur; VNMKV, Parbhani and SKNAU, Durgapura
4.	Wheat (6)	ICAR-IARI, New Delhi; SKNAU, Durgapura, CSKHPKV, Palampur, JNKVV, Jabalpur, PAU, Ludhiana and CCS HAU, Hisar

***The seeds will be procured by TERI, Gurugram in consultation with IISS, Mau and distributed to each centre well in time**

Note: The coated seeds as well as nano nutrients for foliar sprays will be provided by TERI, Gurugram. Besides, the soil nutrient analysis will be undertaken at TERI Gurugram, Haryana. (Contact Person: Dr. Sanjay Parmar, Centre for Mycorrhizal Research Sustainable Agriculture, TERI, Gurugram; Mobile No.: 9450501895)

Pre-sowing/ post-sowing soil sample (100 g dried or 200 g wet) and tissue sample (preferably dried leaf & harvested seed 100 g each) to be sent to TERI for analysis. One pooled sample needs to be prepared for each treatment from replication plots and sent to TERI, Gurugram.

Treatment	Treatment details

T_1	No fertilizer (Control)
T_2	State recommended dose of fertilizer
T_3	100% RDF + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**
T_4	100% RDF + seed coating of nano Zn+Fe (Zinc + Iron) @ 125 ml ha^{-1} **(100% seed coating)**
T_5	75% RDF (100% N/K with 75% P) + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**
T_6	75% RDF (100% NPK with 75% Zn/Fe) + Seed coating of nano Zn+Fe (Zinc + Iron) @ 125 ml ha^{-1} **(100% seed coating)**
T_7	100% RDF + seed coating of nano P (Phosphorus) @ 62.5 ml ha^{-1} +Foliar spray of nano P (Phosphorus) @ 250 ml ha^{-1}**(50% seed coating + 50% Foliar)**
T_8	100% RDF + Seed coating of nano Zn+Fe (Zinc + Iron) @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe (Zinc + Iron) @ 250 ml ha^{-1} **(50% seed coating + 50% Foliar)**
T_9	75% RDF (100% N/K with 75% P) + Seed coating of nano P (Phosphorus) @ 62.5 ml ha^{-1} +Foliar spray of nano P (Phosphorus) @ 250 ml ha^{-1}**(50% seed coating + 50% Foliar)**
T_{10}	75% RDF (100% NPK with 75% Zn/Fe) + Seed coating of nano Zn+Fe (Zinc + Iron) @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe (Zinc + Iron) @ 250 ml ha^{-1} **(50% seed coating + 50% Foliar)**

P: Phosphorus**; Zn + Fe: Zinc + Iron**

MAIZE	
No. of treatments	**10**
Replications	**4**
Design	**RBD (Randomized Block Design)**
Plot Size (m)	**5.0 x 3.0**
Spacing (cm)	**75 x 20**
Total plots	**40 (Area- 600 m^2)**
Sowing: Direct sowing @ 20 kg seed/ ha; Prepare ridge at 75cm spacing	
Seed requirement 100 seed wt - 33 g (approx.) 1 plot- 4 rows, 5 m each i. e. 25 plants per row and 4x25 plants/ plot i.e. 100 plants/ plot. We need to sow at least 30 seeds/ row (assuming 80% field emergence) Hence, seed reqt. / plot = 4x30= 120 seeds (40 g) Total seed reqt. for 40 plots = 40 x 120= 4800 seeds (1.6 kg), which can be adjusted to 2.0 kg per centre	

Note:

- Apply FYM 10 t/ ha, 10-15 days prior to sowing, supplemented with 165:75:75 kg/ ha N: P: K dose (RDF), respectively and 25 kg/ ha of Zinc Sulphate (as per the treatment schedule)
- Full doses of P, K and Zn should be applied as basal. Nitrogen is split applied at four dosages as:

S. No.	Crop Stage	Nitrogen (%)
1	**Basal (before sowing)**	**20**
2	**V_4 (four leaf stage)**	**25**
3	**V_8 (eight leaf stage)**	**30**
4	**V_T (tasseling stage)**	**25**

- Weeding, inter culture, irrigation, plant protection etc. be followed for raising healthy crop.

Foliar spray	Nano P and Nano Zn + Fe foliar spray at V8 (eight leaf stage)
Source fertilizers	
1. Nitrogen	Urea (46 % N)
2. Phosphorus	Single Super phosphate (SSP) (16 % P_2O_5)
3. Potassium	Muriate of Potash (MOP) (60 % K_2O)
4. Zinc	Zinc Sulphate ($ZnSO_4$)(Zinc 21%)
OR	
1. Nitrogen and Phosphorus	DAP (18 % N and 46 % P_2O_5)
2. Potassium	Muriate of Potash (MOP) (60 % K_2O)
3. Zinc	Zinc Sulphate ($ZnSO_4$)(Zinc 21%)

Fertilizer	Dose (kg/ha)	Fertilizer requirement (per ha)	Dose for one plot of 15m^2 (g)	Fertilizer requirement with 100% RDF for one plot of 15 m^2 (g)	Fertilizer requirement with 75% RDF for one plot of 15 m^2 (g)
N	165	358.70 kg Urea (165 kg N)	165g	538 g Urea	-NA-
P	75	468.75 kg SSP (75kg P)	75g	703.12 g SSP	527.34 g SSP
K	75	125 kg MOP (75kg K)	75	187.5 g MOP	-NA-

$ZnSO_4$	25	25 kg $ZnSO_4$ (21% Zinc)	25	37.5 g $ZnSO_4$	28.125 g $ZnSO_4$
***$FeSO_4$**	Use state recommended fertilizer dose and calculate accordingly				

***To be applied on the basis of soil test report, if deficient**

Note: 100% RDF means application of 100% NPK along with 100% Zn and 100% Fe

Treatments	**Treatment details**	**Fertilizer through soil application for one plot of 15 m^2**
T_1	No fertilizer (Control)	-NA-
T_2	Recommended Dose of Fertilizer incl. Zn + Fe (Soil application only)	538 g Urea + 703.12 g SSP + 187.5 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_3	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**	538 g Urea + 703.12 g SSP + 187.5 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_4	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano Zn + Fe (Zinc + Iron) @ 125 ml ha^{-1} **(100% seed coating)**	538 g Urea + 703.12 g SSP + 187.5 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_5	**100% N, K, Zn + Fe with 75% P (Soil application)** + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**	538 g Urea + 527.34 g SSP + 187.5 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$
T_6	**100% NPK and 75% Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 125 ml ha^{-1} (**100% seed coating)**	538 g Urea + 527.34 g SSP + 187.5 g MOP + 28.13 g $ZnSO_4$ + $FeSO_4$
T_7	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano P @ 62.5 ml ha^{-1} +Foliar spray of nano P @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	538 g Urea + 703.12 g SSP + 187.5 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_8	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe (Zinc + Iron) @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	538 g Urea + 703.12 g SSP + 187.5 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_9	**100% N, K, Zn + Fe and 75% P (Soil application)** + Seed coating of nano P (Phosphorus) @ 62.5 ml ha^{-1} +Foliar spray of nano P @ 250 ml ha^{-1}**(50% Seed coating + 50% Foliar)**	538 g Urea + 527.34 g SSP + 187.5 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$
T_{10}	**100% NPK and 75% Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	538 g Urea + 527.34 g SSP + 187.5 g MOP + 28.13 g $ZnSO_4$ + $FeSO_4$

P: Phosphorus; Zn + Fe: Zinc + Iron

Plant protection measures: As per state recommended package of practices

Pest / disease control

- **Shoot fly** (*Atherigona sp*.)**:** Seed treatment with Imidacloprid @ 6ml/ kg seed
- **Termites** (*Odontotermes obesus*)**:** Fipronil granules @ 20 kg ha^{-1}, followed by light irrigation.
- **Turcicum leaf blight** (*Exserohilum turcicum*)**:** Need based sprays of Mancozeb @ 2.5 g/ l (with adjuvant @ 0.05%) at 8-10 days interval.
- **Maydis leaf blight** (*Drechslera maydis*)**:** Need based sprays of Mancozeb/ Zineb @ 2.5g/ l (with adjuvant @ 0.05%) of water).
- **Common rust** (*Puccinia sorghi*): Spray of Mancozeb @ 2.5 g/ l (with adjuvant @ 0.05% of water) at first appearance of pustules.
- **Downy mildew** (*Peronosclerospora sorghi, Sclerophthora rayssiae var. zeae, Peronosclerospora hetropogoni*): Seed treatment with Metalaxyl @ 2.5 g/ kg seed and need based foliar sprays of systemic fungicide such as Metalaxyl @ 2-2.5 g/ l (with adjuvant @ 0.05%) is recommended at first appearance of disease symptoms.

Observations to be recorded (Tables 5.1 and 5.2):

- Location details of experimental plot (including GPS coordinates)
- Soil nutrient analysis (pre and post experiment)/ Tissue analysis (TERI, Gurugram)
- Field emergence
- Plant stand establishment
- Plant height at 30 DAS and at harvest
- Leaf chlorophyll – 30 DAS at V10-VT stage (SPAD value)
- Days to first flowering
- Days to 50 % flowering
- No. of cobs/ plant
- Seed yield/ plant (gm)
- Seed yield/ ha
- 1000 seed weight (gm)
- Seed recovery (%) - manual basis
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Net monetary returns (Rs.) and Benefit Cost ratio (proforma attached)

GROUNDNUT	
No. of treatments	**10**
Replications	**4**

<table>
<tr><td>Design</td><td>RBD (Randomized Block Design)</td></tr>
<tr><td>Plot Size (m)</td><td>5.0 x 2.25</td></tr>
<tr><td>Spacing (cm)</td><td>45 x 15</td></tr>
<tr><td>Total plots</td><td>40 (Area- 450 m^2)</td></tr>
<tr><td colspan="2">Sowing: Direct sowing@100 kg seed/ ha</td></tr>
<tr><td colspan="2">Seed requirement
100 kernel wt- 55 g (approx.)
1 plot - 4 rows, 5 m each i. e. 33 plants per row and 5x33 plants/ plot i.e. 165 plants/ plot
We need to sow at least 50 kernels/ row (assuming 66% field emergence)
Hence, kernel reqt. / plot = 4x50= 200 kernels (110 g)
Total reqt for 40 plots - 40 x 200= 8000 kernels (4.4 kg) – which can be adjusted to 6.0 kg per centre</td></tr>
<tr><td colspan="2">Note

Apply FYM 10 - 12 t/ ha, 10 to 15 days prior to sowing, supplemented with 20:60:30 kg/ ha N:P:K dose (RDF), respectively and 25 kg/ ha of Zinc Sulphate (as per the treatment schedule).
Full doses of P and Zn should be applied as basal. Nitrogen and Potassium is split applied at two dosages as:
<table>
<tr><th>S. No.</th><th>Crop Stage</th><th>Nitrogen (%)</th><th>Potassium (%)</th></tr>
<tr><td>1</td><td>Basal (before sowing)</td><td>50</td><td>50</td></tr>
<tr><td>2</td><td>20 days after sowing</td><td>50</td><td>50</td></tr>
</table>
Seeds treatment with Thiram or Captan or Carbendazim or Mancozeb at 2 g/ kg seed 24 hours before sowing to control the soil borne diseases. Treat with Imidacloprid 2 ml/ kg seed to control sucking pests.
Weeding, inter culture, irrigation, plant protection etc. be followed for raising healthy seed crop.
</td></tr>
<tr><td>Foliar spray</td><td>Nano P and Nano Zn + Fe foliar spray at 30 DAS</td></tr>
<tr><td colspan="2">Source fertilizers</td></tr>
<tr><td>1. Nitrogen</td><td>Urea (46 % N)</td></tr>
<tr><td>2. Phosphorus</td><td>Single Super phosphate (SSP) (16 % P_2O_5)</td></tr>
<tr><td>3. Potassium</td><td>Muriate of Potash (MOP) (60 % K_2O)</td></tr>
<tr><td>4. Zinc</td><td>Zinc Sulphate ($ZnSO_4$) (Zinc 21%)</td></tr>
<tr><td colspan="2">OR</td></tr>
<tr><td>1. Nitrogen and Phosphorus</td><td>Diammonium Phosphate (DAP) (18 % N and 46 % P_2O_5)</td></tr>
<tr><td>2. Potassium</td><td>Muriate of Potash (MOP) (60 % K_2O)</td></tr>
</table>

3. Zinc	Zinc Sulphate ($ZnSO_4$) (Zinc 21%)

***To be applied on the basis of soil test report, if deficient**

Fertilizer	Dose (kg/ha)	Fertilizer requirement (per ha)	Dose for one plot of 15m² (g)	Fertilizer requirement with 100% RDF for one plot of 15 m² (g)	Fertilizer requirement with 75% RDF for one plot of 15 m² (g)
N	20	43.48 kg Urea (20 kg N)	20	65.22 g Urea	-NA-
P	60	375 kg SSP (60 kg P)	60	562.5 g SSP	421.875 g SSP
K	30	50 kg MOP (30kg K)	30	75 g MOP	-NA-
$ZnSO_4$	25	25 kg $ZnSO_4$ (21% Zinc)	25	37.5 g ZnSO4	28.125 g $ZnSO_4$
***$FeSO_4$**	Use state recommended fertilizer dose and calculate accordingly				

Note: 100% RDF means application of 100% NPK along with 100% Zn and 100% Fe

Treatments	Treatment details	Fertilizer through soil application for one plot of 15 m²
T_1	No fertilizer (Control)	-NA-
T_2	State Recommended Dose of Fertilizer incl. Zn + Fe (Soil application only)	65.22 g Urea + 563 g SSP + 75 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_3	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**	65.22 g Urea + 563 g SSP + 75 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_4	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano Zn + Fe (Zinc + Iron) @ 125 ml ha^{-1} **(100% seed coating)**	65.22 g Urea + 563 g SSP + 75 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_5	**100% N, K, Zn + Fe with 75% P (Soil application)** + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**	65.22 g Urea + 423 g SSP + 75 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$
T_6	**100% NPK and 75% Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 125 ml ha^{-1} (**100% seed**	65.22 g Urea + 563 g SSP + 75 g MOP + 28.2 g $ZnSO_4$ +

	coating)	$FeSO_4$
T_7	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano P @ 62.5 ml ha^{-1} +Foliar spray of nano P @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	65.22 g Urea + 563 g SSP + 75 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_8	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe (Zinc + Iron) @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	65.22 g Urea + 563 g SSP + 75 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_9	**100% RDF of N, K, Zn + Fe and 75% P (Soil application)** + Seed coating of nano P (Phosphorus) @ 62.5 ml ha^{-1} +Foliar spray of nano P @ 250 ml ha^{-1}**(50% Seed coating + 50% Foliar)**	65.22 g Urea + 423g SSP + 75 g MOP + 37.5 g $ZnSO_4$ + $FeSO_4$
T_{10}	**100% NPK and 75% Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	65.22 g Urea + 563 g SSP + 75 g MOP + 28.2 g $ZnSO_4$ + $FeSO_4$

P: Phosphorus; Zn + Fe: Zinc + Iron

Plant protection measures: As per state recommended package of practices

Pest / disease control:

- **Red Hairy caterpillar** (*Amsacta albistriga, A. moorei*)**:** Apply Phosalone 35 EC 750 ml/ ha in 375 l of water insecticides at 25 kg/ ha (for young caterpillars) or Dichlorvos 76 EC 627 ml/ha
- **Termites** (*Odontotermes obesus*)**:** Apply Fipronil granules @ 20 kg/ ha, followed by light irrigation
- **White grub** (*Lachnosterna serrata* and *Lachnosterna consanguinea*): Seed treatment with Chlorpyriphos 20 EC at 12.5 ml/ kg seed. Soil Application of Malathion 5D at 25 kg/ ha or Carbofuran 3G granules in the furrow at 1 kg a.i. /ha at the time of sowing
- **Early leaf spot (*Cercospora arachidicola*) and late leaf spot (*Phaeoisariopsis personata*)**: Need based sprays of 0.1% Carbendazim 50 WP or 0.2% Mancozeb 50 WP or 0.2% Chlorothalonil 75 WP at 15–20 days interval
- **Rust (*Puccinia arachidis*)**: Need based spray of 0.2% Chlorothalonil 75 WP or 0.2% Mancozeb 50 WP or 0.5% Calixin 80 EC or 0.1% Propiconazole 25 EC or 0.1% Hexaconazole 5 EC at 15–20 days interval and need based foliar sprays of systemic fungicide such as Metalaxyl @ 2-2.5 g/ l (with adjuvant @ 0.05%) is recommended at first appearance of disease symptoms.

Observations to be recorded (Tables 5.3 and 5.4):

- Location details of experimental plot (including GPS coordinates)

- Soil nutrient analysis (pre and post experiment)/ Tissue analysis (TERI, Gurugram)
- Field emergence
- Plant stand establishment
- Plant height at 30 DAS and at harvest
- Leaf chlorophyll – 40-50 DAS at first bloom stage/budding stage (SPAD value)
- No. of pods/ plant
- Seed yield/ plant (gm)
- Seed yield/ ha
- 1000 seed weight (gm)
- Seed recovery (%) – manual basis
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Net monetary returns (Rs.) and Benefit Cost ratio (proforma attached)

CHICKPEA	
No. of treatments	**10**
Replications	**4**
Design	**RBD (Randomized Block Design)**
Plot Size (m)	**5.0 x 2.0**
Spacing (cm)	**30 x 10**
Total plots	**40 (Area- 300 m^2)**
Seed requirement 100 seed wt- 25 g (approx.) 1 plot - 6 rows, 5 m each i.e. 50 plants/ row and 6x50 plants/ plot i.e. 300 plants/ plot We need to sow at least 100 seeds/ row Hence, seed reqt. / plot = 6x50= 600 seeds (150 g) Total reqt for 40 plots - 40 x 600= 24000 seeds (6.0 kg), which can be adjusted to 8.0 kg per centre	
Sowing: Direct sowing @ 60-80 kg seed / ha, depth of sowing-6-8 cm	
Note: • Apply FYM 5 - 10 t/ ha, 10 to 15 days prior to sowing supplemented with 20-25:40:25 kg /ha N:P:K dose, respectively and 25 kg/ ha of Zinc Sulphate(as per the treatment schedule). • Seed treatment with 0.25 percent Thiram/Carbendazim (Bavistin) before sowing. • Pre-emergence herbicides, such as Fluchloralin @ 1 kg a.i./ ha or Pendimethalin @ 1.0 to 1.5 kg a.i. /ha for controlling early flush of weeds. • Chickpea is generally grown as a rainfed crop, but two irrigations, one each at branching and pod filling stages, are recommended for higher yield.	

Foliar spray	Nano P and Nano Zn + Fe foliar spray at 30 DAS
Source fertilizers	
1. Nitrogen	Urea (46 % N)
2. Phosphorus	Single Super phosphate (SSP) (16 % P_2O_5)
3. Potassium	Muriate of Potash (MOP) (60 % K_2O)
4. Zinc	Zinc Sulphate ($ZnSO_4$) (Zinc 21%)
OR	
1. Nitrogen and Phosphorus	Diammonium Phosphate (DAP) (18 % N and 46 % P_2O_5)
2. Potassium	Muriate of Potash (MOP) (60 % K_2O)
3. Zinc	Zinc Sulphate ($ZnSO_4$) (Zinc 21%)

Fertilizer	**Dose (kg/ha)**	**Fertilizer requirement (per ha)**	**Dose for one plot of 10m² (g)**	**Fertilizer requirement with100%RDF for oneplot of 10m² (g)**	**Fertilizer requirement with75%RDF for one plot of 10m² (g)**
N	18	100 kg DAP (18 kg N)	100	100 g DAP	-NA-
P	45	100 kg DAP (46 kg P)	100	100 g DAP	75 g DAP + 10 g Urea
K	25	42 kg MOP (30kg K)	25	42 g MOP	-NA-
$ZnSO_4$	25	25 kg $ZnSO_4$ (21% Zinc)	25	25g $ZnSO_4$	18.75g $ZnSO_4$
***$FeSO_4$**	Use state recommended fertilizer dose and calculate accordingly				

***To be applied on the basis of soil test report, if deficient**

DAP: 18% N + 46 % P; Urea: 46 % N

Note: 100% RDF means application of 100% NPK along with 100% Zn and 100% Fe

Treatments	**Treatment details**	**Fertilizer through soil application for one plot of 10 m²**
T_1	No fertilizer (Control)	-NA-
T_2	State Recommended Dose of Fertilizer incl. Zn + Fe (Soil application only)	100 g DAP + 42 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_3	**100% RDF incl. Zn + Fe (Soil application)**	100 g DAP + 42 g MOP +

	+ Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**	25g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_4	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano Zn + Fe (Zinc + Iron) @ 125 ml ha^{-1} **(100% seed coating)**	100 g DAP + 42 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_5	**100% N, K, Zn + Fe with 75% P (Soil application)** + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**	75 g DAP + 10 g Urea + 42 g MOP + 25g $ZnSO_4$ + $FeSO_4$
T_6	**100% NPK and 75% Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 125 ml ha^{-1} (**100% seed coating)**	100 g DAP + 42 g MOP + 18.75 g $ZnSO_4$ + $FeSO_4$
T_7	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano P @ 62.5 ml ha^{-1} +Foliar spray of nano P @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	100 g DAP + 42 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_8	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe (Zinc + Iron) @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	100 g DAP + 42 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% RDF)
T_9	**100% RDF of N, K, Zn + Fe and 75% P (Soil application)** + Seed coating of nano P (Phosphorus) @ 62.5 ml ha^{-1} +Foliar spray of nano P @ 250 ml ha^{-1}**(50% Seed coating + 50% Foliar)**	75 g DAP + 10 g Urea + 42 g MOP + 25g $ZnSO_4$ + $FeSO_4$
T_{10}	**100% NPK and 75% Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	100 g DAP + 42 g MOP + 18.75 g $ZnSO_4$ + $FeSO_4$

P: Phosphorus; Zn + Fe: Zinc + Iron

Plant protection measures: As per state recommended package of practices

Pest / disease control

- **Wilt:** Seed treatment with Benlate T or a mixture of Benlate of Thiram (1:1) @ 2.5 g/ kg seed.
- **Sclerotinia Blight: S**oil treatment with a mixture of fungicides like Brassicol and Captan @ 10 kg/ ha.
- **Ascochyta Blight:** Use healthy and vigorous seed only. Seed treatment with fungicides like Thiram or Carbendazim (Bavistin) @ of 2.5 g/kg of seed before planting.
- **Gram Pod Borer:** Spray Monocrotophos (Nuvacron) 36 EC at the time of pod formation at the rate of 1 ml mixed in 1 l of water. The amount of solution may vary from 600-800 l /ha. The spray should be repeated, if needed after 15 days.
- **Cutworm:** The pest is sporadic in nature and can be controlled by the soil application of Lindane 6% granules @ 20-25 kg/ ha.

