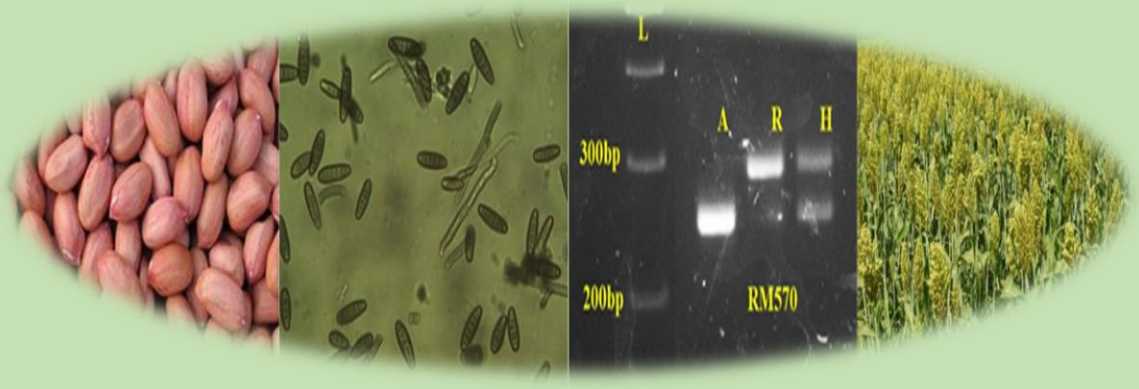
PROCEEDINGS

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

TECHNICAL PROGRAMME
(2020-21)

14-15 MAY, 2020

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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Session I

Inaugural Session

Date : 14.05.2020 **Time : 10.00-1.00**

Chairman	:	**Dr. S.A. Patil** Former Chairman Farmers Commission of Karnataka & Former Director, ICAR-IARI, New Delhi
Co-Chairman	:	**Dr. T.R. Sharma** DDG (CS), ICAR, New Delhi
Co-Chairman	:	**Shri. Ashwani Kumar** Joint Secretary (Seeds), DoAC&FW, New Delhi
Convenors	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi **Dr. Dinesh.K. Agarwal** Director (Actg.), ICAR-IISS, Mau
Rapporteurs	:	**Dr. Umesh R. Kamble** Scientist, ICAR-IISS, Mau **Dr. Sripathy K.V.** Scientist, ICAR-IISS, Mau

ICAR- Indian Institute of Seed Science, Mau organized 35th Annual Group Meeting of AICRP-NSP (Crops) and 15th Annual Review Meeting of ICAR Seed Project through video conferencing mode during 14th -15th May, 2020. Inaugural session of the meet was Chaired by Dr. S. A. Patil, Former Chairman, Farmers Commission of Karnataka and Former Director, ICAR-IARI, New Delhi. Session was jointly Co-Chaired by Dr. T. R. Sharma, Deputy Director General, (Crop Science), ICAR, New Delhi and Sh. Ashwini Kumar, Joint Secretary (Seed), DAC & FW, New Delhi. This session was convened by Dr. D. K. Yadava, ADG (Seed), ICAR, New Delhi and Dr. Dinesh K. Agarwal, Director (Acting), ICAR-IISS, Mau.

At the outset, Dr. D.K. Yadava, ADG (Seed), ICAR in his introductory remarks underlined the significant contribution made by AICRP-NSP (Crops) and ICAR Seed Project in ensuring seed security in the country and policy decisions undertaken by ICAR and Government of India. He also applauded the critical role played by SSCs, NSC, private sector, SAUs & ICAR institutes in shaping Indian seed domain. Dr. Yadava, highlighted the initiatives taken jointly by ICAR and DAC&FW in reducing varietal mis-matches in breeder seed production and enhancing the Varietal Replacement Rate (VRR) through inclusion of newly released crop varieties in breeder seed indents. He also mentioned that the relevance of AICRP-NSP (Crops) in Indian seed realm is going to magnify in the era of 'New Seed Bill'. Dr. Yadava pointed out issues associated with seed sector viz. need for further rationalization of breeder seed indents & strengthening of downstream seed multiplication, revisiting of seed data base (contribution of formal & informal seed sector in the country and bottlenecks in implementation of OECD Seed Schemes by Designated Authorities). Further, owing to challenges posed by climate change, he stressed upon need for identification of alternative

seed production sites and inclusion of multiple stress resistant/ tolerant crop varieties in seed chain in years to come.

Dr. Dinesh K. Agarwal, Director (Actg.), ICAR-IISS, Mau presented Action Taken Report on recommendations of Joint AGM of AICRP-NSP Crops) & ICAR Seed Project held at CCSHAU, Hisar during 07-09 April, 2019, which was followed by presentation on achievements of AICRP-NSP (Crops) & ICAR Seed Project during 2019-20. Dr. Agarwal appraised about overall breeder seed production, reduction of varietal mis-matches, enhancement in VRR & efforts made for inclusion of new crop varieties in seed chain and special efforts made by ICAR-IISS for strengthening of maintenance breeding. Further, he also highlighted about the achievements made under STR component of AICRP-NSP (Crops) and accentuated the progress made in quality seed production, quantum of quality production in new varieties, progress of Tribal Sub Plan (TSP) and capacity building activities carried under ICAR Seed Project during 2019-20.

Sh. Ashwini Kumar, Joint Secretary (Seed), DAC&FW in his remarks emphasized to identify alternative seed production sites for soybean crop to abate recurring shortfalls in breeder seed production. He also emphasized to have regular interaction with soybean breeder seed production centres to review the status of seed crop during kharif season. He requested all cooperating centres to give emphasis on quality of breeder seed produced in light of implementation of 'New Seed Bill'. Further, he underlined that, few old varieties are still popular among farmers and there is a need to break this barrier and there should be some effective mechanism for popularization of new crop varieties. He also stressed on need for development of safe storage protocols for breeder seeds by ICAR. He also assured that, DAC&FW along with ICAR will take all necessary steps to address this issue of non-lifting of breeder seeds in future.

Dr. T.R. Sharma, Deputy Director General (Crop Science), ICAR, New Delhi made emphasis on critical role played by seed as an 'Basic Entity of Agriculture' in transfer of technology to farmers field. In order to have a sustained seed production & supply chain, he asked all centres to take utmost care to maintain quality of breeder seeds. He also pointed out the need for strengthening of downstream multiplication and creation of seed reserves in the era of climate change. Dr. Sharma stressed upon research encompassing seed longevity; detection of seed borne pathogens using advanced RT-PCR based kits and seed quality enhancement using irradiation treatments. Further, Co-Chair suggested to hold frequent interface meetings of ICAR, DAC&FW & BSP centres to deliberate on issues pertinent to breeder seed production on regular basis. In light of production of breeder seeds on higher side (30% higher than indented quantity) during 2019-20, he emphasized the need for meticulous planning of breeder seed production to avoid wastage of resources. He asked to develop real–time ICT based dashboard in order to ensure traceability and to reduce non-lifting issues in breeder seed. DDG (CS) also urged to develop standard operating procedures to be followed during conduct of experiment to generate precise data across the centres.

Dr. S.A. Patil, Former Chairman, Farmers Commission of Karnataka and Former Director, ICAR-IARI, New Delhi opined to have proper storage structures for nucleus/ breeder seeds at every breeder seed producing institutions. He asked the house to come up with

holistic project proposal for seed sector in line with 'ICAR Mega Seed Project' for which funding may be sought from World Bank. Emphasizing on role of maintenance breeding for production of breeder seeds of highest genetic purity, he suggested to organize capacity building programmes for all seed scientists associated with breeder seed production at some well-established centres viz. ICAR-IARI, RS, Karnal and ICAR-IARI, RS, Indore every year. He requested Joint Secretary (Seed) to have a mechanism to caution and discourage chronic non-lifters of breeder seed (non-lifting continuously for 2 or 3 years) and also to have Medium Term Cold Storage facility at all centres for storage of carryover breeder seeds. He stressed upon the issue of replacement of popular old varieties, in this regard he mentioned to relook upon the policy of aggressive promotion of new varieties at the cost of performing old varieties.

The session came to an end with formal vote of thanks by Dr. Govind Pal, Principal Scientist, ICAR-IISS, Mau.

Joint Annual Group Meeting of AICRP- NSP (Crops) and ICAR Seed Project through video conferencing organized by ICAR-IISS, Mau during 14th -15th May, 2020.

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

1. ICAR Seed Project Centres shall take initiatives for promotion of new / multiple stress tolerant crop varieties through their own seed production programmes. **[Action: Nodal Officers, ISP Centres]**
2. Medium-term cold storage facility shall be developed at all BSP centres for safe storage of nucleus and breeder seeds **[Action: Director, ICAR-IISS, Mau]**

Session II

Presentation of Seed Technology Research Achievements during 2019-20 by Principal Investigators

Date : 14.05.2020 **Time : 2.00-5.00**

Chairman	:	**Dr. A. K. Singh** Director, ICAR-IARI, New Delhi **Dr. T.R. Sharma** DDG (CS), ICAR, 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. Malavika Dadlani** Former JD (R), ICAR-IARI, New Delhi **Dr. J.S. Chauhan** Former ADG (Seed), ICAR, New Delhi **Dr. R.K. Chowdhary** Former Director, ICAR-IISS, Mau
Convener	:	**Dr. Dinesh K. Agarwal** Director (Actg.), ICAR-IISS, Mau
Rapporteurs	:	**Dr. Govind Pal** Principal Scientist, ICAR-IISS, Mau **Dr. S.P. Jeevan Kumar** Scientist, ICAR-IISS, Mau

Session was Chaired jointly by Dr. A.K. Singh, Director, ICAR-IARI, New Delhi and Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi. Session was Co-Chaired by Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi and Dr. Dinesh K. Agarwal, Director (Acting), ICAR-IISS, Mau convened the meeting as host. The session was also graced by external experts' viz. Dr. R.R. Hanchinal, Former Chairperson, PPV&FRA, New Delhi, Dr. Malavika Dadlani, Former Joint Director (Research), ICAR-IARI, New Delhi, Dr. J.S. Chauhan, Former ADG (Seed), ICAR, New Delhi and Dr. R.K. Chowdhary, Former Director, ICAR-IISS, Mau.

The discipline wise presentation of progress report for the year 2019-20 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:

Dr. R.R. Hanchinal highlighted the importance of 'Soil Analysis' data before conductance of experiment for proper interpretation of results under the experiment on 'Development of organic seed production technology for field crops'. He also underlined the need to assess the new packaging material available for safe storage of seeds. He underlined the need for development of low-cost conditioned seed godowns for safe storage of seeds for minimum period of 3 years. He also asked to study the seed borne nature of *Cercospora kikuchii* causing purple staining of seed in soybean.

Dr. R.K. Chowdhury opined to have controlled seed storage facility for safe storage of nucleus and breeder seeds in all cooperating centres. He also suggested to mention specific location-wise information i.e. village/ block/ district while collecting the farmer saved seeds under the experiment on 'Seed health status of farm saved seeds'. He also stressed on the need for grading of centres based on the performance of centres over the years.

Dr. Malavika Dadlani stressed upon on need for institution of 'Controlled seed storage' in centres falling in coastal areas/ high humidity areas (Cuttack, Thrishur, Pondicherry etc.). Dr. Dadlani asked to divide the country into several zones based on climatological information for better interpretation of data and zone specific assessment of data in the experiment on 'Ascertaining the validity of certified seed lots of field crops'. She felt the need to record the temperature prevailing inside the packaging material in order to comment on the lethal temperature for targeted insect pest under experiment on 'Effect of solarization for management of pulse beetle'. She also suggested to come up with the status paper on farmers saved seeds based on the data collected over the years under theme areas viz. Seed Pathology and Seed Entomology. Dr. Dadlani suggested to analyze the data w.r.t. methodologies developed for detection of seed borne pathogens and further submit the same to ISTA Technical Committee for its validation and inclusion in International Seed Testing Rules.

Dr. S.N. Sinha stressed upon the need for development of integrated strategies for management against insect pest infesting seeds. He also suggested to develop an atlas highlighting hotspots for seed insect pest infestation in the country in order to devise effective integrated pest management strategies.

Dr. A. K. Singh suggested to undertake studies on synchronization of parental lines in newly released hybrids of crops viz. paddy, pearlmillet, maize and cotton. He stressed upon the need for initial studies/ assessment on efficacy of bio-formulations before including as treatment in technical programme of various STR experiments. Dr. Singh underlined the importance of DNA fingerprinting in genetic purity testing in paddy hybrids. He suggested to release all matured technologies generated out of STR component of AICRP-NSP (Crops) during Annual Group Meet for the benefit of seed industry.

Dr. T.R. Sharma suggested all centres to include 'Colour sorters' in the seed processing units for precision grading of seed lots. He underlined to have standardized tissue culture protocols in vegetatively propagated crops including few vegetable crops also. He emphasized

on use of gamma radiation and nano based seed coating for seed quality enhancement under seed physiology component of STR. He asked to have presentations on topics of interest related to seed domain from experts during Annual Group Meet.

The session came to an end with formal vote of thanks by Dr. Vijayakumar H.P. Senior Scientist, ICAR-IISS, Mau.

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

1. Under the experiment 'Development of organic seed production technology for field crops', the concerned centres shall undertake soil analysis before the conduct of experiment and shall correlate the same with the results. **[Action: Concerned STR centres & PI (Seed Production & Certification)]**
2. Specific location-wise information viz. village/ block/ district need to be mentioned while collecting the farmer saved seeds under the experiment on 'Seed health status of farm saved seeds'. **[Action: Concerned STR Centres, PI (Seed Entomology) and PI (Seed Pathology)]**
3. For better interpretation of results and zone specific recommendations in the experiment 'Ascertaining the validity of certified seed lots of field crops', there is a need to classify the country into different zones based on climatological data. **[Action: PI (Seed Physiology, Storage & Testing)]**
4. A status paper on seed health status of 'farmers saved seeds' based on the data collected over the years under theme areas viz. Seed Pathology and Seed Entomology shall be prepared. **[Action: PI (Seed Entomology) and PI (Seed Pathology)]**
5. Methodologies developed for detection of seed borne pathogens need to be compiled and submitted to ISTA Technical Committee for its validation and inclusion in International Seed Testing Rules. **[Action: PI (Seed Pathology)]**
6. The recommendations/ technologies generated out of STR component of AICRP-NSP (Crops) shall be released during Annual Group Meet by presenting multiple years results of the experiment across the locations and after thorough deliberation the same may be submitted to Central Seed Certification Board, GoI for notification for the benefit of seed industry. **[Action: Director, ICAR-IISS, Mau and all concerned PIs]**
7. Invited talks from experts on various issues related to seed domain needs to be arranged during Annual Group Meetings of AICRP-NSP (Crops) and ICAR Seed Project. **[Action: Director, ICAR-IISS, Mau]**

Session III

Finalization of Recommendations and Technical Programme Formulation for the Year 2020-21

Date : 15.05.2020 **Time : 10.00-2.00**

External Experts	:	**Dr. R.R. Hanchinal** Former Chairperson, PPV&FRA, New Delhi **Dr. S. Rajendra Prasad** Vice-Chancellor, UAS, Bengaluru **Dr. Malavika Dadlani** Former JD (R), ICAR-IARI, New Delhi **Dr. J.S. Chauhan** Former ADG (Seed), ICAR, New Delhi **Dr. R.K. Chowdhary** Former Director, ICAR-IISS, Mau **Dr. S. Swain** Former Head, Dept. of SST, OUAT, Bhubaneshwar
Convenors	:	**Dr. Sandeep K. Lal** Principal Investigator (Seed Production & Certification) **Dr. Shiv K. Yadav** Principal Investigator (Seed Physiology, Storage & Testing) **Dr. Atul Kumar** Principal Investigator (Seed Pathology) **Dr. Amit Bera** Principal Investigator (Seed Entomology) **Dr. Ashwani Kumar** Principal Investigator (Seed Processing)
Rapporteurs	:	**Dr. Vijayakumar H.P.** Senior Scientist, ICAR-IISS, Mau **Dr. Ramesh K.V.** Scientist, ICAR-IISS, Mau

A. Seed Physiology, Storage & Testing:

Dr. Dadlani emphasized that recommendations for concluding experiments should be derived after presenting the year-wise data during AGM. Dr. Agarwal supplemented that in the experiment on 'Hybrid purity testing through molecular marker', the basic objective is to identify the unique molecular marker for confirming hybridity rather than genetic purity assessment.

Dr. Hanchinal suggested to follow uniform set of packaging material across the centres for experiment on 'Ascertaining the validity period of certified seed lots of field crops'. He underlined to explore the possibility to conduct study on gamma radiation on seed longevity, Dr. Dadlani suggested PI (Seed Physiology) to consult BARC, Mumbai in this regard.

Dr. Chauhan suggested to that there should be proper design and statistical analysis for all the experiments in order to draw a meaningful conclusion.

Dr. S.K. Yadav, PI (Seed physiology) proposed one new experiment on Quantification of the seed vigour in field crops using a universal scale.

B. Seed Production & Certification:

Dr. Hanchinal suggested to go for large scale trails with best treatment combination along with state recommended dose of fertilizer as a check for three millets viz. fingermillet, Kodomillet & Littlemillet under experiment on 'Integrated nutrient management technology for seed production in millets'. Further he suggested to continue the experiment in other two millets viz. Prosomillet and Foxtailmillet for one more year. He also suggested to conduct survey on Seed Replacement Rate (SRR) in Eastern India for major field crops to identify the use of quality seed by farming community in the region and in response Dr. Agarwal agreed to initiate an in-house activity at ICAR-IISS, Mau in this regard.

Dr. S.K. Lal, PI (Seed Production) raised the issue of breaking of male sterility in A-line (MJA-5) of mustard hybrid supplied Dr. Bhagirath Ram, PS, ICAR-DRMR, Bharathpur during *Rabi* 2019-20. In this regard, Dr. Bhagirath Ram assured to supply seed samples of stable male sterile line for forth coming *Rabi* season for experimentation purpose. Dr. Lal also intimated that GMS male sterile line of cotton was supplied by PDKV, Akola during *Kharif* 2019 for conduct of experiment 'Redefining isolation distance in cotton' hence centre faced difficulty in rouging 50% fertile plants at the time of flowering. In this regard, PDKV, Akola was asked to supply CGMS based lines for conduct of experiment during Kharif 2020.

Experts opined that the experiment on 'Development of organic seed production technology' may be continued in centres belonging to NEH region, Kerala and Himachal Pradesh in only selected crops viz. rice, ragi, urd and maize. Dr. Hanchinal suggested to use popular farmers varieties for the referred experiment. Dr. Sinha added that in organic based eco-system there will be lot of spiders which will control other pests, which necessitates taking observation on predator/ beneficial insects also. Dr. Dadlani opined that cost benefit ratio need to be calculated in experiment 'Optimization of seed rate in soybean'.

Dr. Lal, proposed three new experiments viz. Seed quality evaluation of breeder seed samples, Preparation of atlas for quality seed production pockets of different crops in India, Nutrient management through nano-formulations. W.r.t. new experiment on nano-formulations, Dr. Chauhan expressed concern on bio-safety issues, in response to this Dr. Dadlani suggested that nano-conjugates of Zinc & Silver are already being used in different products and to consult TERI, Gurugram for further information in this regard. Dr. Hanchinal suggested DSST, ICAR-IARI, New Delhi to take pilot project on 'Standardization of seed production technology in CMS based pigeonpea hybrids'.

C. Seed Pathology:

Dr. R.K. Chowdhary urged to compile the recommendations of concluded STR experiments and submit the same to Central Seed Certification Board for further approval.

Dr. Atul Kumar, PI (Seed Pathology) proposed one new experiment on 'Development of certification standards for important seed borne diseases in crops' (Soybean seed rot & Bakane disease in paddy). Dr. Chowdhary, opined to conduct the referred experiment on seed borne diseases which are having economic significance w.r.t. seed production & certification. He also suggested to prepare state-wise profile of seed borne diseases in major crops.

D. Seed Entomology:

Dr. Amit, PI (Seed Entomology) proposed one new experiment on 'Integrated approach for management of pulse beetle (*Callosobruchus* spp.)', wherein best treatments identified from previously concluded experiments shall be taken for the study. He also proposed one pilot study on 'Effectiveness of entomo-pathogens for management of seed storage insect pests' at PJTSAU, Hyderabad.

E. Seed Processing:

Dr. Prasad, suggested to deploy smart equipments in seed processing unit to identify minor defects in seed lots. He also suggested to collaborate with private sector in order to develop advanced electronic devices for detection of pest incidence during storage and asked to identify few centers, which are capable to work on these areas. Dr. Ashwani, PI (Seed Processing) proposed one new experiment on 'to assess the stage-wise post-harvest losses in seed quality parameters'.

The session came to an end with formal vote of thanks by Dr. Umesh R. Kamble, Scientist, ICAR-IISS, Mau.

