PROCEEDINGS

39th ANNUAL GROUP MEETING OF AICRP ON SEED (CROPS)

TECHNICAL PROGRAMME (2024-25)

02-03 May, 2024

held at
University of Agricultural Sciences, Bangalore

ICAR-Indian Institute of Seed Science
(Indian Council of Agricultural Research)
Mau 275 103 (UP), INDIA
(ISO 9001: 2015 Certified Institute)
www.seedres.icar.gov.in

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CONTENT

Session- I

Inaugural session of 39th AGM of AICRP on Seed (Crops)

Date: 02.05.2024 **Time: 09.45 AM-11.30 AM**

Chairman	:	**Dr. S.V. Suresha** Vice-Chancellor, UAS, Bangalore
Chief Guest	:	**Dr. T.R. Sharma** DDG (Crop Science), ICAR, New Delhi
Guest of Honour	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi
Convener	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	**Dr. Gireesh C.,** Principal Scientist, ICAR-IISS, RS, Bangalore **Dr. Banoth Vinesh,** Scientist, ICAR-IISS, Mau

ICAR-Indian Institute of Seed Science, Mau in collaboration with University of Agricultural Sciences, Bangalore organized 27th Annual Breeding Seed Review meeting and 39th AGM of AICRP on Seed (Crops) during 02-03 May, 2024 at CoA, UAS, Bangalore. The inaugural session was chaired by Dr. S.V. Suresha, Vice-Chancellor, UAS, Bangalore, Dr. T.R. Sharma, DDG (Crop Science), ICAR, New Delhi was the Chief Guest and Dr. D.K. Yadava ADG (Seed), ICAR, New Delhi was the Guest of Honor. The session was convened by Dr. Sanjay Kumar, Director, ICAR-IISS, Mau.

At the onset, Dr. Venkatesh, Director of Research, UAS, Bangalore welcomed the dignitaries to the AGM. He briefed about the journey of UAS, Bangalore Seed Unit and highlighted its achievements in the area of seed production and research.

Dr. Sanjay Kumar, Director, ICAR-IISS, Mau presented the progress report of 2023-24 and the action taken report (ATR). He appraised about the progress under AICRP on Seed (Crops) in increasing the breeder/ quality seed production, improvement of varietal replacement and seed replacement rate. He highlighted the achievements under the seed production and certification, seed physiology, storage & testing, seed pathology, seed entomology and seed processing themes. He stressed upon the need for finalizing the seed health standards, development of organic seed production and certification, and modalities for quality seed production in farmers varieties/ landraces etc., on urgent basis. He urged cooperating centres to enhance quality seed production of newly released varieties and work on novel seed research through PPP mode and reduction of varietal mis-matches in breeder seed production below <5.0 %. The urgent need for identification of offseason areas for seed production was highlighted in the light of climate aberrations. Strengthening seed laboratories to meet the global standards (ISTA and NABL accreditation) need to be

accentuated. He also advocated to declare 2nd Sept (the date of enact of seed law 1966) as national seed day.

Dr. D. K. Yadava, ADG (Seed), ICAR, New Delhi in his introductory remarks highlighted the objectives and mandate of aforesaid components and contributions of AICRP Seed in Indian seed domain in last four decades. He emphasized the need for increasing the seed indent and achieving higher varietal replacement and phasing out of old varieties. The phasing out of poor performing centres as an administrative measure will be taken up by Council regularly, he emphasized. The need for meticulous planning and strategies to enhance higher breeder seed production in soybean, urd bean and groundnut, undertaking of research program for more diseases to address the issues of seed health, employing the cutting-edge technology for development of diagnostic tools and incorporation of AI and digital technology for better quality seed production was accentuated.

Dr. S.V. Suresha, Vice-Chancellor, UAS, Bangalore acknowledged the role of AICRP on Seed (Crops) in enhancing the seed availability in the country. He urged the group to focus on quantification of economic impact of seed research technology, reducing the duplication of research work through effective linkages, involvement of seed processing engineers and pathologist in seed production system, and encouraging rural youths for seed production through skill development training.