Observations to be recorded (Tables 5.5 and 5.6):

- Location details of experimental plot (including GPS coordinates)
- Soil nutrient analysis (pre and post experiment)/ Tissue analysis (TERI, Gurugram)
- Field emergence
- Plant stand establishment
- Plant height at 30 DAS and at harvest
- Leaf chlorophyll – 40-50 DAS at first bloom stage/budding stage (SPAD value)
- No. of pods/ plant
- Seed yield/ plant (gm)
- Seed yield/ ha
- 1000 seed weight (gm)
- Seed recovery (%) – manual basis
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Net monetary returns (Rs.) and Benefit Cost ratio (proforma attached)

WHEAT	
No. of treatments	**10**
Replications	**4**
Design	**RBD (Randomized Block Design)**
Plot Size (m)	**5.0 x 2.0**
Spacing (cm)	**22.5x 10**
Total plots	**40 (Area- 300 m^2)**
Seed requirement 1000 seed wt- 40 g (approx.) 1 plot - 8 rows, 5 m each i.e. 50 plants/ row and 8x50 plants/ plot i.e. 400 plants/ plot We need to sow at least 100 seeds/ row Hence, seed reqt. / plot = 8x100 seeds=800 seeds (32 g) Total reqt for 40 plots - 40 x 800= 32000 seeds (1.28 kg), which can be adjusted to 1.5 kg per centre	
No. of treatments	**10**
Sowing: Direct sowing @100 kg seed/ ha, depth of sowing: 5-6 cm; spacing:22.5 cm	
Note: • Where white ants or other pests are a problem, Aldrin 5% or BHC 10% dust at the rate of 25 kg/ha should be applied to the soil after the last ploughing or before planking. • Apply FYM 10 to 12 t/ ha, 10 to 15 days prior to sowing supplemented with 120:60:40 kg/ ha N:P: K dose, respectively and 25 kg/ ha of Zinc Sulphate (as per the treatment schedule). • Full doses of P, K and Zn should be applied as basal. Nitrogen is split applied at two	

dosages. • Treat seeds with Thiram or Captan or Carbendazim or Mancozeb at 2 / kg of seed 24 hours before sowing to control the soil borne disease. • Weeding to be done 45-60 DAS or weedicides like 2,4 D, Avadex or Nitrofen (Tok E-25) for controlling weeds like *Chenopodium* sp, *Angallis* sp., *Asphodelus* sp. and *Phalaris* sp. • 5-6 irrigations should be given at critical growth stages viz. Crown root initiation, tillering, jointing, flowering, milk and dough which come at 21-25 days after sowing (DAS), 45-60 DAS, 60-70 DAS, 90-95 DAS, 100-105 DAS and 120-125 DAS, respectively.	
Recommended dose of fertilizer (N:P:K)	120:60:40 kg/ ha or State recommended dose of fertilizer
Cultivar	Any recommended cultivar appropriate for seed production season
Foliar spray	Nano P and Nano Zn + Fe foliar spray at 30 DAS
Source fertilizers	
1. Nitrogen	Urea (46 % N)
2. Phosphorus	Single Super phosphate (SSP) (16 % P_2O_5)
3. Potassium	Muriate of Potash (MOP) (60 % K_2O)
4. Zinc	Zinc Sulphate ($ZnSO_4$)(Zinc 21%)
OR	
1. Nitrogen and Phosphorus	Diammonium Phosphate (DAP) (18 % N and 46 % P_2O_5)
2. Potassium	Muriate of Potash (MOP) (60 % K_2O)
3. Zinc	Zinc Sulphate ($ZnSO_4$) (Zinc 21%)

Fertilizer	**Dose (kg/ha)**	**Fertilizer requirement (per ha)**	**Dose for one plot of 10m² (g)**	**Fertilizer requirement with100%RDF for oneplot of 10m² (g)**	**Fertilizer requirement with75%RDF for one plot of 10m² (g)**
N	120	261 kg Urea (120 kg N_2)	120 g	261 g Urea	-NA-
P	60	375 kg SSP (60 kg P)	60 g	375 g SSP	281.25 g SSP
K	40	67 kg MOP (40 kg K)	40 g	67 g MOP	-NA-
$ZnSO_4$	25	25 kg $ZnSO_4$ (21% Zinc)	25 g	25g $ZnSO_4$	18.75g $ZnSO_4$

***$FeSO_4$**	Use state recommended fertilizer dose and calculate accordingly

***To be applied on the basis of soil test report, if deficient**

Note: 100% RDF means application of 100% NPK along with 100% Zn and 100% Fe

Treatments	Treatment details	Fertilizer through soil application for one plot of 10 m^2
T_1	No fertilizer (Control)	-NA-
T_2	State Recommended Dose of Fertilizer incl. Zn + Fe (Soil application only)	261 g Urea + 375 g SSP + 67 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% of RDF)
T_3	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**	261 g Urea + 375 g SSP + 67 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% of RDF)
T_4	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano Zn + Fe (Zinc + Iron) @ 125 ml ha^{-1} **(100% seed coating)**	261 g Urea + 375 g SSP + 67 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% of RDF)
T_5	**100% N, K, Zn + Fe with 75% P (Soil application)** + Seed coating of nano P (Phosphorus) @ 125 ml ha^{-1} **(100% seed coating)**	261 g Urea + 281.2 g SSP + 67 g MOP + 25g $ZnSO_4$ + $FeSO_4$
T_6	**100% NPK and 75% Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 125 ml ha^{-1} (**100% seed coating)**	261 g Urea + 375 g SSP + 67 g MOP + 18.75 g $ZnSO_4$ + $FeSO_4$
T_7	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano P @ 62.5 ml ha^{-1} +Foliar spray of nano P @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	261 g Urea + 375 g SSP + 67 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% of RDF)
T_8	**100% RDF incl. Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe (Zinc + Iron) @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	261 g Urea + 375 g SSP + 67 g MOP + 25g $ZnSO_4$ + $FeSO_4$ (100% of RDF)
T_9	**100% RDF of N, K, Zn + Fe and 75% P (Soil application)** + Seed coating of nano P (Phosphorus) @ 62.5 ml ha^{-1} +Foliar spray of nano P @ 250 ml ha^{-1}**(50% Seed coating + 50% Foliar)**	261 g Urea + 281.2 g SSP + 67 g MOP + 25g $ZnSO_4$ + $FeSO_4$
T_{10}	**100% NPK and 75% Zn + Fe (Soil application)** + Seed coating of nano Zn+Fe @ 62.5 ml ha^{-1} + Foliar spray of nano Zn+Fe @ 250 ml ha^{-1} **(50% Seed coating + 50% Foliar)**	261 g Urea + 375 g SSP + 67 g MOP + 18.75 g $ZnSO_4$ + $FeSO_4$

P: Phosphorus; Zn + Fe: Zinc + Iron

Plant protection measures: As per state recommended package of practices

Pest / disease control

- **Rust:** Spray with Propiconazole (Tilt 25 EC @ 0.1 per cent) at stripe rust initiation is recommended. Mancozeb at 3g/l is recommended for other rusts.
- **Karnal Bunt**: One spray of Propiconazole 25EC (Tilt 25 EC) @ 0.1 per cent or Tebuconazole 250 EC (Folicur 250 EC) @ 0.1 per cent be given in mid-February to control the disease.
- **Flag smut of wheat:** Seed dressing with Vitavax @ 2 g/ kg seed or Bavistin or Benlate @ 2.5 g or Thiram 75% @ 3g or Raxil @ 1 g/ kg seed before sowing.
- **Loose smut of wheat:** Treat the seeds with any of the recommended systemic fungicide like Carboxin, Carbenadzim @ 1 to 1.5 gm/ kg seed at the time of sowing.

Observations to be recorded (Tables 5.7 and 5.8):

- Location details of experimental plot (including GPS coordinates)
- Soil nutrient analysis (pre and post experiment)/ Tissue analysis (TERI, Gurugram)
- Field emergence
- Plant stand establishment
- Plant height at 30 DAS and at harvest
- Leaf chlorophyll – Flag leaf stage (SPAD value)
- No. of tillers/ m^2
- Dry matter accumulation/ m^2 (at harvest)
- Seed yield/ plant (gm)
- Seed yield/ ha
- 1000 seed weight (gm)
- Seed recovery (%) – manual basis
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Net monetary returns (Rs.) and Benefit Cost ratio (proforma attached)

Experiment 1

Table 1.1: Flowering and seed setting behaviour in parental lines

Isolation distances/ Parental lines	Days to flower initiation	Day to 50% flowering	Duration of flowering	Extent of selfing by bagging	Plant height at harvest (cm)	Seed set (%)	Seed yield / plant (gm)	Test weight (gm)
Pollen parent (R line)								
				-NA-		-NA-		
Female parent (CMS line)								

D1								
D2								
D3								
..								
..								
..								
Dn								
Mean								

Table 1.2: Observations on pollinator activity at different isolation distances*

Isolation distances/ Parental lines	**Honeybee/other pollinators**			
	Pollen gatherers		**Nectar collectors**	
	FN (8-9 AM)	**AN (2-3 PM)**	**FN (8-9 AM)**	**AN (2-3 PM)**
Pollen parent (R line)				
Female parent (CMS line)				
D1				
D2				
D3				
..				
..				
..				
Dn				
Mean				

Expected output: The revised isolation distance will be worked out for maintaining genetic purity of seed and enhancing seed quality

Experiment 5

Details for soil and tissue sample collection Soil and tissue sample collection

S. No.	**Sample**	**Quantity**	**Replicate**
1	Soil (pre-sowing)	100 gm dried or 200 gm wet sample	1. Send 1 consolidated sample drawn from 3 to 4 replicates combined. 2. Store other replicate/sample for future use or in case of any mishap during transportation. 3. Packaging needs to be leakage proof.
2	Tissue	About 100 gm dried sample to prevent fungal growth	
3	Seed/grain	100 gm	

4	Soil (post-sowing)	100 gm dried or 200 gm wet sample	4. Scheduling of sample dispatch needs to be organized for timely sampling, processing and analysis.

Seedling vigour indices: The indices need to be calculated by using the formula suggested by Abdul-Baki and Anderson (1973) and expressed as whole number **(no decimal places).**

Seedling length: The seedling length will be recorded on the final germination count day on ten normal seedlings selected randomly in each replication of standard germination test. The shoot and root length need to be measured separately on linear scale.

Seedling dry weight: The seedlings selected (10 seedlings/ replication) for measurement of seedling length will be covered with butter paper and dried in Hot Air Oven overnight at 90°C. After drying, they will be kept in a desiccator for cooling (about 30 minutes) and weighed carefully using an analytical balance (0.1 mg precision).

Seedling vigour index-I = Standard germination (%) x Seedling length (cm)

Seedling vigour index-II = Standard germination (%) x Seedling dry weight (mg)

Maize

Table 5.1: Effect of nano nutrient seed coating and foliar spray on plant growth and seed yield attributes in Maize

Treatments	Field emergence (%)	Plant stand establishment	Days to first flowering	Days to 50% flowering	Leaf Chlorophyll content (SPAD value)	Plant height at 30DAS (cm)	Plant height at harvest (cm)	No. of cob/ plant	Seed yield/ plant (g)	Seed yield (q/ha)
T1										
T2										
T3										
T4										
T5										
T6										
T7										
T8										
T9										
T10										
Mean										
SEm±										
CD (P=0.05)										

Table 5.2: Effect of Nano nutrient seed coating and foliar spray on seed recovery, seed quality and economic indicators of Maize

Treatments	Seed recovery (%)	Test weight 1000 seeds (g)	Seed quality			Net monetary returns (Rs.)	Benefit Cost ratio
			Germination (%)	Vigour index I	Vigour index II		
T1							
T2							
T3							
T4							
T5							
T6							
T7							
T8							
T9							
T10							
Mean							
SEm±							
CD (P=0.05)							

Groundnut

Table 5.3: Effect of nano nutrient seed coating and foliar spray on plant growth and seed yield attributes in Groundnut

Treatments	Field emergence (%)	Plant stand establishment	Days to first flowering	Days to 50% flowering	Chlorophyll content (SPAD value)	Plant height at 30DAS (cm)	Plant height at harvest (cm)	No. of pods/plant	Seed yield/ plant (g)	Seed yield (q/ha)
T1										
T2										
T3										
T4										
T5										
T6										
T7										
T8										

T9										
T10										
Mean										
SEm±										
CD (P=0.05)										

Table 5.4: Effect of Nano nutrient seed coating and foliar spray on seed recovery, seed quality and economic indicators of Groundnut

Treatments	Seed recovery (%)	Test weight 1000 seeds (g)	Seed quality			Net monetary returns (Rs.)	Benefit Cost ratio
			Germination (%)	Vigour index I	Vigour index II		
T1							
T2							
T3							
T4							
T5							
T6							
T7							
T8							
T9							
T10							
Mean							
SEm±							
CD (P=0.05)							

Chickpea

Table 5.5: Effect of nano nutrient seed coating and foliar spray plant growth and seed yield attributes in Chickpea

Treatments	Field emergence (%)	Plant stand establishment)	Days to first flowering	Days to 50% flowering	Chlorophyll content (SPAD value)	Plant height at 30DAS (cm)	Plant height at harvest (cm)	No. of pods/plant	Seed yield/ plant (g)	Seed yield (q/ha)
T1										
T2										

T3										
T4										
T5										
T6										
T7										
T8										
T9										
T10										
Mean										
SEm±										
CD (P=0.05)										

Table 5.6: Effect of Nano nutrient seed coating and foliar spray on seed recovery, seed quality and economic indicators of Chickpea

Treatments	Seed recovery (%)	Test weight 1000 seeds (g)	Seed quality			Net monetary returns	Benefit Cost ratio
			Germination (%)	Vigour index I	Vigour index II		
T1							
T2							
T3							
T4							
T5							
T6							
T7							
T8							
T9							
T10							
Mean							
SEm±							
CD (P=0.05)							

Wheat

Table 5.7: Effect of nano nutrient seed coating and foliar spray plant growth and seed yield attributes in Wheat

Treatments	Field emergence (%)	Plant stand establishment	Days to first flowering	Days to 50% flowering	Chlorophyll content (SPAD value)	Plant height at 30DAS (cm)	Plant height at harvest	No. of tillers/m^2	DM accumulation/ m2	Seed yield/ plant (g)	Seed yield (q/ha)

							(cm)				
T1											
T2											
T3											
T4											
T5											
T6											
T7											
T8											
T9											
T10											
Mean											
SEm±											
CD (P=0.05)											

Table 5.8: Effect of Nano nutrient seed coating and foliar spray on seed recovery, seed quality and economic indicators of Wheat

Treatments	Seed recovery (%)	Test weight 1000 seeds (g)	Seed quality		Net monetary returns	Benefit Cost ratio
			Germination (%)	Vigour index		
T1						
T2						
T3						
T4						
T5						
T6						
T7						
T8						
T9						
T10						
Mean						
SEm±						
CD (P=0.05)						

Pro-forma for Calculating Expenditure, Income and BC Ratio for STR Experiments

Sl.	Particulars	Amount (Rs./ha)
A	**Expenditure / Cost**	
1	Recurring cost of imposing the treatment (T1, T2, T3….Tn) (materialistic cost only *i.e.* chemicals, packaging materials, other physical inputs etc.)	
2	Additional labour cost on imposing treatments	
3	Salary component (as per man-days spent for imposing treatments)	
4	Miscellaneous cost	
	Sub total	
5	Interest on working capital (@ 12% per annum for total above, adjusted accordingly as per duration of experiment)	
	Total Expenditure / cost (A)	
B	**Gross income by imposing the treatment**	
1	Seed yield in particular treatment (q/ha)	
2	Price / sale value of seed (Rs./q)	
	Gross Income by imposing the treatment (B**)**	
C	**Gross income in control (T_0)**	
1	Seed yield in control (q/ha)	
2	Price / sale value of seed (Rs./q)	
	Gross Income in control (C)	
D	**Increase in Gross income by imposing the treatment (B - C)**	
E	**Increase in Net income by imposing the treatment (D - A)**	
F	**BC ratio for imposing the treatment (D/A)**	

Note:

1. The above information needs to be calculated for individual/every treatment
2. Expenditure, income etc. may be calculated on per quintal basis for storage experiment
3. For any further queries, contact Dr. Govind Pal, Principal Scientist, ICAR-IISSS, Mau (Mob. No.: 09473821374; Email: drpal1975@gmail.com)

B. Seed Physiology, Storage and Testing

Date: 21.04.2021

Chairman	:	**Dr. Malavika Dadlani** Former Joint Director (Research), ICAR-IARI, New Delhi
External Experts	:	**Dr. R. R. Hanchinal**, Former Chairperson, PPV&FRA, New Delhi **Dr. S.K. Rao**, Vice-Chancellor, RVSKVV, Gwalior **Dr. J. S. Chauhan**, Former ADG (Seed), ICAR, New Delhi **Dr. D.K. Yadava,** ADG (Seed), ICAR, New Delhi
Convener	:	**Dr. Shiv Kumar Yadav,** Principal Investigator/ Principal Scientist, ICAR-IARI, New Delhi

In Seed Physiology, Storage and Testing, a total of six experiments with 3 sub experiments each under experiment numbers third, fourth and fifth were conducted during 2020-21. Based on the deliberations on the findings of these experiments by cooperating centres with the scientists and experts present in the house, the following decisions were taken for finalisation of experiments and inclusion in the Technical Programme for the Year 2021-22.

1. The validity periods for commodities/crops; Wheat, Paddy, Maize, Sorghum, Chickpea, Cotton, Castor, Soybean and Groundnut have been worked out during last three years and recommended, so the **experiment 1** would continue at identified centres with the same objective as was earlier but these commodities/crops would be replaced with other important crops.
2. It was decided that the SSR markers validated during the year under report for paddy hybrids; JRH-19 and CO-4 and maize hybrid, PMH 10 are recommended for commercial use. The other markers that have been identified from the **experiment 2** in crops; Paddy, Maize, Sunflower & Cotton etc. during last two years are to be validated at other cooperating centres and at the identifying centre. Identifying centres to supply sufficient quantity seeds of hybrids and their parental lines. These centres share details of identified markers/protocol with all other participating centres for validation. The centres validating the results of SSR markers must compare these results with GOT in all crops and calculate B:C ratio of both these methods. Efforts for identification of microsatellites markers for additional/new hybrids in crop/s to continue, including Castor where no polymorphic markers were found during 2020-21.
3. Under the **experiment 3**, priming technologies for enhancing planting value of seed under optimal and sub-optimal conditions in some field crops; Chickpea, Kabuli Chickpea, Paddy,

Field pea, Lentil, Mustard, Cotton and Specialty Maize have been validated that should be taken up for demonstration in larger plots at different centres. The priming technologies for low temperature stress during seedling establishment and organic production has been standardized in Maize and Paddy which need to be validated. Moreover, certain field crops; Sunflower, Barley, Pearl millet and Oat may be taken up for development of priming technologies for enhancing planting value of seed under optimal and sub-optimal conditions.

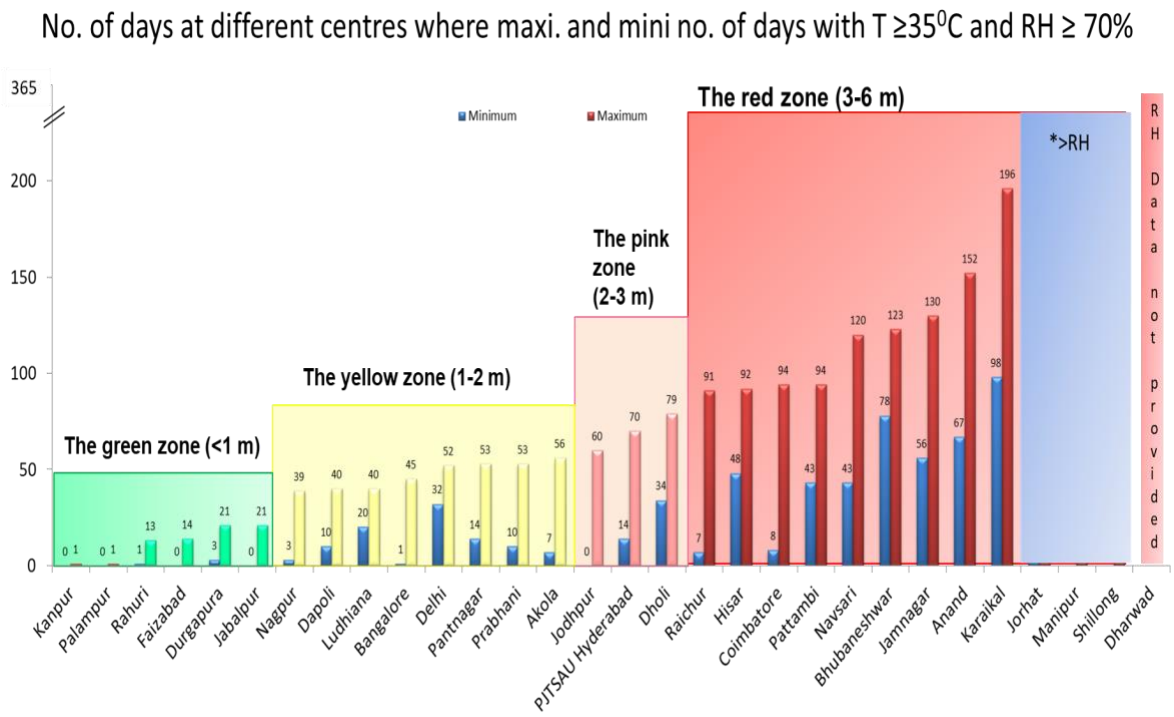
4. The optimum concentrations of different nano-particles of NPs that have been found effective in chickpea and paddy under the **experiment 4** during this year need to be validated and the storability studies of same concentrations along with control would be initiated from this year. Similar to the last years' studies in chickpea and paddy, all combinations to be tried in wheat and maize to standardize the optimum concentration of different nano-particles for seed treatment. It was also decided that the most efficient treatment reported in Soybean & Pigeon pea should be demonstrated.
5. The decision of demonstrating finalized recommendations reported in the wheat, paddy and sorghum from **experiment 5** was taken. This experiment would continue to evaluate the adverse effect of heat stress and its mitigation during the reproductive phase in chickpea and finger millet.
6. Since it was first year for the **experiment 6**, so it was decided that it would continue this year as well. It was also emphasized that the data on radicle emergence % and time taken for maximum numbers of radicles emerged in each crop must be recorded and correlation with seedling factor need to worked out with all other vigour parameters. The centres report, "highest value of correlation was observed between VI-I and field emergence in ..'. Actually we need to quantify the value, how much was it that can classify the low or high vigour? So, this year clear quantification of vigour in each crop is expected to be recommended that could be accepted as universal scale.
7. Wrap up tables as given in last years' technical programme shall be used to summarize and report the six experiments.
8. The findings of the experiment 1 "To reaffirm the validity periods of certified seeds of field crops (as per the IMSCS regulations)" revealed that the decline in vigour may be the concern even if germination % was maintained ≥IMSCS in different crops. Therefore, it was recommended that an **additional experiment (No.7)** to study the effect of revalidation on plant stand establishment and yield should be taken up.
9. The supplement the findings and recommendations of the experiment 1 it was also decided that **one more experiment (No.8)** on data collection on all the crops for assessment of status of revalidated seed lots in the country should be taken up by all the participating centres.

10. All the observations in every crop/experiment to be recorded on minimum four replications of 100 seeds each, except SMC, which will be estimated on dry weight basis as per ISTA recommendations.
11. While calculating vigour indices, average/mean length in centimetres and wet/dry weight in gram of 10 randomly selected seedlings on the day of final count should be taken. The formula to be used uniformly by all the centres; SVI-I= Mean Total Seedling length (cm) X Germination (%) and SVI-II= Mean Seedling Dry Wt. (g) X Germination (%).
12. The proforma for calculation of benefit cost ratios, wherever required shall be provided separately by the Directorate of ICAR-IISS, Mau.

Finalized Recommendations

A. Divide the country in four zones based on the weather conditions for development of dedicated seed storage facilities as per priority requirements at cooperating centres:

- Ten year data on temperature (Max. & Mini.) and relative humidity % (Max. & Mini.) was collected from 28 centres. Based upon the prevailing temperature and humidity conditions across centres, the country may be divided in four different zones for suitability to seed for storage. The red zone categorised as having more than 90 days in total when Temperature and Relative Humidity (RH) remained ≥35°C and ≥70%, respectively. The centres where RH remained ≥70% for more than 180 days were also included in this zone. These are; Karaikal, Anand, Jamnagar, Bhubaneswar, Navsari, Pattambi, Coimbatore, Hisar, Raichur, Jorhat, Imphal and Shillong. The pink zone categorised as having ≥60 to <90 days when Temperature and Relative Humidity (RH) remained ≥35°C and ≥70%, respectively and these are; Jodhpur, Hyderabad and Dholi. The yellow zone categorised as having ≥30 to <60 days when Temperature and Relative Humidity (RH) remained ≥35°C and ≥70%, respectively and these are; Nagpur, Dapoli, Ludhiana, Bengaluru, Delhi, Pantnagar, Parbhani and Akola. The last one could be the green zone categorised as having ≥1 to <30 days when Temperature and Relative Humidity (RH) remained ≥35°C and ≥70%, respectively and these are; Kanpur, Palampur, Rahuri, Faizabad, Durgapura and Jabalpur. Therefore, it was recommended that the Government of India may take up for nationwide development of dedicated seed storage facilities as per priority requirements of different zones.