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

1. Under the experiment 'Ascertaining the validity period of certified seed lots of field crops', centre shall strictly follow the uniform set of packaging material as mentioned in the technical programme. **[Action: Concerned STR centres]**
2. Large scale demonstration trails at selected centres with best treatment combination along with state recommended dose of fertilizer as a check for three millets viz. fingermillet, Kodomillet & Littlemillet under experiment on 'Integrated nutrient management technology for seed production in millets' shall be included in technical programme. **[Action: PI (Seed Production & Certification) & Concerned Centres as per technical programme]**
3. In order to identify the extent of use of quality seed in eastern Uttar Pradesh region, a survey on Seed Replacement Rate (SRR) in major field crops shall be taken up by ICAR-IISS, Mau. **[Action: Director, ICAR-IISS, Mau]**

4. Stable male sterile line of mustard hybrid should be supplied to all concerned centres during *Rabi* 2020-21 for implementation of experiment 'Redefining isolation distance in mustard'. **[Action: Nodal Officer (Seed), ICAR-DRMR, Bharathpur]**
5. PDKV, Akola shall explore the possibility of supply of CGMS based male sterile line of cotton hybrid (hirsutum cotton) during *Kharif* 2020 for conduct of experiment 'Redefining isolation distance in cotton'. **[Action: SRO, PDKV, Akola]**
6. Under new experiment on 'Nutrient management through nano-formulations for seed production', PI should consult TERI, Gurugram to gather information on bio-safety issues of these nano-formulations. **[Action: PI (Seed Production & Certification)]**
7. Division of Seed Science & Technology, ICAR-IARI, New Delhi shall initiate a pilot study on 'Standardization of seed production technology in CMS based pigeonpea hybrids' during 2020-21. **[Action: The Head, DSST, ICAR-IARI, New Delhi]**
8. A state-wise profile of seed borne diseases in major crops shall be prepared and presented in Annual Group Meeting during 2020-21. **[Action: PI (Seed Pathology)]**

SEED TECHNOLOGY RESEARCH TECHNICAL PROGRAMME 2020-21

A. Seed Production & Certification

Date: 15.05.2020

Chairman	:	**Dr. R. R. Hanchinal** Former Chairperson, PPV&FRA, New Delhi
Convener	:	**Dr. Sandeep Kumar Lal** Principal Scientist, ICAR-IARI, New Delhi

General observations

The delay in receipt of data and reports was viewed seriously, which should be avoided. 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.

Decision taken:

- The centers should follow the technical programme strictly, without any modification.
- The deadline mentioned in the proceedings of the calendar year should be strictly adhered to.
- The data should be reported in the prescribed format after subjecting to appropriate statistical analysis.
- Centers will provide CV and CD data for the experiments conducted, as the standard error alone is not sufficient to analyze the precision of the experiment.
- As per the deliberations and suggestions from experts, centers should provide meteorological data and soil test report to analyze the environmental variations between the centers. Centres should strictly abide by this decision. Henceforth, the data will not be considered valid without soil test report and meteorological data report.
- As per the technical program guidelines, centres should provide the net and gross plot area.

Salient findings:

- Finger 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.
- **Soybean:** In case of medium duration varieties, the seed yield due to reduced seed rate of 60 kg/ha (21.38) was at par with the recommended seed rate of 70 kg/ha (21.53 q/ha),

with a negligible reduction of 0.7% over recommended seed rate, irrespective of the sowing methods. Further, medium duration variety with ridge and furrow sowing method and seed rate @ 70 kg/ha recorded highest seed yield (22.56 q/ha), which was at par with seed rate of 60 kg/ha (21.71 q/ha). Hence, the reduced seed rate of 60 kg/ha along with ridge & furrow sowing method may be recommended in medium duration varieties.

- However, these findings will be validated through demonstration trials at designated centres, where experiments had been conducted previously and ICAR Seed Project/ BSP Centres with field demonstrations of one acre each.

Recommendations:

- In paddy, the maximum permissible limit of ODVs can be enhanced from 20 (IMSCS, 2013) to 30/kg seed in certified seed class so that more lots of all varieties (fine, medium and coarse grained) can qualify for seed certification, without compromising on seed quality.

EXPERIMENT-WISE TECHNICAL PROGRAMME FOR THE YEAR 2020-21

Experiment 1: Integrated approach for enhancing seed yield and quality in millets
Year of start: 2015-16

Crop	Centres
1. Foxtail millet	ANGRAU, Guntur; TNAU, Coimbatore and UAS Dharwad
2. Proso millet	ANGRAU, Guntur; UAS, Bangalore and RPCAU, Pusa

Objective: To optimize the nutrient management practices and seed quality enhancement treatments for enhancing the production potential of millets

Rationale: The millets are generally cultivated by resource poor farmers as low fertilizer input crop and hence suffer from low crop yields. Moreover, these soils are deficient in major and micronutrients, mainly due to continuous cropping, low use of mineral fertilizers, poor recycling of crop residues and low rates of organic matter application, which can limit yield potential. Therefore, it is important to optimize nutrient management practices and study the yield responses to inorganic fertilizers (macronutrients and micronutrients), farmyard manure (FYM), green manures, organic by-products, and biofertilizers in millets. Further, seed priming promotes rapid and uniform germination, thereby providing initial stimulus and manifested in crop growth and seed yield. Hence, these experiments have been proposed to enhance the production potential of millets through combination of nutrient management practices and seed quality enhancement treatments.

SMALL MILLETS TREATMENT DETAILS	
No. of treatments	**Main plots** (Nutrient Management): **05** **Sub-plots** (Seed Priming): **04**
Sowing method: Direct sowing	

Spacing: 30 x 10 cm - sown at 3-4 cm depth		
Treatment details		
I. Main-Plot treatments (Nutrient management)		
N1 - Control: No fertilizer		
N2 - 125 kg Neem + 1250 kg Vermicompost per ha or 12.5 tons FYM/ha		
N3 - 50 kg Urea + 50 kg Single Super phosphate (SSP) and 50 kg Muriate of Potash (MOP) per ha + Top dressing Urea at 3-4 weeks after transplanting + 2% Borax spray at flowering		
N4 - 125 kg Neem + 1250 kg Vermicompost (or) 12.5 tons FYM/ha + 50 kg Urea + 50 kg Super Phosphate and 50 kg Muriate of Potash per ha + Top dressing Urea at 3-4 weeks after transplanting/ DS + 2% Borax spray at flowering		
N5- State Recommended Dose of Fertilizer (SRDF)		
II. Sub-plot treatments (Seed priming)		
P1 - Control: No priming		
P2 - Hydropriming for 8 h by adopting seed to solution ratio of 1:1 (w/v) and airdrying, followed by mixing with Carbendazim (Bavistin) @ 2.5 - 3.0 gm/kg seed and leaving the mixture for 24 hours before sowing		
P3 - Seed priming with 2 % KH_2PO_4 for 8h by adopting seed to solution ratio of 1:1 (w/v), airdrying and then mixing with Carbendazim (Bavistin) @ 2.5-3.0 gm/ kg seed, and leaving the mixture for 24 hours before sowing		
P4 - Seed priming with 20 % liquid *Pseudomonas fluorescens* by adopting seed to solution ratio of 1:1 (w/v).		
Design		Split Plot Design
No. of replications		3
Plot size	**Gross plot size**	2 m × 5.0 m (10.0 m^2)
Space between plots		60 cm
Recommended dose of fertilizer (NPK)		75 kg P_2O_5 and 25 kg K_2O per ha or best recommended fertilizer dosage for the respective state, region or zone
Cultivar		A set of 2 cultivars to be used for each crop by the respective centre (s)
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. Micronutrients: Magnesium (20 kg per acre) and Calcium (6 kg per acre) or Dolomite/Limestone (40 kg per acre)		
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. Micronutrients: Magnesium (20 kg per acre) and Calcium (6 kg per acre) or Dolomite/ Limestone (40 kg per acre).

Pest / disease control

- **Blast:** Seed treatment with Carbendazim (Bavistin) @ 2.5 gm/kg seed
- **Seedling blight:** Spray Mancozeb 75 % WP @ 2 gm per litre in the nursery 15 days before sowing or 15 days after transplantation
- **Downy mildew:** Spray the crop with Mancozeb 75 % W.P. @ 2 gm per litre of water at the onset of the disease, or when symptoms are seen in 5-10% of the plants
- **Stem borer:** Use Regent granules @ 7 kg / acre. In case of liquid formulation, 1 ml of the Regent chemical should be mixed with 2 litres of water

Observations to be recorded (as per table 1.1 and 1.2):

- Field emergence after two weeks
- Plant stand establishment after 6 weeks
- Plant height at 30 days and at harvest
- Chlorophyll content at maximum tillering stage (in top most leaf of main tiller) & 15 days after anthesis (in flag leaf of main tiller)
- Days to first flowering
- Days to 50% flowering
- No. of tillers/ plant
- Seed yield/ plant (g)
- Seed yield (q/ ha)
- Seed recovery per cent
- Seed quality - 1000 seed weight (g), Seed germination and Vigour Index- I
  (Vigour Index - I = Germination percent x Average seedling length of 10 seedlings in cm.)
- Net monetary returns (Rs.) - to be calculated uniformly on the basis of specified parameters
- Benefit Cost ratio (BCR)

Note:

1. The soil of the experimental site should be analysed for texture, bulk density, pH, EC, organic carbon content, available N, P, K, Zn at pre- and post-experiment stages
2. The nutrient composition of the organic nutrient sources (N, P, K, Zn and other nutrients, if any in case of T3) and the spore concentration (cfu/g) of *Pseudomonas fluorescens* should be analyzed/ furnished before use/ field application
3. All the above observations should be recorded, failing which the results of the concerned centre will not be considered for publication in Annual Report

Table 1: Effect of nutrient management and seed priming treatments on plant growth and seed yield attributes in Finger/ Kodo/ Little millet

Treatments	Field emergence (%)	Plant height at 30 days (cm)	Days to first flowering	Days to 50% flowering	Chlorophyll content (SPAD value)	Plant height at harvest (cm)	No. of tillers /hill	Seed yield/ plant (g)	Seed yield (q/ha)
Nutrient Management treatments (N)									
N_1									
N_2									
N_3									
N_4									
N_5									
Mean									
SEm±									
CD (P=0.05)									
Seed Priming treatments (P)									
P_1									
P_2									
P_3									
P_4									
Mean									
SEm±									
CD (P=0.05)									
N x P (Nutrient management x Seed priming)									
N_1P_1									
N_1P_2									
N_1P_3									
N_1P_4									
N_2P_1									
N_2P_2									
N_2P_3									
N_2P_4									
N_3P_1									
N_3P_2									
N_3P_3									
N_3P_4									

N_4P_1									
N_4P_2									
N_4P_3									
N_4P_4									
N_5P_1									
N_5P_2									
N_5P_3									
N_5P_4									
Mean									
SEm±									
CD (P=0.05)									
CV (%)									

Table 2: Effect of seed priming and nutrient management treatments on seed recovery, seed quality and economic indicators of Finger/ Kodo/ Little millet

Treatments	Seed recovery (%)	Test weight 1000 seeds (g)	Seed quality		Net monetary returns	Benefit Cost ratio
			Germination (%)	Vigour index		
Nutrient Management treatments (N)						
N_1						
N_2						
N_3						
N_4						
N_5						
Mean						
SEm±						
CD (P=0.05)						
Seed Priming treatments (P)						
P_1						
P_2						
P_3						
P_4						
Mean						
SEm±						
CD (P=0.05)						
N x P (Nutrient management x Seed priming)						
N_1P_1						
N_1P_2						

N_1P_3						
N_1P_4						
N_2P_1						
N_2P_2						
N_2P_3						
N_2P_4						
N_3P_1						
N_3P_2						
N_3P_3						
N_3P_4						
N_4P_1						
N_4P_2						
N_4P_3						
N_4P_4						
N_5P_1						
N_5P_2						
N_5P_3						
N_5P_4						
Mean						
SEm±						
CD (P=0.05)						
CV (%)						

Field demonstration in Finger millet, Kodo millet and Little Millet

S. No.	CROP	CENTRE (s)
1.	Finger millet	UAS, Bangalore; ANGRAU, Guntur; UAS, Dharwad; KKV, Dapoli; HPKV, Palampur and IGKV, Raipur and VPKAS, Almora
2.	Kodo millet	JNKVV, Jabalpur; IGKV, Raipur, TNAU, Coimbatore and ANGRAU, Guntur
3.	Little millet	JNKVV, Jabalpur; TNAU, Coimbatore; IGKV, Raipur; OUA&T, Bhubaneshwar & ZARS, Kolhapur (MPKV, Rahuri)

Sowing method: Direct Sowing (Kodo millet and Little Millet)

Spacing: 30 x 10 cm, sown at 3-4 cm depth

Finger millet: Transplanting with spacing of 30 X 10 cm (raising a nursery and transplanting at 21 days in wet field capacity of soil)

Note:

1. Only one method of planting should be followed for each crop as mentioned above
2. Nursery management and Transplanting (Finger millet) for one ha of main field:
   - Select 12.5 cents (500 m^2) of nursery area near a water source, where water does not stagnate. Mix 37.5 kg of Single Super Phosphate with 500 kg of FYM/ compost and spread the mixture uniformly on the nursery area

- Plough 2-3 times with a mould board plough or five times with a country plough to form raised beds by marking units of 6 plots each of size 3m x 1.5 m
- Provide 30 cm space between plots for irrigation
- Excavate the soil from the interspace and all around to a depth of 15 cm to form channels and spread the soil removed from the channels on the bed and level it 4-5 days before removing plants. Spray the nursery with the fungicide, Mancozeb 75% WP @ 2 gm /litre
- Transplant the seedlings from the nursery into the main field, when they are only 15-25 days old
- Before transplanting, irrigate the nursery for approximately 2 hours in advance, to moisten and loosen the soil for removing the plants easily if the soil is dry in that time
- Carefully uproot the seedlings, keeping the soil intact around the roots; if possible, lift them out with a trowel or spade as this gives support to the soil and helps to keep it intact with the roots
- Transfer the uprooted seedlings to the main plot within the next 30 minutes, before the root and soil can dry out. The spacing should be maintained at 30 x 10 cm, by using a rope or a marker
- Transplant the seedlings at shallow depth in the pits; do not press or inure the roots while placing the seedlings at the intersection of planting lines

3. Micronutrients: Micronutrients: Magnesium (20 kg per acre) and Calcium (6 kg per acre) or Dolomite/Limestone (40 kg per acre). Apply these micronutrients, 20-25 days before transplantation
4. The soil of the experimental site should be analysed for texture, bulk density, pH, EC, organic carbon content, available N, P, K, Zn at pre- and post-experiment stages
5. The nutrient composition of the organic nutrient sources (in case of N3 - for N, P, K, Zn and other nutrients, if any) and the spore concentration (cfu/g) of *Pseudomonas fluorescens* should be analyzed/ furnished before use/ field application

No of treatments: 2 (One plot for each treatment)	
Treatment details	
1. T1 - State Recommended Dose of Fertilizer (SRDF)	
2. T2 (Best treatment) - Seed priming with 20 % liquid *Pseudomonas fluorescens* in combination of nutrient management with 125 kg Neem + 1250 kg Vermicompost/ ha or (or) 12.5 tons FYM/ ha + 50 kg Urea + 50 kg SSP + 50kg MOP per ha + Top dressing of Urea at 3-4 weeks after transplanting + 2% Borax spray at flowering	
Plot size	0.2 ha (2000 m^2)
Cultivar	Any recommended cultivar appropriate used in the experiments earlier
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)

OR	
1. Nitrogen and Phosphorus	Diammonium Phosphate (DAP) - 18 % N and 46 % P_2O_5
2. Potassium	Muriate of Potash (MOP - 60 % K_2O)

Observations to be recorded:

- Plant Stand/sq metre (at 10 random places in a plot)
- Plant height at harvest*
- No. of tillers/ plant*
- Seed yield/ plant*
- Seed yield (q/ha - whole plot basis)
- Seed recovery per cent
- Seed quality - 1000 seed weight (g), Seed germination and Vigour Index- I
  (Vigour Index - I = Germination percent x Average seedling length of 10 seedlings in cm.)
- Net monetary returns (Rs.) **
- Benefit Cost ratio (BCR)

***A minimum of 50 plants/ treatment should be tagged for recording the observations**

****** **Net monetary returns to be calculated uniformly on the basis of specified parameters (Performa will be circulated for the same by IISS, Mau)**

Experiment 2: Optimization of seed rate in Soybean *(Glycine max* L.)

The validation studies will be undertaken through field demonstrations to be conducted by the BSP units/ centres of soybean.

Objectives:

- To increase the productivity with reduced seed rates
- To study the effect of less plant population on control of insect and disease infestation
- To find out economic viability of low seed rate and production

Expected output: The seed rate for soybean will be optimized through reduction in seed requirement, resulting in higher monetary returns to the farmers

S. No.	Centre	Variety (s)
1.	JNKVV, Jabalpur	JS-2094 and JS-2098
2.	VNMKV, Parbhani	MAUS-162
3.	UAS, Dharwad	DSB 21 and JS-9305
4.	MPKV, Rahuri	JS-9305
5.	IISR, Indore	JS 2069
6.	PDKV, Akola	JS 335 and PDKV Gold
7.	PJTSAU, Hyderabad	JS 335 and ADB-22 Basara
8.	UAS, Bengaluru	JS 335 and Karune
9.	UAS, Raichur	DSB 21 and JS-9305

10.	RSKVV, Gwalior	JS 2029 and JS 2034
11.	AU, Kota	JS 2029 and JS 2034
12.	MPUAT, Udaipur	JS 2029 and JS 2034
13.	IGKV, Raipur	JS-9305 and CG Soy 1

Methodology:

1. The field should be well prepared. Dry seeding should not be undertaken and sowing should be completed before July 15, 2020.
2. The sowing will be done by BBF planter and need to be adjusted for each category of seed *i.e.* small, medium and bold, accordingly.
3. The row to row and plant to plant distance for 0.20 ha (50 m length X 40 m width) area for each seed rate is given in the table given below.
4. The crop should be harvested at physiological maturity stage and shattering should be avoided.