Dr. R.C. Jagadeesha, Vice-Chancellor, KSNUAHS, Shimoga was also present in the dais. He urged for retrospection of seed production system to increase VRR. He requested the group to work on seed research aspects in some underutilized crops (medicinal, aromatic, forest species). The need for establishment of centre of excellence in seed testing and research, and development of farmers friendly way of seed pelleting with fungicides, pesticides, nutrients was accentuated.

The dignitaries on the dais also presented the best quality seed production centre awards to SAUs and ICAR Institutes for the year 2023-24 to UAS, Bangalore and ICAR-IIPR, Kanpur, respectively whereas, PDKV, Akola bagged the best STR center award for 2023-24. The technology identification certificates in the discipline of seed physiology, storage and testing (4 nos) and seed processing (1 nos) were presented to concerned PIs. The book entitled 'Essential tenets of seed testing laboratory: An overview of the establishment, accreditation and contemporary regulation' compiled by ICAR-IISS, Mau was released.

Dr. T.R. Sharma, DDG (CS) chief guest in his address congratulated the efforts of participating centers including ICAR institutes, SAU's as well as ICAR-IISS, Mau for their critical role in facilitating quality seed production. He urged the group to undertake basic research program in seed biology, nutrient homeostasis, hormonal regulation of seed germination. He also highlighted the need for utilization of RNAi technologies to knock down the negative regulators in aleurone layer, identification of sunken endosperm in soybean to address seed viability issues etc., He advocated to undertake research program on seed dormancy and seed genomics (seed differentiation, mucilage layers, seed ageing related genes) and applications of multi-spectrum optical devices for seed quality analysis.

The session ended with vote of thanks by Dr. K. Madhusudan, Special Officer (Seeds), UAS, Bangalore.

During the detailed deliberations, following action points were emerged:

- Given the evident impact of climate change on seed production programs, it is imperative to identify offseason seed production sites to guarantee a adequate supply of high-quality seeds, particularly for oilseed and pulses crops. **[Action: Director, ICAR-IISS, Mau]**
- To secure the availability of quality seeds in farmers' varieties and landraces, cooperating centers will commence efforts to identify, purify, and produce quality seeds in these referenced varieties, aligning with regional demand. **[Action: Director, ICAR-IISS, Mau & Nodal Officers, AICRP on Seed (Crops)]**
- To emphasize the significance of quality seeds in bolstering national food security, it is proposed to commemorate National Seed Day in the country. In this endeavor, ICAR-IISS, Mau, and the Seed Division of ICAR will collaborate with DA&FW, MoA&FW to advocate for the declaration of 2nd September (the date of the enactment of the Seeds Act, 1966) as 'National Seed Day'. **[Action: Director, ICAR-IISS, Mau & ADG (Seed), ICAR]**

Session II

Presentation of Seed Technology Research Achievements during 2023-24 by Principal Investigators and Identification of Technologies by the Panel of Experts

Date: 02.05.2024 **Time: 2.00 PM to 4.30 PM**

Chairman	:	**Dr. S.A. Patil** Former VC, UAS, Dharwad and Former, Director, ICAR-IARI, New Delhi
Co-Chairman	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi
External Experts	:	**Dr. R.R. Hanchinal** Former Chairperson, PPV&FRA, New Delhi **Dr. S. Rajendra Prasad** Former VC, UAS, Bengaluru and Former Director, ICAR-IISS, Mau **Dr. Malavika Dadlani** Former Joint Director (Research), ICAR-IARI, New Delhi **Dr. M. Bhaskaran** Former VC, TNOU & Former Chairman, RAC, ICAR-IISS, Mau **Dr. Devaraja** Managing Director, KSSC Ltd., Bengaluru **Dr. Sadashiva V.** Director, KSSOCA, Bengaluru **Dr. G.V. Jagadish** Head, QA, Indo American Hybrid Seeds Pvt. Ltd., Bengaluru
Convener	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	**Dr. C. Vanitha,** SRO, Seed Centre, TNAU, Coimbatore **Dr. Kuldip Jayaswal,** Scientist, ICAR-IISS, Mau