B. Recommendations from the experiments by various centres during the period under report

Experiment 1: To reaffirm the validity periods of certified seeds of field crops (as per the IMSCS regulations)

Considering the huge impact of these recommendations on seed sector and based on the observations on storage period in different crops at various centres following recommends are made.

In case of the commodities/crops; Wheat, Paddy, Maize, Sorghum, Chickpea, Cotton and Castor: It was recommended that after analysis of sample, if seed is found to conform to the prescribed standards, the Certification Agency shall extend the validity of seed for a further period of six months from the date of expiry of previous validity period or date of test, whichever is earlier. It was also suggested that in these crops II revalidation would be permitted only with special permission of DAC.

In case of the commodities/crops; Soybean and Groundnut: It was recommended that the validity period shall be **six** months from the date of test at the time of initial certification. After analysis of sample, if seed is found to conform to the prescribed standards, the Certification Agency shall extend the validity of seed for a further period of **three** months from the date of expiry of previous validity period or date of test, whichever is earlier. It was also suggested that in no case II revalidation would be permitted in these two crops.

General recommendation: Seed meant for marketing and/or growing of the crops should be dried at optimal moisture content and properly stored with recommended seed storage practices. Moreover, the seed should not be exposed to a combination of RH (70%) and temperature (30^{o}C) for more than a total of 60 days in a year. Decline in vigour may still be the concern even if germination % was maintained ≥IMSCS in different crops.

Experiment 2: Hybrid purity testing using molecular markers in public sector hybrids of field crops

For testing of hybridity and determination of genetic purity following SSR markers are recommended for paddy and maize hybrids.

- SSR markers; RM-228 and RM-570 for paddy hybrids; JRH-19 and CO-4, respectively.
- SRR markers; umc 1627, umc 1786 and umc 1366 for maize hybrid, PMH 10.

Experiment 3: Physiological studies and development of priming technologies for enhancing planting value of seed in field crops under optimal and sub-optimal conditions

Following priming technologies are recommended for enhancing planting value of seed under optimal and sub-optimal conditions in different field crops.

Chickpea: Seed coating (on hydro primed seeds (6h @ 20˚C) with BioNPK + Drought Alleviating Bacteria; Seed coating with *Trichoderma harzianum* (CFU – 2 X 10^{6}per gm) @ 15g/kg seed.

Kabuli Chickpea: Seed coating on hydro primed (4h @ 20˚C) seed with Drought Alleviating Bacteria + Biogrow.

Paddy: Seed coating on hydroprimed (30h @ 25˚C) seeds with *Trichoderma harzianum* (CFU – 2 X 10^{6}per gm) @ 15g/kg seed.

Field Pea: Seed coating on hydroprimed (10h @ 20˚C) seeds with Biogrow

Lentil: Seed coating on hydroprimed (8h @ 25˚C) seeds with Drought Alleviating Bacteria + Biogrow.

Mustard: Seed coating with Biophos on hydro primed (16h @ 20˚C) seeds.

Cotton: Seed coating with Drought Alleviating Bacteria on hydro primed (12h @ 25˚C) seeds.

Speciality Maize: Seed hydropriming (17h @ 25˚C) alone or with dry dressing with thiram.

Pigeon pea: The demonstrations of thermopriming (24h @40˚C) treatment resulted in higher plant stand establishment as compared to untreated control and therefore produced on an average of 8% increased yields and thus the profit. Hence, the simple technology is ready for commercial use.

NB: All the microbial consortia (containing 1 x 10^{9} cfu/g) are recommended to be used with 10% sugar @ 250 ml for seed of one ha.

Experiment 4: Use of nano-particles in enhancing seed quality and storability of seeds

Following treatments amongst the various standardized treatments were validated for their significant effect on enhancing seed quality and storability of seeds and therefore recommended in selected field crops.

Pigeon pea: Seed treatment with nano particle ZnO @ 500 ppm

Soybean: Seed treatment with nano particle ZnO @ 500 ppm

Onion: Seed treatment with nano particle TiO2 @ 250 ppm

Experiment 5: Influence of terminal heat stress on seed set, seed yield and quality in field crops

Following treatments amongst the various standardized treatments were validated for their significant effect on mitigation of heat stress during the reproductive phase in maintaining or improving the yield and seed quality parameters and therefore recommended in selected field crops.

Wheat: Two sprays of Salicylic acid (800 ppm) at Vegetative and Anthesis stages.

Sorghum: Two sprays of Salicylic acid (400 ppm) at Vegetative and Anthesis stages.

Paddy: Two sprays of Salicylic acid (400 ppm) at Vegetative and Anthesis stages.

Mustard: Two sprays of Salicylic acid (400 ppm) at Vegetative and Anthesis stages.

Technical Programme for 2021-22

Experiment 1: To reaffirm the validity periods of certified seeds of field crops (as per the IMSCS regulations)

Year of Start: 2017-18

Rationale: The aim of IMSCS, is to ensure optimal plant stand in the farmers' fields with supply of quality seed with achievable germinability by the producers. As per the present law of the land, the certification tags issued to the seed lots after procedural formalities are valid for 9 months from the date of first test and can be revalidated for another 6 months till they maintain viability ≥IMSCS on the date of test. This has been causing practical problems for those who are into seed trade as well for the end-users. Therefore, it is required to assess the period till viability in various crops at different locations that can actually be maintained ≥IMSCS and the status of vigour during variable storage period. So, the findings of this experiment are expected to provide scientific evidence for consideration of revision of validity, if required.

Objective: To study the planting values of seeds to examine the prescribed periods of validity of seed lots of some major field crops.

Crops	Centres

Pigeon pea (2500 g)#	:	PDKV, Akola; UAS, Dharwad; VNMKV, Parbhani; **PAU, Ludhiana*** and PJTSAU, Hyderabad
Kabuli Chickpea (7500 g)#	:	**MPKV, Rahuri***; PJTSAU, Hyderabad; NDUAT, Faizabad and CCSHAU, Hisar
Lentil (1100 g)#	:	**JNKVV, Jabalpur***; AAU, Jorhat; RAU TCA Dholi; AAU, Jorhat and IISS, Mau
Mustard (500 g)#	:	SKNAU, Jobner; CAZRI, Jodhpur; CCSHAU, Hisar; UBKV, Pundibari and **NDUAT, Faizabad***
Sunflower (1300 g)#	:	**UAS, Bengaluru***; PJTSAU, Hyderabad; JAU, Jamnagar; BSKKV, Dapoli; OUAT, Bhubaneswar and TNAU, Coimbatore
Barley (1100 g)#	:	ICAR-IISS, Mau; RAU TCA Dholi; PAU, Ludhiana; CSKHPKV, Palampur; **ICAR-IIWBR, Karnal*** and CCSHAU, Hisar
Pearl millet (550 g)#	:	JAU, Jamnagar; VNMKV, Parbhani; **SKNAU, Jobner***; MPKV, Rahuri and CCSHAU, Hisar
Oat (1100 g)#	:	PAU, Ludhiana; JNKVV, Jabalpur; OUAT, Bhubaneswar; UBKV, Pundibari; CSKHPKV, Palampur; RAU TCA Dholi and **SKUAST, Srinagar (only to supply seeds)***
Onion (500 g)#	:	UAS, Bengaluru; MPKV, Rahuri; JNKVV, Jabalpur; AAU, Anand; PJTSAU, Hyderabad; ICAR-IARI, New Delhi and **UAS, Dharwad***

***Centres to send the required quantity/Minimum weight (g) # of freshly harvested seeds of two varieties each in moisture impervious packaging material (≥700 gauge polythene) to respective cooperating centres of the crop/s.**

NB: The minimum weight (g) in different crops have been calculated for approximate requirements using the test wt. values available at; https://www.agriexam.com/test-weight-of-different-crops. Therefore, each identified centre **MUST** ascertain test wt. (1000 seed wt.) of their varieties first and calculate the requirement. After that send about 20-25% more than the calculated quantity to each participating centre that is sufficient to test for 24 months, please. ***The identified centre would ascertain the date of harvest of each variety and test the seeds for germination and moisture before supplying to the respective centres and also share the initial results to respective cooperating centres.***

Technical Programme:

The very purpose of this objective of the experiment is to know how long the seeds lots can maintain viability over and above IMSCS. The experiment will be terminated once the germination % count reaches below IMSCS in respective crop/s or for maximum period of 24 months, whichever is earlier.

Materials:

Seed lots:

- For different crops, different **centres identified*** (in bold text above) to timely post/send the sufficient quantities of seeds in moisture impervious package (700 gauge) as mentioned above (#).
- Sufficient quantities of fresh seeds of their two popular varieties in each crop will be sent by the centres identified to the every cooperating centres of that crop. It may be 25% more than the worked out quantities. **Date of harvesting, Moisture content, Viability (Germination %), and Date of test should be noted and made known to all the participating centres.**
- The ICAR-IISS, Mau will bear the cost of purchase of the seeds for this purpose and the postage, if required.

Handling of Seed lots upon receipt by participating centres:

- The participating centres would immediately upon receipt test both the varieties for Moisture content, germination % and work out Vigour index-I & II.
- The received seeds after initial testing at respective centre would be divided into two equal parts and one part is to be stored safely under ambient laboratory conditions in gunny bag while other part in HDPE bags of uniform specifications (130 GSM, non-woven type).
- Kindly note that moisture content may be required to bring down by drying before storage to maximum limit allowed as specified in IMSCS, 2013 for concerned crops for both packaging materials, if it is more than the recommended levels for each crop.
- Keep on recording germination percentage at one month interval for at least 24 months from date of harvesting or till the germination approaches to IMSCS in respective crops, whichever is earlier. The moisture content (MC) may be taken at three months interval.
- *The centres may fumigate the stored seeds, if needed but will not treat. The details of fumigation/s done are to be reported.*

Laboratory Observations:

- Seed Moisture Content % (ISTA) - **Monthly**
- Germination Percentage (ISTA) - **Monthly**
- Centres may take any other observations; Time (hrs) for maximum numbers of radicle emergence (≥2mm), First count %, Vigour index-I & II (Abdul Baki and Anderson, 1973) etc.

Kindly Note:

- *The climate data at respective participating centres; Monthly mean temperature (^{0}C) and RH %, from start of storage till termination of experiment need to be correlated and reported.*

Experiment 2: Hybrid purity testing using molecular markers in public sector hybrids of field crops

Year of Start: 2011- 2012

Rationale: Identification and genetic purity testing are the two important issues of quality control in seed sector. Genetic purity of parental lines and hybrids is of crucial importance. One percent reduction in purity of hybrid seed, results in a reduction of about 100 kg/ha in yield of commercial crop. Traditionally genetic purity is done by Grow-out Tests (GOT), based on morphological assay. Commonly used grow-out tests, based on morphological identification are time-consuming, labour intensive and space demanding, so field trials are difficult to distinguish the increasing number of hybrids and test their purities. Application of the molecular marker analysis technology has shown potential in cultivar identification and hybrid purity testing of crops, To detect loci in parental inbred and corresponding F_1 is the most important step in seed genetic purity testing of hybrid (F_1). The molecular markers tightly linked with the important agricultural traits would facilitate the purity testing of hybrid/s. The SSR markers have an advantage of co-dominance inheritance, easy scoring of the alleles, reproducibility and accessibility to laboratories. These markers have both female and male specific bands and are very useful in genetic & hybrid purity testing. Moreover, being objective, efficient, time-saving, less labour intensive and reproducible, the SSR markers could play an important role in identification of varieties as well hybrids and seed genetic purity testing, and have the potential to replace the grow-out test (GOT). Therefore, the experiment was designed to identify the hybrid specific SSR markers and validate to determination hybrid purity as an alternate to GOT.

Objectives:

1. To validate the identified markers for establishing hybridity in different hybrids of various field crops
2. To assess the efficiency of molecular markers in hybrid purity testing in comparison to the grow-out test (GOT) in various field crops.
3. To identify microsatellites markers for establishing hybridity in additional/new hybrids of various field crops

Crops	**Centres***	
Paddy	:	PJTSAU, Hyderabad; TNAU, Coimbatore; JNKVV, Jabalpur; AAU, Jorhat and KAU, RARS, Pattambi
Maize#	:	UAS, Bengaluru; ICAR-IISS, Mau and PAU, Ludhiana
Pearl millet	:	SKNAU, Jobner and NAU, Navsari
Sunflower	:	UAS, Bengaluru and RAU, TCA, Dholi
Cotton	:	ICAR-CICR, Nagpur; PAU, Ludhiana; ICAR-IISS, Mau and PDKV, Akola
Castor	:	PJTSAU, Hyderabad and ICAR-IISS, Mau (ICAR-IIOR, Hyderabad – only to

		supply seed and details of markers/protocol)
Sorghum	:	PDKV, Akola; UAS, Bengaluru and ICAR-IIMR, Hyderabad

* All the centres will make the available seeds with parental lines of newly released hybrids, if any, by their institute/university to every centre of that crop for identification of new marker/s. Participating centre/s for specific crop/s to also supply seeds and share details of identified markers identified and protocol followed by them with all other centres for validation, in addition to carrying out the proposed research. The results of markers must be compared with results of GOT in all crops and B:C ratio of both these methods is to be calculated.

The participating centres of maize must also to follow ISTA recommended method of testing of hybrid purity using isozymes as available (Orman *et al.,* 1991) this year at least.

Details of the markers for validation and efficiency (Objective 1 & 2)

Crop	Name of Hybrid	Name of the Marker	Identifying Centre
Paddy	JRH 19	RM 228	JNKVV, Jabalpur
	JRH5	RM276	
Maize	PMH 1	Umc 1798	PAU, Ludhiana
	PMH 10	Umc 1627	
	MAH-14-5	Bnlg 1520	UAS, Bengaluru
		Bnlg1185	
		Umc 1288	
		Umc1594	
	HEMA	Phi053	
		Bnlg 1621	
		Bnlg 1014	
		Bnlg1185	
		Umc1594	
	Palam Sankar Makka-2	umc 1066	CSKHPKV Palampur
Sunflower	ORS-57 and ORS-170	KBSH-78	UAS, Bengaluru
	ORS-610	KBSH-79	
	ORS-513 and ORS-613	KBSH-41	
	ORS-716	KBSH-44	
	ORS-621 and ORS-811	KBSH-53	

	ORS-513, ORS-605 and ORS-337	NSH-10	
Cotton	PDKV Suvarna & PKV DH-1	BNL 1694, BNL 226, NAU 2000 and BNL 4049	PDKV, Akola

Identification of Microsatellites Markers for Additional Hybrids (Objective 3)

Sincere efforts in the mentioned crops to identify unique makers to be made by all participating centres in Paddy, Maize, Pearl millet, Sunflower, Cotton, Castor, Sorghum and any other crop/s of interest of centre/s where hybrids are available. Further, for pre-released hybrids, include only those hybrids which have entered AVT-II stage or above.

Special Note: Each centre need to identify a minimum two unique makers for each hybrid employed in the study. It was also decided that Dr. Sharmila Dutta, AAU Jorhat and Dr. N. Nethra, UAS Bengaluru shall compile the markers identified and validated till 2020-21in different crops since inception of this experiment.

Technical Programme:

Materials:

The details of identified markers, protocol followed and seeds of hybrids with parental lines shall be shared among the centres as indicated above. The participating centres are requested to contact each other immediately to share seeds and protocols etc. The PI should be informed in case of problem(s), if any (pispnsp@gmail.com). Kindly keep the Director, IISS Mau in the loop for all the correspondences. DNA profiles of parents and hybrids for which they are available at ICAR-NBPGR, New Delhi or in public domain will be used as standard profiles. Also, for varieties/hybrids for which unique polymorphic markers are not available, will be developed through genotyping/GBS, if funds are available from any other source. The details of markers identified by parent institute(s) for their own hybrids, if any and seeds of hybrids and their parents will be supplied by the ICAR-CICR, Nagpur (Contact person: Dr. P. R. Vijaya Kumari, 9822572302; rachelvk123@gmail.com) and PDKV, Akola (Contact person: Dr. A.A. Akhare, 9881880083; atulakhare@yahoo.com) for cotton; by PDKV, Akola (Contact person: Dr. A.A. Akhare, 9881880083; atulakhare@yahoo.com) for Sorghum and by ICAR-IIOR, Hyderabad (Contact person: Dr. S.N. Sudhakara Babu, 9440847405; sudhakarababu.sn@icar.gov.in) for Castor. In addition to seeds of newly released hybrids and their parental lines from participating centres of each crop, each centre will also try to take seeds of the available public sector released hybrids and their parental lines, preferably from the breeding institutes for the purpose of identification of unique molecular markers.

Methodology:

There are standardized methods available for testing of hybrid purity/ hybridity using molecular markers in each crop and will be used for;

1. Genomic DNA extraction by CTAB/modified CTAB method (Taylor *et al.,* 1995; Liu *et al.,* 2003) or Kit method.
2. Quantification of DNA and assessment of DNA quality for each sample on 1.2% agarose gel.
3. PCR analysis using unique markers (e.g. Paddy- Nandakumar *et al.*, 2004, Sundaram *et al.*, 2008; Maize- Mingsheng *et al.*, 2010; Pearl millet- Nagawade *et al.*, 2016; Sunflower- Antonova *et al.*, 2006, Pallavi *et al.*, 2011 and Cotton- Dongre *et al.*, 2011). The protocols may need further standardization for detection of mixtures or off-types using the serial dilution of DNA as template DNA for PCR based detection.
4. The results of molecular marker analysis will be compared with the Grow-Out Test:
   Size of working sample for GOT; The minimum population required for taking the observations shall be 400 plants when minimum genetic purity of ≤99% is required; however, it will also depend on the maximum permissible off-type plants prescribed for the species under consideration in the Indian Minimum Seed Certification Standards. The number of seeds required for raising the crop to obtain the required number of plants shall depend on the germination percentage of the seed sample and hence, seed rate should be adjusted accordingly. Grow out test shall be conducted in specified areas recommended for the hybrid or in off-season nurseries. The standard sample of a hybrid (control) to be obtained from the originating plant breeder / breeding institute, which will be the official standard against which all other samples of the seed of the hybrid will be judged/compared. Standard and recommended agronomic / cultural practices such as field preparation, size of the plot, row length, distance between rows, the distance between the plants, irrigation and fertilization, etc., in respect of the specific crop shall be followed both for the sample in question and its control (standard sample).
   Methods for taking observations: Grow-out test plots must be examined throughout the growing season with emphasis on the period from the flowering to ripening. All plants must be examined keeping in view the distinguishing characters described for the hybrid both in the test crop as well as the control. While taking the observation, the plants showing deviations in characters against the control should be tagged and examined carefully at a later stage to confirm whether they are off-types or not. The number of the total plants and the off-type plants found should be recorded.
   Calculation and interpretation of the results: Percentage of other cultivars, species or aberrant found must be calculated up to one decimal place. While interpreting the results, tolerances should be applied by using the reject number for prescribed standards with reference to sample size. The reject numbers will be; 8, 24, 44 and 64 for sample size of 400 plants if 99, 95, 90 and 85% purity, respectively is targeted.

5. The DNA profiling of all the hybrids along with parents grown as check in GOT plots may be done to validate the findings.
6. For validation studies, two dimensional DNA sampling strategies is to be adopted for purity assay suggested by Nas *et al.* (2002). Thus, a total of 40 DNA bulks representing 20 rows and 20 columns can be used for comparison with GOT.
7. Every centre to work out cost effectiveness (B:C ratio) for GOT vis-à-vis molecular markers, taking all components of cost into account.

Experiment 3: Physiological studies and development of priming technologies for enhancing planting value of seed in field crops under optimal and sub-optimal conditions

Year of start: 2018-19

Rationale: Seed priming, the pre-sowing treatments which lead to a physiological state that enable seed to germinate more efficiently under optimal conditions and enhance emergence even under adverse agro-climatic conditions such as cold and wet or extreme heat. Priming often involves soaking seed in predetermined amounts of water, solutions of hormones, osmotic agents and salts and drying back to initial moisture content Some physical treatments (heat/thermo-priming, cold, UV, etc.) also provide germination improvement thus suggesting that priming effects are not necessarily related to seed imbibition. Primed seeds are expected to exhibit faster, vigorous and more synchronized germination under stress conditions. Moreover, there are areas in our country where paddy and maize grown in normal season are chronically affected by various biotic, abiotic and natural calamities. This forces the farmers to grow particularly in a winter season in which these crops normally don't perform better. Exposure to low-temperature stress, during germination and early seedling growth, can negatively affect the initial stand establishment and finally the yields. A better understanding of the metabolic events taking place during the priming treatment and the subsequent germination should help to use this simple and cheap technology in a more efficient way. Any such technology tested positive should be validated at different locations before recommending it for up scaling. Therefore, this experiment was designed with the following objectives;

Objectives:

1. Standardization of priming technologies for enhancing planting value of seed under optimal and sub-optimal conditions in selected field crops
2. Validation of standardized priming technologies for low temperature stress during seedling establishment in Maize and Paddy
3. Demonstrations of identified priming technologies in different field crops for sub-optimal/stress conditions

1. For standardization of priming technologies		
Crops		**Centres**
Sunflower	:	UAS, Bengaluru; PJTSAU, Hyderabad; PDKV, Akola; OUAT, Bhubaneswar and TNAU, Coimbatore
Barley	:	ICAR-IISS, Mau; RAU TCA Dholi; PAU, Ludhiana; CSKHPKV, Palampur and ICAR-IIWBR, Karnal
Pearl millet	:	JAU, Jamnagar; SKNAU, Jobner; CCSHAU, Hisar and NDUAT, Faizabad
Oat	:	PAU, Ludhiana; JNKVV, Jabalpur; OUAT, Bhubaneswar; CCSHAU, Hisar and RAU TCA Dholi
2. Validation of standardized priming technologies for low temperature stress		
Maize	:	ICAR-IARI, New Delhi; ICAR-*VPKAS, Almora CSKHPKV, Palampur and* RAU TCA, Dholi
Paddy	:	AAU, Jorhat; UBKV, Pundibari; GBPUAT, Pantnagar; SKUAST, Kashmir, Srinagar and ICARRC NEH Region - Manipur Centre
3. Demonstrations of validated priming technologies (Mini. 500sqm for Treat. & Ctrl.)		
Chickpea	:	ICAR-IISS, Mau; PDKV, Akola; UAS, Raichur; VNMKV, Parbhani and CCS HAU, Hisar
Kabuli Chickpea	:	PAU, Ludhiana; UAS, Raichur; MPKV, Rahuri; and PDKV, Akola
Paddy	:	UAS, Bengaluru; ICAR-IIRR, Hyderabad; GBPUAT, Pantnagar; OUAT, Bhubaneswar and TNAU, Coimbatore
Field pea	:	PAU, Ludhiana; CSKHPKV Palampur and ICAR-IISS, Mau
Lentil	:	JNKVV, Jabalpur; AAU, Jorhat and NDUAT, Faizabad
Mustard	:	ICAR-IARI, New Delhi; AAU, Jorhat; UBKV, Pundibari; ICAR-CAZRI, Jodhpur; and CCS HAU, Hisar
Cotton	:	AAU, Anand and MPKV, Rahuri
Specialty Maize	:	ICAR-IARI, New Delhi; ICAR-*VPKAS, Almora;* RAU TCA, Dholi and AAU, Anand
Pigeon pea	:	PJTSAU, Hyderabad; ICAR-IISS, Mau; AAU, Jorhat; and PAJANCOA&RI, Karaikal

NB: Every centre was required to work out the cost effectiveness (B/C ratio) for the maximum two significantly better treatments in comparison with control taking all components of cost into account (proforma attached).