Observations to be recorded (as per table 2.1 and 2.2):

(The observations must be recorded from 5 different locations i.e. 5 replications/ observations for statistical analysis)

1. 100 seed weight (Mean of 8 replications)
2. Number of plants per square meter (at least 10 locations and mean of it)
3. Number of branches per plant*
4. Number of pods per plant*
5. Number of seeds per pod*
6. Seed yield per plant (g)* and per plot (kg)
7. Seed yield (q /ha) - whole plot basis
8. Seed quality - Seed moisture content, 100 seed weight, Seed germination and Vigour Index – I

   (Vigour Index - I = Germination percent x Average seedling length of 10 seedlings in cm.)
9. Insect-pest and disease incidence
10. Net monetary returns (Rs.) **
11. Benefit Cost ratio (BCR)

***A minimum of 50 plants/ treatment should be tagged for recording the observations**

****** Net monetary returns to be calculated uniformly on the basis of specified parameters**

Plant to plant spacing calculation:

Plot size: 0.20 ha = 2000m^2 (50 m length X 40 m width); **No. of plots/variety**: 2 (one plot for each seed rate)

Row to row spacing - 45 cm

100 seed weight	**Seed rate for field demonstration**	
14 g	70 kg/ha	60 kg/ha
12g	70 kg/ha	60 kg/ha

10g (as 100 seed wt. is less the number of seeds in 70 kg are more hence should be compared with 50 kg)	70 kg/ha	50 kg/ha

Seed rate / 100 seed weight	**Plant to plant distance (cm)**		
	14 g	**12g**	**10g**
Recommended-70 kg/ha	4.4	3.8	3.2
	10,000 m^2: 70 kg; 2000m^2: 14 kg		
	100000 seeds **(14 kg)**	116666 seeds **(14 kg)**	140000 seeds (**14 kg)**
	100000 seeds/ 89 rows = **1124 seeds/ row**	116666 seeds/ 89 rows = **1311 seeds/ row**	140000 seeds/ 89 rows = **1573 seeds/ row**
	Row length: 50m = 5000 cm		
	P-P distance 5000 cm / 1124 seeds = **4.4 cm**	P-P distance 5000 cm/ 1311 seeds = **3.8 cm**	P-P distance 5000 cm /1573 seeds = **3.2 cm**
Reduced - 60 kg/ha	5.2	4.5	3.7
	10,000 m^2: 60 kg; 2000m^2: 12 kg		
	85714 seeds **(12 kg)**	100000 seeds **(12 kg)**	120000 seeds **(12 kg)**
	85714 seeds/ 89 rows = **963 seeds/ row**	100000 seeds/ 89 rows = **1123 seeds/ row**	120000 seeds/ 89 rows = **1348 seeds/ row**
	Row length: 50m = 5000 cm		
	P-P distance 5000 cm/ 963 seeds = **5. 2 cm**	P-P distance 5000 cm/ 1123 seeds = **4.5 cm**	P-P distance 5000 cm/ 1348 seeds = **3.7 cm**
Reduced - 50 kg/ha	6.2	5.3	4.5
	10,000 m^2: 60 kg; 2000m^2: 10 kg		
	71429 seeds **(10 kg)**	83333 seeds **(10 kg)**	100000 seeds **(10 kg)**
	71429seeds/ 89rows = **803 seeds/row**	83333seeds/ 89 rows = **936 seeds/row**	100000seeds/ 89rows = **1123 seeds/row**
	Row length: 50m = 5000 cm		
	P-P distance 5000 cm/803 seeds = **6.2 cm**	P-P distance 5000 cm/ 1123 seeds = **5.3 cm**	P-P distance 5000 cm/ 1123 seeds = **4.5 cm**

Table 2.1: Effect of varieties and seed rate on plant growth and seed yield attributes in soybean

Treatments	Number of plants per square meter	Number of branches per plant	Number of pods per plant	Number of seed per pod	Seed yield per plant (g)	Seed yield per plot (kg)	Seed yield per ha(q)	100 seed weight	Cost benefit ratio and	Net monetary returns	Insect pest and disease incidence
Varieties (V)											
V_1											
V_2											
Mean											
SEm±											
CD (P=0.05)											
Seed rates (R)											
R_1											
R_2											
Mean											
SEm±											
CD (P=0.05)											
V x R (Varieties x Seed rate)											
V_1R_1											
V_1R_2											
V_2R_1											
V_2R_2											
CD (P=0.05)											
CV (%)											

Table 2.2: Effect of varieties and seed rate on seed quality attributes in Soybean

Treatments	Germination (%)	Seedling length (cm)	Seedling dry weight	Vigour index I	Vigour index II	Moisture content (%)	Seed mycoflora (%)
Varieties (V)							
V_1							
V_2							
Mean							
SEm±							
CD (P=0.05)							
Seed rate (R)							
R_1							

R_2							
Mean							
SEm±							
CD (P=0.05)							
V x R (Varieties x Seed rate)							
V_1R_1							
V_1R_2							
V_2R_1							
V_2R_2							
CD (P=0.05)							
CV (%)							

Experiment 3: Standardization 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 experimentations for working out isolation distance standards and recommend for inclusion in the revised 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	PJTSAU, Hyderabad; MPKV, Rahuri; GBPUAT, Pantnagar; PDKV, Akola and JNKVV, Jabalpur
Mustard	ICAR-IARI, New Delhi; PAU, Ludhiana; GBPUAT, Pantnagar; NDUAT, Faizabad; SKNAU, Durgapura and ICAR- IISS, Mau

Methodology:

Pigeon pea: The pollen parent (R line) will be sown in a plot size of 2.25 m (width) X 24 m (length) with a spacing of 75 X 30 cm and surrounded on one side (along the wind direction) by three rows of female parent (CMS line) of 3 meters length each, at different distances *viz.,* 250, 300, 350, 400, 450, 500, 550 and 600m from the pollen parent (Fig. 1). Precaution should be taken that no other pigeon pea crop should be grown within a periphery of 600m.

Seed Source: Parental lines of pigeonpea hybrid ICPH 2470 i.e. 40 g seeds of A-line and 50 g seeds of R-line will be supplied to all centres by Dr. T. Pradeep, Director (Seeds), PJTSAU, Hyderabad (Mob. No.- 9441374391, Email ID- srtcpjtsau@gmail.com).

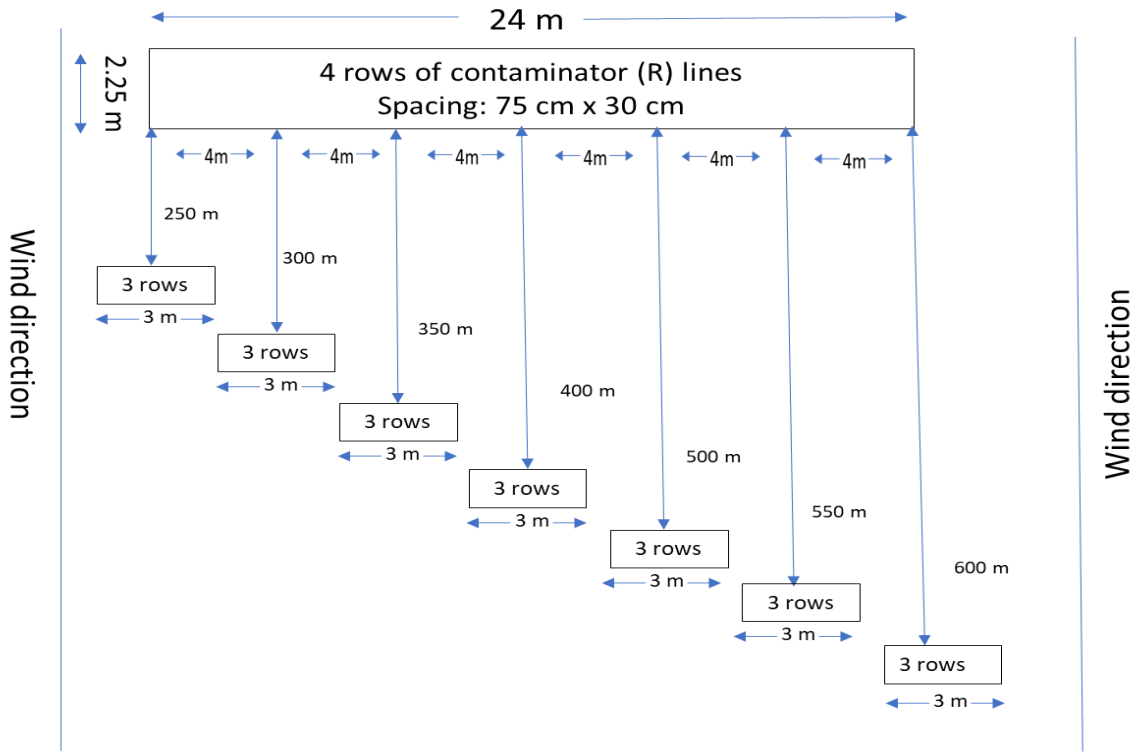

Fig. 1: Schematic field layout for standardization of isolation distance in Pigeon pea

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 (*Helicoverpa armigera*), spraying of Indoxacarb (15.8% EC @ 400-500 ml /ha) or Tracer (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 5 PM.

Mustard: The pollen parent (R line) is to be grown in a plot size of 1.5 m (width) X 24 m (length), with a spacing of 45 X 15 cm and surrounded on one side (along the wind direction) by three rows of female parent (CMS line) of 3 meters length each at different distances *viz..,* 100, 200, 300,

400, 500, 600 and 700 m from the pollen parent (Fig. 2). Precaution should be taken that no other mustard crop should be grown within a periphery of 700m.

Seed Source: 100 g seed each of pollen (R line) and female parent (CMS line) will be supplied by Dr. Bhagirath Ram, Principal Scientist, ICAR-DRMR, Bharatpur, Rajasthan (Mob. No.: 9660114965)

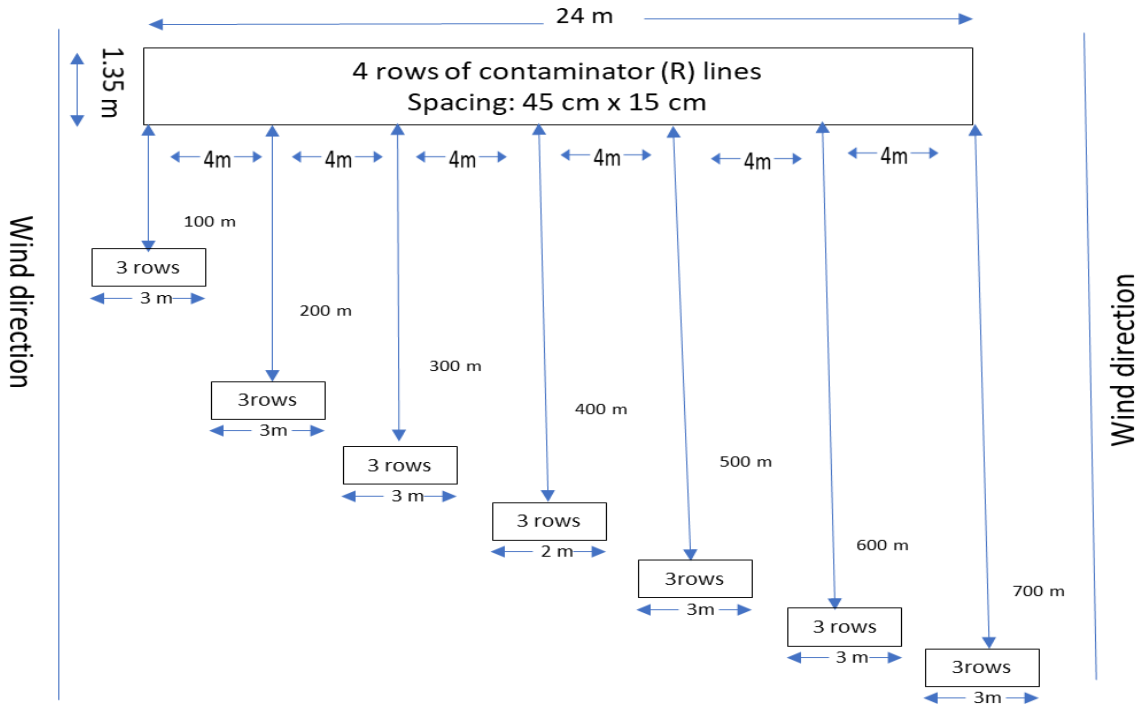

Fig. 2: Schematic field layout for standardization of isolation distance in Mustard

Observation to be recorded:

1. Days to flower initiation in parental lines
2. Day to 50% flowering in parental lines
3. Duration of flowering in parental lines
4. Evaluation of extent of selfing in female line by bagging
5. Plant height at harvest
6. Seed setting percentage in female parent

Note: 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).

Table 3.1: Observations on pollinator activity at different isolation distances

Parental lines	Honeybee/ other pollinators	Remarks

	Pollen gatherers		Nectar collectors		
	FN (8-9 am)	**AN (3-4 pm)**	**FN (8-9 am)**	**AN (3-4 pm)**	
Contaminator (male line)					
CMS (Female lines)					
D1					
D2					
D3					
D4					
D5					
D6					
D7					

Note: The timings for recording observations can be adjusted depending upon visit of honeybee/ pollinators. Five random plants (around 10 min. /plant) should be observed for the visit of insect pollinators during peak flowering stage. Honeybee carrying pollen from contaminator plots should be recorded as pollen gatherers. The nectar collectors will be devoid of pollen in their pollen basket. The observations should be repeated for three days.

Experiment 4: Optimization of organic seed production systems in selected crops

Objectives:

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

CROP	**CENTRE**
Rice	ICAR RC NEHR, Sikkim Centre (NOFRI); ICAR RC Meghalaya; ICAR RC NEHR Manipur Centre (Black rice); AAU, Jorhat; IGKV, Raipur; IISS, Mau; PJTSAU, Hyderabad; UAS, Bangalore
Maize	ICAR RC Meghalaya; ICAR RC NEHR Manipur Centre; GBPUAT, Pantnagar; PJTSAU, Hyderabad; UAS, Dharwad and VNMKV, Parbhani
TREATMENT DETAILS	
No. of treatments: 03	**Replications:** 03
Sowing method	
Direct sowing – 30 x 10 cm (Rice) and 45 x 15 cm (Maize – sown at 3-4 cm depth)	
Treatment details (Common to rice & maize)	
N1 – Control (No Fertilizer & Manure)	

<table>
<tr><td colspan="3">N2 – State Recommended Dose of NPK Fertilizer (Inorganic): Not applicable in case of NOFRI, Sikkim</td></tr>
<tr><td colspan="3">N3 – RDN through Green manure/ FYM/ Vermicompost/ Neem Cake/ Azospirillum, as either sole application or combination of different sources + 10kg PSB/ ha + 10kg KSB/ ha</td></tr>
<tr><td colspan="3">Note:
The dose of organic sources has to be calculated as per the N requirement of respective crop prescribed equivalent to State RDN (Recommended dose of Nitrogen).
In addition to ‘N’, some quantity of Phosphorus will be supplied through application of Neem cake/ FYM /Vermicompost/ Green manure, but remaining phosphorus needs to be supplied through Rock Phosphate.</td></tr>
<tr><td colspan="2">Design</td><td>Randomized block design (Fixed plot)</td></tr>
<tr><td>Plot size</td><td>Gross plot size</td><td>3 m × 5.0 m =15.0 m^2 for rice, ragi, wheat and black gram and 3.25 x 5=16.25m^2 for Maize</td></tr>
<tr><td colspan="2">Spacing between plots (Plot Border)</td><td>One metre in all crops</td></tr>
<tr><td colspan="2">Cultivars</td><td>A set of 3 local/ traditional/ Organic varieties (minimum) and improved variety as check (in consultation with agronomists / farming systems experts)</td></tr>
<tr><td colspan="2">Seed treatment</td><td>In case of cereals, seed treatment with biocontrol agents viz., Trichoderma harzianum or Pseudomonas fluorescens @ 10g/ kg of seed;
In black gram, seed treatment with Rhizobium @10 gm/kg seed shall be followed.</td></tr>
<tr><td colspan="2">Plant protection
(As prophylactic measure)</td><td>Uniform application of botanicals i.e. Neem oil (@ 5 ml/ litre of water) to all the plots. Spray of commercially available T. harzianum EC@ 2 ml/ litre or P. fluorescens EC @ 5 ml/ litre or Combination of P. fluorescens + Bacillus subtilis @ 5 gm/ litre water as a prophylactic measure.
Application schedule of P. fluorescens (Rice)
i. Boot Emergence stage
ii. 50% emergence of panicle stage
iii. Pre-harvest (15 days prior to harvest) stage
Application schedule of combination of P. fluorescens + B. subtilis (Wheat)
i. Boot Emergence stage
ii. 50% emergence of panicle stage
iii. Pre-harvest (15 days prior to harvest) stage</td></tr>
</table>

	Application schedule of combination of *P. fluorescens* + *B. subtilis* (Maize and Ragi) i. 45 DAS ii. 60 DAS iii. 90 DAS **Application schedule of combination of *P. fluorescens* + *B. subtilis* (Black gram)** i. 30 DAS ii. 50 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 (as per table 4.1 and 4.2):

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

Guidelines

1. The experiment should be conducted only in organically maintained plots. The organic treatment plots have to be laid out in separate block (preferably in 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 should be estimated for 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 N3 – 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 before use/ field application and furnished during reporting of results.
4. The organic sources of NPK *viz.,* Neem cake, FYM/Vermicompost should be applied to experimental plots as per treatment schedule, atleast 20 days prior to sowing. The biofertilizers *viz.,* Azospirillum, PSB and KSB should be mixed with FYM/ Vermicompost at the time of field application.
5. 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.

Table 4.1: Effect of organic nutrient management on plant growth and seed yield attributes

Treatments/ Parameters	Field emergence (%)	Plant height at 30 DAS (cm)	Plant height at harvest (cm)	Days to first flowering	Days to 50% flowering	No. of tillers/ plant	Seed yield/ plant	Seed yield (q/ ha)
Varieties (V)								
V1								
V2								
V3								
V4								
Mean								
Sem±								
CD								
CV (%)								
Nutrient Management treatments (N)								
N1								
N2								
N3								
Mean								
Sem±								

CD								
CV (%)								
Interaction effects								

Table 4.2: Effect of organic nutrient management on seed quality parameters and economic indicators

Treatments/ Parameters	Seed Recovery (%)	100 seed weight (g)	Seed quality		Net monetary returns (Rs.)	Benefit Cost ratio
			Germination (%)	Vigour index-I		
Varieties (V)						
V1						
V2						
V3						
V4						
Mean						
Sem±						
CD						
CV (%)						
Nutrient Management treatments (N)						
N1						
N2						
N3						
Mean						
Sem±						
CD						
CV (%)						
Interaction effects						

Experiment 5: Seed quality assessment of breeder seed samples

Objective: To assess the seed quality of the breeder seed produced by the respective University (to be done in collaboration with BSP unit of the respective centres).

S. No.	Centre	Crops
1	CSKHPKV, Palampur	Paddy, Wheat, Urd, Mustard
2	PAU, Ludhiana	Paddy, Wheat, Mung, Urd, Mustard, Cotton

3	ICAR-IARI, New Delhi	Paddy, Wheat, Chickpea, Pigeonpea, Mung, Mustard
4	GBPUAT, Pantnagar	Paddy, Wheat, Urd, Mung, Chickpea, Soybean
5	JNKVV, Jabalpur	Paddy, Wheat, Mung, Urd, Chickpea, Soybean
6	MPKV, Rahuri	Sorghum, Pigeonpea, Chickpea, Soybean, Groundnut
7	PDKV, Akola	Sorghum, Mung, Urd, Chickpea, Soybean
8	UAS, Bengaluru	Paddy hybrid (parental lines), Sunflower Hybrid (parental lines), Fingermillet, Pigeonpea, Groundnut
9	TNAU, Coimbatore	Paddy, Mung, Urd, Groundnut, Cotton
10	OUAT, Bhubaneshwar	Paddy, Groundnut, Mung, Urd
11	PAJANCOA &RI, Karaikal	Paddy
12	VNMKV, Parbhani	Sorghum, Pigeonpea, Chickpea, Soybean

Minimum no. of lots to be GOT evaluated: At least 5 seed lots per crop (may be same or different varieties of a crop depends on availability of varieties in a crop.)

Methodology:

- The Seed Technology Research Unit (Seed Production and Certification group) will draw the samples of breeder seed produced during the *kharif* and *Rabi* season, following the prescribed ISTA procedures. The seed produced in the *kharif* and *rabi* seasons may be supplied by the end of December and by the end of May, respectively
- The background information on crop variety, area sown, date of sowing and meteorological data shall be furnished along with the seed samples.
- The grow out test for *kharif* breeder seed samples may be conducted in the month of - February-March, i.e. *Summer* season
- At many places, off season grow out test for *rabi* crops may not be possible. Hence, the GOT for rabi crops may be conducted 30 - 40 days before the onset of rabi season
- The number of plants to be observed and plot size may be decided based on the specified genetic purity percentage, as per IMSCS 2013.
- The crop should be monitored/ inspected by the concerned breeder and observations on the off types may be recorded on the basis of morphological characters of the variety.

Observations to be recorded (as per table 5.1): Seed quality parameters (Seed Moisture content, Physical purity including ODVs, Germination per cent and Seed Health test) will be tested on samples drawn from BS and Plant population, percent off types, percent genetic purity will be recorded in GOT.

Expected Outcome: It will help in reliable assessment and documentation of seed quality status of breeder seed produced at SAUs and ICAR Institutes.

Table 5.1: Seed quality assessment of breeder seed samples

Location	Crop	Variety	Plant population	Off types (%)	Genetic purity (%)	Seed Moisture content (%) Initial and prior to sowing in next planting season	Physical purity (%)	ODVs	Germination (%) Initial and prior to next planting season	Seed mycoflora (%) Initial and prior to next planting season
Season: Kharif/Rabi										

Experiment 6: Preparation of Atlas for quality seed production pockets of different crops in India

Objectives:

- Delineation of areas for quality seed production in different crops in India
- To assure better quality seed to the farmers in domestic and export markets

Crop	Centres
Paddy	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; IARI, New Delhi; IARI RS, Karnal; GBPUA&T, Pantnagar; UAS, Dharwad; CCSHAU, Hisar; VPKAS, Almora; RARS (KAU), Pattambi; BAU, Sabour; JNKVV, Jabalpur; NRRI, Cuttack; 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-RCER, Patna; ICAR-CSSRI, Karnal; RVSKVV, Gwalior; ICAR NEH Region Tripura; ICAR NEH Region, Manipur; ICAR NEH Region, Meghalaya; ICAR- CIARI, Port Blair

Methodology: It is a survey type integrated and inter-disciplinary experiment, which will be done in line with soil maps and whole production environment. It will encompass technical

collaboration among all STR disciplines *viz.,* Seed Production and Certification, Seed Physiology, Storage and Testing, Seed Pathology Seed Entomology and Seed Processing.