Session was Chaired by Dr. S.A. Patil, Former VC, UAS, Dharwad and Former, Director, ICAR-IARI, New Delhi and Co-Chaired by D.K. Yadava, ADG (Seed), ICAR, New Delhi. Dr. Sanjay Kumar, Director, ICAR-IISS, Mau convened the meeting. The session was graced by external experts' *viz*., Dr. R.R. Hanchinal, Former Chairperson, PPV&FRA, New Delhi; Dr. S. Rajendra Prasad, Former VC, UAS, Bengaluru and Former Director, ICAR-IISS, Mau; Dr. Malavika Dadlani, Former Joint Director (Research), ICAR-IARI, New Delhi; Dr. M. Bhaskaran, Former VC, TNOU & Former Chairman, RAC, ICAR-IISS, Mau; Dr. Devaraja, Managing Director, KSSC Ltd., Bengaluru; Dr. Sadashiva V., Director, KSSOCA, Bengaluru; Dr. G.V. Jagadish, Head, QA,

Indo American Hybrid Seeds Pvt. Ltd., Bengaluru. The discipline wise presentation of progress report for the year 2023-24 was made by the respective Principal Investigators.

Sl. No.	Discipline	Principal Investigator
1	Seed Production & Certification	Dr. Sandeep K. Lal Pr. Scientist, DSST, ICAR-IARI, New Delhi
2	Seed Physiology, Storage and Testing	Dr. Shiv K. Yadav Pr. Scientist, DSST, ICAR-IARI, New Delhi
3	Seed Pathology	Dr. Atul Kumar Pr. Scientist, DSST, ICAR-IARI, New Delhi
4	Seed Entomology	Dr. Amit Bera Sr. Scientist, ICAR-CRIJAF, Barrackpore
5	Seed Processing	Dr. Ashwani Kumar Pr. Scientist, ICAR-IARI, RS, Karnal

Some of the important issues deliberated in the Session are:

Seed Production & Certification:

Dr. Sandeep Kumar Lal, Principal Investigator, ICAR, IARI presented the significant findings for 6 experiments for the year 2023-24. Dr. R.R. Hanchinal, suggested the Principal Investigator to standardize the certification standards for organic seed production and also to use organically produced seeds as a source seed. Further, he instructed to assess the inoculum load in the bioformulation used for seed treatment. Dr. Malavika Dadlani pointed out that composite variety of maize may be used for organic cultivation. Dr. S. Rajendra Prasad instructed that in every experiment after harvest soil analysis should be done to know the nutrient status.

Seed Physiology, Storage & Testing: Dr. Shiv Kumar Yadav, PS, ICAR-IARI, New Delhi & PI presented the highlights for 6 experiments pertinent to 2023-24. Dr. M. Bhaskaran informed that challenges in seed physiology should be addressed and common template may be formulated to overcome the inconsistency of data from different centres. Dr. G.V. Jagadish informed that the storage period of millets may be verified and the temperature and RH of the storage environment may be assessed and correlated with storability of seeds. He also pointed out that the list of weeds identified by the different centres may be verified with Indian Weed Seed Atlas and Monograph developed by ISTA.

Dr. Malavika Dadlani suggested that in molecular markers validation experiment, if more than one centre has obtaining similar result, it can be accepted for recommendation. She also recommended that vacuum container or vapour proof container may be used for seed storage experiment. Dr. R.R. Hanchinal requested that newly released wheat varieties may be included in terminal heat stress experiment and he also opined that degradable bags may be tried for storage experiment. Dr. Agarwal suggested that for reaffirming the validity

period experiment, based on the statistical analysis, lowest mean value can be taken for conclusion of the experiment. Dr. S. Rajendra Prasad informed that the period between seed harvest to testing should be included for assessing the seed validity period and also, he opined that any one of the vigour tests can be imposed for validation of seed lots.