Sub. Experiment I (Objective 1): Development of priming technologies for enhancing planting value of seed under optimal and sub-optimal conditions in selected field crops

Technical programme:

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 (within the acceptable limits of germination) 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 standardization 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* - The centre shall standardize the duration (start from 4hr of soaking to 30hr) and amount of water (Wt./Vol. - Half to One and half times) to soak seeds for optimal hydropriming. To start with the time interval for soaking should not more than 2 hours, however further adjustment (±30min, one hour, one and half hour) of time interval within the last lag would be required, if radicle emergence is observed.

- The temperatures at which standardization of priming may be kept at 25°C, 20°C, 30°C and 20°C for Sunflower, Barley, Pearl millet and Oat, respectively.
- Treated seeds are dried back to initial moisture (air-drying in shade (~25°C for minimum 48h) or in drying cabinet at 35 ± 1°C).
- 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 (Maximum volume of water/solution = 1.5 times the Wt. of seed is suggested.* The period, temperature and drying specified above may be the same for all other priming treatments.
- Before drying the treated seeds till initial moisture levels, care must be taken that seeds are wiped with tissue paper and or spread on germination paper so as there should not any water remained adsorbed on the seed coat. Drying under fan must be done in shade by spreading seeds individually on germination paper.

4. *Thermopriming* – Exposure of seeds to different temperatures (30, 35, 40, and 45°C) for different periods (6, 12, 24, 36 and 48 hr) would be required for standardization.
5. *Pre-chilling:* **S**eeds are to be kept at a temperature of 5 to 10°C for a period of 7 days.

Observations:

After drying seeds are tested along with controls as mentioned above under specific stress conditions (Drought/moisture and temperature) for all crops. The treated seeds along with both the controls would be tested as per ISTA method for seed quality parameters in prescribe media at recommended temperatures (control) along with the different stress conditions as the seeds have been given the treatments. Effect of the treatments on biotic stress (fungal infections) to be recorded. For emergence studies, the drought/moisture stress could be created by controlling the water supply in trays/pots/field. Use germinators set at different temperatures for temperature stress or sowing dates can be adjusted (prepone/postpone). For additional studies, if interested, on biotic (fungal) stress sowing in sick plots and or inoculating with the target fungus. Be carefully about reporting the significance of a treatment over control, under normal growing/testing (no stress) conditions the control may still give better results.

Observations: Following observations are to be recorded in all treatment combinations.

- Moisture content (ISTA) before and after treatment
- Time (hrs) for maximum numbers of radicle emergence (≥2mm)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)
- Incidence of seed borne pathogens (%)
- Seedling/Field emergence (%)

Sub. Experiment II (Objective 2): Validation of standardized priming technologies for low temperature stress during seedling establishment in Maize and Paddy

Year of start: 2018-19

Technical programme:

Materials: Two most prevailing varieties in each crop are to be taken.

Microbial consortia (Biophos, Draught Alleviating Bacteria (DAB) & cold adoptive Plant Growth–Promoting (rhizo) Bacteria (PGPB) etc.) for priming and abiotic stress mitigation to be supplied by the Coordinating Unit, ICAR-IISS, Mau, and organics; *Trichojal, Metajal & Beauverijal* for treatment to be made available by AAU, Jorhat, please. The methodology for microbial consortia treatments will be followed as mentioned below.

Method/dosage of treatment of microbial consortia and for the treatment with Biophos & Drought Alleviating Bacteria;

1. Dosage for 1/2 acre sowing area: Dilute 50 ml of formulation in 500 ml water. Add sugar or sucrose @ 10%. This quantity is sufficient to treat seeds required ½ acre.

2. Dilute required quantity of specific formulation as per seed requirement of particular plot size @ 1:10 ratio (microbial formulation: water) and add sugar or sucrose @ 10 % of final volume.
3. The bacterial suspension is then sprinkled on the seeds and the seeds are slowly but thoroughly mixed to have a uniform coating. Leave it for 30 minutes
4. Then the seeds are spread uniformly for drying on a gunny bag or cement floor in shade for 30-45 minutes avoiding direct sunlight.
5. In case of direct seeded paddy the seeds may be treated while in transplanted paddy, root dip treatment should also be given.

Treatments:

1. Control (Untreated)
2. Control (Recommended PoP)
3. Crop specific treatments for validation as mentioned below

Name of Crop	Name of the Treatments (In addition to 2 controls)
Paddy	For low temperature stress: 1. Seed coating on hydroprimed (30h @ 25^{O}C) seeds with *Trichoderma harzianum* 2. Primed with GA (@100ppm) followed by DAB + Biophos 3. Seed coating with cold adoptive PGPB
	For organic conditions: 1. Seed treatment with organic *Trichojal* @5ml/kg seed /lit. 2. Seed treatment with organic *Metajal* @5ml/kg seed /lit. 3. Seed treatment with organic *Beauverijal* @5ml/kg seed /lit.
Maize	For low temperature stress: 1. Primed with GA (@100ppm) followed by DAB+Biophos 2. Seed coating on hydroprimed (30h @ 25^{O}C) seeds with *T. harzianum* 3. Seed coating with cold adoptive PGPB

NB: The participating centre/s may include any other beneficial treatment/s (max. 2) based upon literature or their experience

Laboratory observations (before and after treatments):

- Seed Moisture content (ISTA)
- Time (hrs) for maximum numbers of radicle emergence (≥2mm)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)

Field observations: To be observed in a minimum of 5 randomly selected plants or panicles/cobs /rep/treatment from # 3 to 9.

1. Speed of emergence(JD Maguire, 1962)
2. Final plant stand establishment (%) after 5 weeks
3. Total number of tillers
4. Number of productive/effective tillers
5. Plant height (cm)
6. Panicle or cob length (cm)
7. Total number of seeds/panicle or cob
8. Number of empty seeds/panicle or cob
9. Seed set %
10. 1000 seed weight of seed produced (g)
11. Plot yield (kg)
12. Harvest Index
13. Evaluation of quality (as per ISTA) of seed produced (all laboratory observations as mentioned above)

Following are to be observed only for control and max. 3 significantly better treatments.

14. α-amylase activity in seed produced
15. Total soluble sugar content in seed produced
16. EC of seed leachates in seed produced
17. Cost benefit ratio of the best treatment in each crop identified at your centre

Sub. Experiment III (Objective 3): Demonstrations of identified priming technologies in different field crops for sub-optimal/stress conditions

Year of start: 2020-21

Objective: To demonstrate the benefits of identified priming technologies in different field crops for sub-optimal/stress conditions

Technical programme:

Materials: Two most prevailing varieties are to be taken.

Treatments:

1. Control (Untreated)
2. Control (Recommended PoP)
3. Crop Specific validated treatment as mentioned below

Name of Crop	Name of the Treatments (In addition to 2 controls)
Chickpea	1. Seed coating (on hydro primed seeds (6h @ 20^{O}C) with BioNPK +

	Drought Alleviating Bacteria (DAB) 2. Seed coating with *T. harzianum* (CFU – 2 X 10^6per gm) @ 15g/kg seed
Kabuli Chickpea	1. Seed coating on hydro primed (4h @ 20^OC) seed with DAB+ Biogrow
Paddy	1. Seed coating on hydroprimed (30h @ 25^OC) seeds with *Trichoderma harzianum*
Field pea	1. Seed coating on hydroprimed (10h @ 20^OC) seeds with biogrow
Lentil	1. Seed coating on hydroprimed (8h @ 25^OC) seeds with DAB+ Bio grow
Mustard	1. Seed coating (on hydro primed (16h @ 20^OC) seeds) with Biophos
Cotton	1. Seed coating (on hydro primed (12h @ 25^OC) seeds) with Drought Alleviating Bacteria
Specialty Maize	1. Seed hydropriming (17hrs 25^0C) alone or with dry dressing with thiram
Pigeon pea	1. For Moisture Stress: Hydro-priming (10h @ 25^OC)
	1. For Salt Stress: Halopriming (6dSm^{-1} solution of NaCl + $CaCl_2$ for 8h @25^0C)

Planting: The treated and untreated (control) seeds are to be planted in at least 500Sqm each at the time when day temperatures will expected to be ≥40°C for mini. 10 days after sowing in kharif and above ≥30°C for mini. 10 days after sowing in rabi. The recommended package and practices are to be followed for raising good crop.

Laboratory observations (before and after treatments):

- Seed Moisture content (ISTA)
- Time (hrs) for maximum numbers of radicle emergence (≥2mm)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)

Field observations:

1. Final plant stand establishment (%) after 5 weeks - (Observations to be taken on seedlings/plants in control as well as treatment plots at randomly selected 4 places in 5 meter row lengths)
2. Plant height (cm) of 5 plants each at randomly selected 4 places in plots.
3. Total number of pods/plant in 5 plant each at randomly selected 4 places in plots.
4. Total number of seeds/pod in 5 pods/plant each at randomly selected 4 places in plots.
5. Per plant yield in 5 plant each at randomly selected 4 places in plots.
6. 1000 seed weight of seed produced (4 replications from each plot)
7. Plot yield (kg)
8. Harvest Index
9. Evaluation of quality (as per ISTA) of seed produced

10. Benefit: Cost ratio

Experiment 4: Use of nano-particles in enhancing seed quality and storability of seeds

Year of start: 2016-17

Rationale: In order to improve seed quality there are several seed quality enhancement techniques are used and have their own benefit. Application of nano materials for agriculture is relatively new as compared to their use in biomedical and industrial sectors. Nano materials are very tiny particles, size ranging from 1 nano meter (one-billionth of a metre) to 100 nano meter. In modern agriculture, sustainable production and efficiency are unimaginable without the use of agrochemicals, fertilizers etc. Nanotechnology has the potential to increase food quality, plant protection, detection of plant and animal diseases, monitoring of plant growth, global food production and improving seed quality. As the literature suggest that both ROS and aquaporins play important roles in enhancing seed germination. Nanopriming could enhance α-amylase activity, resulting in higher soluble sugar content for supporting seedlings growth. Furthermore, nanopriming stimulated the up-regulation of aquaporin genes in germinating seeds and has been found to increase ROS production in germinating seeds. However, differences in seedling sensitivities depending on the concentrations and the types of NPs are also reported in different crops. Thus, it is imperative to explore the use of nanoparticles as seed treatment can speed up germination, increases seedling vigour and strength, limit the fructification of disease causing fungal spores, improve seed quality and storability in various field crops. Therefore, this experiment was designed with the following objectives;

Objectives:

1. To standardize the optimum concentration of different nano-particles for seed treatment in Wheat and Maize.
2. To validate the effect of different nano-particle treated seeds on seed quality parameters and effect on storability of Pigeon pea, Paddy and Chickpea.
3. To demonstrate the enhanced planting value of validated nano-particle treated seeds of Onion and Soybean.
4. *To study the effect on storability of the Nano fertilizer treated seeds from TERI and longevity of seed produced under SPC experiment in different crops*

Crops		**Centres#**
1. For standardization of optimum concentration of different NP's (Objective -1)		
Wheat	**:**	GBPUAT, Pantnagar; MPKV, Rahuri; **HAU, Hisar*** and NDUAT, Faizabad
Maize	**:**	**PAU, Ludhiana***; RAU TCA, Dholi and CSKHPKV Palampur

2. Validation of optimum concentration of different NP's (Objectives -2)		
Chickpea	:	UAS, Dharwad; UAS, Raichur and ICAR- IISS, Mau (**HAU, Hisar*;** To supply seed only)
Paddy	:	PJTSAU, Hyderabad; AAU, Jorhat; KAU, RARS, Pattambi and PAJANCOA&RI, Karaikal (**PAU, Ludhiana***; To supply seed only)
Pigeon pea	:	AAU, Jorhat; PAU, Ludhiana; UAS, Bengaluru and PAJANCOA&RI, Karaikal (**ICAR-IARI, New Delhi***; To supply seed only)
3. Demonstrations of NP priming technologies (Mini. 500sqm for Treat. & Ctrl.) (Objectives -3)		
Soybean	:	**JNKVV, Jabalpur***; IARI, New Delhi; VNMKV, Parbhani; NAU, Navsari ; GBPUAT, Pantnagar; and PDKV, Akola
Onion	:	**MPKV, Rahuri***; AAU, Anand and NDUAT, Faizabad
4. Storability of the Nano fertilizer treated seeds from TERI & Longevity of seed produced (Objectives -4)		
As per SPC Experiment	:	**At two identified centres in experiment 7 of the SPC group**

***Nodal Officers/In-Charges, NSP/STR of identified centres to supply seeds to TNAU, Coimbatore. #TNAU, Coimbatore to treat seeds and supply to participating centres.**

Technical programme:

Availability of Seed Materials and Treatments:

The Nodal Officers/In-Charges, NSP/STR of identified centres to kindly ensure the **timely supply of required quantities of seeds (total) of two varieties each in all crops to TNAU, Coimbatore for treatment with desired nanoparticles.** The details of treatments have been mention below under different sub experiments. TNAU, Coimbatore shall treat all the seeds with desired nanoparticles and send the proportionate seed in proper packaging to all the participating centres of each crop. In case of any problems contact the PIs and NP seed treatment related issues, Dr. C. Vanitha, Assistant Professor, SST, TNAU, Coimbatore (+91-9080461717; cvani_seed@yahoo.co.in) may be contacted**,** please**.**

NB: To address the issue of safety issue, this year as well, all centres to evaluate seedlings for sensitivity to different concentrations of various NPs at seed germination stage. However, the participating centres are given options to take observations as deemed fit, till the competent body of GoI issues approved guidelines in this regard, in collaboration with other scientists of appropriate disciplines on effect on NPs on health of plants, soil, environment, humans, animals, insects, microbes, etc.

Sub. Experiment I (Objective 1): To standardize the optimum concentration of different nano-particles for seed treatment in Wheat and Maize

Materials and Methods:

Crops and Varieties: Minimum one predominant variety in each crop is to be taken for studies/treatments by every participating centre. In case of Wheat two centres; GBPUAT, Pantnagar and CCS HAU, Hisar will work on one variety while the two centres; MPKV, Rahuri and NDUAT, Faizabad will work another one variety. The sufficient quantity of seeds of both these varieties is to be supplied by the CCS HAU, Hisar centre to TNAU, Coimbatore for treatment. In case of Maize two centres; PAU, Ludhiana and RAU TCA, Dholi will work on one variety while the two centres; BSKKV, Dapoli and CSKHPKV Palampur will work another one variety. The sufficient quantity of seeds of both these varieties is to be supplied by the PAU, Ludhiana centre to TNAU, Coimbatore for treatment.

- Designated centres/scientists will send the required quantities of seed for NP treatments to TNAU Coimbatore.
- Seeds will be dried to safe and uniform moisture level before treatment and directly treated with the listed combinations of NPs in a plastic or glass jar by mixing thoroughly for even distribution.
- The TNAU Coimbatore centre will only assess the seed moisture content before and after treatments and communicate to respective centres with treated seeds.

Treatments:

Formulations**:** Dry & Wet (Both)

Forms: Bulk and Nano (Both).

Nano-particles: Zinc oxide, Titanium dioxide and Silicon dioxide

Dosage: Controls -2 (Untreated & Recommended PoP): 50, 100, 250, 500 and 750ppm

Replication: Three (Minimum of 100 seeds each)

Observations taken: The treated seed along with 2 controls (1. Untreated and 2. Recommended PoP) of one variety each by respective centres shall be evaluated for various seed quality parameters;

1. Time (hrs) for maximum numbers of radicle emergence (≥2mm)
2. Seed germination (%) (ISTA)- First count and final count
3. Increase or decrease in abnormal and dead seeds over control in different conc. of NPs.
4. Increase or decrease in seedling root and shoot length over control in different conc. of NPs.
5. Seedling vigour index I and II (Abdul Baki and Anderson, 1973)
6. Electrical conductivity of seed leachate (µS/cm/g)

7. Total dehydrogenase activity (A_{480} nm)
8. Seed health (infection and infestation)
9. Field emergence %
10. Final plant stand establishment (%)

Sub. Experiment-II (Objective 2): To validate the effect of different nano-particles on seed quality parameters and effect on storability of NP treated seeds in Pigeon pea, Paddy and Chickpea

Technical programme:

Materials and Methods:

The CCS HAU Hisar centre would only supply the sufficient quantity of seeds of minimum two chickpea varieties to TNAU, Coimbatore for NP treatments as given below. The TNAU, Coimbatore after the treatment shall divide the chickpea seeds in equal halves and send treated seeds of one chickpea variety to JNKVV, Jabalpur and UAS, Dharwad while the treated seeds of other chickpea variety to UAS, Raichur and ICAR- IISS, Mau for further studies.

The PAU, Ludhiana Hisar centre would only supply the sufficient quantity of seeds of minimum two paddy varieties to TNAU, Coimbatore for NP treatments as given below. The TNAU, Coimbatore after the treatment shall divide the paddy seeds in equal halves and send treated seeds of one paddy variety to PJTSAU, Hyderabad and KAU, RARS, Pattambi while the treated seeds of other paddy variety to AAU, Jorhat and PAJANCOA&RI, Karaikal for further studies.

The ICAR-IARI, New Delhi centre would only supply the sufficient quantity of seeds of minimum two pigeon pea varieties to TNAU, Coimbatore for NP treatments as given below. The TNAU, Coimbatore after the treatment shall divide the pigeon pea seeds in equal halves and send treated seeds of one pigeon pea variety to AAU, Jorhat and PAU, Ludhiana while the treated seeds of other pigeon pea variety to UAS, Bengaluru and PAJANCOA&RI, Karaikal for further studies.

The TNAU Coimbatore centre will only assess the seed moisture content before and after treatments and communicate to respective centres with treated seeds. The selected concentrations of NP treatments those gave better results for improving the plating values in both the crops that will be validated for quality enhancement as well as storability studies till 18 months.

Treatments:

The selected concentrations of NP treatments those gave better results in both the crops are given below;

Name of Crop	**Name of the Treatments + 2** Controls (untreated & Recommended PoP)
Paddy	1. Dry Bulk SiO_2 @100 ppm

	2. Dry Bulk ZnO @ 500 ppm 3. Dry Nano SiO2 @500ppm 4. Dry Nano TiO_2 @100ppm 5. Dry Nano TiO_2 @250ppm 6. Dry Nano TiO_2 @500ppm 7. Dry Nano ZnO @ 750 ppm 8. Wet Bulk TiO_2 @750ppm 9. Wet Bulk ZnO @ 250ppm
Chickpea	1. Dry Bulk SiO_2 @100 ppm 2. Dry Bulk ZnO @ 500 ppm 3. Dry Nano SiO2 @500ppm 4. Dry Nano TiO_2 @100ppm 5. Dry Nano TiO_2 @250ppm 6. Dry Nano TiO_2 @500ppm 7. Dry Nano ZnO @ 750 ppm 8. Wet Bulk TiO_2 @750ppm 9. Wet Bulk ZnO @ 250ppm
Pigeon pea	1. Nano particle SiO_2 @ 50 ppm 2. Nano particle SiO_2 @ 100 ppm 3. Nano particle ZnO @ 500 ppm

A. Observations for validation of enhancement in planting value

Laboratory (before and after treatments**):**

- Seed Moisture content (ISTA)
- Time (hrs) for maximum numbers of radicle emergence (≥2mm)
- First count %
- Germination % (ISTA)
- Increase or decrease in abnormal and dead seeds over control in different conc. of NPs.
- Increase or decrease in seedling root and shoot length over control in different conc. Of NPs.
- Vigour index-I & II (Abdul Baki and Anderson, 1973)

Field observations:

- Field emergence (%) – (to be recorded in all four replications in each treatment)
- Final plant stand establishment (%)– (to be recorded in all four replications in each treatment)
- Seed yield (g/plot)
- Percent increase/decrease in yield
- Increase/ decrease in cost of best treatment over control

- B:C ratio

B. Observations for studying the storability (Max. 18 months of storage)

At monthly interval:

1. Seed Moisture content (ISTA)
2. Seed germination (%) (ISTA)- First count and final count
3. Increase or decrease in abnormal and dead seeds over control in different conc. of NPs.
4. Increase or decrease in seedling root and shoot length over control in different conc. of NPs.
5. Seedling vigour index I and II (Abdul Baki and Anderson, 1973)
6. Insect infestation (Names on insects and level of infestation)
7. Seed health (infection and infestation)

At three months interval:

1. Seedling emergence (%) in sand/soil AND/OR Field emergence (%)
2. Final plant stand establishment (%) just before normal sowing time of respective crops (i.e. once in a year at crop specific centres).
3. Electrical conductivity of seed leachate (µS/cm/g)

NB: *A minimum of four numbers of replications; two/four rows with 100/50 seeds, per replication are must for field evaluation studies.* **The experiment will be terminated once the germination % count reaches 5% below IMSCS or completion of 18 months of storage.**

Sub. Experiment-III (Objective 3): To demonstrate the enhanced planting value of validated nano-particle treated seeds of Onion and Soybean.

Technical programme:

Materials and Treatments:

The MPKV, Rahuri centre would supply the seeds of two onion varieties each sufficient for demonstrations at all the four centres in at least 500sqm to TNAU, Coimbatore for NP treatment as given below. The TNAU, Coimbatore after the treatments shall divide the seeds of both the onion varieties in four equal parts and send treated seeds of these two varieties to MPKV, Rahuri; JNKVV, Jabalpur; AAU, Anand and NDUAT, Faizabad for demonstrations. The MPKV, Rahuri shall also send sufficient quantity of untreated seeds of both the onion varieties separately to all the four centres for planting/ transplanting in control plots of at least 500sqm each.

The JNKVV, Jabalpur centre would supply the seeds of two Soybean varieties each sufficient for demonstrations at all the four centres in at least 500sqm to TNAU, Coimbatore for NP

treatment as given below. The TNAU, Coimbatore after the treatments shall divide the seeds of both the Soybean varieties in four equal parts and send treated seeds of these two varieties to JNKVV, Jabalpur; NAU, Navsari ; GBPUAT, Pantnagar; and PDKV, Akola for demonstrations. The JNKVV, Jabalpur shall also send sufficient quantity of untreated seeds of both the Soybean varieties separately to all the four centres for planting in control plots of at least 500sqm each.

Technical programme:

Materials: Two most prevailing varieties are to be taken.

Treatment for demonstrations:

1. Control (Untreated)
2. Control (Recommended PoP)
3. Crop Specific validated treatment as mentioned below

Name of Crop	Name of the Treatments (In addition to 2 controls)
Soybean	1. Nano particle ZnO @ 500 ppm
Onion	1. Nano particle TiO2 @ 250 ppm

Planting: The treated, untreated (control 1) and crop specific recommended (control 2) seeds are to be planted in at least 500Sqm each at the normal sowing time. The recommended package and practices are to be followed for raising good nursery and crop/s.