The seed production and certification group will collect the seed samples from seed producing centers within the jurisdiction of their respective ICAR Institutes/ SAUs along with the information on different seed production points during *kharif, rabi* and *summer* season with following observations (Table 6.1 to 6.5)

Observations to be recorded:

Table 6.1: Seed Production and Certification

S. No.	Location	Crop	Variety	Stage	Date of sowing	Date of harvest	Soil test report	Metrological data during crop growth	Pest and disease infestation during crop growth	Seed yield (q/ha)

Table 6.2: Seed Processing

S. No.	Location	Crop	Variety	Stage	Seed Recovery %	Test weight - 100 seed (g)	Any other relevant observation/ remarks

Table 6.3: Seed Physiology Storage and Testing

S. No.	Location	Crop	Variety	Seed quality (Seed moisture content, Germination %, Vigour Index I and II)

Table 6.4: Seed Pathology

S. No.	Location	Crop	Variety	Initial Seed health status of produce (% incidence of seed borne pathogens)

Table 6.5: Seed Entomology

S. No.	Location	Crop	Variety	Initial insect infestation of produce (%)

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 quality seed production pockets of different crops in India during *kharif, rabi and summer seasons*.

Experiment 7: 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	PAU, Ludhiana; GBPUAT, Pantnagar and JNKVV, Jabalpur; ICAR-IARI, New Delhi; RPCAU, Pusa
2	Groundnut	JAU Jamnagar; UAS, Bangalore, PJTSAU, Hyderabad; UAS, Dharwad and SKNAU, Durgapura
3	Chickpea	ICAR-IARI, New Delhi; MPKV, Rahuri; PDKV, Akola, IISS, Mau; CCS HAU, Hisar; JNKVV, Jabalpur; VNMKV, Parbhani; SKNAU, Durgapura
4	Wheat	ICAR-IARI, New Delhi; SKNAU, Durgapura, CSKHPKV, Palampur, and JNKVV, Jabalpur, PAU, Ludhiana and CCS HAU, Hisar

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 done at TERI Gurugram, Haryana

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**

<table>
<tr><td colspan="3">MAIZE</td></tr>
<tr><td colspan="2">No. of treatments</td><td>10</td></tr>
<tr><td colspan="3">Sowing: Direct seed sowing @ 20 kg seed/ ha; Spacing of 75 x 25cm
Prepare ridge at 75cm spacing.</td></tr>
<tr><td colspan="3">Note:
Apply FYM 10 t/ ha, 10-15 days prior to sowing, supplemented with 165:75:75 kg/ ha N:P:K dose, respectively and 25 kg/ ha of Zinc Sulphate.
Full doses of P, K and Zn should be applied as basal. Nitrogen is split applied at four dosages as:<table><tr><th>S. No.</th><th>Crop Stage</th><th>Nitrogen (%)</th></tr><tr><td>1</td><td>Basal (before sowing)</td><td>20</td></tr><tr><td>2</td><td>V_4 (four leaf stage)</td><td>25</td></tr><tr><td>3</td><td>V_8 (eight leaf stage)</td><td>30</td></tr><tr><td>4</td><td>V_T (tasseling stage)</td><td>25</td></tr></table>
Weeding, inter culture, irrigation, plant protection etc. be followed for raising healthy crop.</td></tr>
<tr><td colspan="2">Design</td><td>Randomized Block Design</td></tr>
<tr><td colspan="2">No. of replications</td><td>3</td></tr>
<tr><td>Plot size</td><td>Gross plot size</td><td>5 m × 2 m (10m^2)</td></tr>
<tr><td colspan="2">Space between plots</td><td>60 cm</td></tr>
<tr><td colspan="2">Recommended dose of fertilizer (N:P:K)</td><td>165:75:75 kg/ ha or State recommended dose of fertilizer</td></tr>
<tr><td colspan="2">Foliar spray</td><td>Nano P and Nano Zn + Fe foliar spray at knee stage</td></tr>
<tr><td colspan="2">Cultivar</td><td>VMH-53</td></tr>
<tr><td colspan="3">Source fertilizers</td></tr>
<tr><td colspan="2">1. Nitrogen</td><td>Urea (46 % N)</td></tr>
<tr><td colspan="2">2. Phosphorus</td><td>Single Super phosphate (SSP) (16 % P_2O_5)</td></tr>
<tr><td colspan="2">3. Potassium</td><td>Muriate of Potash (MOP) (60 % K_2O)</td></tr>
</table>

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%)

Plant protection measure: 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

- Soil nutrient analysis (pre and post experiment) – TERI, Gurugram
- Field emergence
- Plant height at 30 DAS and at harvest
- Leaf chlorophyll – 30 DAS
- 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 (%)
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Net monetary returns (Rs.) and Benefit Cost ratio

<table>
<tr><td colspan="4">GROUNDNUT</td></tr>
<tr><td colspan="2">No. of treatments</td><td colspan="2">10</td></tr>
<tr><td colspan="4">Sowing: Direct seed sowing @100 kg seed/ ha; Spacing of 40 x 15 cm</td></tr>
<tr><td colspan="4">•</td></tr>
<tr><td colspan="4">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, respectively and 25 kg/ ha of Zinc Sulphate.
• 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 colspan="2">Design</td><td colspan="2">Randomized Block Design</td></tr>
<tr><td colspan="2">No. of replications</td><td colspan="2">3</td></tr>
<tr><td>Plot size</td><td>Gross plot size</td><td colspan="2">5 m × 2 m (5m^2), 5 rows of 5 m</td></tr>
<tr><td colspan="2">Space between plots</td><td colspan="2">60 cm</td></tr>
<tr><td colspan="2">Recommended dose of fertilizer (N:P:K)</td><td colspan="2">20:60:30 kg/ ha or State recommended dose of fertilizer</td></tr>
<tr><td colspan="2">Foliar spray</td><td colspan="2">Nano P and Nano Zn + Fe foliar spray pre flowering stage</td></tr>
<tr><td colspan="2">Cultivar</td><td colspan="2">RG578</td></tr>
<tr><td colspan="4">Source fertilizers</td></tr>
<tr><td colspan="2">1. Nitrogen</td><td colspan="2">Urea (46 % N)</td></tr>
<tr><td colspan="2">2. Phosphorus</td><td colspan="2">Single Super phosphate (SSP) (16 % P_2O_5)</td></tr>
<tr><td colspan="2">3. Potassium</td><td colspan="2">Muriate of Potash (MOP) (60 % K_2O)</td></tr>
<tr><td colspan="2">4. Zinc</td><td colspan="2">Zinc Sulphate ($ZnSO_4$) (Zinc 21%)</td></tr>
<tr><td colspan="4">OR</td></tr>
<tr><td colspan="2">1. Nitrogen and Phosphorus</td><td colspan="2">Diammonium Phosphate (DAP) (18 % N and 46 % P_2O_5)</td></tr>
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</table>

Plant protection measure: 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 (as per table 7.1 and 7.2):

- Soil nutrient analysis (pre and post experiment)
- Field emergence
- Plant height at 30 DAS and at harvest
- Leaf chlorophyll – 30 DAS
- No. of pods/ plant
- Seed yield/ plant (gm)
- Seed yield/ ha
- 1000 seed weight (gm)
- Seed recovery (%)
- Seed quality parameters: Seed germination, Vigour indices and Seed health
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<tr><td colspan="4">Note
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• Full doses of P and Zn should be applied as basal. Nitrogen and Potassium is split applied at two dosages as:
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<tr><th>S. No.</th><th>Crop Stage</th><th>Nitrogen (%)</th><th>Potassium (%)</th></tr>
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• 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 colspan="3">Design</td><td>Randomized Block Design</td></tr>
<tr><td colspan="3">No. of replications</td><td>3</td></tr>
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<tr><td colspan="3">Recommended dose of fertilizer (N:P:K)</td><td>20:60:30 kg/ ha or State recommended dose of fertilizer</td></tr>
<tr><td colspan="3">Foliar spray</td><td>Nano P and Nano Zn + Fe foliar spray pre flowering stage</td></tr>
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<tr><td colspan="3">1. Nitrogen and Phosphorus</td><td>Diammonium Phosphate (DAP) (18 % N and 46 % P_2O_5)</td></tr>
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</table>

Plant protection measure: 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 (as per table 7.3 and 7.4):

- Soil nutrient analysis (pre and post experiment) – TERI, Gurugram
- Field emergence
- Plant height at 30 DAS and at harvest
- Leaf chlorophyll – 30 DAS
- No. of pods/ plant
- Seed yield/ plant (gm)
- Seed yield/ ha
- 1000 seed weight (gm)
- Seed recovery (%)
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Net monetary returns (Rs.) and Benefit Cost ratio

CHICKPEA	
No. of treatments	**10**
Sowing: Direct sowing @ 60-80 kg seed / ha, Spacing- 30 x 10 cm, 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.	

• 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.		
Design		Randomized Block Design
No. of replications		3
Plot size	**Gross plot size**	5 m × 2 m (10 m^2)
Space between plots		60 cm
Recommended dose of fertilizer (N:P: K)		20-25:40:25 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 optimum growth 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		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%)

Plant protection measure: 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 (as per table 7.5 and 7.6):

- Soil nutrient analysis (pre and post experiment)
- Field emergence
- Plant height at 30 days after sowing and at harvest
- Leaf chlorophyll - 30 DAS
- No. of pod/plant
- Seed yield/ plant (gm)
- Seed yield/ ha
- 1000 seed weight (gm)
- Seed recovery (%)
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Net monetary returns (Rs.) and
- Benefit Cost ratio

<table>
<tr><td colspan="3">WHEAT</td></tr>
<tr><td colspan="2">No. of treatments</td><td>10</td></tr>
<tr><td colspan="3">Sowing: Direct sowing @100 kg seed/ ha, depth of sowing: 5-6 cm; spacing:20-22.5 cm</td></tr>
<tr><td colspan="3">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. 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. 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.</td></tr>
<tr><td colspan="2">Design</td><td>Randomized Block Design</td></tr>
<tr><td colspan="2">No. of replications</td><td>3</td></tr>
<tr><td>Plot size</td><td>Gross plot size</td><td>5 m × 2 m (10 m^2)</td></tr>
<tr><td colspan="2">Space between plots</td><td>60 cm</td></tr>
</table>

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 optimum growth 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	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%)

Plant protection measure: 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, Carbendzim @ 1 to 1.5 gm/ kg seed at the time of sowing.

Observations to be recorded (as per table 7.7 and 7.8):

- Soil nutrient analysis (pre and post experiment) – TERI, Gurugram
- Field emergence
- Plant height at 30 DAS and at harvest
- Leaf chlorophyll
- No. of filled seeds/plant
- Seed yield/ plant (gm)
- Seed yield/ ha
- 1000 seed weight (gm)

- Seed recovery (%)
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Net monetary returns (Rs.) and Benefit Cost ratio

Maize

Table 7.1: Effect of nano nutrient seed coating and foliar spray plant growth and seed yield attributes in Maize

Treatments	Field emergence (%)	Plant height at 30 days (cm)	Days to first flowering	Days to 50% flowering	Chlorophyll content (SPAD value)	Plant height at 30DAS (cm)	Plant height at harvest (cm)	No. of cob/plot	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 7.2: 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	Benefit Cost ratio
			Germination (%)	Vigour index		
T1						
T2						
T3						
T4						

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

Groundnut

Table 7.3: Effect of nano nutrient seed coating and foliar spray plant growth and seed yield attributes in Groundnut

Treatments	Field emergence (%)	Plant height at 30 days (cm)	Days to first flowering	Days to 50% flowering	Chlorophyll content (SPAD value)	Plant height at 30DAS (cm)	Plant height at harvest (cm)	No. of pod/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 7.4: 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	Benefit Cost ratio
			Germination (%)	Vigour index		
T1						
T2						
T3						
T4						
T5						
T6						
T7						
T8						
T9						
T10						
Mean						
SEm±						
CD (P=0.05)						

Chickpea

Table 7.5: Effect of nano nutrient seed coating and foliar spray plant growth and seed yield attributes in Chickpea

Treatments	Field emergence (%)	Plant height at 30 days (cm)	Days to first flowering	Days to 50% flowering	Chlorophyll content (SPAD value)	Plant height at 30DAS (cm)	Plant height at harvest (cm)	No. of pod/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 7.6: 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		
T1						
T2						
T3						
T4						
T5						
T6						
T7						
T8						
T9						
T10						
Mean						
SEm±						
CD (P=0.05)						

Wheat

Table 7.7: Effect of nano nutrient seed coating and foliar spray plant growth and seed yield attributes in Wheat

Treatments	Field emergence (%)	Plant height at 30 days (cm)	Days to first flowering	Days to 50% flowering	Chlorophyll content (SPAD value)	Plant height at 30DAS (cm)	Plant height at harvest (cm)	No. of filled seed/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 7.8: 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)						

B. Seed Physiology, Storage and Testing

Date: 15.05.2020

Chairman	:	**Dr. Malavika Dadlani** Former JD (Research), ICAR-IARI, New Delhi
Convener	:	**Dr. Shiv K. Yadav** Principal Scientist, ICAR-IARI, New Delhi & PI, SPST

General Observations

In Seed Physiology, Storage and Testing project a total of five experiments with 3 sub experiments each under experiment numbers third and fourth were conducted during 2019-2020. Based on the deliberations on the findings from these experiments by different centres with the scientists and experts present in the house, the following decisions were taken.

- All the experiments will continue with some modifications as mentioned therein. An additional experiment on "Quantification of the Seed Vigour" was also recommended to be taken up from this year.
- The experiment 1 "To validate the validity periods of certified seeds of field crops" to continue at each centre with the stored seed which was made available/supplied last year by the earmarked/ identified centres. However, outcome of the experiment during 2020-21 must be reported for minimum of 24 months from date of harvesting or storage period of 18 months or till viability is maintained ≥IMSCS by the seed lot(s). The final recommendations for the validity periods in different crops would be made on the basis of the lowest values (non-significant difference between at least two or more centres), rejecting the outliers.
- Since HDPE bag was found effective in maintaining germination of seed lots for longer storage periods, so the group suggested that all the seeds should be packaged in HDPE bags at recommended levels of Moisture Content for vapour proof containers.
- Further, separate storage experiment using numerous types of packaging materials available in the market should be taken up. Whereas, general specifications of all types of bags viz., material, thickness, vapour perviousness must be known and every centre uses the same materials.
- Participating centres will continue their efforts to identify unique molecular markers under experiment 2 for hybrid purity testing in more public bred hybrids; newly released hybrid(s), if any and or older hybrid(s) that have not been studied yet under this experiment, but are in active chain.
- Validation of unique markers identified for purity testing by various centres will be done by other participating centre(s) of respective crops.

- For validation of suggested markers, if any, by the Parent University/ institute(s) for their own hybrids; the originating/parental institute/university shall make available hybrid/s along with parental line seeds of respective crops to the participating centre(s) in sufficient quantities and details of marker/s with protocol/s.
- Respective centres shall also repeat the experiment for in-house revalidation of identified markers (in 2019-20) with the same materials and methods in addition to exploring more markers in other hybrids.
- For validation, comparison of laboratory results with GOT analysis and calculations of cost for conduct of both these test is must.
- The originating/parent institute and or the identifying university/institute(s) will share the unique molecular markers (primer sequences), name of companies whose chemicals have been used, seeds of hybrids and their parental lines in sufficient quantities and the exact protocol followed with other participating centre(s)/ institute(s) for that crop(s), as was done last year. For example, parent institute(s) for their own hybrids; ICAR-CICR, Nagpur, ICAR-IIOR, Hyderabad and PDKV, Akola for Cotton, Castor and Sorghum etc.
- The experiment 3 "Physiology studies and development of priming technologies for enhancing planting value of the seed in field crops under optimal and sub-optimal conditions" will continue for validation of crop specific treatments only which have been found better by various centre(s) for improving the planting value. The ICAR-NBAIM, Mau shall supply sufficient quantities of all the bio-agents/cultures including *T. harzianum* to participating centres till 15th June, 2020, while the AAU, Jorhat to get double the quantity for taking up an additional experiment under organic conditions. Besides this a separate experiment on use of endophytes for enhancement of plating value of field crops was recommended to be taken up by "Seed Pathology" group.
- For development of seed enhancement techniques for low temperature stress during seedling establishment in Maize and Paddy, participating centres may try additional treatments for better results under the sub-experiment II of experiment 3.
- Under the sub-experiment III of experiment 3 the participating centre(s) will take up the demonstrations for thermo-priming technology in pigeon pea under heat stress conditions.
- The thermo priming technology (Exposure of seeds for 24hrs at 40^{0}C) in pigeon pea has been validated to perform better under heat stress. It could be taken up for large scale demonstrations at farmers' field(s) by the centre(s).
- Some centres have reported better germination with hydro primed seeds. Also any treatment which is effective under temperature stress could also do well under moisture stress. Therefore, validation of these two treatments by the participating centre(s) under moisture stress conditions available and or created, if any.

- Validation of halo priming technology in pigeon pea will be taken up only at centre(s) that has salinity/alkalinity conditions at their research farms and or can use such land of any farmer(s) near to the participating centre(s).
- Sub-experiment III of experiment 4 "Evaluation of silver nano-conjugates as seed priming agents against *Fusarium fuzikoroi* causing Bakkane disease of Paddy" has been concluded with the recommendation that paddy seed priming for 8 hours prior to sowing with silver nano conjugate (1, 2, 4-triazolodithiocarbamate conjugated silver nanoparticles aqua emulsions = B) followed by seedling root dip treatment (in B solution) before transplanting for 6 hours resulted in maximum control of Bakkane disease and also gave maximum seed yield in paddy.
- Validation of standardized nano particles for enhancement in planting value and storability to continue under experiment 4 "use of nano-particles in enhancing seed quality and storability of seeds". Additional observations on toxicity to roots by nano-particle(s) will be included. The centres shall use the previously nano particle treated stored seeds at their centres. Any centre(s) in need of getting seeds of any crop treated with standardized nano particle may request Dr. C. Vanitha, AP (SST), TNAU, Coimbatore (cvani_seed@yahoo.co.in) to facilitate the conduct of this experiment. Two new crops; Chickpea and Paddy will be included in objective I of experiment 4.
- The objectives of experiment 4 are revised: 1. To standardize the optimum concentration of different nano-particles for seed treatment in Chickpea and Paddy; 2. To validate the effect of identified nano-particles on planting quality of Pigeon pea, Onion and Soybean; and 3. To study the effect of identified nano-particles on seed quality of treated seeds of Pigeon pea, Onion and Soybean in storage for form 3 Sub-experiments.
- The ADG (Seeds), ICAR, New Delhi and Director, IISS, Mau may contact the Director, ICAR-IIVR, Varanasi and or ICAR-DOGR, Pune and ensure that experiments on enhancement in planting value and storability through treatment with nano particles in onion are not being formulated under AICRP on vegetable crops to avoid repetition.
- Under the experiment 5 "Influence of terminal heat stress on seed set, seed yield and quality in field crops" last year, it was suggested that each centre shall also to compare untreated (control) with salicylic acid @ 400 ppm in the demonstration plots of (minimum 500sqm each) to elucidate the mitigation of impact of elevated temperatures on various important crops at respective centre(s).
- Chickpea crop has been added from this year to evaluate adverse effect of heat stress during the reproductive phase and its mitigation. The participating centre(s) of the respective crop under experiment 5 will continue to validate only crop specific heat mitigation treatments which have been found better by various centre(s) for improving the quality of the seed produced under heat stress while maintaining comparable yields with normal sown crops. The experiment will conducted at centre(s) where crop(s) either naturally experience elevated

(appox. 5°C) temperature at terminal stage under normal/staggered sowing situations or has controlled growth chamber facilities.

- Experiment 5 will be carried out with three objectives (Sub-experiments): 1. To evaluate the adverse effect of heat stress during the reproductive phase in chickpea and its mitigation; 2. To validate the effect on yield and seed quality of standardized treatments for mitigation of heat stress during the reproductive phase in selected field crops; and 3. Demonstration of the most efficient treatment reported among the crops.
- It is reiterated that the complete reports in all respects should be prepared on analyzed data and submitted timely. 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. However, it is advised to discuss with the peers and statisticians of your organization for use of deeded fit designs. Guidelines to improve the outcome of the experiments will be communicated to everyone separately.
- After writing the results for each crop in different experiments every participating centre must provide the required information in wrap up table provided in Technical Programme. Also you should give the explanations while jotting down concluding remarks on the results of the year.
- Every scientist/staff associated with STR, AICRP-NSP at each centre shall critically read this document and confirm, through email to PI with copy to Director, IISS, Mau that they have understood the programme fully and shall conduct the experiments as proposed.

General recommendation

Based upon the prevailing temperature and humidity, the country needs to be divided in different zones for validity period of seed lots. Moreover, the Government of India should make efforts for nationwide development of dedicated seed storage facilities by prioritizing the requirements of zones.

Action: All Participating Centres

The centres shall collect the climate data of last 10 years from respective Institute/University/State agro-meteorological observatories. Take the temperature (Max. & Mini.) and relative humidity % (Max. & Mini.) data from it and compile the numbers of days during each year when the maximum temperature was more than 35^0C and maximum relative humidity remained above 70%. Finally, pin pointing the dates from start to end (months/periods) when temperature and relative humidity remained ≥ prescribed limits. This information along with the data received from agro-meteorological observatories should mandatorily reach to PI (pispnsp@gmail.com) within 45 days of circulation of the programme.