Seed Pathology: Dr. Atul Kumar, PS, ICAR-IARI, New Delhi and PI presented the salient achievements for 2023-24. Dr. Malavika Dadlani madam suggested that the seed borne pathogens included in plant quarantine may be verified for maintaining seed health.

Seed Entomology: Dr. Amit Bera, Senior Scientist, ICAR-CRIJAF, Barrackpore and PI presented the achievements for 2023-24. Dr. M. Bhaskaran suggested that cost benefit ratio for the best seed treatment may be worked out for technology release. Dr. G.V. Jagadish informed that moisture content of seeds may be assessed and recommended the suitable moisture content for imposing the treatment. Dr. Malavika Dadlani suggested that data may be compiled and published for seed quality assessment of farmers saved seeds.

Seed Processing: Dr. Ashwani Kumar, PS, ICAR-IARI, RS, Karnal and PI presented the progress report for 2023-24. Dr. M. Bhaskaran suggested that temperature and RH maintained inside and outside of the solar drier should be assessed during drying of seeds.

Some of the suggestions given by the Chairman, Co-chairman and external experts are:

Dr. D.K. Yadava, Co-Chairman of the session, instructed that the data pertaining to seed physiology experiment should be reported with precision by all the centres on time. He also suggested that rapid diagnostic tool viz., artificial Intelligence for pest and disease identification for development of effective forecasting model may be utilized. He also instructed that the centres involved in STR experiments should follow the technical programme strictly for conducting the experiment and reporting the results.

Dr. S.A. Patil, Chairman of the session, suggested that the STR experiment may be allotted based on zone (or) region wise depending upon the better performance of the centres for getting uniform result. Cotton crop may be included in some Seed Technology Research experiments he suggested.

The session ended with formal vote of thanks by Dr. C. Gireesh., Principal Scientist, ICAR-IISS, RS, Bengaluru.

During the detailed deliberations, following action points were emerged:

- When assessing the effectiveness of bio-formulations in improving seed quality, it is recommended to ascertain the inoculum load present in the bio-formulation applied during seed treatment in these experiments. **[Action: PI (SPC), PI (SPST) and PI (Seed Pathology)]**

- In the experiment to reaffirm the validity periods of certified seeds, in order to gain insights into the vigour status of seed lots, it is recommended at least one seed vigour test in the experimentation. **[Action: PI (Seed Physiology, Storage & Testing)]**
- In the experiment on development of weed seed atlas, list of weeds identified by the centres need to be cross checked with either Indian weed seed atlas or ISTA monograph. **[Action: PI (Seed Physiology, Storage & Testing)]**
- The survey data regarding the quality of farm-saved seeds produced in the seed pathology and seed entomology theme can be leveraged for the development of AI-based forecasting models. Additionally, pooling the data over multiple years and publishing it simultaneously is also recommended. **[Action: PI (Seed Pathology and Seed Entomology) and Director, ICAR-IISS, Mau]**
- In the experiment assessing the efficacy of a solar tunnel dryer for soybean seed drying, it is advised to monitor the temperature and relative humidity levels both inside and outside the solar tunnel unit during the seed drying process. **[Action: PI (Seed Processing)]**

Session III and IV

Centre-wise Presentation of Achievements under QSP and STR during 2023-24

Session III

Date: 02.05.2024 **Time: 4.30 PM to 6.00 PM**

Chairman	:	**Dr. S. Rajendra Prasad** Former Director, ICAR-IISS, Mau and Former VC, UAS, Bengaluru **Dr. Dinesh Kumar Agarwal** Registrar General, PPV&FRA, New Delhi
Convenor	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	**Dr. Inderpreet Dhaliwal,** SRO, PAU, Ludhiana **Dr. Anjitha George,** Senior Scientist, ICAR-IISS, RS, Bengaluru