Laboratory observations (before and after treatments):

- Seed Moisture content (ISTA)
- Time (hrs) for maximum numbers of radicle emergence (≥2mm)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)

Field observations: (Observations to be taken on seedlings/plants in control as well as treatment plots at randomly selected 4 places in 5 meter row lengths)

1. Field emergence % / Seedling emergence % in nursery of onion
2. Final plant stand establishment (%) after 4 weeks in soybean / - Percent seedling survived in nursery of onion after 5 weeks (Seedling ready for transplanting)
3. Plant height (cm) of 5 plants each at randomly selected 4 places in plots.
4. Soybean: Total number of pods/plant in 5 plant each at randomly selected 4 places in plots.
5. Soybean: Total number of seeds/pod in 5 pods/plant each at randomly selected 4 places in plots.
6. Soybean: Per plant yield in 5 plant each at randomly selected 4 places in plots.
7. Soybean: 1000 seed weight of seed produced (4 replications from each plot)

8. Onion: Average bulb wt. (5 bulbs each at randomly selected 4 places in plots)
9. Plot seed/bulb (onion) yield (kg)
10. Harvest Index
11. Soybean: Evaluation of quality (as per ISTA) of seed produced
12. Benefit: Cost ratio

Sub. Experiment-IV (Objective 4): To study the effect on storability of the Nano fertilizer treated seeds from TERI and longevity of seed produced under SPC experiment in different crops

Year of Start: 2021-22

Technical Programme:

The very purpose of this objective of the experiment is to know how long the Nano fertilizer treated/coated seeds lots and seed thus produced can maintain viability over and above IMSCS. The experiment will be terminated once the germination % count reaches 5% below IMSCS in respective crop/s or completion of 18 months of storage, whichever is earlier.

Materials:

Seed lots:

- For different crops, two **centres identified** (in TP of experiment 7 of SPC group) to timely receive the sufficient quantities of treated seeds in moisture impervious package (700 gauge) from TERI, Gurugram.
- In addition to the above sufficient quantities of seed for longevity studies will be retained/taken from the seed produced under the experiment on production aspects by SPC group at different participating centres as indicated in TP of experiment 7.

Treatments:

1. Control (Untreated)
2. Control (Recommended Seed Treatment in each crop)

Name of Crops	**Name of the Treatments (In addition to 2 controls)**
All the crops mentioned in SPC group TP of experiment 7	As provided by TERI, Gurugram

Laboratory Observations (Monthly):

TERI, Gurugram will assess the Seed Moisture content (ISTA) before and after treatments and share with the different participating centres.

- Seed Moisture Content % (ISTA)
- Time (hrs) for maximum numbers of radicle emergence (≥2mm)
- First count %

- Germination Percentage (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)
- Insect infestation (Names on insects and level of infestation)
- Seed health (infection and infestation)

Experiment 5: Influence of terminal heat stress on seed set, seed yield and quality in field crops

Year of start: 2017-18

Rationale: Climate is rapidly changing and can disrupt food availability, reduce access to food, and affect food quality. The projected increases in temperatures, changes in precipitation patterns, changes in extreme weather events and reductions in water availability may all result in reduced agricultural productivity. Heat (high temperatures) stress will be the prime abiotic constraint, under the current and climate change scenario in future. Although, heat obstruct productivity at all crop growth stages, the extent of damage at reproductive phase of crop growth, mainly the seed filling phase, is critical and causes considerable yield losses as well as the quality of seed produced. It could substantially affect the seed yields by reducing seed size and number, eventually affecting the commercial trait '1000 seed weight' and seed quality. There are various strategies for improvement of seed yield and quality under high temperature stress. A well-integrated genetic and agronomic management option may be good option to enhance tolerance to heat. Recently, emphasis has been placed on exploiting prompt and inexpensive means of obtaining satisfactory yields under heat stress conditions, which is very much expected in times to come. One of the programmatic approaches could be the exogenous use/spray of heat stress alleviating compounds, inorganic salts, natural and synthetic plant growth regulators and stress signaling molecules having specific properties and roles to improve yields and germination in a number of agri-horticultural crops.

Objectives:

1. To evaluate the adverse effect of heat stress and its mitigation during the reproductive phase in chickpea and finger millet.
2. To demonstrate the most efficient treatment validated for mitigation of heat stress in the wheat, mustard, paddy and sorghum.

Crops		**Centres**
1. Evaluation of adverse effects of heat stress & its mitigation (Objective -1)		
Chickpea	:	CCSHAU, Hisar; SKNAU, Jobner; NDUAT, Faizabad and UAS, Raichur
Finger millet	:	PJTSAU, Hyderabad; BSKVV, Dapoli; PDKV, Akola and UAS, Bengaluru
2. Demonstrations of validated heat stress mitigation technologies (Mini. 500sqm for Treat. & Ctrl.) (Objectives -2)		

Wheat	:	ICAR-IARI, New Delhi; PDKV, Akola; GBPUAT, Pantnagar; VNMKV, Parbhani and RAU, TCA, Dholi
Sorghum	:	UAS, Dharwad; PDKV, Akola; VNMKV, Parbhani; TNAU, Coimbatore and ICAR-IIMR, Hyderabad
Paddy	:	PAU, Ludhiana; OUAT, Bhubaneswar; BSKVV, Dapoli; ICAR-IIRR, Hyderabad; UBKV, Pundibari; ICAR-IISS, Mau and PAJANCOA&RI, Karaikal
Mustard	:	CCS HAU Hisar; MPKV, Rahuri; UBKV, Pundibari; ICAR-CAZRI, Jodhpur and NDUAT, Faizabad

Sub. Experiment I (Objective 1): To evaluate the adverse effect of heat stress and its mitigation during the reproductive phase in chickpea and finger millet.

Technical programme:

Materials:

One most popular chickpea and finger millet (ragi) variety recommended for normal dates of sowing will be taken for the study.

Methodology:

1. Set 1: The experiment in open field conditions (where growth chamber facilities for elevated temperature are not available) is to be conducted by sowing each crop thrice; normal, late and very late sowing dates. The dates may differ depending upon the location of centre with respect to a particular crop. Hence, the sowing dates may be adjusted accordingly (experiment may be conducted with normal date of sowing and two more sowings at 15-20 days intervals, thereafter). Dates of sowings and harvestings shall be recorded. The climatic data also collected and correlated with the results.
2. Set 2: Where growth chamber facilities for elevated temperature are available, the experiment will also be conducted at normal temperature requirements of that crop and 5°C elevated temperature conditions were maintained from anthesis onwards.

Mitigation treatments:

1. Control
2. Salicylic acid (800 ppm)
3. Salicylic acid (400 ppm)
4. Ascorbic acid (10 ppm)
5. KCl (1%)
6. Thiourea (400 ppm)
7. Cycocel (please ensure that *a.i.* concentration should not exceed 1250 ppm)
8. KNO3 @ 0.3%

Spray Schedule:

1. Control (Without spray)
2. Vegetative stage (35-40 days after sowing or transplanting)
3. Anthesis stage (Vary from crop to crop and location to location)
4. Vegetative + anthesis stage

Note:

1. Please don't mix or store Cycocel in aluminium containers or use any aluminium equipment.
2. Avoid using biomass/straw or seeds for feed or food until 6 weeks of a spray of these chemicals.

Observations: To be observed (Trait 2 to 8 at physiological maturity) in minimum of 5 randomly selected plants or pods/rep/treatment

1. Days to pod/ panicle formation
2. Plant height
3. Time taken to reach harvest maturity
4. Chickpea: Number of unfilled pods
5. Finger millet: Length of finger
6. Finger millet: Number of panicles/plant
7. Finger millet: Total number of tillers/plant
8. Finger millet: Number of productive tillers/plant
9. Chickpea: Total number of pods
10. Finger millet: Seed set %
11. Average number of seeds/pod/ finger
12. 1000 seed weight
13. Plot yield (kg)
14. Harvest Index
15. Benefit to cost ratio of the best treatment in each crop identified at your centre
16. Evaluation of quality of seed produced (as per ISTA).

Sub. Experiment II (Objective 2): To demonstrate the most efficient treatment validated for mitigation of heat stress in the wheat, mustard, paddy and sorghum.

Technical programme:

Materials:

One most popular variety recommended for normal dates of sowing in each crop will be taken for the study.

Methodology for Sowing/Planting of Crops (Wheat, Sorghum, Paddy and Mustard):

Each participating centre shall sow/plant the respective crop/s in two blocks of at least 500Sqm each. One/two block/s would serve as untreated/recommended (control/s) and other would be treated/sprayed twice; Vegetative (35-40 days after sowing or transplanting) + Anthesis stage

(Days to anthesis will vary from crop to crop and location to location). The recommended package and practices are to be followed for raising good crop.

Treatment for demonstrations:

1. Control (Untreated)
2. Control (Recommended PoP, if any)
3. Crop Specific validated Mitigation treatment as mentioned below

Name of Crop	**Name of the Treatments (In addition to control/s)**
	Two Sprays of following at: 1. Vegetative and 2. Anthesis stage
Wheat	Salicylic acid @ 800 ppm
Sorghum	Salicylic acid @ 400ppm
Paddy	Salicylic acid @ 400 ppm
Mustard	Salicylic acid @ 400 ppm

Observations recorded:

Observation to be taken on plants in control as well as treatment plots at randomly selected 4 places in 5 meter row lengths.

1. Days to booting/spike/ear/silique formation -50% of plants each at randomly selected 4 places in plots
2. Plant height (cm) of 5 plants each at randomly selected 4 places in plots at physiological maturity.
3. Total number of spike/ear/silique per plant in 5 plant each at randomly selected 4 places in plots at physiological maturity.
4. Time taken to reach harvest maturity--50% of plants each at randomly selected 4 places in plots
5. Total number of seeds per spike/ear/silique in 5 spike/ear/silique per plant each at randomly selected 4 places in plots.
6. Per plant yield in 5 plant each at randomly selected 4 places in plots.
7. 1000 seed weight of seed produced (4 replications from each plot)
8. Plot yield (kg)
9. Harvest Index
10. Benefit cost ratio
11. Evaluation of quality (as per ISTA) of seed produced

Experiment 6: Quantification of the Seed Vigour in Field Crops Using a Universal Scale

Year of start: 2020-21

Rationale: Germination testing remains the principle, and internationally accepted, criterion for seed viability. Even high germinating seed lots may differ substantially in field emergence when

sown at the same time in the same field, and/or may differ in performance and during storage in the same environment. Then the question arises, why there is difference in field performance and or storability? These differences could be caused by another component of seed quality, seed vigour. But, seed testing laboratories only perform vigour tests at the request of the client. Though, vigour testing is equally important to measure not only the percentage of viable seed in a sample, but also to know the ability of those seeds to produce normal seedlings under less than optimum or adverse growing conditions. Hence, research on quantification of the seed vigour is required not only to provide more information about which seed production practices impair seed vigour, and the steps necessary to improve the vigour status of seed lots, but also to know the minimum levels of vigour the viable seed lots should possess to result in potential performance under field conditions and or in storage. Therefore, this experiment was designed with the following objectives;

Objective:

- Reliable estimation and comparative evaluation of vigour in seed lots of field crops

Crops	**Centres**	
Paddy	**:**	TNAU, Coimbatore; ICAR-IISS, Mau and PAJANCOA & RI, Karaikal
Wheat	**:**	JNKVV, Jabalpur; ICAR-IISS, Mau and PAU, Ludhiana
Maize	**:**	CSKHPKV, Palampur and TCA, Dholi
Chickpea	**:**	ICAR-IARI, New Delhi and UAS, Dharwad
Pigeon pea	**:**	ICAR-IARI, New Delhi and UAS, Raichur
Soybean	**:**	MPKV, Rahuri and UAS, Bengaluru
Mustard	**:**	SKNAU, Jobner and ICAR-CAZRI, Jodhpur
Sunflower	**:**	UAS, Bengaluru; ICAR-IIOR, Hyderabad and JAU, Jamnagar
Cotton	**:**	ICAR-CICR, Nagpur and PDKV Akola

Technical Programme:

Materials: Centres must collect sufficient seed lots of selected crops from their own sources. At least 10 seed lots to be taken in each crop, having germination above IMSCS, it may be different varieties.

Observations recorded:

1. Time (hrs) for maximum numbers of radicle emergence (≥2mm)
2. Germination % (ISTA), 4 replications.
3. Total Seedling Length (TSL) or Total Seedling Wt (TSW*) were taken on at least 10 normal seedlings per replication on Final Count Day. Calculate average TSL or TSW. *Fresh or Dry Wt.
4. Field Emergence (at least 4 Replications of 50 seeds each).

Methodology: Correlation (r) needs to be calculated among following observations

a) GSF and FE (%) of the seed lots.
b) G (%) and FE (%) of the seed lots
c) VI 1 and FE (%) of the seed lots
d) VI 2 and FE (%)of the seed lots

Calculations of GF & SF:

- Germination and seedling weight or length will be converted to Germination Factor (**GF**) and Seedling Factor (**SF**), respectively.
- Let there be 10 seed lots of wheat under study.
- Let the G (%) of these be: 85, 97, 86, 98, 88, 96, 89, 90, 87, 92.
- Convert G% into Germination Factor by dividing by 100, to bring all values between 0 and 1.0
- Let germination of seed lot *1* and *2* be 85% and 97%.
- Therefore, GF will be 0.85 and 0.97.
- TSL or TSW: Let the highest TSW of Lot 10 lots be 0.25 mg.
- Let the TSW of lot *1* and *2* be 0.20 mg and 21 mg.
- Therefore, SF of seed lots 1 and 2 will be 0.20 / 0.25 = 0.80 and 0.21 / 0.25 = 0.84
- Now, Germination Seedling Factor (**GSF**) will be;
    - Lot 1: 0.85 X 0.80 = 0.680
    - Lot 2: 0.97 X 0.84 = 0.8148 or 0.815

NB: Compare the correlation (r) with FE with Factors (GF/SF) and other vigour parameters and finally the quantified value of vigour is to be recommended for each crop.

Experiment VII. To study the effect of revalidation on seed vigour and performance of field crops.

Year of Start: 2021-22

Rationale: The findings of the experiment 1 "To reaffirm the validity periods of certified seeds of field crops (as per the IMSCS regulations)" during last three years revealed that the decline in vigour may be the concern even if germination % was maintained ≥IMSCS in different crops. Therefore, it is imperative to study the effect of revalidation on plant stand establishment and yield in different field crops.

Objective:

- To study the effect of revalidation on plant stand establishment and yield of crops.

Crops	**Centres**	
Paddy	**:**	PAU, Ludhiana; PJTSAU, Hyderabad; TNAU, Coimbatore; UAS, Bengaluru; PAJANCOA&RI, Karaikal; KAU, RARS, Pattambi; AAU, Jorhat; SKUAST,

		Kashmir, Srinagar; BSKKV, Dapoli and OUAT, Bhubaneswar
Wheat	:	GBPUAT, Pantnagar; AAU, Anand; MPKV, Rahuri; HAU, Hisar and CSKHPKV, Palampur
Chickpea	:	JNKVV, Jabalpur; UAS, Raichur; VNMKV, Parbhani and HAU, Hisar
Pigeon pea	:	PDKV, Akola; UAS, Bengaluru and PJTSAU, Hyderabad
Soybean	:	GBPUAT, Pantnagar; JNKVV, Jabalpur; VNMKV, Parbhani; MPKV, Rahuri and UAS, Dharwad
Mustard	:	SKNAU, Jobner; HAU, Hisar; NDUAT, Faizabad and UBKV, Pundibari

Materials:

The participating centres shall collect fresh, revalidated (I) and revalidated (II) seeds of preferably same variety (predominant) of their areas from the respective certification agencies and or seed corporations and or any other source for these studies. The centres may collect/procure the required seeds while visiting them (SSCA) for collecting data on prevalence of revalidated seed lots. The centres may use fresh seeds of their own university/institute, but only when revalidated (I) and revalidated (II) seeds of same variety is available/procured from any other authentic source.

Special Note: If seed lots are not available within reach, centres can source RV (I) & RV (II) seed lots of preferably the same varieties from other centres for the sake of experimentation.

Laboratory Observations (Initial for all crops):

- Seed Moisture content (ISTA)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)
- Insect infestations (names and extent), if any
- Pathogen infestations (names and extent), if any

Field Observations:

These observations will be recorded in all crops which are to be planted/sown in normal growing season in minimum of 4 replications. Two/four rows of 100/50 seeds/seedlings shall constitute one replication. All the recommended package of practices for raising good crops shall be followed.

- Field emergence (%) (in case of paddy it may be recorded in nursery)
- Final plant stand establishment (%) after 5-6 weeks
- Disease incidence (in the field) %
- Quantification of loss in seed yield (%)
- Average seed yield/plant (g)

- 1000 seed weight of seed produced (g)
- Seed yield/plot - size need to defined (kg) and according yield/ha may be calculated. The yield/ha should not be calculated based upon yield/plant, please.
- Evaluation of quality (as per ISTA) of seed produced (parameters as mentioned above)

Experiment VIII. Assessment of prevalence of revalidated seed lots in the country

Year of Start: 2021-22

Rationale: The experiment "To reaffirm the validity periods of certified seeds of field crops (as per the IMSCS regulations)" was proposed three years back to assess the longevity of the seeds in different crops retain germination ≥IMSCS upon which the certificates for revalidations could be issued by the certification agencies. But, there is hardly any data available which suggests how seed lots of specific varieties in different crops are actually offered for revalidation. Therefore, to supplement the findings and recommendations of the above experiment it was considered necessary to collect data on all the crops for assessment of prevalence of revalidated seed lots in the country.

Objective:

- To collect the data from Seed Certification Agencies on prevalence of revalidated seed lots in the country

Crops	**Centres**	
Dominant crops of each state	**:**	All the STR Centres

*** Cereals (03 crops); Pulses (04 crops); Oilseeds (03 crops); Fibre (01 crop) & Forages (02 crops) minimum to be assessed.**

Methodology: The data of last five years is to be collected from Seed Certification Agencies by all the centres in the proforma given below.

Name of the Centre:	**Name of the State Seed Certification Agency:**		
Name of Crop: (Say Paddy)	**Location/Place of the SSCA:**		
Name/s of varieties/Lot nos.			
Year 2020-21	**No. of Varieties**	**Percent of Var.**	**Percent of lots**
Total Numbers of lot/s offered for certification (Initial)		100	100
Total Numbers of lot/s accepted for certification (Initial)			
Total Quantity of lot/s accepted for certification (Initial)			

Total Numbers of lot/s offered for revalidation (RV-I)			
Total Numbers of lot/s accepted for revalidation (RV-I)			
Total Quantity of lot/s accepted for revalidation (RV-I)			
Total Numbers of lot/s offered for revalidation (RV-II)			
Total Numbers of lot/s accepted for revalidation (RV-II)			
Total Quantity of lot/s accepted for revalidation (RV-II)			
Similar information to be collected for other years			
Year 2019-20	**No. of Varieties**	**Percent of Var.**	**Percent of lots**
Total Numbers of lot/s offered for certification (Initial) …….		100	100
Year 2018-19			
Year 2017-18			
Year 2016-17			
Similarly information to be collected for all the five years for all other major crops			
Name of Crop: (Say Wheat)	**Location/Place of the SSCA:**		
Name/s of varieties/Lot nos.			
Year 2020-21	**No. of Varieties**	**Percent of Var.**	**Percent of lots**
Total Numbers of lot/s offered for certification (Initial) …….		100	100

NB: The copies of the same performa may be used for collecting desired information for different lots of various crops and their varieties.

Pro-forma for Calculating Expenditure, Income and BC Ratio for STR Experiments

Sl.	Particulars	Amount (Rs./ha)
A	**Expenditure / Cost**	
1	Recurring cost of imposing the treatment (T1, T2, T3….Tn) (materialistic cost only *i.e.* chemicals, packaging materials, other physical inputs etc.)	
2	Additional labour cost on imposing treatments	

3	Salary component (as per man-days spent for imposing treatments)	
4	Miscellaneous cost	
	Sub total	
5	Interest on working capital (@ 12% per annum for total above, adjusted accordingly as per duration of experiment)	
	Total Expenditure / cost (A)	
B	**Gross income by imposing the treatment**	
1	Seed yield in particular treatment (q/ha)	
2	Price / sale value of seed (Rs./q)	
	Gross Income by imposing the treatment (B)	
C	**Gross income in control (T_0)**	
1	Seed yield in control (q/ha)	
2	Price / sale value of seed (Rs./q)	
	Gross Income in control (C)	
D	**Increase in Gross income by imposing the treatment (B - C)**	
E	**Increase in Net income by imposing the treatment (D - A)**	
F	**BC ratio for imposing the treatment (D/A)**	

Note:

4. The above information needs to be calculated for individual/every treatment
5. Expenditure, income etc. may be calculated on per quintal basis for storage experiment
6. For any further queries, contact Dr. Govind Pal, Principal Scientist, ICAR-IISSS, Mau (Mob. No.: 09473821374; Email: drpal1975@gmail.com)

Important points to be considered while reporting to avoid exclusion of their reports from the STR annual reports and not face any deemed fit consequences:

- **Adherence to the time for reporting:**
  The centres who have not reported results of experiment on Rabi crops are required to send the detailed reports by 31 July, 2021. It may please noted again that the experiments on crops harvested from January to May shall always be reported on or before 31st July, and the experiments on crops harvested from June to December and the experiments of continuous nature (e.g. storage) shall be reported latest by 31st January next year. Non sub-mission of reports and or incomplete reports shall be treated as non-conduct of experiments by the centre(s). Reports submitted late and or not in proper format shall not be included in proceedings of the workshop.

- **Report for shake of reporting are Discouraged:**
  It is reiterated that the complete reports in all respects should be prepared on analysed data and submitted timely. **Mere writing experiment in progress and or copying from the technical programme and putting some values in tables and sometimes only mean tables and not writing anything in the name of report is highly undesirable and has been viewed very seriously.** In general, the designs used for analysis of laboratory experiments is completely randomized design (CRD) and for field experiments is randomized complete block design (RCBD). Depending upon the numbers of treatment combinations factorial structure could also be employed. For testing hypotheses about the mean of a small sample drawn from a normally distributed population when the population standard deviation is unknown e.g. for demonstrations "Student's t-test" can be used. **First understand the objective of experiment and anticipate the outcome and then prepare report accordingly.** Don't repeat the results that you have already validated and reported in a particular crop. However, it is advised to discuss with the peers and statisticians of your organization for use of deeded fit designs.

- **Uniformity in reporting:**
  It has been noticed that the different centres use different format for reporting. It was decided that every centre should report as per the following headings; **Name of the Centre, Number and Name of the Experiment (It should be the same as in TP and NOT the Number at which you conducted/reported at/from your centre), Crop/s (Report separate for separate crops), No need to write objectives. Materials used (justifying, if it is different than the TP), Treatments given (justifying, if it is different than the TP), Methods of treatments, Observations recorded, Methods of recording observation (MUST), Results (separate tables/figs./plates for separate experiment/s and crop/s) with proper elaboration of each table numbers, Salient Findings of the year OR Conclusions, Suggestion, if any.** Centres should give the explanations while jotting down concluding remarks on the results of the year/s.

- **Submission of highlights and Slides:**
  For highlighting the Salient Finding(s) of your centre by PIs in the workshop, it is also desired that each centre shall submit 1-2 slides each for each crop in every experiment they were involved during the year/s under report on or before 15th March of next year.

- **Relook at the report before you submit:**
  It is advised to all the centres to see the report of previous year/s. Look out for legends/ headings of Table/s 4.5: Seed quality parameters in different treatments of different Nano particles **(.** Without full stop in end**);** 4 is experiment number and 5 is the table number you

are reporting. DO refer the table number individually in the body of text of the results. Similarly for headings of figures and plates, the repetition of same data in chart/diagram causes confusion only, moreover photos/plates without any significance are meaningless. Avoid copying tables directly from excel, if you have do please check to rows columns are proper. Do see the data for uniformity before and after decimal in the tables (No need to have more than four figures in total!). Write C.D. (p=0.05) and SEd± etc. uniformly. Mark the critical value of 'r' at 5% and at 1% with '*' or '**'. Just providing monthly mean weather data without indicating its affect on results is of no use. Explain the abbreviation/s used there in the tables. Running the **Spell Check is must before submission.**

- **Confirmation by each centre:**
  Every scientist/staff associated with STR, AICRP-NSP at each centre shall critically read this document and confirm within a week, through email to PI (pispnsp@gmail.com) with copy to Coordinating Unit, Directorate, ICAR-IISS, Mau (seednsp@gmail.com) that they have understood the programme fully and shall conduct the experiments as proposed. Please feel free to discuss with your pears and or PI for clarifications, if any.