EXPERIMENT-WISE TECHNICAL PROGRAMME FOR THE YEAR 2020-21

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. 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 is 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 finding of this experiment is expected to provide scientific evidence for consideration of revision of validity period, 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
Wheat	:	ICAR-IARI, New Delhi; GBPUAT, Pantnagar; VNMKV, Parbhani; RARI, Durgapura, Raj.; MPKV, Rahuri; **HAU, Hisar***; NDUAT, Faizabad; CSAUAT, Kanpur; SKUAST, Kashmir, Srinagar; ICAR-IISS, Mau & CSKHPKV, Palampur
Paddy	:	**ICAR-IARI, New Delhi***; PAU, Ludhiana; PJTSAU, Hyderabad; TNAU, Coimbatore; UAS, Bengaluru; **PAJANCOA&RI, Karaikal***; KAU, RARS, Pattambi; AAU, Jorhat; SKUAST, Kashmir, Srinagar; ICAR-IISS, Mau and OUAT, Bhubaneswar
Maize	:	ICAR-IARI, New Delhi; TNAU, Coimbatore; ICAR-IISS, Mau and **PAU, Ludhiana***
Sorghum	:	ICAR-IIMR, Hyderabad; **PDKV, Akola***; VNMKV, Parbhani; MPKV, Rahuri and UAS, Dharwad
Cotton	:	**ICAR-CICR, Nagpur***; PDKV, Akola; PJTSAU, Hyderabad and UAS, Dharwad
Soybean	:	ICAR-IARI, New Delhi; GBPUAT, Pantnagar; JNKVV, Jabalpur; **MPKV, Rahuri*** and UAS, Dharwad
Chickpea	:	ICAR-IARI, New Delhi; JNKVV, Jabalpur; VNMKV, Parbhani; **RARI, Durgapura***; ICAR-IISS, Mau and CSAUAT, Kanpur
Castor	:	**PJTSAU, Hyderabad***; JAU, Jamnagar and AAU, Anand

Groundnut : AAU, Anand; OUAT, Bhubaneswar; JAU, Jamnagar; MPKV, Rahuri; UAS, Bengaluru and **UAS, Dharwad***(both *Kharif* and *Rabi* harvest); RARI, Durgapura and BSKKV, Dapoli

***Centres to supply seed material**

Technical Programme:

Materials:

Seed lots: It is presumed that;

- All the participating centres were supplied with the packed seeds (pods in case of groundnut) in 700 gauge polythene from identified centres (in bold text above*) last year.
- The participating centres must have divided the received lots of each variety in two equal parts and stored in Gunny bags and HDPE bags at ambient conditions of respective centres.
- All the participating centres have in their store(s), the sufficient numbers of seeds of two varieties in each crop that were sent last year to them. All centres to continue taking observations on these lots till the period as prescribed.
- Some of the participating centres may also have in their store(s), sufficient seeds of revalidated lots (once or twice) of minimum two varieties in each crop that they have been evaluating since 2018 and that seed has still the viability ≥IMSCS. May continue taking observations on these lots, if satisfied with the outcome that it is in line of the rationale of the experiment.
- **Date of harvesting, Date of test, Moisture content (%), Viability/Germination (%) and validity period (in case of revalidated lots) have been noted as made known to all the participating centres by the identified centres* who supplied the seed and or known from where the fresh/revalidated lots were procured by them.**

Observations to be recorded on seed lots:

Centres will test all seed lots in alternate months for following observations till germination falls 5% below IMSCS;

1. Radicle (2mm) emergence time - (hrs), First count (%) and Germination (%) as per ISTA and vigour indices (Abdul Baki and Anderson, 1973)
2. Moisture content (MC), ISTA (2018)
3. Field emergence (%) and final plant stand (%) establishment. The final plant stand establishment will be recorded/ taken after 6 weeks of sowing for cotton and all cereal crops, whereas it will be 3-4 weeks after sowing of groundnut and pulses. OR
4. In extreme hot or cold months which hamper normal seedling growth, seedling emergence in trays/pots must be tested in growth house/greenhouse using soil as germination medium. The minimum germination percentage as per IMSCS, 2013 is 85%, 80%, 90%, 75%, 65% for

varieties and 75% for hybrids, 70%, 85%, 70% and 70% in Wheat, Paddy, Maize, Sorghum, Cotton, Soybean, Chickpea, Castor and Groundnut, respectively.

5. The experiment will be terminated once the germination falls 5% below IMSCS. Complete report to be submitted by every centre.

Kindly note the following for recording the observations and reporting;

1. Data of this experiment could be analyzed using Design. In this experiment storage period is the most important factor that should always be taken as one of the independent variables (germination will be dependent variable) while analyzing the data.
2. Observations 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.
3. While calculating vigour indices, average/mean length in centimeter and wet/dry weight in gram of 10 randomly selected seedlings on the day of final count should be taken.
4. The formula to be used uniformly by all the centres; SVI-I= Seedling length (cm) X Germination (%) and SVI-II= Seedling Dry Wt. (g) X Germination (%).
5. Don't store the seed in a conditioned cold storage. Seeds may be kept at rodent free, cool/shade and dry place in a room maintaining ambient conditions.
6. The climate data, fortnightly mean minimum & maximum temperature (^{0}C) and RH %, from start of storage till termination of experiment should be furnished and must be used to explain the results for period of storage at respective participating centres.

Wrap up table for experiment I

Centre Name	**Crop Name**	**Information Collected/Generated**	**Name of Varieties (2 Mini.)**		
			1 (Name)	**2 (Name)**	**3/4 (Name)...**
ABC	**Wheat**	Date of harvesting			
		Date of first test at originating/producing organization			
		Germination (%) at if done at producing organization			
		Date of receipt/ procurement of seed lots			
		Date of first test at your centre			
		Germination (%) at time of first test at your centre			
		Germination (%) after 1 month of storage			

		Germination (%) after 2 months of storage			
		Germination (%) after 3 months of storage			
		Moisture content (%) after 3 months of storage			
		Germination (%) after ..... (so on) months of storage			
		Field emergence (%)			
		Final plant stand establishment (%)			
		Similarly to continue			
		Germination (%) at time of last test (... months of storage) at your centre			
		Field/ Seedling emergence (%) at time of last test (... months of storage) at your centre			
		Final plant stand establishment (%) at time of last test, if taken (... months of storage) at your centre			
		Remarks, if any			
	Similarly to continue for other crops				
Finally Specify for each crop max. period(m) for which it can maintain viability above IMSCS					

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 of hybrid purity as an alternate to GOT.

Objectives:

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

Crops		**Centres***
Paddy	:	PJTSAU, Hyderabad; TNAU, Coimbatore; JNKVV, Jabalpur; UAS, Raichur; AAU, Jorhat and KAU, RARS, Pattambhi, ICAR-IISS, Mau
Maize#	:	UAS, Bengaluru and PAU, Ludhiana
Pearl millet@	:	RARI, Durgapura; CCS HAU Hisar and NAU, Navsari
Sunflower	:	UAS, Bangalore and RAU, TCA, Dholi
Cotton@	:	ICAR-CICR, Nagpur, PDKV, Akola and AAU, Anand
Castor	:	PJTSAU, Hyderabad and AAU, Anand (ICAR-IIOR, Hyderabad - only to supply seed and details of markers/protocol)
Sorghum@	:	PDKV, Akola 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.

*Participating centre/s for specific crop/s to also supply seeds and share details of 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 C:B ratio of both these methods is to be calculated.

@ Sincere efforts in these crops to identify unique makers to be made by all participating centres.

#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.

Given are some of markers in different crops that need to be worked upon by participating centres, as mentioned below;

Action: PJTSAU, Hyderabad; TNAU, Coimbatore; AAU, Jorhat and JNKVV, Jabalpur

1. Modification in standardized protocol with respect to annealing temperature is required, if any for amplification of markers; RM 206 and RM 276 for purity testing of paddy hybrids; JGLH-1 and JRH 5, respectively.
2. Identified markers; Xa 21, RM 570, RM 105 and RM 234 for JGLH 1, TNAU Rice hybrid CO4, JGLH1, and AAUH3, respectively are required to be compared with GOT and validated.

Action: UAS, Bengaluru and PAU, Ludhiana

1. Primer umc 1798 for maize PMH 10 need not be evaluated again for polymorphism.
2. The results of SSR markers; umc 1627, bnlg1185, umcl223 and umc 1066 for maize hybrids; PMH 10, MAH-14-5, HEMA, and Palam Sankar Makka-2 are required to be compared with GOT and C:B ratio to be worked out.
3. The SSR Markers; Phi053 and bnlg 1520 for hybrids; Hema and MAH-14-5 identified this year need to be retested for their uniqueness wrt to both these hybrids jointly as well as individually.

Action: UAS, Bangalore and RAU, TCA, Dholi

1. Confirmation of identified eleven Unique SSR markers for six sunflower hybrids are required to be validated, compared with GOT and C:B ratio to be worked out.

Action: PJTSAU, Hyderabad and AAU, Anand

1. EST-SSR markers RcDES55 and RcDES45 for castor hybrids; DCH-177 and DCH-519, required to be validated, compared with GOT and C:B ratio to be worked out.

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.

Identification and Validation of Microsatellites Markers for Additional Hybrids

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 (GOT):
   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 (C/B ratio) for GOT vis-à-vis molecular markers, taking all components of cost into account.

Wrap up table for experiment II

Details for each crop	**Description**
Name of Crop	
Name of Hybrid	
Name of Female Parent	
Male Parent	
Name of Unique Primer identified/validated	
Forward Primer Sequence	
Reverse Primer Sequence	
Name of Centre which identified Unique Primer and Protocol	
Name of Centre which Modified Protocol, if any	
Cost of Conduct of Molecular Analysis: Cost of Conduct of GOT for each hybrid	

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-thermopriming, 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. Validation of identified priming technologies in different field crops for sub-optimal/stress conditions
2. Development of seed enhancement techniques for low temperature stress during seedling establishment in Maize and Paddy
3. Demonstrations for thermo-priming technology in pigeon pea under heat stress conditions

1. For validation of identified priming technologies		
Crops		**Centres**
Chickpea	**:**	ICAR-IISS, Mau, UAS, Raichur and CCS HAU, Hisar
Kabuli Chickpea	**:**	PAU, Ludhiana; JNKVV, Jabalpur; UAS, Raichur; MPKV, Rahuri; RARI, Durgapura, Raj. and PDKV, Akola
Paddy	**:**	UAS, Bengaluru; GBPUAT, Pantnagar; OUAT, Bhubaneswar and SKUAST, Kashmir, Srinagar

Field pea	:	CSAUAT, Kanpur; JNKVV, Jabalpur and NDUAT, Faizabad
Lentil	:	JNKVV, Jabalpur; NDUAT, Faizabad and CSAUAT, Kanpur
Mustard	:	ICAR-IARI, New Delhi; ICAR-CAZRI, Jodhpur and AAU, Anand;
Cotton	:	ICAR-CICR, Nagpur; AAU, Anand and MPKV, Rahuri
Speciality Maize	:	ICAR-IARI, New Delhi and RAU and TCA, Dholi
Pigeonpea	:	AAU, Jorhat and PAJANCOA&RI, Karaikal
2. For testing under low temperature stress		
Paddy	:	AAU, Jorhat* and ICARRC NEH Region - Manipur Centre
Maize	:	RAU, TCA, Dholi and AAU, Jorhat*
3. Demonstrations for thermo-priming technology (Mini. 500sqm for Treat. & Ctrl.)		
Pigeonpea	:	ICAR-IARI, New Delhi, UAS, Raichur and PAU, Ludhiana

* ICAR-IISS, Mau to provide double the quantity of cultures for taking up an additional experiment under organic conditions.

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

Technical programme:

Sub. Experiment I (As per Objective 1): Validation of identified priming technologies in different field crops for sub-optimal/stress conditions

Methods and Materials:

For validation of identified priming technologies in field crops for sub-optimal conditions, each participating centre will use the seeds of any two most popular varieties in their region. Microbial consortia (Bio-NPK, Bio-grow, Bio-phos, etc.) for priming and abiotic stress mitigation to be supplied by Coordination unit, IISS, Mau. Same methodology as mentioned/adapted last year will be followed for all treatments.

Method/dosage of treatment of microbial consortia: For the treatment with BioNPK, Biogrow, 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 so as 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

NB: 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.
Kindly 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.

Treatments:
Treat the seeds 2-3 days before sowing as per the details given are below;

- Number of Treatments: In all crops there will be two common treatments;
  1. Control-I (Untreated).
  2. Control-II (Recommended package of practices for that crop specific for location of participating centre/s).
  3. Treated seeds are to be dried back to initial moisture (air-drying in shade (≈25°C for minimum 48h) or in drying cabinet at 35 ± 1°C)
  4. After drying seeds will be tested along with controls as mentioned above under specific stress conditions (Drought and biotic (fungal) for all crops, but for pigeon pea (moisture and salinity stress).
  5. The drought and moisture stresses could be created by controlling the water supply in pots/fields. For temperature stress sowing dates can be adjusted (prepone/postpone), for biotic (fungal) stress sowing in sick plots and or inoculating with the target fungus, the fields with >2 to <6dSm conductivity of the saturation extract of soils may be good to study the salinity.
  6. Numbers of treatments in each crop will vary as per the reports of significance given by various centres, as given below.

Name of Crop (Total Treat.)	**Name of the Treatments (In addition to controls)**
Chickpea (6)	1. Hydro-priming (6h @ 20^{O}C) 2. Seed coating (on hydro primed seeds) with BioNPK 3. Seed coating (on hydro primed seeds) with BioNPK + DAB 4. Seed coating with *Trichoderma harzianum* (15g/kg)
Kabuli Chickpea (8)	1. Hydro-priming (4h @ 20^{O}C) 2. Seed coating (on hydro primed seeds) with Biophos 3. Seed coating (on hydro primed seeds) with DAB + Biophos 4. Seed coating (on hydro primed seeds) with DAB + Biogrow

	5. Halo-priming (KNO_3 @ 0.3%) 6. Seed coating with *Trichoderma harzianum* (15g/kg)
Paddy (12)	1. Hydro-priming (30h @ 25^{O}C) 2. Halo-priming with 0.5% KH_2PO_4 3. Seed coating with *Trichoderma harzianum* (15g/kg) 4. Seed coating with *T. harzianum* and Thiram 5. Seed coating (on hydro primed seeds) with *T. harzianum* and Thiram 6. Seed coating (on hydro primed seeds) with Biophos 7. Seed coating (on hydro primed seeds) with DAB + Biophos 8. Seed coating (on hydro primed seeds) with Biogrow 9. Seed coating (on hydro primed seeds) with Bio NPK 10. Seed priming with salicylic acid @ 800 ppm
Field pea (6)	1. Hydro-priming (10h @ 20^{O}C) 2. Seed coating with *Trichoderma harzianum* (15g/kg) 3. Seed coating (on hydro primed seeds) with Biogrow 4. Seed coating (on hydro primed seeds) with DAB + Biogrow
Lentil (7)	1. Hydro-priming (8h @ 25^{O}C) 2. Seed coating (on hydro primed seeds) with Biogrow 3. Seed coating (on hydro primed seeds) with DAB + Biogrow 4. Seed coating with *Trichoderma harzianum* (15g/kg) 5. Halo-priming with Zn_2SO_4 (@0.3%) + $MnSo_4$ (@0.5%)
Mustard (7)	1. Hydro-priming (16h @ 20^{O}C) 2. Seed coating with *Trichoderma harzianum* (15g/kg) 3. Seed coating (on hydro primed seeds) with Biophos 4. Seed coating (on hydro primed seeds) with DAB + BioNPK 5. Halo-priming with Zn_2SO_4 (@0.3%) + $MnSo_4$ (@0.5%)
Cotton (8)	1. Hydro-priming (12h @ 25^{O}C) 2. Seed coating with *Trichoderma harzianum* (15g/kg) 3. Seed coating (on hydro primed seeds) with Biophos 4. Seed coating (on hydro primed seeds) with DAB + BioNPK 5. Halo-priming with KH_2PO_4 (@0.5%) 6. Halo-priming with KNO_3 (@0.3%)
Speciality Maize (9)	1. Hydro-priming (17h @ 25^{O}C) 2. Hydro-priming followed by dry dressing with Thiram 3. Seed coating with *Trichoderma harzianum* (15g/kg) 4. Seed coating (on hydro primed seeds) with DAB + Biophos 5. Seed priming with salicylic acid @ 800 ppm 6. Halo-priming with ZnSo4 @0.3% + MnSo4 @0.5%

	7. Halo-priming with KNO_3 (@0.3%)
Pigeon pea (4)	1. Hydro-priming (10h @ 25^OC) 2. Halopriming (6dSm^{-1} solution of NaCl + $CaCl_2$ for 8h @25^0C)

Experimental Details:

- Number of Varieties: Two (in each crop)
- Number of replications: Four (in all crops)
- Number of rows per replication: Four (100 seeds/replication)
- Total area required for the experiment will depend up on the size of each plot required for four replications with four rows having sown 100 seeds in each row at specified distance that will subsequently depend on length of each row based on plant to plant distance required to be maintained in each crop.

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

- Seed Moisture content (ISTA)
- Radicle (2mm) emergence time - (hrs)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)

NB: Observations to be recorded on minimum four replications of 100 seeds each, except SMC, which will to be estimated on dry weight basis as per ISTA recommendations.

Field observations (Under Prescribed Stress Conditions):

- 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 in yield and
- Increase/ increase in cost of best treatment over control

Sub. Experiment II (As per Objective 2): Development of seed enhancement techniques for low temperature stress during seedling establishment in Maize and Paddy

Year of start: 2018-19

Objectives:

1. To attenuate low-temperature stress at seedlings stage with seed enhancement techniques in Paddy and Maize

2. To improve the tillering and synchronous flowering under low-temperature stress in Paddy and Maize
3. To study the effect of different seed enhancement techniques on field emergence and yield attributing traits in Paddy and Maize raised under low temperature conditions.

Technical Programme:

Materials:

Each centre will use the seeds of most popular photo and thermo insensitive variety. Please note the initial seed moisture content should be below 10.0% (on dry weight basis).

Treatments:

1. Control (Untreated)
2. Control (Crop and location specific recommended seed treatment(s) as per package of practices)
3. Hydropriming – Soaking in water for 18h (at 20°C for maize) and 30h (at 20°C for Paddy) and drying as per procedure given above
4. Chilling treatment (Place the seeds in contact with the moist substratum at 4^0C for five days)
5. Thermal treatment (at 40^0C for 24h)
6. Chilling followed by Thermal treatment
7. Priming with Gibberellic acid (@50 mg/l) and drying
8. Halopriming- Soaking in 800ppm solution of Salicylic acid and drying
9. Halopriming- Soaking in 400ppm solution of Salicylic acid and drying
10. Halopriming- Soaking in 50µM solution of Melatonin and drying
11. Halopriming- Soaking in 500 µmol l^{-1}solution of GABA (Gamma-aminobutyric acid) and drying
12. Halopriming- Soaking in aerated solution 2.2% of $CaCl_2$ and drying
13. Seed coating (on dry seeds) with cold adoptive PGPB (will be supplied by IISS, Mau)
14. Microbial consortia (Draught Alleviating Bacteria, Biophos, etc.) for abiotic stress mitigation (will be supplied by IISS, Mau)
15. Microbial consortia (As supplied and treatment method suggested by the ICAR-VPKAS, Almora. Please contact: Dr. P. K. Misra, misrapank12@gmail.com (+91-9412589393).

Method/dosage of treatment of microbial consortia: For the treatments Biophos, Drought Alleviating Bacteria & cold adaptive PGPB:

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 so as 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

NB: The participating centre/s may include any other beneficial treatment and or delete some of these based upon literature or their experience, but a minimum of 15 treatments may be tried.

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

- Seed Moisture content (ISTA)
- Radicle (2mm) emergence time - (hrs)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)

NB: Observations to be recorded on minimum four replications of 100 seeds each, except SMC, which will to be estimated on dry weight basis as per ISTA recommendations.

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
6. Panicle or cob length
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
11. Plot yield (kg)
12. Harvest Index
13. Evaluation of quality (as per ISTA) of seed produced

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

Note: Observations (no. 3 to 9) have to be observed in a minimum of 5 randomly selected plants or panicles/cobs /rep/treatment.

Sub. Experiment III (As per Objective 3): Demonstrations for thermo-priming technology in pigeon pea under heat stress conditions

Year of start: 2020-21

Objective: To demonstrate the benefits of thermo-priming technology in pigeon pea under heat stress conditions

Materials: Two most prevailing varieties are to be taken.
Treatments:

1. Control
2. Thermopriming (exposure at 40^0C of seeds for 24hrs)

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 ≥40^0C for mini. 10 days after sowing. The recommended package and practices are to be followed for raising good crop.