Session IV

Date: 03.05.2024 **Time: 09.30 AM to 12.15 PM**

Chairman	:	**Dr. Malavika Dadlani** Former Joint Director (Research), ICAR-IARI, New Delhi **Dr. M. Bhaskaran** Former VC, TNOU & Former Chairman, RAC, ICAR-IISS, Mau
Convener	:	**Dr. Sanjay Kumar,** Director, ICAR-IISS, Mau
Rapporteurs	:	**Dr. Udaya Bhaskar K.,** Senior Scientist, ICAR-IISS, RS, Bengaluru **Dr. R. Shiva Ramakrishnan,** ASRO, JNKVV, Jabalpur

The **Session III** was jointly chaired by Dr. S. Rajendra Prasad, former VC, UAS, Bangalore and Former Director, ICAR-IISS, Mau and Dr. Dinesh Kumar Agarwal, Registrar General, PPV&FRA, New Delhi. There was a brief presentation on online registration and working flow chart of user-oriented centralized portal, SATHI by Sh. D.V. Singh, Senior Systems Analyst, NIC, New Delhi. The SATHI portal provides a holistic approach to encompass the complete seed life cycle over multiple seed generations. The presenter informed that the portal was officially launched on April 19, 2023 and emphasized the importance of this Centralized Online System for seed traceability, authentication and inventory designed to deal with the challenges of seed production, quality seed identification and seed certification. All the seed production centres were requested to complete their registration via SATHI portal and hereafter all the seed indents will be processed only through this online portal.

The **Session IV** was jointly Chaired by Dr. Malavika Dadlani, Former Joint Director (Research), ICAR-IARI, New Delhi and Dr. M. Bhaskaran, Former VC, TNOU & Chairman, RAC,

ICAR-IISS, Mau, and Convened by Dr. Sanjay Kumar, Director, ICAR-IISS, Mau. Two centres viz., SKRAU, Bikaner and RVSKVV, Gwalior not presented due to absence of Nodal Officers. The panel appreciated the centres for their great efforts and urged to follow strict guidelines with reference to quality seed production programmes. The centre-wise important issues deliberated during session III and session IV were given below.

PJTSAU, Hyderabad center was asked to resolve the non-lifting issue of soybean by NSC as well as to expand their HRD programmes in the coming years. Varietal mismatch and failure in germination in soybean were the issues observed at MPKV, Rahuri. The chairman and convenor urged all the centers to follow the RKVY seed subsidy scheme followed at JAU, Junagadh in order to expand the seed production programmes in other states. Dr. Rajendra Prasad emphasized the importance of developing SOP for TL seeds also. He also requested all the centers especially the AICRP centers in Maharashtra state to develop a fully automated seed farm and that necessary steps may be taken to develop such models where well-equipped lab infrastructures are already available. Dr. Sanjay Kumar requested the centers (with special reference to AAU, Anand) to utilize the fund appropriately so that it is not refunded every year.

There was a short presentation by Dr. Bharat Kumar M Davda from TARA international, Vadodara. They deal in equipment's catering to seed industry like Video meter Seed/ Grain Analyser, multi-spectral image analyser for identification of infested seeds in a seed lot, Video meter Food Analyser, Video meter Pharmaceutical Analyzer, automated seed germination unit etc.

The chairman urged for patenting of technologies before popularizing it among the farmers. Further, more focus has to be given to assess and report the impact created from the technologies developed through AICRP experiments among farmers. Centres were asked to immediately fill the sanctioned vacant posts at the earliest. Following are some major points raised during the deliberation, the research publications with high NAAS rating should be improved in the coming years and centre's are requested to submit their research papers in seed research journal, non-reporting of data should not be observed in the coming years and centre's may take efforts to commercialize their technologies developed through private companies on a non-exclusive basis.