C. Seed Pathology

Date: 21.04.2021

Chairman : **Dr. Karuna Vishunavat**
Scientist- Emeritus, GBPUAT, Pantnagar
Dr. R.N. Pandey
Former HOD, Dept. of Plant Path., AAU, Anand

Convener : **Dr. Atul Kumar**
Principal Investigator/ PS, ICAR-IARI, New Delhi

Technical Programme 2021-22

Experiment 1: Monitoring and detection of seed borne diseases of significance in major crops

Objectives:

1) Identification and documentation of important seed borne diseases.
2) Monitoring of emerging diseases of seed borne nature.
3) Identification of disease free areas (state wise)

Year of start : 2021-22

Crop (a): Paddy : Bunt, Bacterial Leaf Blight, False smut, Grain discolouration, Bakanae

Centres: AAU, Jorhat; SKUAST, Srinagar; TNAU, Coimbatore; CSKHPAU, Palampur; PAJANCOA&RI, Karaikal; MPKV, Rahuri; ICAR-IARI, New Delhi; DRPCAU, Pusa; PAU Ludhiana, CCSHAU Hisar, PJTSAU, Hyderabad; OUAT, Bhubaneshwar and AAU, Anand.

Methodology

- **Detection Technique:** Standard NaOH seed soak be followed for bunt in rice seed samples. Minimum seed sample size is 100 from all the sources, covering the popularly grown rice varieties. Mention the range of infection for each location.
- For BLB rating scale is 0-9. Record the disease in farmer's field and seed production plots. Minimum number of fields to be visited is 50 per location and plants to be observed are 100 for bacterial blight and Panicle blight.
- Meteorological data should be incorporated for correlation studies.
    - Seed borne pathogens responsible for seed discoloration be reported.
    - Impact on germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) and seed rot be reported.
    - Correlation of association of pathogen with seed germination (normal seedlings)

and seedlings with primary infection (part of abnormal seedlings category) is specified separately.

b- Monitoring of any other seed borne disease of importance as per centre

c- Detailed information regarding recording of all other diseases in paddy will be as per SES IRRI scale available on IRRI website.

Note: *Already supplied data sheet to be followed.*

1) The incidence of unreported new pathogens and diseases of seed-borne nature should be observed.
2) *Information on symptoms, causal organism and factors affecting development of the particular diseases (all about epidemiology) is to be supplemented with photographs.*

Crop (b): Wheat: Karnal bunt, Loose smut, Spot Blotch and Head Blight

Centres: CCSHAU, Hisar; PAU, Ludhiana, GBPUAT, Pantnagar; CSKHPAU, Palampur; RARI, Durgapura; and MPKV, Rahuri

Note:

1) For each crop, respective centre will compile and prepare the disease distribution map of the state based upon the last 5 years data.
2) Sensitization drive of farmers shall be made at hot spots for the management of rice bunt and Karnal bunt of wheat with awareness for safe storage and significance of replacement of varieties.

Methodology:

- **Detection Technique:** Standard NaOH seed soak be followed for bunt in seed samples. Minimum seed sample size is 100 from all the sources, covering the popularly grown wheat varieties.
- For ear cockle, visual observation and standard water soak be followed.
- Incidence of loose smut is to be recorded under field conditions by GOT.
- Incidence of head smut is to be recorded under field conditions as per standard rating scale.

Note:

1) *Prepare a map depicting the selected locations;*
2) *Provide the photographs showing the associated seed-borne pathogens.*

Crop (c): Soybean: Purple seed stain, Pod rot, Anthracnose

Centre: RARI, Durgapura; JNKVV, Jabalpur; MPKV, Rahuri; VNMKV, Parbhani and PJTSAU, Hyderabad

Methodology

- A minimum of 100 seed samples from all the sources, covering the popularly grown varieties.

Crop (d): Groundnut: Collar Rot, Seed rot

Centre: AAU, Anand; MPKV, Rahuri; RARI, Durgapura; JNKVV, Jabalpur; TNAU, Coimbatore

Methodology:

- Minimum seed sample size is 100 from all the sources, covering the popularly grown varieties.

Crop (e):Chickpea: Wilt, Grey Mould

Centre: MPKV, Rahuri; RARI, Durgapura,

Methodology:

- A minimum number of seed sample is 100 from all the sources, covering the popularly grown varieties.

Crop (f): Ragi: To be decided by centre

Year of start : 2020-21

Centre : PJTSAU, Hyderabad, MPKV Rahuri, JNKVV Jabalpur, TNAU, Coimbatore

Methodology:

- A minimum number of seed sample is 100 from all the sources, covering the popularly grown varieties. Report the range.

Experiment 2 : Studies on seed health status of farmers saved seeds

Objective

To determine the health status of seed samples from the farmers own saved seeds

Year of start : 2000

Status : Continued during 2021-22

Crop (a) : **Wheat**

Centres: CCSHAU, Hisar; PAU, Ludhiana, GBPUAT, Pantnagar; CSKHPAU, Palampur; RARI, Durgapura; RPCAU, Pusa; and MPKV, Rahuri

Note:

3) For each crop, respective centre will compile and prepare the disease distribution map

of the state based upon the last 5 years data.

4) Sensitization drive of farmers shall be made at hot spots for the management of rice bunt and Karnal bunt of wheat with awareness for safe storage and significance of replacement of varieties.

Methodology:

- **Detection Technique:** Standard NaOH seed soak be followed for bunt in seed samples. Minimum seed sample size is 100 from all the sources, covering the popularly grown wheat varieties.
- For ear cockle, visual observation and standard water soak be followed.
- Incidence of loose smut is to be recorded under field conditions by GOT.

Note:

Prepare a map depicting the selected locations; Provide the photographs showing the associated seed-borne pathogens.

Crop (b) : Soybean

Centre : RARI, Durgapura; JNKVV, Jabalpur; MPKV, Rahuri; VNMKV, Parbhani and PJTSAU, Hyderabad

Methodology

- A minimum of 100 seed samples from all the sources, covering the popularly grown varieties. Seed health is to be determined by employing standard blotter method (ISTA, 1996) and visual inspection of seeds.
- The per cent recovery of the important seed borne pathogens (*Macrophomina phaseolina, Fusarium oxysporum, Colletotrichum dematium* (*C. truncatum*), *Cercospora kikuchii, Fusarium* spp, *Diaporthe* spp) in farmers own saved seed shall be recorded based on the observations of 400 seeds / sample.
- Symptoms of SMV be also recorded both in field and seed samples.
- Impact of different seed-borne pathogens on germination, seedling growth and seed rot be recorded
- Correlation of association of pathogen with seed germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) is specified separately.

Note: *Prepare a map depicting the selected locations; Provide the photographs showing the associated pathogens; Provide the information that farmers used their own saved seeds or of any public or private agency/company.*

Crop (c) : Rice

Centres : AAU, Jorhat; SKUAST, Srinagar; TNAU, Coimbatore; CSKHPAU, Palampur;

PAJANCOA&RI, Karaikal; MPKV, Rahuri; ICAR-IARI, New Delhi; DRPCAU, Pusa; PAU Ludhiana, CCS HAU Hisar, PJTSAU, Hyderabad; OUAT, Bhubaneshwar and AAU, Anand

Methodology

- **Detection Technique:** Standard NaOH seed soak be followed for bunt in rice seed samples. Minimum seed sample size is 100 from all the sources, covering the popularly grown rice varieties. Report the range of infection for each location
- Seed borne pathogens responsible for seed discoloration be reported.
- Impact on germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) and seed rot be reported.
- Correlation of association of pathogen with seed germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) is specified separately.

Note: *Prepare a map depicting the selected locations; Provide the photographs showing the associated pathogen; Provide the information of the crop (upland or lowland); Information of storage conditions.*

Crop (d) : Groundnut

Centre : AAU, Anand; MPKV, Rahuri; RARI, Durgapura; JNKVV, Jabalpur; TNAU, Coimbatore;

Methodology:

- Seed health is to be determined by employing visual inspection of seeds and standard blotter method (ISTA, 1996)
- Minimum seed sample size is 100 from all the sources, covering the popularly grown varieties.
- Impact on germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) and seed rot be reported.
- Correlation of association of pathogen with seed germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) is specified separately.

Note: *Prepare a map depicting the selected locations; provide the photographs showing the associated pathogen*

Crop (e) : Chickpea

Centre: MPKV, Rahuri; RARI, Durgapura, PJTSAU, Hyderabad

Methodology:

- Seed health be determined by employing standard blotter method (ISTA, 1996) and

visual inspection of seeds

- A minimum number of seed sample is 100 from all the sources, covering the popularly grown varieties. Report the range.
- Impact on germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) and seed rot be reported.
- Correlation of association of pathogen with seed germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) is specified separately.

Note: *Prepare a map depicting the selected locations; Provide the photographs showing the associated pathogen.*

Crop (f) : Ragi
Year of start : 2020-21
Centre : PJTSAU, Hyderabad, MPKV Rahuri, JNKVV Jabalpur, TNAU, Coimbatore
Methodology:

- Seed health be determined by employing standard blotter method (ISTA, 1996) and visual inspection of seeds
- A minimum number of seed sample is 100 from all the sources, covering the popularly grown varieties. Report the range.
- Impact on germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) and seed rot be reported.
- Correlation of association of pathogen with seed germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) is specified separately.

Note: *Prepare a map depicting the selected locations; Provide the photographs showing the associated pathogen.*

Experiment 3: Standardization of detection methods for seed borne pathogens of significance

Objective
To work out the efficacy of different techniques for the detection of seed borne pathogens of significance prevalent in a particular region
Year of start : 2008
Status : To be continued during 2020-21

Centres: PJTSAU, Hyderabad; TNAU, Coimbatore; JNKVV, Jabalpur; SKUAST, Srinagar and ICAR-IARI, New Delhi
Note:

- *Provide the photographs showing the associated pathogen.*
- *The protocol found effective should be documented step by step with critical information on temperature, humidity, light cycles, substrate, incubation period, identification under stereoscopic binocular and characteristics of pathogen, to draw the conclusions and must be compared with the standard protocol of ISTA.*
- *If the ISTA protocol is not available for the subjected pathogen, a protocol be developed and standardized which gives the maximum recovery of the pathogen.*
- *If required, serological and nucleic acid based techniques must also be developed and standardized.*

Ludhiana, Pantnagar and Jabalpur center will also validate PJTSAU developed method in year 21-22.

Experiment 4: Monitoring of seed borne viruses in soybean and pulses and standardization of methods for detection through biological, serological and molecular techniques

Objective

- To identify the seed associated viruses in the samples obtained from various parts of the country.
- To develop and standardize the nucleic acid based techniques for detection of seed associated viruses.

Year of start : 2009
Status : Continued during 2020-21
Pathogen : Soybean Mosaic Virus
Centre : AAU, Anand, SKAUST Srinagar and IARI, New Delhi

Note:

1) For identification of seed borne viruses in different crops, the other cooperating Centers are directed to supply the samples to IARI New Delhi.
2) Samples of leaves and /or seeds may be sent, for determination of viruses.
3) Information on sampling and dispatch procedure may be enquired from AAU, Anand prior to submission.

Experiment 5: Management experiments

(A) Impact of different storage conditions on longevity of *Macrophomina phaseolina, Colletotrichum dematium* in Green gram / Black gram (To be concluded)

Objective

1) To determine the extent of association of pathogen(s) with freshly harvested seeds.
2) To determine the influence of fungicide treatment on development of pathogen and its impact on seed quality parameters under different storage conditions and periods

Year of start : 2016
Status : To be concluded this year
Crop : Green gram / Blackgram
Source of seed : (i) Farmer (ii) Seed production / Research Fields
Pathogen : *Macrophomin aphaseolina, Colletotrichum dematium*,
Centre: TNAU, Coimbatore, PAJANCOA&RI, Karaikal; MPKV, Rahuri; OUAT, Bhubaneshwar and AAU, Jorhat

Storage container: (i) Gunny bags (ii) Poly lined gunny bags and (iii) Cloth bags
Methodology:

- Basic seed dressing with Captan @ 0.25% (prior to storage); 2. Subsequent storage in different containers; 3. Untreated seeds will serve as check.
- Freshly harvested seeds will initially be tested for extent of mycoflora and other seed quality parameters and designated as zero stage evaluation.
- Later at 30 days interval, sample(s) will be withdrawn from the lot and tested for associated mycoflora by standard blotter method, determination for seed moisture by universal seed moisture meter, seed germination by standard paper towel method, seed emergence by GOT (in pots / trays filled with natural field soil /sterile soil), seedling vigour by standard method (root /shoot elongation technique).
- The investigation will be terminated when any of the sample exhibit the value of seed germination below the Indian Minimum Seed Certification Standard

Note: ***Information on storage condition including temperature, moisture should be provided.***

(B) Management of purple blotch and Stemphylium blight of onion through seed treatment by bio-agents and foliar sprays with plant products and fungicides(To be concluded)

Objective: To determine the influence of bio-agents and foliar sprays with plant products and fungicides on yield and quality of harvested seed and disease control.

Year of start : 2016-2017
Status : To be concluded this year
Crop : Onion
Pathogen : *Alternaria porri / Stemphylium vesicarium*
Centres : PAU, Ludhiana; SKUAST, Srinagar, IARI New Delhi, RARI Durgapura and MPKV, Rahuri

Methodology

1. Basic seed dressing with *Trichoderma viride*
2. Foliar applications of fungicides and plant products amended with sticker agent as soon as the disease appears and subsequent 3 applications at 10 days interval

Treatment: 6 fungicides+ 3 plant products+ 1 untreated check

Design: RBD

		Periodicity
T:01	Sprays of Mancozeb @0.3%	at 10 days interval after first application
T:02	Sprays of Metiram 55% + Pyraclostrobin 5% @0.3%	-do-
T:03	sprays of Difenconazole @0.1%	-do-
T:04	sprays of Zineb75% WP @0.2%	
T:05	sprays of Tebuconazole @0.1%	-do-
T:06	sprays of Kitazine 48% EC @ 0.2%	-do-
T:07	sprays of *Lantana camara* @ 5 %	-do-
T:08	sprays of *Pongamiapinnata*@ 5%	-do-
T:09	spray of crude leaf extract of *Azadirachtaindica* @ 5%	-do-
T:10	Check (No spray)	-

Observations : Disease development; yield; impact on seed quality parameters including seed germination, root length, shoot length and seeding vigour index

Note: Information on statistical data, cost: benefit ratio (economics); yield data and correlation with meteorological data should be supplemented. Selection of fungicides, dosages, application may be refined by PAU, Ludhiana considering the crop label claim as per recommended and approved list and data sheet will be supplied among the centers.

(c) Effect of pre-harvest fungicidal sprays on seed health and quality of soybean.

(To be concluded)

Objective

- To sustain the quality and viability of soybean seed by reducing seed borne infections

Year of start : 2018-2019

Status : To be concluded this year

Crop : Soybean
Variety : JS 335
Pathogen : All Seed borne fungal infections
Centre : PJTSAU, Hyderabad, GBPUA&T, Pantnagar, JNKVV Jabalpur

Treatments :

Treatment No.	Treatment	Mode of Treatment	Doses
T1	Seed treatment with Carboxin + Thiram (Treated control)	Seed treatment	0.3%
T2	T1 + 3 sprays with Pyraclostrobin + Metiram (One each at R3, R5 and R7 stages)	Prophylactic sprays	0.2%
T3	T1 + 2 sprays with Pyraclostrobin + Metiram (One each at R5 and R7 stages)	Prophylactic sprays	0.2%
T4	T1 + 1 sprays with Pyraclostrobin + Metiram (One spray at R7 stage)	Prophylactic spray	0.2%
T5	T1 + 3sprays with Carbendazim + Mancozeb (One each at R3 , R5 and R7 stages)	Prophylactic sprays	0.2%
T6	T1 + 2sprays with Carbendazim + Mancozeb (One each at R5 and R7 stages)	Prophylactic sprays	0.2%
T7	T1 + 1spray with Carbendazim + Mancozeb (One spray at R7 stage)	Prophylactic spray	0.2%
T8	T1 + 3sprays with Pyraclostrobin + Thiophanate (One each at R3 , R5 and R7 stages)	Prophylactic sprays	0.2%
T9	T1 + 2sprays with Pyraclostrobin + Thiophanate (One each at R5 and R7 stages)	Prophylactic sprays	0.2%
T10	T1 + 1spray with Pyraclostrobin + Thiophanate (One spray at R7 stage)	Prophylactic spray	0.2%
T11	Untreated control	-	-

Stages of the Plant:

1. At pod development
2. At seed development
3. At seed maturity (when green colour is disappearing and 1normal pod on main stem turn brown/tan in colour)

Replication : 3

Layout would be supplied by PJTSAU, Hyderabad

Observations:

Percent Disease incidence, Seed yield, Seed health status with reference to fungal seed borne pathogens on harvested seed. Harvested seeds would be treated with T1 and kept in the storage for subsequent seed health studies till further sowing.

Experiment 6: Development of seed health standards for important seed borne diseases in crops.

Objective:

- To initiate systematic studies for the development of standards
- To expand the scope of bringing new seed borne diseases under Indian Seed Act to facilitate quality seed production.
- To standardize uniform techniques for wider adaptability at national level.

Year of start : 2020-21

Crops : Soybean

Target Diseases : Purple seed stain caused by *Cercospora kikuchii*

Centres proposed: JNKVV Jabalpur; PJTSAU Hyderabad; MPKV, Rahuri; VNMKV, Parbhani and IARI, New Delhi

Methodology : Detailed data sheet and methods available with centre

Experiment 7: Systematic studies for evaluation of alternative chemicals and bio-agents for effective management of seed borne pathogens of major crops.

Project rationale: Several seedborne pathogens are known to be associated with paddy seeds causing seed rot and seedling mortality in nursery. Seed treatment is the best option to protect the nursery from these seedborne pathogens. The seed dressing fungicides that are used for this purpose for the past few decades are going to be banned in near future and there is a need of identification of best suited and cost effective seed dressing fungicide(s) to protect rice nurseries from seed and seedling associated pathogens.

Year of Initiation: 2021-22

Crops: Paddy, Pigeonpea, Greengram. Blackgram, Groundnut, Soybean

I. Project title: Effect of seed dressing fungicides on seed and seedling associated pathogens of Paddy. (Blast, False smut, Brown spot, Sheath rot, Bakanae)

Centres: PJTSAU Hyderabad, TNAU, Karaikal, Pusa Bihar, Pantnagar, Jorhat, PAU Ludhiana, Anand, CCSHAU Hisar, SUKAST Kashmir and IARI New Delhi.

Objectives: To test the efficacy of novel fungicides on seed health and seed quality parameters of paddy.

Materials and methods:

Seed material : Paddy seeds of any variety susceptible to one or more seed borne diseases (Preferably multiple disease susceptibility)

Fungicides : As listed in treatment details

No. of replications : 4

No. of seeds/rep : 100

Technique to be adopted:

1. Standard blotter method
2. Paper towel method

Methodology :

- Treat 1kg paddy seeds with X and 2X doses of fungicides separately by maintaining 1kg untreated seeds as control.
- Evaluate the treated seeds after seed treatment (next day) for seed health and quality parameters.

Data to be recorded:

1. No. of seeds germinated (normal seedlings)
2. Seedling length (Root length +Shoot length)
3. No. of seeds infected
4. Type of fungi observed
5. Frequency of fungi observed

Treatment details:

Tr. No.	Fungicide	Label claim status	Dosage (%)	
			X	2X
1.	Azoxystrobin + Difenoconazole (Amistar top)	Yes	0.05	0.1
2.	Propiconazole + Difenconazole (Taspa)	Yes	0.05	0.1
3.	Propiconazole + Picoxystrobin (Galiloio)	Yes	0.1	0.2
4.	Pyraclostrobin + Metiram(Cabriotop)	--*	0.1	0.2
5.	Trifloxystrobin + Tebuconazole (Nativo)	Yes	0.05	0.1
6.	Difenconazole (Score)	Yes	0.1	0.2
7.	Propiconazole (Tilt)	Yes	0.05	0.1
8.	Pyraclostrobin (Headline)	Yes	0.05	0.1

9.	Tebuconazole (Raxil)	Yes	0.05	0.1
10.	Azoxystrobin +Tricyclazole (Azotrix)	Yes	0.75	1.5
11	Tricyclazole (Beam)	Yes	0.5	1.0
11.	Control			

*Fungicide not having label claim but found effective in preliminary studies at Hyderabad center

II. Project title: Effect of seed dressing fungicides on seed and seedling associated pathogens of Pigeonpea (Wilt, Root rot)

Centre- PJTSAU Hyderabad

Year of Initiation: 2021-22

Objectives: To test the efficacy of novel fungicides on seed health and seed quality parameters of Pigeonpea.

Materials and methods:

Seed material : Pigeonpea seeds of any variety susceptible to one or more seed borne diseases (Preferably multiple disease susceptibility)

Fungicides : As listed in treatment details

No. of replications : 4

No. of seeds/rep : 100

Technique to be adopted:

i) Standard blotter method

ii) Paper towel method

Methodology:

- Treat 1kg pigeonpea seeds with X and 2X doses of fungicides separately by maintaining 1kg untreated seeds as control.
- Evaluate the treated seeds after seed treatment (next day) for seed health and quality parameters.

Data to be recorded:

1. No. of seeds germinated (normal seedlings)
2. Seedling length (Root length + Shoot length)
3. No. of seeds infected
4. Type of fungi observed
5. Frequency of fungi observed

Treatment details:

Tr.	Fungicide	Label claim	Dosages(%)

No.		status	X	2X
1.	Azoxystrobin + Difenoconazole (Amistar top)	--*	0.05	0.1
2.	Propiconazole + Difenconazole (Taspa)	--	0.05	0.1
3.	Difenconazole +Fluxapyroxad (Sercadis Plus)	--	0.1	0.2
4.	Penflufen + Trifloxystrobin (Ever Golxtend)	--	0.05	0.1
5.	Difenconazole (Score)	--	0.1	0.2
6.	Pyraclostrobin (Headline)	--	0.05	0.1
7.	Tebuconazole (Raxil)	--	0.05	0.1
8.	Metalaxyl (Mask)	--	0.1	0.2
9.	Control	--	-	-

*Fungicide not having label claim but found effective in preliminary studies at Hydcenter

III. Project title : Effect of seed dressing fungicides on seed and seedling associated pathogens of greengram and blackgram

Blackgram:
Centres: PJTSAU Hyderabad, Karaikal TNAU
Greengram:
Centres: PJTSAU Hyderabad, Karaikal TNAU, RARI Durgapura, AAU Jorhat, MPKV Rahuri, CCSHAU Hisar

Year of Initiation : 2021-22

Objectives : To test the efficacy of novel fungicides on seed health and seed quality parameters of Greengram and Blackgram.

Materials and methods:

Seed material : Greengram and Blackgram seeds of any variety susceptible to one or more seed borne diseases (Preferably multiple disease susceptibility)
Fungicides : As listed in treatment details
No. of replications : 4
No. of seeds/rep : 100

Technique to be adopted:

i) Standard blotter method
ii) Paper towel method

Methodology :

- Treat 1kg greengram and blackgram seeds with X and 2X doses of fungicides separately by maintaining 1kg untreated seeds as control.

- Evaluate the treated seeds after seed treatment (next day) for seed health and quality parameters.