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

- Seed Moisture content (ISTA)
- Radicle (2 mm) emergence time - (hrs)
- First count %
- Germination % (ISTA)
- Vigour index-I & II (Abdul Baki and Anderson, 1973)

NB: Observations to be recorded on minimum four replications of 100 seeds each, except SMC, which will to be estimated on dry weight basis as per ISTA recommendations.

Field Observations:

1. Final plant stand establishment (%) after 5 weeks-(Observation 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. Cost benefit ratio

Wrap up table for experiment III sub experiments (1 &2)

Details for each crop	**Description for Variety (1)**	**Description for Variety (2)**
Name (Crop: ?)		
Moisture content before treatment		
Treatment name (Maximum Moisture content)		
Maximum Moisture content (%)		
Germination (%) Control		
Germination (%) in First best treatment		
Germination (%) in Second best treatment		
Plant stand establishment (%) in First best treatment		
Plant stand establishment (%) in Second best treatment		
Plot size		
Seed yield (Kg/plot) & Seed yield (Kg/ha)		
Per cent increase in yield over control		
Per cent inc./dec. in cost of best treatment over control		
C:B ratio		
Modification done in any of the suggested treatment method, if any		

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, 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 Chickpea and Paddy
2. To validate the effect of identified nano-particles on planting quality of Pigeon pea, Onion and Soybean
3. To study the effect of identified nano-particles on seed quality of treated seeds of Pigeon pea, Onion and Soybean in storage.

Crops		**Centres**
Objective -1		
Chickpea	**:**	ICAR-IARI, New Delhi; CSKHPKV, Palampur; JNKVV, Jabalpur and UAS Dharwad
Paddy	**:**	UAS, Bengaluru; ICAR-IARI, New Delhi; PAU, Ludhiana and PAJANCOA&RI, Karaikal
Objectives -2&3		
Pigeon pea	**:**	TNAU, Coimbatore and UAS, Bengaluru
Onion		ICAR-IARI, New Delhi and TNAU, Coimbatore
Soybean	**:**	ICAR-IARI, New Delhi; TNAU, Coimbatore; VNMKV, Parbhani and PDKV, Akola

Technical programme:

The participating centres of the crops; Pigeon pea, Onion and Soybean shall validate the effect of identified nano-particle treatments on planting quality as well as seed quality during storage,

while the work at identified centres on standardization of the optimum concentrations of different nano-particles for seed treatments in Chickpea and Paddy has been included from this year. To start with the work on safety issue, this year onward the centres will also be evaluating seedlings for sensitivity to different concentrations of various NPs at seed germination stage. However, till the any competent body of GoI issues approved guidelines in this regard, the participating centres may take observations, as deemed fit, in collaboration with other scientists of appropriate disciplines on effect on NPs on health of plants, soil, environment, humans, animals, insects, microbes, etc.

NB: The participating centres must have the nano particle treated seeds of Pigeon pea, Soybean and Onion available with them in their stores for storability studies. However, for validation of the effect of identified nano-particle treatments on planting quality and to standardize the optimum concentrations in chickpea and paddy, sufficient quantities of seeds for treatments are to be sent to TNAU, Coimbatore. For sending seeds for treatment you may, if required, please contact; Dr. Sandeep K. Lal & Dr. Monika A Joshi, Principal Scientists, DSST, ICAR-IARI, New Delhi (skl_nsp@yahoo.com OR +91-9811048932 & monikakshat622@gmail.com OR 9910026346) for Soybean, Onion, Paddy and Chickpea seeds and Dr. K. Madhusudan, SOS, UAS, Bangalore (sosnsp@gmail.com OR +91-09449866925/080-23620494) for Pigeon pea seeds. The chickpea seeds of JNKVV varieties will be sent to TNAU, Coimbatore for various Nano-particle treatments by Dr. Sharad Tiwari, Director (Seed & Farms), JNKVV, Jabalpur (seeds.jnkvv@gmail.com OR +91-9424658241/ 0761-2681021). Dr. C. Vanitha, Assistant Professor, SST, TNAU, Coimbatore (cvani_seed@yahoo.co.in OR 9080461717) to please facilitate the seed treatment with nano particles and will also make treated seed of ADT 53 or any other TNAU available to participating centres in this experiment.

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

Materials:

Crops and Varieties: Minimum one predominant variety in each crop is to be taken for studies/treatments by every participating centre. In case of Chickpea; ICAR-IARI, New Delhi and CSKHPKV, Palampur will work only one IARI variety (BGD 72 OR Pusa 5028), while JNKVV, Jabalpur and UAS Dharwad will work only one JNKV variety (JGK 1 or JG-12) for standardization. In case of paddy; ICAR-IARI, New Delhi and PAU, Ludhiana will work on either of the IARI varieties (Pusa Sambha 1850 OR Pusa Basmati 1509), whereas UAS, Bengaluru and PAJANCOA&RI, Karaikal will work on ADT 53 OR any other suitable variety whose treated seeds will be made available by TNAU.

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)

Methodology:

- Designated centres/scientists will send the required quantities of seed for NP treatments to TNAU.
- 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.
- TNAU will only assess the seed moisture content before and after treatments and communicate to respective centres with treated seeds.

Observations: 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. Radicle (2mm) emergence time - (hrs)
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. Plant stand establishment (%)
11. C:B ratio

NB: Treated seeds to be evaluated for both direct and transplanted methods in paddy. In addition to FE and PSE in nursery, the Survival/Final stand establishment (%) may recorded after transplanting.

Sub. Experiment-II (As per Objective 2): To validate the effect of identified nano-particles on planting quality of Pigeon pea, Onion and Soybean

Materials: NP Treated seeds of Two Varieties in each crop.

Treatments:

The selected concentrations of NP treatments those gave better results for improving the plating values in different crops that will be validated this year have been given below;

Name of Crop	**Name of the Treatments + 2** Controls (untreated & Recommended PoP)
Pigeonpea	1. Nano formulation of ZnO@ 500ppm 2. Nano formulation of SiO_2@ 500 ppm 3. Nano formulation of SiO_2@ 100 ppm 4. Nano formulation of SiO_2@ 500 ppm
Soybean	1. Bulk formulations of ZnO@ 500ppm 2. Nano formulations of ZnO@ 500ppm 3. Bulk formulations of ZnO@ 750ppm 4. Nano formulations of ZnO@ 750ppm 5. Bulk formulations of SiO_2@ 500ppm 6. Nano formulations of SiO_2@ 500ppm 7. Bulk formulations of SiO_2@ 750ppm 8. Nano formulations of SiO_2@ 750ppm 9. Bulk formulations of TiO_2@ 500ppm 10. Nano formulations of TiO_2@ 500ppm
Onion	1. Nano formulations of TiO_2@ 250ppm 2. Nano formulations of TiO_2@ 500ppm 3. Nano formulations of ZnO@ 100ppm 4. Nano formulations of ZnO@ 250ppm 5. Nano formulations of SiO_2@ 100ppm 6. Nano formulations of SiO_2@ 250ppm

Experimental Details:

- Number of replications (For lab & field evaluation): Four (in all crops)
- Number of rows per replication (For field evaluation): Four (100 seeds/replication)

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

- Seed Moisture content (ISTA)
- Radicle (2mm) emergence time - (hrs)
- 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)

NB: Observations to be recorded on minimum four replications of 100 seeds each, except SMC, which will to be estimated on dry weight basis as per ISTA recommendations.

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) & Bulb yield (kg/plot) in Onion
- Percent increase in yield
- Increase/ increase in cost of best treatment over control
- C:B ratio

Sub. Experiment-III (As per Objective 3): To study the effect of identified nano-particles on seed quality of treated seeds of Pigeon pea, Onion and Soybean in storage.

Materials and Treatments:

The best NP treatments, which responded positively to different concentrations of nano-particles during previous years in Sub-experiment-I, selected to study their influence on seed quality during storage will continue. The treated seeds of 2 varieties packed in cloth bag and stored under ambient conditions must be available in sufficient quantities with laboratories of participating centres. The centre to conduct storage studies up to a total of 18 months or till the germination reaches ≤IMSCS, whichever is earlier. The climate data, fortnightly mean minimum & maximum temperature (^{0}C) and RH %, from start of storage till termination of experiment should be furnished and must be used to explaining the results for period of storage at respective participating centres. Following observations on stored seeds will be recorded at monthly interval including weather data of storage conditions.

Observations:

At monthly interval:

1. Radicle (2mm) emergence time - (hrs)
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. Seed health (infection and infestation)

NB: Observations on seed quality parameters 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.

At three months interval:

1. Seed Moisture content
2. Seedling emergence (%) in sand/soil AND
   Field emergence (%) and 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: The experiment will be terminated once the germination % count reaches 5% below IMSCS or completion of 18 months of storage.

Wrap up table for experiment IV

Centre Name	**Crop Name**	**Information Collected/Generated**	**Name of Varieties**		
			1 (Name)	**2**	**3**
ABC	**Onion**	Date of harvesting			
		Date of first test at originating/producing organization			
		Germination (%) first test, if done at producing organization			
		Date of receipt/ procurement of seed lots			
		Date of first test of treated seeds at your centre			
		Germination (%) at time of first test treated seeds at your centre			
		Increase (+) or decrease (-) in abnormal seedlings over control in different conc. of NPs.			
		Increase (+) or decrease (-) in dead seeds over control in different conc. of NPs.			

		Increase (+) or decrease (-) in seedling shoot length over control in different conc. of NPs.			
		Increase (+) or decrease (-) in seedling root length over control in different conc. of NPs.			
		Germination (%) after 1 month of storage of treated seeds			
		Increase (+) or decrease (-) in abnormal seedlings over control in different conc. of NPs.			
		Increase (+) or decrease (-) in dead seeds over control in different conc. of NPs.			
		Increase (+) or decrease (-) in seedling shoot length over control in different conc. of NPs.			
		Increase (+) or decrease (-) in seedling root length over control in different conc. of NPs.			
		Similarly to continue			
		Germination (%) after ..... (so on) months of storage			
		Germination (%) at time of last test (... months of storage) at your centre			
		Increase (+) or decrease (-) in abnormal seedlings over control in different conc. of NPs.			
		Increase (+) or decrease (-) in dead seeds over control in different conc. of NPs.			
		Increase (+) or decrease (-) in seedling shoot length over control in different conc. of NPs.			
		Increase (+) or decrease (-) in seedling root length over control in different conc. of NPs.			
		Remarks, if any			
ABC	Similarly for other crops	All information as above for Onion			

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 during the reproductive phase in chickpea and its mitigation.
2. To validate the effect on yield and seed quality of standardized treatments for mitigation of heat stress during the reproductive phase in selected field crops.
3. Demonstration of the most efficient treatment reported among the crops

Crops	**Centres**	
Chickpea*	:	MPKV, Rahuri; CCSHAU, Hisar; RARI, Durgapura and UAS, Raichur
Wheat	:	ICAR-IARI, New Delhi; PDKV, Akola; JNKVV, Jabalpur; UAS, Dharwad; RAU, TCA, Dholi; PAU, Ludhiana; GBPUAT, Pantnagar; VNMKV, Parbhani; ICAR-IISS, Mau
Sorghum	:	MPKV, Rahuri; VNMKV, Parbhani and PDKV, Akola
Paddy	:	PJTSAU, Hyderabad; TNAU, Coimbatore; OUAT, Bhubaneswar; BSKKV, Dapoli; KAU, RARS, Pattambi and PAJANCOA&RI, Karaikal
Mustard	:	ICAR-IARI, New Delhi; ICAR-CAZRI, Jodhpur; NDUAT, Faizabad and CSAUAT, Kanpur

Technical Programme:

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

Materials:

One most popular chickpea 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 the centre with respect to a particular crop. Hence, the sowing dates may be adjusted accordingly (experiment may be conducted with the 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 need to be 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 to be 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 (400ppm)
7. Cycocel (please ensure that a.i. concentration should not to exceed 1250ppm)
8. KNO_3 @ 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 (*In Chickpea*)**:** To be observed (Trait 2 to 4 at physiological maturity) in minimum of 5 randomly selected plants or pods/rep/treatment

1. Days to pod formation

2. Plant height (cm)
3. Time taken to reach harvest maturity
4. Total number of pods
5. Number of unfilled pods
6. Average number of seeds/pod
7. 1000 seed weight
8. Plot yield (kg)
9. Harvest Index
10. Evaluation of quality of seed produced (as per ISTA).
11. Cost benefit ratio of the best treatment in each crop identified at your centre

NB: Observations on seed quality parameters 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.

Sub. Experiment II (As per Objective 2): To validate the effect on yield and seed quality of standardized treatments for mitigation of heat stress during the reproductive phase in selected field crops.

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

Methodology:
Sowing in field and or growth chamber facilities as mentioned above

Mitigation treatments (For Validation):
Numbers of treatments in each crop (Wheat, Sorghum, Paddy and Mustard) will vary as per the reports of significance given by various centres, as given below.

Name of Crop	**Name of the Treatments (In addition to control)**
	Spray of following at: 1. Vegetative + anthesis stage and 2. Anthesis stage
Wheat	1. KCl @1% 2. Ascorbic acid @ 10 ppm 3. Salicylic acid @ 800 ppm 4. Salicylic acid @ 400ppm 5. Cycocel 6. Thiourea @ 400ppm
Sorghum	1. Cycocel

	2. Salicylic acid @ 400ppm 3. Salicylic acid @ 800ppm
Paddy	1. Ascorbic acid @ 10 ppm 2. Salicylic acid @ 400 ppm 3. Salicylic acid @ 800ppm
Mustard	1. KNO_3 @ 0.3%, 2. Salicylic acid @400 and 3. Salicylic acid @800 ppm

Spray Schedule:

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

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 spray of these chemicals.

Observations (*In Cereals*)**:** To be observed in a minimum of 5 randomly selected plants or panicles /rep/treatment

1. Total number of tillers
2. Number of productive/effective tillers
3. Days to booting/spike/ear formation
4. Plant height (cm)
5. Time taken to reach harvest maturity
6. Panicle length
7. Total number of seeds/panicle
8. Number of empty seeds/panicle
9. Seed set %
10. 1000 seed weight
11. Plot yield (kg)
12. Harvest Index
13. Evaluation of quality of seed produced (as per ISTA)
14. Cost benefit ratio of the best treatment in each crop identified at your centre

Observations (*In Mustard*)**:** To be observed (Trait 1 to 8 at physiological maturity) in a minimum of 5 randomly selected plants or pods/rep/treatment

1. Days to siliqua formation
2. Plant height (cm)

3. Time taken to reach harvest maturity
4. Main shoot length
5. Total number of siliqua on main shoot
6. Number of unfilled siliqua on main shoot
7. Siliqua set % on main shoot
8. Number of primary branches/plant
9. Number of secondary branches/plant
10. Total number of seeds/pod
11. 1000 seed weight
12. Plot yield (kg)
13. Harvest Index
14. Evaluation of quality of seed produced (as per ISTA).
15. Cost benefit ratio of the best treatment in each crop identified at your centre

NB: Observations on seed quality parameters to be recorded on minimum four replications of 100 seeds each, except SMC, which will be estimated on a dry weight basis as per ISTA recommendations.

Wrap up table for experiment V (Sub experiments 1 & 2)

Details for each crop	**Description for Variety (1)**	**Description for Variety (2)**
Name (Crop:)		
Modification done in any of the suggested spray, if any		
Plot size		
Plot yield (kg) – Control (Normal Sown Conditions)		
Plot yield (kg) - First best treatment (NSC)		
Plot yield (kg) - Second best treatment (NSC)		
Per cent increase in yield over control (NSC)		
% increase in cost of best treatment over control (NSC)		
Plot yield (kg) – Control (Late Sown Conditions)		
Plot yield (kg) - First best treatment (LSC)		
Plot yield (kg) - Second best treatment (LSC)		
Per cent increase in yield over control (LSC)		
% inc./dec. in yield by best treat. (LSC)over control of NSC		
% increase in cost of best treatment over control (LSC)		
Plot yield (kg) – Control (Very Late Sown Conditions)		
Plot yield (kg) - First best treatment (VLSC)		

Plot yield (kg) - Second best treatment (VLSC)		
Per cent increase in yield over control (VLSC)		
% inc./dec. in yield by best treat. (VLSC) over control of NSC		
% increase in cost of best treatment over control (VLSC)		
1000 seed weight - Control		
1000 seed weight - First best treatment		
1000 seed weight - Second best treatment		
Germination (%) Control		
Germination (%) in First best treatment		
Germination (%) in Second best treatment		
C:B ratio		

Sub. Experiment III (As per Objective 3): Demonstration of the most efficient treatment reported among the crops.

Materials:
One most popular variety is to be taken.

Treatments:

1. Control
2. Foliar spray of Salicylic acid @ 800ppm (at Vegetative (35-40 days after sowing or transplanting) + Anthesis stage

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 block would serve as untreated (control) 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.

Observations:
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.
3. Time taken to reach harvest maturity--50% of plants each at randomly selected 4 places in plots

4. Total number of spike/ear/silique per plant in 5 plant 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. Evaluation of quality (as per ISTA) of seed produced
11. Cost benefit ratio

NB: Observations on seed quality parameters 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.

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:

1. 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
Pigeonpea	:	ICAR-IARI, New Delhi and UAS, Raichur
Soybean	:	MPKV, Rahuri and UAS, Bengaluru
Mustard	:	RARI, Durgapura and ICAR-CAZRI, Jodhpur
Sunflower	:	UAS, Bengaluru 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 MSCS, it may be different varieties.

Observations to be recorded:

1. Radicle (2mm) emergence time - (hrs)
2. Germination (ISTA), 4 replications.
3. Total Seedling Length (TSL) or Total Seedling Wt (TSW*) to be taken of 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:

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

Compare the correlation (r) between

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

Kindly refer RN Basu (2016). Approaches to quantification of seed vigour. Seed Research, 44(2): 156-177 for more details.

Decisions made during deliberations

- Every scientist/staff associated with STR, AICRP-NSP at each centre shall critically read the whole document and confirm, every year through email to Concern PIs with copy to Director, IISS, Mau that they have understood the programme fully and shall conduct the experiments as proposed.
- Any committed experiment/s shall not be retracted without prior approval from the competent authority/Director, IISS and shall be intimated to PIs within a week of circulation of the technical programme.
- In view of the problems in reporting, it is reiterated that the complete report prepared on analyzed data in all respects; Experiment number of discipline, Name of centre & Crop, Experimental details, Results with respect to each table, Conclusion and Suggestion(s), if any as per guidelines circulated during the year 2017-18 should be submitted in time.
    a. Don't use ONLY means for interpretations of your results.
    b. The percentage data should always be transformed to ensure that the data in your variables is normally distributed.
    c. Analysis on both actual data (in per cent) and transformed data is required to be done.
    d. Report transformed data in parentheses below the actual data in table(s). You need to mention CD (p=0.05) and or SEd(±) for transformed data and compare the means using these values ONLY while writing your results.
    e. In reports pasting only figures/tables, not describing properly and referring them individually in body of text/results will not serve any purpose.
    f. Reports submitted by every participating centre without concluding table as per format given after technical programme of experiment/s and lack of explanation shall not be considered.
- To discourage the practice of copying from technical programme and for experiments in Rabi crops writing "Experiment is in progress" in results section by centres are advised to send the detailed reports may be two times in a year i.e. the experiments on crops harvested from January to May shall be reported on or before 31st July, the experiments on crops harvested from June to December and the experiments of continuous nature (e.g. storage) shall be reported before 1st March, every year.