During the detailed deliberations, following action points were emerged:

- In a bid to upgrade the national seed quality system to meet the global standards, centres were urged to take initiatives for ISTA and NABL accreditation in the coming years. **[Action: Director, ICAR-IISS, Mau & Nodal Officers of AICRP on Seed (Crops)]**
- With the objective of establishing centers of excellence in seed production and research, centers situated in Maharashtra are encouraged to establish mechanized seed production farms with financial assistance from the DA&FW, GoI. **[Action: Nodal Officers of AICRP on Seed (Crops) in the state of Maharashtra]**
- To optimize the utilization of generated profits and streamline management, it is imperative to promptly merge relevant ICAR revolving funds associated with seeds.

The respective Nodal Officers shall be granted full administrative authority over the seed revolving fund for promotion of quality seed. **[Action: Nodal Officers of AICRP on Seed (Crops)]**

Session V

Panel discussion on Forging Collaboration for Furthering Contemporary Seed Research and Augmenting Seed Production

Date: 03.05.2024 **Time: 12.30 PM to 02.15 PM**

Chairman	:	**Dr. S.A. Patil** Former VC, UAS, Dharwad and Former, Director, ICAR-IARI, New Delhi
Co-chairman	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi
Moderator	:	**Dr. Vilas A. Tonapi** Ex-Director, ICAR-IIMR and Technical Consultant, Advanta Seeds Pvt. Ltd., Hyderabad
Convenor	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	**Dr. Anandan A.,** Principal Scientist, ICAR-IISS, RS, Bengaluru **Dr. Umesh Hiremath,** Asst. Professor, UAS, Raichur

Panel discussion on **'Forging Collaboration for Furthering Contemporary Seed Research and Augmenting Seed Production'** was held under the chairmanship of Dr. S.A. Patil, Former VC, UAS, Dharwad and Former, Director, ICAR-IARI, New Delhi. Dr. D.K. Yadava, ADG (Seed), ICAR, New Delhi Co-chaired the session. Dr. Vilas A. Tonapi, Ex-Director, ICAR-IIMR and Technical Consultant, Advanta Seeds Pvt. Ltd., Hyderabad moderated the session. Dr. Sanjay Kumar, Director, ICAR-IISS, Mau convened the meeting. At the outset, Dr. Vilas A. Tonapi briefly summarized the areas to be focussed in the panel discussion and welcomed all the panelists to put forth their views. The panel was constituted by seven esteemed speakers viz., Dr. J.C. Rana, National Project Coordinator, Alliance of Bioversity International and CIAT, India; Dr. Rajendra Singh Mahala, President (Research), Seedworks International Pvt. Ltd., Hyderabad; Dr. S.N. Vasudevan, Ex-Dean, CoA, Hassan, UAS, Bengaluru; Dr. G.V. Jagadish, Head (QA), Indo-American Hybrid Seeds India (Pvt.), Ltd., Bengaluru; Dr. Anandakrishna K., Former Managing Director, KSSC, Bangalore; Sh. H.C. Baxi, Executive Director, Bombay Super Hybrid Seeds Ltd., Rajkot and Dr. Basave Gowda, Registrar, UAS, Bangalore.

Post panel discussion, opinion of experts was invited and following points were highlighted viz., Uniform guidelines to exchange parental material, farming technologies, germplasm, etc. between private and public sectors should be formulated; native landraces, which have geographic indications, should be included in the seed chain; to accelerate the testing process of hybrids/varieties, vigor tests like radical emergence, electrical conductivity, and accelerated ageing are recommended; seed priming technology should be made a priority to minimize the wastage of carryover lots; soft loans and subsidies may be extended to the

private seed sector for stocking seeds/produce, and R&D expenses should be given as tax benefits to strengthen seed research etc. The session was concluded by chairman Dr. S.A. Patil with compliments to all speakers.