Data to be recorded:

1. No. of seeds germinated (normal seedlings)
2. Seedling length (Root length + Shoot length)
3. No. of seeds infected
4. Type of fungi observed
5. Frequency of fungi observed

Treatment details:

Tr. No.	Fungicide	Label claim status	Dosages(%)	
			X	2X
1.	Azoxystrobin + Difenoconazole (Amistar top)	--*	0.05	0.1
2.	Propiconazole + Difenconazole (Taspa)	--	0.05	0.1
3.	Trifloxystrobin + Tebuconazole (Nativo)	Yes	0.05	0.1
4.	Pyraclostrobin+Metiram (Cabriotop)	Yes	0.1	0.2
5.	Penflufen + Trifloxystrobin (Ever Golxtend)	--	0.05	0.1
6.	Azoxystrobin (Dynasty)	--	0.05	0.1
7.	Difenconazole (Score)	--	0.1	0.2
8.	Pyraclostrobin (Headline)	--	0.05	0.1
9.	Tebuconazole (Raxil)	--	0.01	0.1
10.	Metalaxyl (Mask)	--	0.1	0.2
11.	Control	--	-	-

*Fungicide not having label claim but found effective in preliminary studies at Hydcenter

IV. Project title : Effect of seed dressing fungicides on seed and seedling associated pathogens of Groundnut (Collar Rot, Seed rot)

Centres: PJTSAU, Hyderabad, Karaikal TNAU, RARI Durgapura, AAU Anand, MPKV, Rahuri

Year of Initiation : 2021-22

Objectives : To test the efficacy of novel fungicides on seed health and seed quality parameters of Groundnut (Wilt, Grey Mould, Stemphylium blight)

Materials and methods:

Seed material : Groundnut seeds of any variety susceptible to one or more seed borne diseases (Preferably multiple disease susceptibility

Fungicides : As listed in treatment details

No. of replications : 4

No. of seeds/rep : 100

Technique to be adopted:

i) Standard blotter method

ii) Paper towel method

Methodology :

- Treat 1kg groundnut seeds with X and 2X doses of fungicides separately by maintaining 1kg untreated seeds as control.
- Evaluate the treated seeds after seed treatment (next day) for seed health and quality parameters.

Data to be recorded:

1. No. of seeds germinated (normal seedlings)
2. Seedling length (Root length + Shoot length)
3. No. of seeds infected
4. Type of fungi observed
5. Frequency of fungi observed

Treatment details:

Tr. No.	Fungicide	Label claim status	Dosages	
			X	2X
1.	Azoxystrobin + Difenoconazole (Amistar top)	--*	0.05	0.1
2.	Azoxystrobin + Tebuconazole (Custodia)	--	0.1	0.2
4.	Fluxapyroxad + Pyraclostrobin (Merivon)	--	0.05	0.1
5.	Pyraclostrobin+Metiram (Cabriotop)	Yes	0.1	0.2
6.	Pyraclostrobin + Epoxyconazole (Opera)	Yes	0.1	0.2
7.	Penflufen + Trifloxystrobin (Ever Golxtend)	Yes	0.05	0.1
8.	Trifloxystrobin + Tebuconazole (Nativo)	Yes	0.05	0.1
9.	Difenconazole (Score)	Yes	0.1	0.2
10.	Pyraclostrobin (Headline)	Yes	005	0.1
11.	Tebuconazole (Raxil)	Yes	0.05	0.1
12.	Control		-	-

*Fungicide not having label claim but found effective in preliminary studies at Hydcenter

V. Project title : Effect of seed dressing fungicides on seed and seedling associated pathogens of Soybean (Purple seed stain, Pod rot, Charcoal Rot, Anthracnose)

Centres: JNKVV Jabalpur, PJTSAU Hyderabad, MPKV Rahuri, VNMKV Parbhani

Year of Initiation : 2021-22

Objectives : To test the efficacy of novel fungicides on seed health and seed quality parameters of Soybean

Materials and methods:

Seed material : Soybean seeds of any variety susceptible to one or more seed borne diseases (Preferably multiple disease susceptibility)

Fungicides : As listed in treatment details

No. of replications : 4

No. of seeds/rep : 100

Technique to be adopted:

i) Standard blotter method

ii) Paper towel method

Methodology :

- Treat 1kg soybean seeds with X and 2X doses of fungicides separately by maintaining 1kg untreated seeds as control.
- Evaluate the treated seeds after seed treatment (next day) for seed health and quality parameters.

Data to be recorded:

1. No. of seeds germinated (normal seedlings)
2. Seedling length (Root length + Shoot length)
3. No. of seeds infected
4. Type of fungi observed
5. Frequency of fungi observed

Treatment details:

Tr. No.	**Fungicide**	**Label claim status**	**Dosages**	
			X	**2X**
1.	Azoxystrobin + Difenoconazole (Amistar top)	--*	0.05	0.1
2.	Azoxystrobin + Tebuconazole (Custodia)	--	0.1	0.2
4.	Fluxapyroxad + Pyraclostrobin (Merivon)	--	0.05	0.1
5.	Pyraclostrobin+Metiram (Cabriotop)	Yes	0.1	0.2
6.	Pyraclostrobin + Epoxyconazole (Opera)	Yes	0.1	0.2
7.	Penflufen + Trifloxystrobin (Ever Golxtend)	Yes	0.05	0.1
8.	Trifloxystrobin + Tebuconazole (Nativo)	Yes	0.05	0.1
9.	Difenconazole (Score)	Yes	0.1	0.2
10.	Pyraclostrobin (Headline)	Yes	005	0.1
11.	Tebuconazole (Raxil)	Yes	0.05	0.1
12.	Control		-	-

Note :

1. **Changes in the fungicide molecule and others if any, can be done in due course as well. Bio-agents will be obtained from NBAIM Mau/ any other centres and will be supplied to PI and then to respective centers as the case may be.**
2. **Approximately 25 Kg seeds is required for conduct of trial for one crop and all chemicals are available online. Seeds are to be preserved for further studies in polylined gunny bags only.**

List of Co-operating Scientists

S. No.	Name	Designation	Centre	Email
1.	Dr. Atul Kumar (Principal Investigator)	Principal Scientist	DSST, ICAR-IARI, New Delhi	atulpathiari@gmail.com 7703820583 (P) / 9013440112 (W)
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4.	Dr. S.S. Jakhar	ASRO (Seed Pathology)	CCS HAU, Hisar	jakhar2023@gmail.com 9416397522
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18.	Dr. C. Jeylakshmi	Professor	PAJANCOA, Karaikal	drcjeya@gmail.com 9442131504

D. Seed Entomology

Date: 21.04.2021

Chairman : **Dr. S. N. Sinha**
Principal Scientist & Former HOD, IARI Regional Station, Karnal

Convener : **Dr. Amit Bera**
Senior Scientist, ICAR-CRIJAF, Barrackpore

Technical Programme 2021-22

Experiment 1: Survey and evaluation of seed health status of farmers' saved seed with respect to insect infestation (to be combined with pathology / storage).

A portion of the sample should be taken from pathology/physiology group for detecting insect damage in seed, type of insect infesting seed as being done earlier under the experiment. Farmer's practice to store/protect seed should also be recorded.

Objectives

- To know the type of insect and its level of infestation under farmer's storage condition.
- Impact of insect infestation on seed quality
- Farmer's practice, if any, to store / protect seeds from insect damage.

Year of start: 2006

All NSP centers including voluntary centers will do the experiment

Methodology: About 500 g of seeds of crop/ variety will be collected from farmers' / seed producers before sowing on payment or gratis. **While collecting samples specific location should be recorded through GPS. Information on category of farmer (Large, medium and small as per land holding) should also be taken.** Each centre should collect seed samples of three major crops of that area and minimum 100 samples from each crop should be collected. Sample should be collected following appropriate sampling procedure so that entire zone can be covered within 2-3 years. 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 farmers - saved one. The following observations are to be recorded.

1. Storage period
2. Seed moisture content (%)
3. Live insect, its species
4. Damage in 400 seeds including internal infestation
5. Germination (%)

6. Vigour test

Experiment 2: Effect of solarization on bruchid's (pulse beetle) infestation and quality of pulse seeds

Crop	Centre
Pigeonpea	NDUAT, Faizabad; PDKV, Akola
Cowpea	UAS, Bangalore; SKNAU, Jobner
Chickpea	JAU, Jamnagar; UAS, Dharwad; MPKV, Rahuri
Black gram	TNAU, Coimbatore; PAJANCOA, Karaikal; AAU, Assam
Green gram	OUA&T, Bhubaneswar; PJTSAU,Telangana; CSAUAT, Kanpur; IISS, Mau

Objectives

- To develop effective eco-friendly, low cost technique for the control of bruchids infesting pulse seed.
- To study the effect of solarization on seed quality attributes of treated seeds.

Treatments

1. Solarization of fresh seeds in clear polythene (700 gauge) packet for 4 h for 2 days
2. Solarization of fresh seeds in clear polythene (700 gauge) packet for 4 h for 4 days
3. Solarization of fresh seeds in clear polythene (700 gauge) packet for 4 h for 6 days
4. Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 4 h for 2 days
5. Solarization of inoculated-seeds in clear polythene (700 gauge) packet for 4 h for 4 days
6. Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 4 h for 6 days
7. Control (Fresh seed)
8. Control (inoculated seed)

A. Packaging Material: Clear polyethylene (700 gauge) packets (30X20 cm) of 2 kg capacity

Replications: 3 **Design:** CRD

Method: One kg of freshly harvested certified seed with high percentage of germination and low moisture content (<10%) will be taken for each treatment. For inoculated pulse seed, it will be inoculated with bruchids (5 pairs/kg seed) and will be kept under ambient condition in the room for two weeks. The adult insects would be removed from seed lot before transferring them in the polythene packets; its germination, insect damage (%) will also be recorded as per standard procedure. Solarization should be done around noon and same schedule should be maintained in every treatment. During solarization, thickness of seed layer inside seed packet should be kept at 5 cm. The temperature outside/inside of packets should be recorded each

day before and after the solarization. After treatment, the seed should be kept under ambient conditions ensuring prevention of cross infestation. The temperature and relative humidity of the room will be recorded on standard week basis.

Observations to be recorded

Every 3 months for a total period of 12 months or loss of germination below IMSCS, whichever is early.

- Seed germination
- Seed moisture content
- Insect infestation (damaged kernel and kernel with bruchid eggs)
- Live and dead insects

The temperature outside/inside of packets should be recorded each day before and after the solarization **along with maximum temperature inside packet during solarization**.

Day	Outside Temperature ^{o}C		Inside Temperature ^{o}C			Remarks
	Before solarization	After solarization	Before solarization	Max. temp during solarization	After solarization	
01						
02						
03						
04						
05						
06						
Cumulative heat						

Cost benefit ratio should also be worked out for each treatments (format appended).

Experiment 3: Efficacy of commercially available Neem products against storage insect-pests during storage under ambient condition

Crop	Centre
Wheat	MPKV, Rahuri; CSAUAT, Kanpur; NDUAT, Faizabad
Paddy	AAU, Jorhat; OUAT, Bhubaneswar; PJTSAU, Telangana; PAJANCOA, Karaikal
Cowpea	UAS, Bangalore; TNAU, Coimbatore
Green gram	SKNAU, Jobner, OUA&T, Bhubaneswar; UAS, Dharwad
Chickpea	IISS, Mau; UAS, Dharwad; PDKV,Akola

Sorghum	TNAU, Coimbatore; PDKV, Akola
Pigeonpea	NDUAT, Faizabad; MPKV, Rahuri, PJTSAU,Telengana
Blackgram	AAU, Assam; PAJANCOA, Karaikal
Field pea	CSAUAT, Kanpur

Objectives

- To evaluate commercial Neem formulations against major storage insect-pests damaging seeds.
- Study of the storability of treated seeds.

Treatment

B. Insecticides/botanicals

1. Neemazal T/S (Azadiractin 10,000 ppm) @25 ppm (2.5 ml formulation/kg seed)
2. Neemazal T/S (Azadiractin 10,000 ppm) @50 ppm (5.0 ml formulation/kg seed)
3. Neemazal T/S (Azadiractin 10,000 ppm) @75 ppm (7.5 ml formulation /kg seed)
4. Neemoz - Gold (Azadiractin 10,000 ppm)@25 ppm (2.5 ml formulation/kg seed)
5. Neemoz - Gold (Azadiractin 10,000 ppm)@50 ppm (5.0 ml formulation/kg seed)
6. Neemoz - Gold (Azadiractin 10,000 ppm)@75 ppm (7.5 ml formulation/kg seed)
7. Deltamethrin @ 1ppm (2.8EC @0.04 ml/kg of seed)
8. Untreated control

C. Packaging Material: Gunny bag-lets of 2 kg capacity

Replications: 3 **Design:** CRD

Method: One kg of freshly harvested and untreated certified seed with very high percentage of germination and low moisture content (<10%) will be taken for each treatment. Required quantity of neem formulations in case of 2.5ml formulation/kg seed may be diluted in 2.5 ml water to treat 1 kg of seed for proper coating if required. Other doses (5ml or 7.5ml/kg) should not be diluted in water. Deltamethrin should be diluted in 5 ml water to treat 1 kg of seed. After drying in shade, seeds will be packed and kept in room under ambient temperature. The temperature and relative humidity of the room will be recorded on standard weekly basis.

Observations

Residual toxicity: Take out 100 g of treated seed, release 10 adult insects *Rhyzopertha dominica / Callosobruchus chinensis* or important insects depending upon the crop and record mortality after 3,7 and 15 days and thereafter, every 3 months for a total period of 12 months or loss of germination below IMSCS, whichever is early.

Observation to be recorded

- Seed germination, seed moisture
- Insect infestation (% kernel damage and types of insect)
- Presence / Absence of insects (live and dead)

Observations will be made on every 3 months for a total period of 12 months or loss of germination below IMSCS, whichever is early.

Cost benefit ratio should also be worked out for each treatments (format appended).

Experiment 4: Evaluation of pre-harvest spraying of insecticides and botanicals 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.

Crop	Centre
Pigeon pea	UAS, Bangalore; PJTSAU, Telangana; PDKV, Akola
Green gram	OUAT, Bhubaneswar; JAU, Jamnagar; NAU, Navsari
Chickpea	MPKV, Rahuri; SKNAU, Jobner; NDUA&T, Faizabad
Black gram	TNAU, Coimbatore; PAJANCOA, Karaikal; AAU, Jorhat
Cowpea	IISS, Mau

Treatments

A. Insecticides/Botanicals

1. Emamectin benzoate 5SG @ 0.3g/L
2. Neemazal T/S 10000ppm @2ml/L
3. Neemazal T/S 10000ppm @4ml/L
4. Neemazal T/S 10000ppm @6ml/L
5. Control

B. Spraying schedule

1. Spraying at 50% pod maturity (S1)
2. Spraying at Maturity (S2)
3. Spraying at 50% pod maturity and at maturity (S1 + S2)

Replication: 3 **Design:** Strip plot

Methodology: Seed crop should be grown with standard package of practices. For each treatment, plot size should be 5m x 3m. Harvest the crop leaving border rows. After threshing, seed should be kept in cloth bag ensuring protection from cross infestation during storage. Observation on adult emergence should be taken at 7 days interval up to two months.

Observation: Count no. of exit holes and express into percentage based on actual number of seeds observed.

Cost benefit ratio should also be worked out for each treatments (format appended).

Experiment 5: Studies on the effect of insecticidal seed treatment on seed viability during storage under ambient condition.

Objectives:

- To evaluate newer molecules against major storage insect-pests damaging seeds.
- Study of the storability of treated seeds.

Year of start: 2019

Crop	Centre
Wheat	IISS, Mau; CSAUAT, Kanpur
Paddy	AAU, Jorhat; PJTSAU, Telangana; PAJANCOA, Karaikal
Pigeonpea	NDUAT, Faizabad; PDKV, Akola; PJTSAU,Telengana
Cowpea	UAS, Bangalore; TNAU, Coimbatore; UAS, Dharwad
Mungbean	SKNAU,Jobner; OUA&T, Bhubaneswar, TNAU, Coimbatore
Chickpea	MPKV, Rahuri; JAU, Jamnagar; UAS, Dharwad
Pearl millet	JAU, Jamnagar
Sorghum	MPKV, Rahuri; PDKV, Akola
Blackgram	PAJANCOA, Karaikal; UAS, Bangalore
Field pea	CSAUAT, Kanpur; NDUAT, Faizabad

Treatment:

A. Chemical

1. Spinetorum @ 1ppm (Delegate 11.7%SC @8.5mg /kg seed)
2. Spinetorum @ 2ppm (Delegate 11.7%SC@ 17mg/kg seed)
3. Spinetorum @ 3ppm (Delegate 11.7%SC @25.6mg /kg seed)
4. Flupyradifurone @2 ppm (Sivanto prime 200SL @0.01ml/kg seed)
5. Flupyradifurone @4 ppm (Sivanto prime 200SL @0.02ml/kg seed)
6. Flupyradifurone @8 ppm (Sivanto prime 200SL @0.04ml/kg seed)
7. Emamectin benzoate @2ppm (Proclaim 5SG @40.0 mg/kg seed)
8. Deltamethrin @ 1.0 ppm (Deltamethrin 2.8EC@ 0.04 ml/kg seed)
9. Untreated control

B. Packaging Material: Gunny bag-lets of 2 kg capacity

Replications: 3 **Design:** CRD

Method: One kg of freshly harvested certified seed with very high percentage of germination and low moisture content (<10%) will be taken for each treatment. Required quantity of pesticides will be diluted in water to make total volume of 5 ml for treating 1 kg of seed for proper coating (if required). After drying in shade, seeds will be packed and kept in room under ambient temperature. The temperature and relative humidity of the room will be recorded on standard weekly basis.

Observations:

Residual toxicity: Take out 100 g of treated seed, release 10 adult insects *Rhyzopertha dominica / Callosobruchus chinensis* or important insects depending upon the crop and record mortality after 3,7 and 15 days and thereafter, every 3 months for a total period of 12 months or loss of germination below IMSCS, whichever is early.

Observation to be recorded

- Seed germination, seed moisture
- Insect infestation (% kernel damage and types of insect)
- Presence / Absence of insects (live and dead)

Cost benefit ratio should also be worked out for each treatments (format appended).

Experiment 6: Integrated approach for management of Pulse beetle (*Callosobruchus* sp.)

Objectives:

- To evaluate various combination treatments against Pulse beetle
- Study of the storability of treated seeds.

Crop	Centre
Pigeonpea	PDKV, Akola; UAS, Bangalore; PJTSAU, Hyderabad
Green gram	OUAT, Bhubaneswar and JAU, Jamnagar
Chickpea	MPKV, Rahuri; NDUA&T, Faizabad
Black gram	TNAU, Coimbatore; PAJANCOA, Karaikal

Treatments:

T1- Pre-harvest spray of Neemazal T/S 10000ppm @6ml/L at 50% maturity and maturity and Solarization of fresh seeds in clear polythene (700 gauge) packet for 4 h for 6 days

T2- Pre-harvest spray of Neemazal T/S 10000ppm @6ml/L at 50% maturity and maturity and seed treatment with Neemazal T/S (Azadiractin 10,000 ppm) @75 ppm (7.5 ml formulation /kg seed)

T3- Pre-harvest spray of Neemazal T/S 10000ppm @6ml/L at 50% maturity and maturity and seed treatment with Diatomaceous earth @ 5g/ kg seed + Desiccant (MgSO4@ 5/kg seed)

T4- Pre-harvest spray of Emamectin benzoate 5SG @ 0.3g/L at 50% maturity and maturity and Solarization of fresh seeds in clear polythene (700 gauge) packet for 4 h for 6 days
T5-Pre-harvest spray of Emamectin benzoate 5SG @ 0.3g/L at 50% maturity and maturity and seed treatment with Neemazal T/S (Azadiractin 10,000 ppm) @75 ppm (7.5 ml formulation /kg seed)
T6- Pre-harvest spray of Emamectin benzoate 5SG @ 0.3g/L at 50% maturity and maturity, and seed treatment with Diatomaceous earth @ 5g/ kg seed + Desiccant (MgSO4@5g/kg seed)
T7- Solarization of fresh seeds in clear polythene (700 gauge) packet for 4 h for 6 days and seed treatment with Neemazal T/S (Azadiractin 10,000 ppm) @75 ppm (7.5 ml formulation /kg seed)
T8- Solarization of fresh seeds in clear polythene (700 gauge) packet for 4 h for 6 days and seed treatment with Diatomaceous earth @ 5g/ kg seed + Desiccant (MgSO4@5g/kg seed)
T9- Untreated control

Packaging Material: Polylined Gunny bag-lets of 2 kg capacity
Replications: 3 **Design:** CRD
Methodology: For pre-harvest spraying seed crop should be grown with standard package of practices. Plot size should be 5m x 3m or more (with 3 replication) to get required quantity seed (9 kg for treatment 1-3 and 9 Kg for treatment 4-6) for combination treatments. Harvest the crop leaving border rows. After threshing and drying, seed should be kept in cloth bag ensuring protection from cross infestation before undertaking second treatment. For combination treatments with solarization treatment (T1) three kg seed (moisture content <10%) obtained from pre-harvest spray with neemazal should be solarized following methodology described in exp-2 on solarization. During solarization, thickness of seed layer inside seed packet should be kept at 5 cm. The temperature outside/inside of packets should be recorded each day before and after the solarization. Maximum temperature inside the packet during solarization should also be recorded. After treatment, the seed should be kept under ambient conditions ensuring prevention of cross infestation. For T2 , treat three kg seed (moisture content <10%) obtained from pre-harvest spray with Neemazal T/S (Azadiractin 10,000 ppm) @75 ppm (7.5 ml formulation /kg seed) without any dilution. After drying in shade, seeds will be packed and kept in room under ambient temperature. For T3, treat three kg seed (moisture content <10%) obtained from pre-harvest spray with Diatomaceous earth @ 5g/ kg seed + Desiccant (MgSO4@5g/ kg of seed). after proper drying After drying in shade, seeds will be packed and kept in room under ambient temperature.
Follow same procedure for T4, T5 and T6 obtaining seed from pre-harvest spray with Emamectin benzoate 5SG @ 0.3g/L.
For T7 & T8 refer to already given procedure.

After completion of treatments, seeds will be packed in polyline gunny bags and kept in room under ambient temperature. The temperature and relative humidity of the room will be recorded on standard weekly basis.

Observations

- Seed germination, seed moisture
- Insect infestation (% kernel damage and types of insect)
- Presence / Absence of insects (live and dead)

Observations will be made on every 3 months for a total period of 12 months or loss of germination below IMSCS, whichever is early.

Cost benefit ratio should also be worked out for each treatments (format appended).

New experiment: Studies on the effect of Entomopathogens and inert dust on storage insect pests and seed viability during storage under ambient condition.

Objectives:

- To evaluate the effect of Entomopathogens and inert dust against major storage insect-pests damaging seeds.
- Study of the storability of treated seeds.

A. Treatment:

1. *Beauveria bassiana* commercial product (CFU: 1.0 X10^8) @ 10g /kg seed
2. *Beauveria bassiana* commercial product @20g /kg seed
3. *Metarhizium anisopliae* commercial product (CFU: 1.0 X10^8) @10g /kg seed
4. *Metarhizium anisopliae* commercial product (CFU: 1.0 X10^8) @20g /kg seed
5. *Beauveria bassiana* commercial product (CFU: 1.0 X10^8) @ 10g /kg seed +Diatomaceous earth @ 5g /kg seed
6. *Beauveria bassiana* commercial product (CFU: 1.0 X10^8) @20g /kg seed +Diatomaceous earth @ 5g /kg seed
7. *Metarhizium anisopliae* commercial product (CFU: 1.0 X10^8) @10g /kg seed +Diatomaceous earth @ 5g /kg seed
8. *Metarhizium anisopliae* commercial product (CFU: 1.0 X10^8) @20g /kg seed +Diatomaceous earth @ 5g /kg seed
9. Deltamethrin@1ppm
10. Untreated control

Packaging Material: HDPE bags

Replications: 3 Design: CRD

Method: One kg of freshly harvested certified seed with very high percentage of germination and low moisture content (<10%) will be taken for each treatment and treated with the

appropriate dose of entomopathogens and seeds will be shaken manually for approximately 2 minutes to achieve uniform distribution of the conidial powder with the seed mass. Seeds will be packed and kept in room under ambient temperature. The temperature and relative humidity of the room will be recorded on standard weekly basis.