- To avoid any disciplinary action, as deemed fit by the competent authority, the reporting must be streamlines. Best way would be to include in 2020-21 report, the findings of experiments conducted during Rabi 2019-20 and Kharif 2020. While analyzing the current data, previous year's/season's data may be pooled, if required for logical conclusions.
- The centres are also required to submit the raw data of last 3 years in excel sheets for each experiment along with the reports of 2020-21in SPSS format.
- It was reiterated that the information on ITK's being used by the farmers for seed/grain storage be collected with the work under the Seed Pathology experiment "Studies on seed health status of farmers own saved seeds" and reported to "Seed Physiology, Storage and Testing" group for taking up the validation studies.
- The reporting with regard to development of weed seed atlas of India was dismal this year. It was reiterated and decided that all the BSP, ISP and STR centres shall collect the weed seeds from the seeds of crops grown in all seasons from respective areas, take 3-4 pictures of individual seed as well as in group of 10-15 seeds after putting them on graph paper and plants, if possible from different angles such that it depicts actual shape, size and color of weed seeds. Every centre should submit the seeds to the extent possible (100seeds to 50g Max.), pictures and local and or scientific name to coordinating unit.
- For highlighting the Salient Finding(s) of your centre in the workshop, it is also desired that each centre shall submit to the PIs 'ONLY ONE SENTENCE/SLIDE' with relevant table/ photo/ fig. of 'ONLY' significant finding/s from each crop and each experiment they are involved on or before 1st March, every year.
- Cost effectiveness (C/B ratio) for the use of molecular markers vis-a-vis GOT as well for seed quality enhancement experiments have to be worked out and reported.
- Retracting any committed experiment/s without approval and or report/s submitted later than the above suggested dates and or submitted without proper analysis of data and or writing nothing in results and or incomplete writing with respect to each table/figure/plate and or without concluding lines shall not be considered as submitted for the purpose of inclusion in proceedings of the workshop. Non sub-mission of report/s of any allotted experiment/s shall be treated as non-conduct/retraction of experiment/s by the centre(s).
- It was also suggested that continuously defaulting and or consistently inconsistent centres should not be allotted experiments. Further, they should be recommended to competent authorities for taking deemed fit action while formulating next EFC. Whereas, budget outlay of performing centres be increased/reallocated out of funds of incessantly non-performing/ dropped centres and regularization of continuously good performing voluntary centres be considered.
- The Directorate shall make a specific mention in allotment letter about the contingency/ funds allotted exclusively for chemicals and glassware so that these are not diverted to any other use.

- It was reconfirmed that respective centres may also use funds allotted under the head 'contingency' for need based payment to contractual(s) hired for these experiments, if all other requirements for these experiments could be met from availability of funds under in-house and or externally funded projects with them.
- It was recommended that all the centres involved in experiment 2 "Hybrid purity testing using molecular markers in public sector hybrids of field crops" should be strengthened with a minimum grant @ Rs. One and half lakh per crop as additional contingency exclusively for purchase of chemicals/glassware and maintenance/repair of equipments.
- Scientists involved are encouraged to discuss for solutions of the problems among peers and with experts. The PI invites the suggestions for improvement of this programme.
- All the centres are requested to keep the PI (pispnsp@gmail.com) informed and it is always better to keep the Directorate (seednsp@gmail.com and or the director.seed@icar.gov.in) in loop about all correspondences.

C. Seed Pathology

Date: 15.05.2020

Chairman : **Dr. Mohan S. Bhale**
Prof., Dept. of Plant Pathology
JNKVV, Jabalpur

Convener : **Dr. Atul Kumar,** Principal Scientist & PI, IARI, New Delhi

Recommendations

- Seed treatment with Captan 75 WS @ 2.5 gm / kg seed and subsequent two foliar sprays of Azoxystrobin (18.2 %) + Difenconazole (11.4 %) @ 0.03% at first appearance of the disease and second after 10 days has been found best amongst all other treatments and can be recommended to farmers involved in seed production of tomato against *Alternaria* blight disease.
- Three protocols have been developed under Experiment - Standardization of detection methods for seed borne pathogens of significance. They are
  1. PCR based detection protocols for the detection of *Colletotrichum* species from chilli seeds.
  2. RT-PCR based detection of *Bean common mosaic virus* (BCMV) from common bean seeds.
  3. RT-PCR based detection of *Pepper mild mottle virus* (PMMOV) from capsicum seeds.

1. Protocol for detection of Bean Common mosaic virus from common bean seeds and infected plants

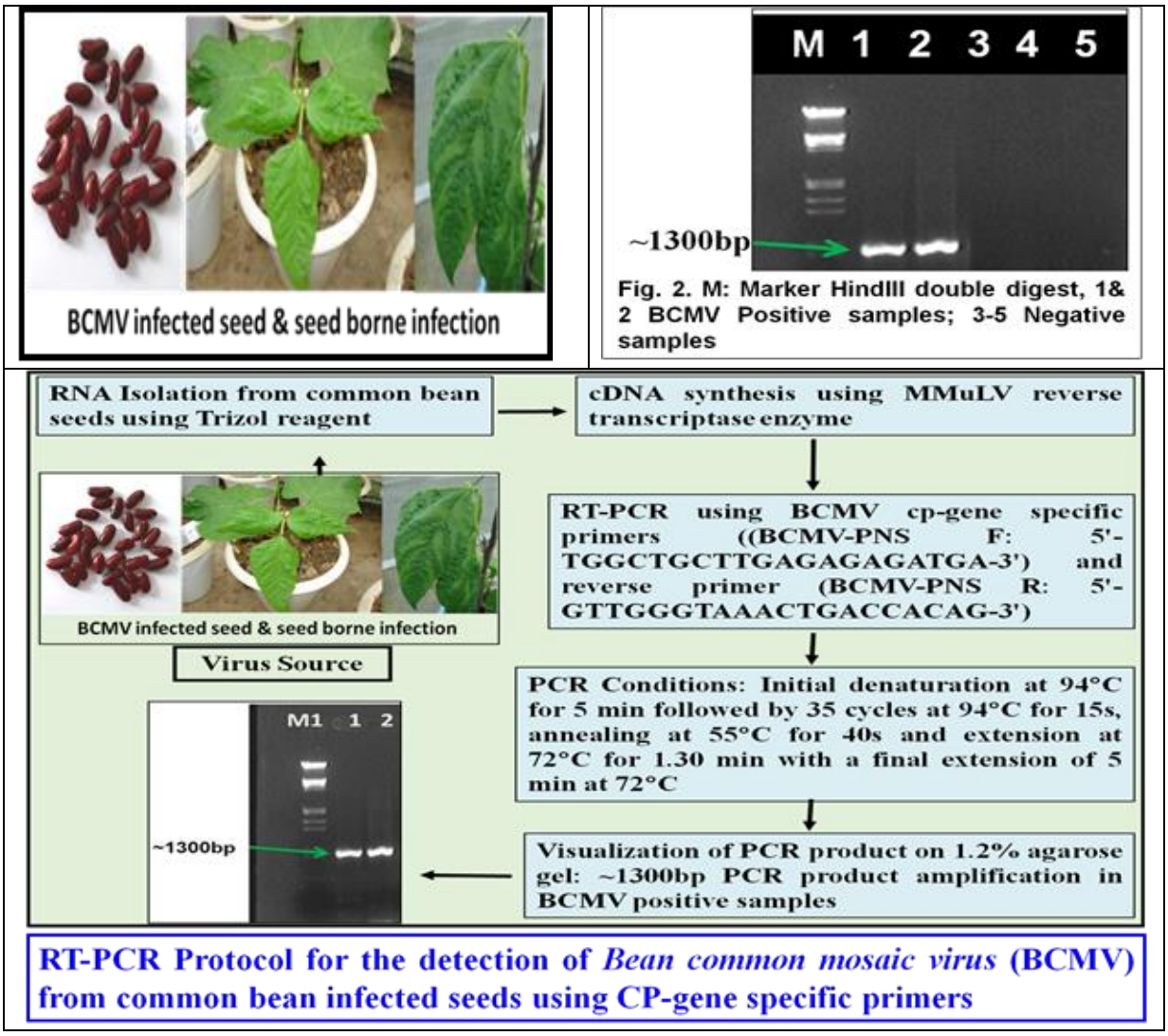
RT-PCR Protocol

1. 100 mg seeds from test seed lot (in designing of protocol, seeds from BCMV infected plants were used)
2. RNA isolateion using Trizol (MRC) reagent as per manufacturer's instructions.
3. cDNA synthesis in a reaction volume of 20 µl reaction containing 5 µl of total RNA, 1 µl of oligod$T_{(10\text{-}18)}$, 4 µl of 5X MMLV buffer, 2 µl of 10 mM each dNTPs mix, 1 µl of 40 U/µl RNAase inhibitor (USB), 1 µl (400U/µl) MMuLV reverse transcriptase (USB) and final volume of 20 µl using nuclease free water. Incubate the contents at 42°C for 90 min (Gen Amp PCR System 9700, Applied Biosystem, USA).
4. For RT-PCR amplification, a reaction volume of 12.5 µl consists of 1.75 µl of 10X Taq buffer, 0.5 µl of 25 mM $MgCl_2$, 1.75 µl of 2 mM dNTPs mix, 0.5 µl of 10 mM forward (5'-TGGCTGCTTGAGAGAGATGA-3') and reverse primer (5'- GTTGGGTAAACTGACCACAG-3'), 1.0 µl of cDNA, 0.1 µl of 5U/µl Taq polymerase (Merck Genei) and final volume adjusted with nuclease free water. Amplification performed in GeneAmp PCR system 9700

(Applied Biosystems) with initial denaturation of 94°C for 5 min followed by 35 cycles at 94°C for 15 s, annealing at 55°C for 40 s and extension at 72°C for 1.30 min with a final extension of 5 min at 72°C.

5. Resolve amplified products on 1.2% agarose gel in 0.5 X TAE buffer containing ethidium bromide (0.5µg/ml) and visualized under Gel Doc system.

Results: RT-PCR amplification results in the generation of predicted product of ~1300 bp in positive samples.



2. Protocol for detection of Pepper mild mottle virus from capsicum seeds and infected plants

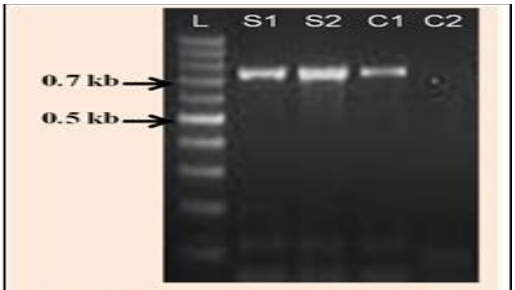
RT-PCR Protocol:

- 100 mg seeds/ leaves (e.g. California wonder) as RNA source
- RNA isolation using Trizol reagent following the manufacturer's protocol and quality check through 1.2 per cent agarose gel containing 0.5 µg/ ml ethidium bromide or Qubit/ DNA count. The protocol can be used to detect the virus from single seed.

- cDNA synthesis using 1 µg of total RNA and oligodT(10-18) primer in 10 µl reaction the MMuLV reverse transcriptase as per manufacturer instructions and RT-PCR (Reverse Transcription- Polymerase Chain Reaction) using the PMMoV CP-gene specific primers as described by Rialch *et al*. (2015).
- RT-PCR amplification based on CP region was carried out in 25 µl reaction volume using 2.5 µl of 10x Taq buffer, 1 µl of 25MgCl2, 2.5 µl of 2mMdNTPs mix each, 1µl of 10 µM each CP gene specific primer (CCAATGGCTGACAGATTACG-F & CAACGACAACCCTTCGATTT- R), 0.2 µl of 5U/µl Taq polymerase. The final volume was adjusted using nuclease free water. The amplification was performed in GeneAmp PCR system 9700/ 2700 (Applied Biosystems) with initial denaturation of 94°C for 4 min followed by 35 cycles of 94°C for 15 sec, 48°C for 40 sec and 72°C for 1 min with a final extension of 7 min at 72°C.
- Visualization of PCR product on 1.2 % agarose gel containing 0.5 µg/ ml ethidium bromide.

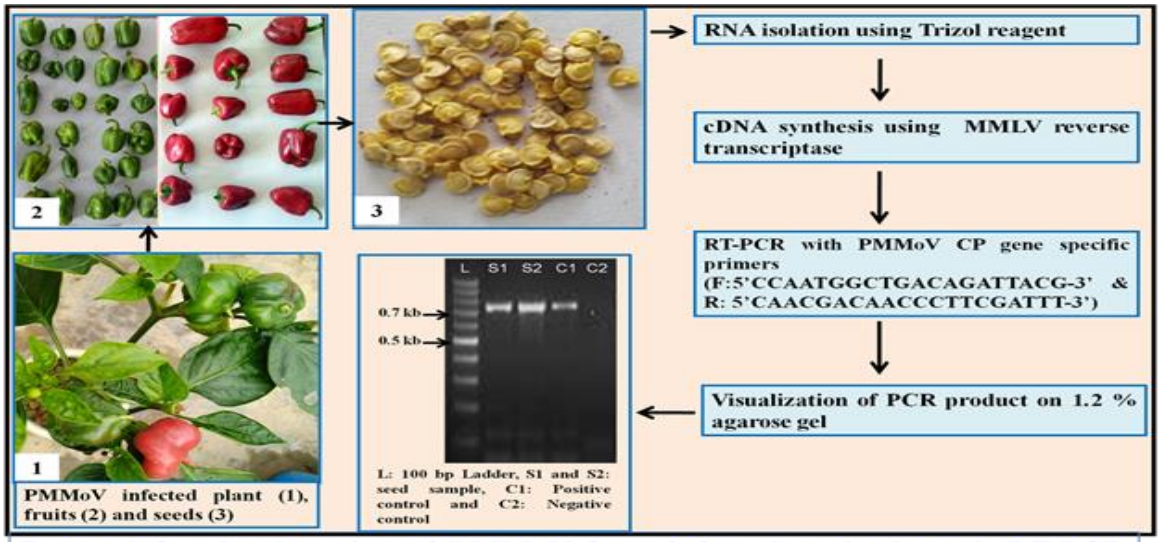
Results: RT-PCR amplification results in the generation of predicted product of ~730 bp fragment in positive samples.

Fig. 1. PMMoV infected Capsicum plant, fruits and seeds



L: 100 bp Ladder, S1 and S2: seed sample, C1: Positive control and C2: Negative control

Fig. 2. RT-PCR amplification of PMMoV Infected Capsicum Fruits and Seeds



Protocol for the detection of PMMoV from infected seeds through RT-PCR using CP-gene specific primers

3. Protocol for detection of *Colletotrichum* species from capsicum seeds

DNA Isolation & PCR protocol

1. 50 mg seeds (12-15 seeds) per sample from infected as well as healthy seeds were used to extract the genomic DNA using CTAB method (Murray and Thompson, 1980) with minor modifications (Katoch *et al*., 2017). The DNA was treated with RNase (Fermentas) to remove RNA contaminations and stored at -80^{o}C in deep freezer (Thermo Co. Pvt. Ltd.) till further use.
2. The *Colletotrichum* sp., specific primers developed by Torres-calzada *et al*., (2011) (*C. truncatum*: Ccap F 5'-GTAGGCGTCCCCTAAAAAGG-3'; Ccap R 5'-TCCTCCGCTTATTGATATATGC-3'; 500bp pro*duct)* and Cullen *et al*., (2002) (*C. coccodes*; Cco1NF 5'-TGCCGCCTGCGGACCCCCT-3' and Cco2NRl 5'-GGCTCCGAGA^{G}GGTCCGCCA-3', 340bp product) used after their validation to amplify *the* two test species.
3. The PCR amplification performed in 25 µl reaction volume having 2.5 *µl o*f 10x Taq b*uffer and 1*.5µl of 25mM $MgCl_2$, 2µl of dNTP mix (2 mM each) (Fermentas/ Banglore Genei), 0.2µl of Taq polymerase (Bangalore Genei, India, 5 U/µl), 2 µl of DNA template (~100ng), 0.5µl of 10 µM each primers (10 µM) and final volume adjusted with nuclease free water. Amplifications performed on thermal cycler (GeneAmp PCR system 9700/ 2700, Applied Biosystems, USA; Eppemdorf Master Cycler) with following conditions.

4. PCR- Conditions

	C. truncatum (capsici)		***C. coccodes***	
Step	Temp (^{o}C)	Time (Min)	Temp (^{o}C)	Time (Min)
Initial denaturation	95	5	95	2
Denaturation	94	0.5	95	0.75
Annealing	62	0.5	72	2.25
Elongation	72	2	72	2.25
Cycles	25	-	35	-
Final extension	72	5	72	5

5. Resolve amplification products on 1.2% agarose gel using ethidium bromide (0.5µg/ml) and visualize under gel documentation.

Results:

Generation of ~500 and ~340 bp amplicon in *C. truncatum* (*capsici*) and *C. coccodes* fungal cultures infected positive samples.

Fig. 1. *Colletotrichum* species infected chilli seeds

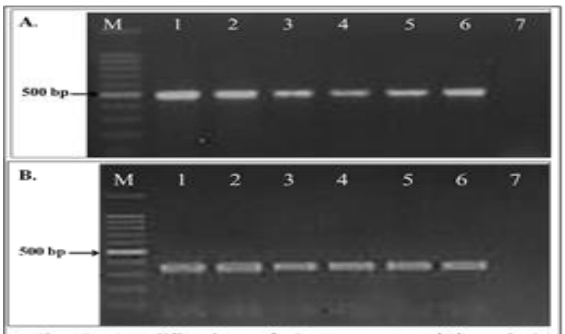
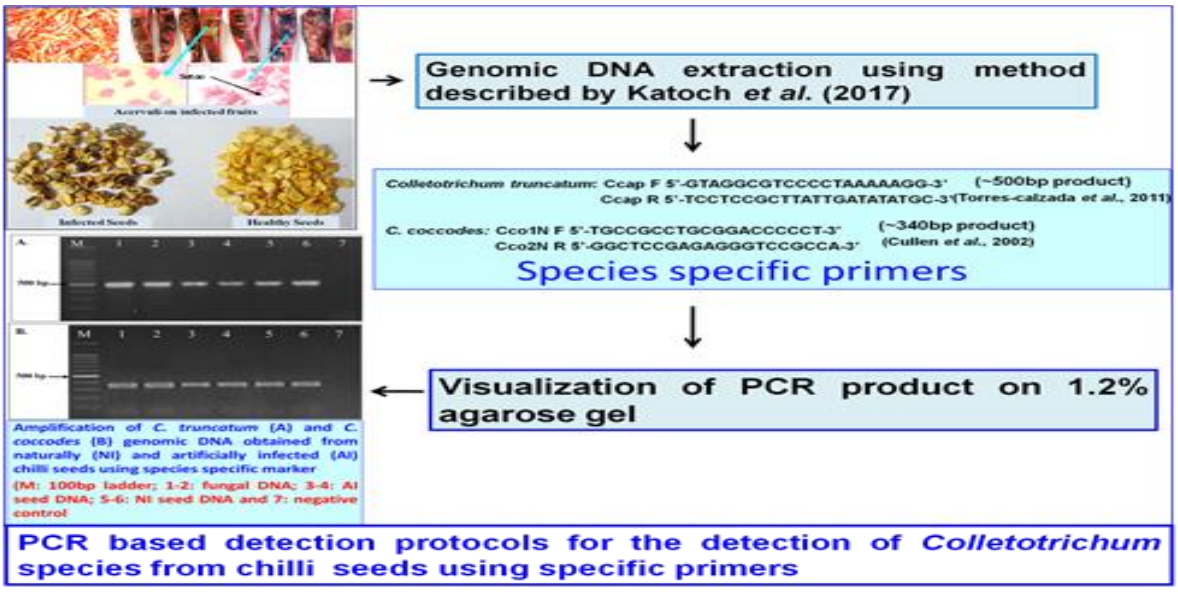


Fig. 2. Amplification of *C. truncatum* (A) and *C. coccodes* (B) genomic DNA obtained from naturally (NI) and artificially infected (AI) chilli seeds using species specific marker
(M: 100bp ladder; 1-2: fungal DNA; 3-4: AI seed DNA; 5-6: NI seed DNA and 7: negative control



Basic Studies:

- The seedborne nature and seed to plant and plant to seed transmission of *Alternaria sesami* was determined by adopting standard detection and transmission techniques. Both seed to plant and plant to seed transmission was proved and validated. This is a basic study and can be used as a reference in research.

EXPERIMENT-WISE TECHNICAL PROGRAMME FOR THE YEAR 2020-21

Experiment 1: Monitoring and detection of rice bunt in processed, unprocessed and farmers' seed sample, and bacterial leaf blight & bacterial panicle blight at farmer's field.

Objective

1) To determine the status of pathogen in seed sample from farmer and processing plant
2) To prepare the distribution map in different locations

Year of start : 2012-13

Status : To be continued during 2020-21

Centres : All centres (AAU, Anand; AAU, Jorhat; GBPUA&T, Pantnagar; OUAT, Bhubaneswar; PJTSAU, Hyderabad; PAU, Ludhiana; CCSHAU, Hisar; CSKHPAU, Palampur; TNAU, Coimbatore; JNKVV, Jabalpur; MPKV, Rahuri; VNMKV, Parbhani; SKUAST, Srinagar; PAJANCOA&RI, Karaikal; ICAR-IARI, New Delhi; DRPCAU, Pusa and ICAR-IISS, Mau)

Methodology

- **Detection Technique:** Standard NaOH seed soak should 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.
- Bacterial Panicle blight may be reported as present or absent.
- Meteorological data should be incorporated for correlation studies.