During the detailed deliberations, following action points were emerged:

- In order to ensure the supply of quality seed in native varieties, it is necessary to strengthen seed chain through Farmer Producer Organizations (FPOs) by implementing a buy-back policy and establishing a community seed bank in addition to effective linkages for marketing of seeds. **[Action: Director, ICAR-IISS, Mau and ADG (Seed), ICAR]**
- PPP mode in seed production and seed research should focus on action-oriented approaches that improve efficiency (skill improvement and time management) and effectiveness (quality improvement) in the public sector. The PPP mode should be mutually beneficial, based on long-term trust and with specific targets. **[Action: Director, ICAR-IISS, Mau and ADG (Seed), ICAR]**
- For ease of licensing of crop varieties, a single license system (One nation and one license) needs to be promoted for promotion of private companies' which could aid in faster dissemination of crop varieties, hybrids, and technology to the farmers. **[Action: Director, ICAR-IISS, Mau and ADG (Seed), ICAR]**

SEED TECHNOLOGY RESEARCH TECHNICAL PROGRAMME, 2024-25

A. Seed Production & Certification

Date: 24.04.2024 & 02.05.2024

Chairman	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Convener	:	**Dr. Sandeep Kumar Lal** Principal Investigator/ Principal Scientist ICAR-IARI, New Delhi
Co-Convener	:	**Dr. Bhojaraja Naik K.** Co-Principal Investigator/Sr. Scientist ICAR-Indian Institute of Seed Science Regional Station, Bengaluru

General Instructions:

- The centers should follow the technical programme strictly, without any deviation/s and conduct the experiment accordingly.
- 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, Co-PI and Director, ICAR- IISS, Mau. Further, the progress of experiments shall be reviewed by PI/ Co-PI as and when necessary.
- The deadline for the submission of reports should be strictly adhered to (July 31 and January 31 for rabi and kharif experiments, respectively).
- The report should be sent in a prescribed format with brief experimental lay out, details about net and gross plot area, name of variety/ hybrid/ parental lines, date of sowing, relevant figures and tables (properly numbered and formatted, along with MS Excel tables), salient findings, interpretation of the results and conclusion, as per the technical programme.
- The centers should furnish meteorological data (monthly mean) and soil analysis report and interpret the results the data to analyze the environmental variations between the centers, failing which the results will not be considered valid.
- The report submitted should be supplemented with location details of experimental plot (including GPS coordinates) should be submitted along with high quality photographs otherwise report will not be accepted.
- The data should be reported after subjecting to appropriate statistical analysis, along with CV and CD data for the experiments conducted as standard error is not sufficient to analyze the precision of the experiment.
- The benefit cost ratio may be worked out for all the experiments to assess the economic feasibility of the developed technologies. In this regard, the centers should

work out the cost of production.

- The excel sheets of raw data need to be supplied along with the report (as per the technical programme) for pooled analysis.

Technical Programme for 2024-25

Experiment 1: Standardization of isolation distance in Mustard hybrids

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

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

Year of start: 2018-19

Crop	Centres
Mustard (3)	ICAR-IARI, Jharkhand; PDKV, Akola and UBKV, Pundibari

Methodology: A plot size of 2.25 m (width) x 27 m (length) with a spacing of 45 x 15 cm (minimum of 5rows) will be maintained for the pollen parent. Four rows of female parent (CMS line) will be planted (3 m row length) at different distances viz., 600, 650, 700, 750, 800, 850, 900, 950 and 1000 m. Precaution will be taken that no other crop variety of mustard should be grown within a periphery of 1000 m.