Bio-assay- After one day, samples of 50 g each, were taken from each treatment with replication and placed in glass vials (8 cm height and 5 cm diameter). Five pairs of 1-3 day old adults were introduced into each glass vial, covered with muslin cloth to provide sufficient aeration. Dead adults were counted after 3, 5 and 7 days of exposure. Dead insects were then incubated in a plastic box with high RH. (approximately 100%) to observe the outgrowth of fungus. The vials will be left at the same conditions for a further 50 days to assess progeny production (F1) of insects.

Observation to be recorded at every three months interval:

- Seed germination, seed moisture
- Insect infestation (% kernel damage and types of insect)
- Presence / Absence of insects (live and dead).
- F1 Progeny production

Crop	Centre	Test insect
Maize	TNAU, Coimbatore	*S. oryzae*
Paddy	PJTSAU, Telangana; PAJANCOA, Karaikal	*R. dominica*
Cowpea	UAS, Bangalore	*C. maculatus*
Blackgram	UAS, Bangalore	*C. maculatus*
Chickpea	MPKV, Rahuri	*C. maculatus*

Decisions made during the deliberations

- Experiment No. 1 on 'Survey & evaluation of seed health status of farmers' saved seed' will be continued in its existing format. Survey should be done following proper sampling procedure. **Specific location of sample collection should be recorded through GPS. Centres with both entomologist and pathologist should work in collaboration. Assign sample number before seed health test and try to correlate seed health after getting results of seed health test by both entomologist and pathologist.**
- Experiment No. 2 on '**Effect of solarization on bruchids (pulse beetle) infestation and quality of pulse seeds'** will be conducted in existing format. **Maximum temperature inside seed packet during solariziation should be recorded along with all other**

observations. Seedling vigour index should also be recorded along with other observations.

- Experiment No. 3 on "**Survey and monitoring of insecticide resistance in storage insect pests infesting seeds in storage godowns**" will be concluded.
- Experiment No. 4 "**Efficacy of commercially available neem products on storage pest management during storage under ambient condition**" will be conducted in its existing format.
- Experiment No. 5 on '**Evaluation of pre-harvest spraying of insecticides and botanicals for management of pulse beetle (*Callosobruchus* sp.)**' will be continued. **Exact spraying schedule (Days after sowing, crop stage etc.) should be documented for providing proper recommendation for different crops.**
- Experiment No. 6 on '**Studies on the effect of insecticidal seed treatment on seed viability during storage under ambient condition'** will be continued in existing format
- **Experiment on '**Integrated approach for management of Pulse beetle **(*Callosobruchus* sp.) during storage under ambient condition'** will be continued at various centres in existing format.
- New experiment on **"Studies on the effect of Entomopathogens and inert dust on storage insect pests and seed viability during storage under ambient condition"** will conducted by the lead. **PJTSAU, Telangana will send required formulations on payment basis**.

Pro-forma for Calculating Expenditure, Income and BC Ratio for STR Experiments

Sl.	Particulars	Amount (Rs./ha)
A	**Expenditure / Cost**	
1	Recurring cost of imposing the treatment (T1, T2, T3….Tn) (materialistic cost only *i.e.* chemicals, packaging materials, other physical inputs etc.)	
2	Additional labour cost on imposing treatments	
3	Salary component (as per man-days spent for imposing treatments)	
4	Miscellaneous cost	
	Sub total	
5	Interest on working capital (@ 12% per annum for total above, adjusted accordingly as per duration of experiment)	
	Total Expenditure / cost (A)	
B	**Gross income by imposing the treatment**	
1	Seed yield in particular treatment (q/ha)	

2	Price / sale value of seed (Rs./q)	
	Gross Income by imposing the treatment (B)	
C	**Gross income in control (T_0)**	
1	Seed yield in control (q/ha)	
2	Price / sale value of seed (Rs./q)	
	Gross Income in control (C)	
D	**Increase in Gross income by imposing the treatment (B - C)**	
E	**Increase in Net income by imposing the treatment (D - A)**	
F	**BC ratio for imposing the treatment (D/A)**	

Note:

7. The above information needs to be calculated for individual/every treatment
8. Expenditure, income etc. may be calculated on per quintal basis for storage experiment
9. For any further queries, contact Dr. Govind Pal, Principal Scientist, ICAR-IISSS, Mau (Mob. No.: 09473821374; Email: drpal1975@gmail.com)

E. Seed Processing

Date : 21.04.2021

Chairman : **Dr. Sanjay Kumar**
Director, ICAR-IISS, Mau

Convener : **Dr. Ashwani Kumar**
Principal Investigator/ Principal Scientist
ICAR-IARI, Regional Station, Karnal

Special mention:

All centres conducting seed processing experiment no. 1 (Standardization of seed sieve size) shall procure SIEVE GRADER. The fund for the same may be met from either contingencies or seed revolving fund of concerned centres. If necessary, ICAR-IISS, Mau will coordinate the purchase of sieve graders at each centre.

All the centers were asked again to increase the number of varieties/ hybrids and include the newer ones also. For Statistical Analysis Complete Randomized Block Design may be adopted.

Recommendations:

In the present era of high yielding crop varieties/ hybrids, there is need to modify the size of the bottom/ grading screen to improve the quality and quantity of the seed and to meet the physical purity standards set by IMSCS. These modifications are based on the data generated by different centers of AICRP National seed Project (Crops) on various crops as per the following table.

Centre	Crop / Seed Size (categories)	Variety	IMSC Recommended Sieve Size (mm)	Standardized Sieve Size (mm)	Seed Recovery (%)
	Paddy				
ICAR-IARI RS, Karnal	Medium slender	PB 1692	1.80 s	1.90 s	93.2
	Medium slender	PB 1609	1.80 s	1.90 s	95.0
TNAU, Coimbatore	Coarse/ Bold	ADT 37	1.85 s	2.20 s	90.5
	Medium slender	ADT 43	1.80 s	2.00 s	87.9
PAJANCOA & RI, Karaikal	Small seeded	TKM 13	1.70 s	1.55 s	95.9
	Medium slender	ADT (R) 46	1.80 s	1.70 s	97.9
	Coarse/ Bold	ASD 16	1.85s	1.85 s	95.0
PDKV, Akola	Small seeded	PKV Tilak	1.70 s	1.60 s	87.7
	Small seeded	PKV Kisan	1.70 s	1.60 s	87.7
	Small seeded	PKV HMT	1.70 s	1.60 s	88.3

	Small seeded	RTN 5	1.70 s	1.60 s	87.0
	Medium seeded	Sakol– 6	1.80 s	1.80 s	86.3
	Medium seeded	MTU 1010	1.80 s	1.80 s	86.3
	Medium seeded	CO 51	1.80 s	1.80 s	86.7
	Medium seeded	Suwarna	1.80 s	1.80 s	87.0
	Medium seeded	Sakol– 9	1.80 s	1.80 s	88.3
	Medium seeded	MTU 1001	1.80 s	1.80 s	86.7
	Wheat (*Triticum aestivum*)				
ICAR-IARI RS, Karnal	Bold seeded	HD 3226	2.30 s	2.40 s	88.3
	Bold seeded	HI 1620	2.30 s	2.40 s	89.3
PAU Ludhiana	Bold seeded	Unnat PBW 550	2.30 s	2.30 s	91.3
	Bold seeded	Unnat PBW 343	2.30 s	2.30 s	91.8
	Medium seeded	Unnat PB 1 Zn	2.10 s	2.30 s	94.0
	Wheat (*Triticum durum*)				
ICAR-IARI RS, Karnal	Bold seeded	HI 8759	2.30 s	2.40 s	89.6
	Bold seeded	HI 8802	2.30 s	2.40 s	95.8
	Bold seeded	WHD 896	2.30 s	2.40 s	97.7
	Bold seeded	WHD 943	2.30 s	2.40 s	98.4
	Chickpea				
UAS, Raichur	Bold seeded	MNK 1	6.00 r	7.50 r	91.5
	Small Seeded	Supper Annigeri	5.00 r	4.75 r	94.1
UAS, Dharwad	Medium seeded	BGD 111-1	5.50 r	6.75 r	92.4
PDKV, Akola	Medium seeded	Caffa	5.50 r	5.50 r	85.7
	Medium seeded	PDKV Kanchan	5.50 r	6.00 r	85.3
	Medium seeded	Jaki 9218	5.50 r	6.00 r	86.0
	Bold seeded	PKV Kabuli-2	6.00 r	6.50 r	87.3
MPKV, Rahuri	Medium seeded	Vijay	5.50 r	6.50 r	90.0
	Bold seeded	Phule Vikram	6.00 r	6.50 r	94.0
	Bold seeded	Phule Vikrant	6.00 r	6.50 r	93.3
	Soybean				
UAS Raichur	Small seeded	DSb21	4.00 s	3.75 s	73.4
UAS, Dharwad	Medium seeded	DSb 23	4.00 s	4.00 s	91.2
	Maize				
UAS, Bengaluru	Small seeded	CAL 1443	6.40/ 7.00 r	6.00 r	93.7
	Small seeded	CML 451	6.40/ 7.00 r	6.00 r	94.0
UAS, Raichur	Medium seeded	RCRMH 2	6.40/ 7.00 r	6.75 r	95.4

	Pigeonpea				
UAS, Bengaluru	Bold seeded	BRG 3	4.75 r	5.00 r	93.2
PDKV, Akola	Medium seeded	BSMR 736	4.00 r	4.00 r	86.0
	Medium seeded	PKV Tara	4.00 r	4.00 r	86.0
UAS Raichur	Small seeded	GRG 811	4.00 r	3.75 r	90.8
	Blackgram				
TNAU, Coimbatore	Bold seeded	VBN 8	2.70 s	3.20 s	94.2
	Bold seeded	CO 6	2.70 s	3.20 s	95.5
PAJANCOA & RI, Karaikal	Medium seeded	ADT 6	2.70 s	2.70 s	97.7
	Dhaincha				
ICAR-IARI RS, Karnal	Medium seeded	CSD 137	---	2.00 s	81.9
	Fieldbean				
UAS, Bengaluru	Medium seeded	HA 4	6.50 r	6.50 r	91.9
	Fingermillet				
UAS, Bengaluru	Medium seeded	KMR 340	1.40 s	1.20 r	91.5
	Sunflower				
UAS, Bengaluru	Medium seeded	KBSH 78	2.40 s	2.40 s	91.5

Technical programme 2021-22

No new experiment has been proposed and continue the earlier three experiments.

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 (small, medium and bold).
2. To standardize the size and type of grading sieve.

Crop		**Centres**
Paddy	**:**	ICAR-IARI, RS, Karnal; TNAU, Coimbatore; PDKV, Akola and PAJANCOA&RI, Karaikal

Wheat	:	ICAR-IARI, RS, Karnal and PAU Ludhiana
Chickpea	:	MPKV, Rahuri; UAS Dharwad; UAS, Raichur; PDKV, Akola
Black gram	:	TNAU, Coimbatore and PAJANCOA&RI, Karaikal
Pigeonpea	:	UAS, Bangaluru; UAS, Raichur and PDKV, Akola
Soybean	:	UAS, Dharwad; UAS, Raichur and MPKV, Rahuri
Maize	:	UAS, Bangaluru and UAS, Raichur
Finger millet	:	UAS, Bengaluru
Field bean	:	UAS, Bengaluru
Sunflower	:	UAS, Bengaluru
Daincha	:	ICAR-IARI, RS, Karnal and PAJANCOA&RI, Karaikal

Treatments

Crop: As above

Machine: Standard sieve shaker (specifications as per ISTA)

Sieve sizes: Grading sieve:

a. Recommended sieve (as per IMSCS)

b. Two sieves above the recommended sieve

c. Two sieves below the recommended sieve

Procedure

Unprocessed seed of the each crop variety will be procured from reliable source. Specified quantity of unprocessed seed material will be sieved using sieve shaker for 3-5 minutes at the rate of 25-30 strokes per minute. Seed material retained over each grading sieve will be tested for observation on seed quality. The screen that retains maximum seeds with superior seed quality will be considered as optimum.

Observations

1. Recovery (%)
2. Seed size: Length, breadth & thickness (mm)
3. First count (%)
4. Germination (%)
5. Physical purity (%)
6. 1000 seed weight (g)
7. Moisture content (%)

Experiment 2: Management of Karnal Bunt through mechanical seed processing.

Objective: Elimination of bunted seed to maximise the processing efficiency

Crop		**Centres**
Wheat	:	ICAR-IARI RS Karnal and PAU Ludhiana

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 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. Physical purity (%)
7. First count (%)
8. Germination (%)
9. 1000 seed weight (g)
10. Processing efficiency (%)

$$\text{Processing efficiency (\%)} = \frac{\text{Final output (100 – KB infection (\%) in final output)}}{\text{Feeding (100 – KB infection (\%) in feeding)}} \text{ X100}$$

Experiment 3: Assessment of postharvest deterioration of Soybean seed quality.

Objective: To access the stage wise postharvest losses in seed germination and quality parameters

Crop		Centres
Soybean	:	Dr. PDKV, Akola; UAS Raichur and MPKV, Rahuri

Treatments

Technical Programme

I) Varieties : 1. JS 335 : Common for all centers

2. Centre wise one local variety existing in seed chain

II) Threshing methods

1. Multi-crop thresher with concave clearance: 20-25mm and alternate stud adjustment

2. Combine harvester at 700 rpm drum speed

III) Sample: Minimum 3 seed lots

Categorization of harvested seeds on the basis of Moisture content:

Category I: ≤15%

Category II: >15%

IV) Testing of Seed Quality Parameters

i) Immediately after threshing

ii) Just prior to processing operations

iii) During processing operations

1. After Cleaning
2. After Size Grading
3. After Gravity Grading

iv) During storage at ambient conditions

Samples of processed seeds may be drawn from lower most two layers separately from godowns itself at an interval of 15 days till the sowing time and mention the stack height also.

Observations

1. Moisture content (%)
2. Damaged seed (%) (broken, cracked) by visual observation and chemical test (NaOCl test)/ radiography
3. 100 seed weight
4. Seed health status (Insect damage):
5. Physical purity (%)
6. First count (%)
7. Germination (%)
8. Electric Conductivity

Expected Output

- Identification of postharvest stage contributing maximum losses to germination.
- Optimization of post-harvest operations.

Session IV

Plenary Session

Date : 21.04.2021 **Time : 12.15 – 01.30**

Chairman	:	**Dr. A.K. Singh** Director, ICAR-IARI, New Delhi
Co-Chairman	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi
Convener	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	Dr. Govind Pal, PS, ICAR-IISS, Mau Dr. Sripathy K.V., Scientist, ICAR-IISS, RS, Bengaluru

The session was Chaired by Dr. A.K. Singh, Director, ICAR- IARI, New Delhi and Co-Chaired by Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi. Dr. Sanjay Kumar, Director, ICAR- IISS, Mau convened the session as host. At the outset, Dr. Sanjay Kumar welcomed the dignitaries and delegates present during the plenary session of joint AGM of AICRP NSP (Crops) and ARM of ICAR Seed Project.

All the PIs of AICRP-NSP (Crops) made a brief presentation on recommendations finalized and technical programme for 2021-22. 'Seed production and certification' was presented by Dr. Sandeep K. Lal and informed that two experiments have been concluded on integrated approach for enhancing seed yield & quality in millets and optimization of seed rate in Soybean and recommendation have been made in relation to the same. The five experiments under the group will continue. Two new experiments on optimization of seed rate in wheat under normal sown condition and use of novel formulation for quality seed production in field crops have been proposed.

The theme, 'Seed physiology, storage and testing' was presented by Dr. Shiv K. Yadav and recommended that country may be divided in to four zones w.r.t. storage of seed. Validity period of seed testing may continue as per existing rule of 1988 and changes have been suggested for Soybean and Groundnut. All crops should initially be tested within three months of date of harvest. He also recommended that initial seed testing validity periods for nine months and revalidation for six months' period before expiry of initial validity, second revalidation will be for three months only. The six experiments under the group will continue. Two new experiments have been proposed under the programme.

The theme area 'Seed pathology' was presented by Dr. Atul Kumar. He informed that one multiplex PCR protocol and one working sheet on seed borne diseases has been developed.

The seven experiments under the group will continue. One new experiment on management of seed borne diseases of significance in major crops have been proposed.

Dr. Amit Bera presented the information pertinent to 'Seed entomology'. He informed that status of insecticide resistance has been prepared in seed storage pests and seven experiments under the group will continue. One new experiment on effect of entomo-pathogens on insect pest and seed viability have been proposed.

The theme area of 'Seed processing' was presented by Dr. Ashwani Kumar. He informed that all the three experiments under the group will continue. Variety-wise sieve sizes have been recommended in various crops.

Dr. R.R. Hanchinal, Former Chairperson, PPVFRA, New Delhi suggested for inclusion of viability issues in seed of horticultural crops like onion and chilly; Seed Technological Research experiments need to be strengthen in NEH region and survey may be conducted for ITK in seed.

Dr. M. Bhaskaran, Chairman, RAC suggested to integrate the work of pathology and entomology for improvement in seed health status. Also seed quality issue and seed treatment should be strengthened.

Dr. D.K. Mishra, Members, RAC pointed the issue of quality in Breeder seed production and suggested to follow the seed production chain. Dr. S.N. Sinha, Members, RAC suggested that economics should be calculated under every experiments for its feasibility. He also stressed that results under safe seed storage experiments needs revalidation across the county.

Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi suggested that seed related issue in horticultural crops may be taken; seed research recommendation should be in the form of notification; technologies developed under AICRP- NSP (Crops) STR component during last 10 years should be compiled. He also suggested that recommendations and technical programme should be circulated among Resource person and Nodal Officer before its finalization.

Dr. A.K. Singh, Director, ICAR- IARI, New Delhi give emphasis on diversification and facilitation in quality seed production in different crops. He stressed for developed technologies should be applicable for both public and private sector for strengthening Public Private Partnership and also need to strengthen role of molecular markers in quality seed testing. Recommendations of seed technological research should be specific and response of the seed industry should also be looked.

Two scientific staff of AICRP- NSP (Crops) and ICAR Seed Project viz. Dr. Mathura Mohan Goswami, Principal Scientist (Seed Entomology), Seed Technology Research Unit, AAU, Jorhat and Dr. T. Pradeep, Director (Seeds), Seed Research & Technology Centre, PJTSAU, Hyderabad were felicitated on the account of superannuation from government service during the year 2021.

The session came to an end with formal vote of thanks by Dr. Sripathy K.V., Scientist, ICAR- IISS, RS, Bengaluru.

During the deliberations, following action points were emerged from the discussions:

- The recommendations coming out of STR experimentation need to be in the form of notification and communicated to DAC&FW for consideration and circulation to various stakeholders. Further, the entire technical programme and recommendations prepared need to be circulated to all Nodal Officers before finalization. **[Action: All concerned PIs & Director, ICAR-IISS, Mau]**

8. In order to strengthen the linkages between public and private sector, the representatives from both the sectors has to actively participate in the deliberations of AGM and the experiments may also be designed to address the difficulties faced by stakeholders of seed industry at ground level. **[Action: Director, ICAR-IISS, Mau]**

Address and Details of Principal Investigators STR - AICRP-NSP (Crops)

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Joint Monitoring Team for 2021-22

Kharif season: Sept. / Oct. 2021; *Rabi* season: Feb. / Mar. 2022 (Virtual/ Physical)

Zone / NSP centres	Name/ Address/ Convener & Member		Email	Mobile No.
Northern Zone: Group I SKUA&T, Srinagar; SKUA&T, Jammu; HPKV, Palampur; PAU, Ludhiana	**Dr. T. Pradeep, PJTSAU, Hyderabad**	**Convener**	**srtcpjtsau@gmail.com**	**8008333783**
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Northern Zone: Group II CCSHAU, Hisar; GBPUAT, Pantnagar; IIWBR, Karnal; VPKAS, Almora; DSST,IARI, Delhi/ Karnal; SVBPUA&T, Meerut; IIMR, Delhi	**Dr. Zahoor Ahmed Dhar, SKUAST, Srinagar**	**Convener**	**zahoorpbg@gmail.com**	**9419048821**
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Western Zone II JAU, Junagadh /Jamnagar; DGR, Junagarh; AAU, Anand; SDAU, SK Nagar; AU, Kota; NAU, Navsari; MPUAT, Udaipur	**Dr. Sandeep K. Lal, ICAR-IARI, New Delhi**	**Convener**	**skl_nsp@yahoo.com**	**9811048932**
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Eastern Zone: Group I NDUAT, Faizabad; IISR, Lucknow; CSAUAT, Kanpur / IIPR, Kanpur; BHU, Varanasi; IISS, Mau	**Dr. Vijay R. Shelar, MPKV, Rahuri**	**Convener**	**vijayrshelar@yahoo.co.in**	**8329938350**
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Calendar of Events for BSP & STR

S. No.	Event	Last date for completion of action	
Calendar of Events for Breeder Seed Production		***Kharif***	***Rabi***
1.	Placement of breeder seed indents to Director of Agriculture by the State Government & State Public Seed Producing Agencies.	15th December of previous year	31st May of year
2.	Submission of indents to DoAC&FW & SAU's	15th January	15th June
3.	Communication of indents by DoAC&FW to ICAR Headquarters.	28th February	15th July
4.	Communication of Breeder Seed Production Plan in BSP-1 by Project Coordinator (Crop) to DoAC&FW and ADG (Seed), ICAR	15th may	15th October
5.	Communication of the BSP-2 by the concerned Breeder to DoAC&FW and ADG (Seed), ICAR	After 15 days of the actual planting	After 15 days of the actual planting
6.	Communication of the BSP-3 by the concerned breeder to DoAC&FW and ADG (Seed), ICAR	After 15 days of actual inspection by the Joint Monitoring team	After 15 days of actual inspection by the Joint Monitoring team
7.	Communication of the final production figures of breeder seed by the ICAR in BSP-4 to DoAC&FW	15th February	15th July
8.	Communication of the Allocation of Breeder seed by DoAC&FW to Director of Agriculture and concerned indentors	31st March	15th September
9.	Lifting of Breeder Seed Production by indenters	30th May	30th October
10.	Communication of the lifting details of breeder seed against the GOI allotment to DoAC&FW by states and other agencies	After 15 days of the cut-off-date	After 15 days of the cut-off-date
11.	Submission of Breeder Seed Production activity to ICAR-IISS, Mau	30th June	30th January
12.	Monitoring of Breeder Seed Production by ICAR-IISS team	Month of Sept. /Oct.	Month of Feb. / Mar.
13.	Submission of Monitoring Team Report to ICAR-IISS, Mau	31st March	
14.	Communication of yearly Breeder Seed Production status to ICAR-IISS, Mau (production, shortfall / mismatch & non-lifting)	30th December	
15.	Annual Breeder Seed Review Meeting by ICAR Seed Division	3rd week of January	

Calendar of Events for Seed Technology Research Experiments under AICRP-NSP (Crops)			
1.	Communication of technical programme for STR experiment to centres	15th May	
2.	Submission of status report of experiments	15th of August	15th of December
3.	Monitoring status of experiments by ICAR-IISS team	Month of Sept. /Oct.	Month of Feb. /Mar.
4.	Submission of yearly experimental results to PI's and ICAR-IISS, Mau- *Kharif* field and storage experiments	31st January	
	Rabi field experiments	31st July	
5.	Submission of Monitoring Team Report to ICAR-IISS, Mau	First week of March	
6.	Annual Group Meeting of AICRP-NSP (Crops)	2nd or 3rd week of April	

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