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

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

Experiment 2: Monitoring of emerging diseases of seed borne nature

Objective

To record the prevalence of new diseases and pathogens associated with seed pathogens

Year of start : 2013-14

Status : Continued during 2020-21

Centres: All Centres (AAU, Anand; AAU, Jorhat; GBPUAT, Pantnagar; OUAT, Bhubaneswar; PJTSAU, Hyderabad; PAU, Ludhiana; CCSHAU, Hisar; CSKHPAU, Palampur; TNAU, Coimbatore; JNKVV, Jabalpur; MPKV Rahuri; VNMKV, Parbhani; SKUAST, Srinagar; PAJANCOA&RI, Karaikal; ICAR-IARI, New Delhi; DRPCAU, Pusa, ICAR-IISS, Mau and RARI, Durgapura)

Note:

1) The incidence of unreported new pathogens and diseases of seed-borne nature should be observed. **List of seed borne pathogens already reported from the state may be provided to PI for record (last six years).**

2) Information on symptoms, causal organism and factors affecting development of the particular diseases (all about epidemiology) is to be supplemented with photographs.

Experiment 3: 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 2020-21

Crop (a) : Wheat

Centres: CCSHAU, Hisar; GBPUAT, Pantnagar; CSKHPAU, Palampur; RARI, Durgapura; RPCAU, Pusa; JNKVV, Jabalpur, ICAR-IISS, Mau 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.

Note:

1) *Prepare a map depicting the selected locations;*
2) *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: OUAT, Bhubaneswar; AAU, Jorhat; SKUAST, Srinagar; TNAU, Coimbatore; CSKHPAU, Palampur; PAJANCOA&RI, Karaikal; MPKV, Rahuri; ICAR-IARI, New Delhi; DRPCAU, Pusa; PAU Ludhiana, PJTSAU, Hyderabad, JNKVV, Jabalpur and AAU, Anand

Methodology

- **Detection Technique:** Standard NaOH seed soak method to 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, JNKVV, Jabalpur

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) : Saffron

Disease New corm rot

Centre : SKUAST, Srinagar

Methodology:

- Seed health be determined by visual inspection of seeds (corm) and by employing grow out test as per the ISTA protocol. Grow out test, be conducted under controlled conditions with sterilized substrate.
- A minimum sample size is 100 corms per farmer and collection from as many farmers as possible from all the sources, covering the popularly grown varieties.
- Economically important pathogens must be isolated and 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*

Crop (g) : Minor Millets (1 each centre)
Year of start: 2020-21
Disease Not known
Centre : PJTSAU, Hyderabad, RARI, Durgapura, 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: Every centre has to select one minor millet based on acreage and production in the state and its status needs to be reported. Information on selected minor millet crop should be reported to PI soon after the receipt of the technical programme. *Prepare a map depicting the selected locations; Provide the photographs showing the associated pathogen.*

Experiment 4: 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: GBPUAT, Pantnagar; PJTSAU, Hyderabad; TNAU, Coimbatore; JNKVV, Jabalpur; SKUAST, Srinagar, ICAR-IISS, Mau 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.*

IARI New Delhi will validate Hyderabad centre expt on standardization of methodology that they have developed.

Experiment 5: 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 AAU, Anand.
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.

***A detailed account with documentation with the findings and protocol be submitted for conclusion in the next group meeting for Soybean Mosaic Virus in soybean.**

Experiment 6 (A): Non chemical management of seed borne infection of bean anthracnose

Objective: To manage seed borne infection and seed health through bio-agents and organic inputs

Year of start **:** 2015 -16
Status **:** To be continued during 2020-21
Crop **:** Bean (*Phaseolus* spp.)
Pathogen **:** *Colletotrichum* spp.
Centres **:** CSKHPAU, Palampur and SKUAST, Srinagar

Note:

- *The results must be supplemented with statistical data, Cost: Benefit ratio (economics); yield data and correlation with meteorological data should be supplemented*

Experiment 6 (B): Impact of different storage conditions on longevity of *Macrophomina phaseolina, Colletotrichum dematium* in Green gram / Black gram

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 continued during 2020-21
Crop **:** Green gram / Blackgram
Source of seed **:** (i) Farmer (ii) Seed production / Research Fields
Pathogen **:** *Macrophomina phaseolina, 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.***

Experiment 6 (C): Detection, location and transmission of seed borne *Macrophomina phaseolina* in sesame

Objective **:** To determine the transmission of seed borne target pathogen
Year of start : 2016

Status : To be continued during 2020-21
Crop : Sesame
Pathogen : *Macrophomina phaseolina*
Centre : TNAU, Coimbatore

Action to be taken: TNAU, Coimbatore

To conclude the experiment, a working sheet be prepared before the termination of the experiment.

- The protocol developed by TNAU for detection of infection of *Macrophomina phaseolina* is to be revalidated by MPKV, Rahuri, RARI Durgapura and PJTSAU, Hyderabad in comparison with the standard ISTA protocol.

- For that matter, the developed protocol and the infected seed would be supplied by TNAU to the respective centres for validation of the protocol.

Experiment 6 (D): Management of purple blotch and Stemphylium blight of onion through seed treatment by bio-agents and foliar sprays with plant products and fungicides

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 continued during 2020-21
Crop : Onion
Pathogens : *Alternaria porri / Stemphylium vesicarium*
Centre : 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

S No.	Treatment	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 T:04	sprays of Difenconazole @0.1% sprays of Zineb75% WP @0.2%	-do-
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 *Pongamia pinnata*@ 5%	-do-
T:09	spray of crude leaf extract of *Azadirachta indica* @ 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.

Experiment 6 (E): Effect of pre-harvest fungicidal sprays on seed health and quality of soybean.

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

Year of start : 2018-2019, continued in 2020-21

Crop : Soybean

Variety : JS 335

Pathogen : All Seed borne fungal infections

Centre : PJTSAU, Hyderabad, GBPUA&T, Pantnagar, RARI Durgapura,

Methodology : Would be supplied by PJTSAU, Hyderabad

Treatments :

	Treatments	Mode of treatment	Doses
T_1	Carboxin + Thiram	Seed treatment	0.3%
T_2	T1 + Pyraclostrobin + Metiram	Prophylactic spray	0.2%
T_3	T1 + Carbendazim + Mancozeb	Prophylactic spray	0.2%
T_4	T1 + Pyraclostrobin + Thiophanate	Prophylactic spray	0.2%
T_0	Control (Untreated)		

Stages of the Plant:

S1 : At 50% pod maturity

S2 : At 75% pod maturity

S3 : At 100%

Replication : 3

Layout would be supplied by PJTSAU, Hyderabad

Observation

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.

New Experiment 7:_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

Status : To be started

Crops : Soybean, Paddy

Target Diseases : Purple seed stain caused by *Cercospora kikuchii*
Seed rot/charcoal root rot/ pod blight in soybean caused by *Macrophomina phaseolina*
Foolish seedling disease/ Bakanae in paddy caused by *Fusarium fuzikuroi*

Centres proposed

Paddy: PAU, Ludhiana; CCSHAU Hisar; CSKHPAU, Palampur; SKUAST, Srinagar; ICAR-IISS, Mau and IARI, New Delhi

Soybean – JNKVV Jabalpur; PJTSAU Hyderabad; MPKV, Rahuri; VNMKV, Parbhani and IARI, New Delhi

Methodology : Detailed data sheet and methods shall be sent later.

Important Note:

1. All the scientists of the co-operating centres are requested to consult other Scientists as well as seed production agencies involved in the crop production of Soybean and Paddy so that a list of seed borne diseases which are problematic can be can be prepared based on their experience.
2. Systematic studies will be initiated with collection of diseased samples (seeds), isolation and purification of the test pathogen from kharif 2020.

Important note: Any mid-term correction can be suggested by PI at any point of time. In case of any query related to any experiment please call PI for clarification. No excuses later on.

D. Seed Entomology

Date: 15.05.2020

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

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

EXPERIMENT-WISE TECHNICAL PROGRAMME FOR THE YEAR 2020-21

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	Centres
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, Hyderabad; 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						

Experiment 3: Survey and monitoring of insecticide resistance in storage insect pests infesting seeds in storage godowns

Centres

TNAU, Coimbatore; UAS, Bangalore; PDKV, Akola;
SKNAU, Jobner; PJTSAU, Hyderabad; MPKV, Rahuri;

UAS, Dharwad; OUA&T, Bhubaneswar; AAU, Assam

Objective: To estimate level of resistance to commonly used insecticides in storage godowns

Target insects:

Rhyzopertha dominica
Sitophilus oryzae
Tribolium castaneum
Callosobruchus maculatus

Insecticides:

Deltamethrin
Malathion

Methodology: All NSP centres should collect the surviving insects from seed storage godowns and also collect information regarding insecticide application schedule. Rear collected insects in the laboratory and Bioassay should be conducted for determination of LC_{50} through probit analysis against suspected insecticide resistance. Bioassay will be conducted by following film method. For film method, coat Petri dish (5 cm diameter) with one milliliter solution of insecticide on their inner sides through uniform spreading in the Petri dish by swirling it gently and then allowing it dry up at room temperature prior to release of insects.

1. Batches of 20 insects are exposed (24h) to dosages of an insecticide. It is desirable to replicate at least four times. The batches of insects should be so formed as to ensure that each batch is a random sample of the population.
2. The dosages for testing should be spaced as evenly as possible over the mortality range (20%-80%). Since the toxicity is being tested with commercially available insecticides, different concentrations of insecticide should be prepared using water/ preferably distilled water. One batch of insects should be treated with water alone for untreated control.

Experiment : 4 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

New Experiment 5: 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	Centres
Pigeon pea	UAS, Bangalore; PJTSAU, Hyderabad and PDKV, Akola
Green gram	OUAT, Bhubaneswar and JAU, Jamnagar; NAU, Navsari
Chickpea	MPKV, Rahuri; SKNAU, Jobner and NDUA&T, Faizabad
Black gram	TNAU, Coimbatore; PAJANCOA, Karaikal and 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.

New experiment 6: 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	Centres
Wheat	IISS, Mau; CSAUAT, Kanpur
Paddy	AAU, Jorhat; PJTSAU, Hyderabad; 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)

New Experiment 7: Integrated approach for management of Pulse beetle (*Callosobruchus* sp.)

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

Objectives

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

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

Decisions made during 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 ascertained through GPS.**
- 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 solarization should be recorded along with all other observations.
- Experiment No. 3 on "**Survey and monitoring of insecticide resistance in storage insect pests infesting seeds in storage godowns**" will be conducted in its existing format. Bioassay for strains showing >100 resistance ratio should be repeated for validation.
- 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 and Some new crops (Pearlmillet, Sorghum, Black gram, Pigeon Pea and Field pea) will be allotted to different centres to cover maximum number of crops..
- 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 and some new crops (Pearlmillet, Sorghum, Black gram and Field pea) will be allotted to different centres to cover maximum number of crops.
- **New Experiment on '**Integrated approach for management of Pulse beetle **(*Callosobruchus* sp.) during storage under ambient condition'** will be conducted at various centres.

E. Seed Processing

Date: 15.05.2020

Chairman : **Dr. S. Rajendra Prasad**
Vice Chancellor, UAS Bengaluru

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. ICAR-IISS, Mau will coordinate the purchase of sieve graders at each centre.

All the centers were asked 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 table 1.

Table 1: Modifications Proposed for Bottom/ Grading screen in Appendix VII (SCREEN APERTURE SIZE FOR SEED PROCESSING) of INDIAN MINIMUM SEED CERTIFICATION STANDARDS 2013

Crop / Seed Size (categories)	IMSCS Recommended Sieve Size (mm)	Standardized Sieve Size (mm)	Modifications proposed
Paddy			
Coarse grain/ Bold type	1.85s	1.85s, 2.00s	1.85s, 2.00s
Medium Slender	1.80s	1.80s, 1.90s	1.80s, 1.90s
Fine/ Super fine	1.70s	1.60s	1.60s, 1.70s
Wheat			
T. aestivum	1.8s, 2.1s, 2.3s	2.1s, 2.2s, 2.3s, 2.4s	2.1s, 2.2s, 2.3s, 2.4s
Maize			
Except popcorn	6.4r, 7.0r	6.4r, 7.0r, 8.0r	6.4r, 7.0r, 8.0r
Chickpea			

Kabuli/ Very bold	5.0r, 5.5r, 6.0r	6.5r	5.0r, 5.5r, 6.0r, 6.5r
Soybean	4.00s	3.75s	4.00s, 3.75s
Pigeonpea	3.20s, 4.00r, 4.75r	3.75r, 5.00r	3.20s, 3.75r, 4.00r, 4.75r, 5.00r
Finger millet	1.4s	1.2r	1.2r

Table 2: Modifications Proposed for Bottom/ Grading screen in Appendix VIII (SCREEN APERTURE FOR SEED PROCESSING OF CERTAIN VARIETIES) of INDIAN MINIMUM SEED CERTIFICATION STANDARDS 2013

S. No.	Name of the Crop	Varieties /Hybrids	Recommended Bottom Screen Size in millimeter
1.	Paddy	Sakoli– 6, MDU-6	2.00 s
		Pusa 44, PB 1718, PB 1509	1.90 s
		CO-51, ADT 37	1.85 s
		PB 1121	1.80 s
		PB 1637, ADT (R) 46, ADT 43, PKV Tilak, PKV Kisan, PKV HMT	1.60 s
2.	Wheat	HD 2967, HD 2851, WR 544, HI 1620, HD CSW 18,	2.40 s
		K 9423	2.30 s
		HS 562	2.20 s
		K 1317	2.10 s
3.	Chickpea	Radhey, Pragati, KWR 108, Udai	5.00 r
		NBeG 47, Caffa, PDKV Kanchan, Jaki 9218,	5.50 r
		NBeG 49, JG11, AKS 1109,	6.00 r
		PKV Kabuli-2, Vijay, Phule Vikram, Phule Vikrant, Digvijay, Vishal,	6.50 r
		BGD 103	6.75 r
		Virat	7.00 r
4.	Soybean	JS 335, DSb21, JS 9305, DS 228, KDS 726, KDS 753, Phule Agrani, Phule. Kalyani	3.75 s
5.	Maize	MAH 14-5	6.40 r
		UMI 1230	7.00 r
		UMI 1200, UMI 1201, COH(M)6, COH(M) 8	8.00 r
6.	Pigeonpea	BRG 3, BRG 5	5.00 r
		PKV Tara, BSMR 736	4.00 r

		GRG 811	3.75 r
7.	Black gram	VBN 4, ADT 3	2.70 s
8.	Finger millet	KMR 630, GPU 6	1.20 r
9.	Sunflower	KBSH 78, KBSH-53	2.40 s

The size of the bottom/ grading screen have been standardized (Table 2) based on the data generated by different centers of AICRP National seed Project (Crops) on various crops to improve the quality and quantity of the seed and to meet the physical purity standards set by IMSCS. The crops and their varieties as enlisted in Table 2 may be included in **Appendix VIII (**Screen Aperture for Seed Processing of Certain Varieties) of Indian Minimum Seed Certification Standards 2013.

Technical programme:

One new experiment has been proposed on 'Assessment of postharvest deterioration of Soybean seed quality during threshing, processing and storage of soybean seeds' in addition to the earlier two experiments.

EXPERIMENT-WISE TECHNICAL PROGRAMME FOR THE YEAR 2020-21

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, PAU Ludhiana and CSAUAT, Kanpur
Chickpea	**:**	MPKV, Rahuri; UAS Dharwad; UAS, Raichur; PDKV, Akola and CSAUAT, Kanpur
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
Mustard	**:**	CSAUA&T, Kanpur
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 maximize 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; MPKV, Rahuri and UAS Raichur

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 : 15.05.2020 **Time : 4.00-5.15**

Chief Guest	:	**Dr. T. Mohapatra** Secretary, DARE & Director General, ICAR, New Delhi
Chairman	:	**Dr. T.R. Sharma** DDG (CS), ICAR, New Delhi
Co-Chairman	:	**Dr. N. Kumar** Vice-Chancellor, TNAU, Coimbatore
Guest of Honour	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi
Convener	:	**Dr. Dinesh K. Agarwal** Director (Actg.), ICAR-IISS, Mau
Rapporteurs	:	**Dr. T. Ramanadane** Professor & Nodal Officer (Seed), PAJANCOA&RI, Karaikal **Dr. Sripathy K.V.** Scientist, ICAR-IISS, Mau

Session was graced by Dr. T. Mohapatra, Hon'ble Secretary, DARE & Director General, ICAR as Chief Guest. The session was Chaired by Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi and was Co-Chaired by Dr. N. Kumar, Vice-Chancellor, TNAU, Coimbatore. Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi joined the session as Guest of Honour. Dr. Dinesh K. Agarwal, Director (Acting), ICAR-IISS, Mau convened the session as host.

At the outset, Dr. Agarwal welcomed the dignitaries and made a brief presentation on progress of AICRP-NSP (Crops) and ICAR Seed Project (2019-20), recommendations finalized and technical programme for 2020-21.

Dr. N. Kumar suggested inclusion of advanced seed treatments viz., Magnetic seed treatment, use of irradiation, use of endophytes in seed quality enhancement studies, use of artificial intelligence in identification of offtype plants in seed production and promotion of mechanization in seed production & post-harvest operations amid COVID 19 pandemic.

Three scientific staff of AICRP-NSP (Crops) and ICAR Seed Project viz. Dr. R.D.S. Yadav, Professor & Head, Dept. of Genetics & Plant Breeding, NDUAT, Faizabad; Dr. P.N. Sharma, Professor, CSKHPKV, Palampur and Dr. Vasant Kandalkar, Professor & Head, Dept. of Genetics & Plant Breeding and Nodal Officer (Seed), RVSKVV, Gwalior were felicitated on the account of superannuation from government service during the year 2020.

Dr. T. R. Sharma, DDG (Crop Science), ICAR, New Delhi as a Chairman of plenary session applauded the progress made by AICRP-NSP (crops) and ICAR Seed Project during 2019-20. He suggested to develop real–time ICT based dashboard to ensure traceability and to reduce the non-lifting issues of breeder seed. Dr. Sharma stressed upon research encompassing seed longevity; detection of seed borne pathogens using advanced RT-PCR based kits and seed quality enhancement using irradiation treatments. He also suggested to have linkages with ICAR-IGFRI, Jhansi for promotion of seed production and seed research in the arena of fodder crops. He underlined the need for branding of seeds by cooperating centres in align with 'Make in India Programme' under ICAR Seed Project. Scope of collaboration w.r.t. seed production & research front with private sector need to be explored with special focus on low volume high value crops.

Dr. T. Mohapatra, Hon'ble, Secretary DARE and Director General, ICAR, New Delhi emphasized to document the increment in Seed Replacement Rate and Varietal Replacement Rate over a period of time and to analyze the conversion rate of breeder seed to subsequent seed classes through downstream multiplication by SSCs, NSC and State Departments. He urged to study informal seed system in India under ICAR Seed Project to identify bottlenecks in the system. He also exhorted to publish a paper with reliable data on formal and informal seed systems in India. He appreciated the efforts taken to lower down varietal mis-matches in breeder seed production and suggested to take stringent measures to bring it down further. In a bid to acquire the technical skills and to build future leadership in seed sector, he stressed upon the need for capacity building of young scientists at recognized International Seed Research Centres. He urged to develop international perspectives of seed markets and seek new opportunities for public bred varieties to enter into global seed market. Dr. Mohapatra suggested developing comprehensive strategies for promotion of export of seeds from public sector. He advised revision of the existing Field and Seed Standards in time bound manner and to develop new seed & field standards w.r.t. medicinal and under-utilized crops. Dr. Mohapatra exhorted to acquire ISTA accreditation of seed testing laboratories functioning in State Agricultural Universities (SAU's) and ICAR Institutes and robust public private partnership in the field of seed research.

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. Linkages to be made with ICAR-IGFRI, Jhansi for the promotion of seed production and research in the arena of fodder crops. **[Action: Director, ICAR-IISS, Mau & Director, ICAR-IGFRI, Jhansi]**

2. Special attention for creation of 'Seed brands' by cooperating centres in align with 'Make in India Programme' under ICAR Seed Project. **[Action: Nodal Officers of ICAR Seed Project]**
3. ICAR-IISS, Mau shall initiate a well-structured study on informal seed system in India under to identify bottlenecks in the system and shall publish a paper on formal and informal seed systems in India. **[Action: Director, ICAR-IISS, Mau]**
4. Revision of the existing Field and Seed Standards shall be taken up in time bound manner and new seed & field standards shall be developed w.r.t. medicinal and under-utilized crops. **[Action: Director, ICAR-IISS, Mau]**

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

Name / Address of Principal Investigators	Office	Mobile	Fax No.
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Seed Entomology **Dr. Amit Bera** Senior Scientist, ICAR- CRIJAF, Barrackpore 743 101 Email: amitbera.iari@gmail.com	0343-2512255	09732709874	0343-2512255
Seed Processing **Dr. Ashwani Kumar** Principal Scientist, ICAR- IARI, Regional Station, Karnal 132001, Haryana Email: ashakmash@gmail.com	0184- 2267169	09416251530	0184- 2266672

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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