Seed Source: 125 g seed (25 g seed per center) each of pollen parent (R line) and female parent (CMS line) will be supplied by **Dr. Gurpreet, PAU, Ludhiana (9814907951)/ Dr. S.K. Chakrabarty, DSST, ICAR-IARI, New Delhi (996827944).**

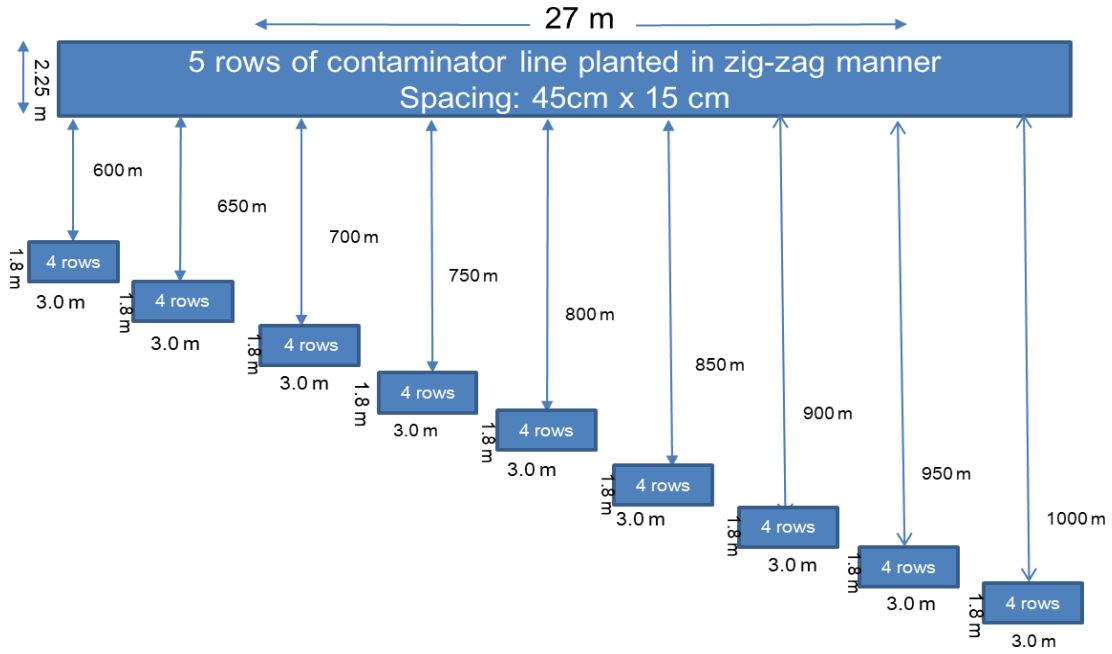

Fig.1.1: Schematic field layout for standardization of isolation distance in hybrid Mustard

Observation to be recorded (Table 1.1 & 1.2)

- Location details of experimental plot (including GPS coordinates) along with photographs
- Field emergence (%) – **up to 30 DAS**
- Plant stand establishment (per m^2) - **Number of plants emerging in 1m2 area to be recorded at 15 DAS**
- Plant height at 30 days and at harvest (cm)
- Days to first flowering and 50% flowering in parental lines
- Duration of flowering in parental lines (days)
- Extent of selfing in female line by bagging (percent seed set on bagging)
- Seed setting percentage in the female parent (percent seed set throughout crossing)
- Seed yield/plant(g) - The data may be recorded on 10 plants each in three rows, constituting three replications
- Test weight - 1000 seed (g)

Note:

1. The recommended packages of practices will be followed for the raising of crop.
2. 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).
3. The most important consideration in spraying of the insecticide is that it should not kill thepollinating insects. Hence, spraying should be done either before 8AM or after 4 PM, as the activity of pollinators are minimum at above timings.
4. The timings for recording pollinator related observations can be adjusted depending upon visit of honeybee/ pollinators. Five random plants (around 10 min. /plant) should be observed for about one hour (8-10AM for FN and 2-4 PM for AN) for the visit of insect pollinators during peak flowering stage (>50% flowering). Honeybees carrying pollen fromcontaminator plots should be recorded as pollen gatherers. The nectar collectors will be devoid of pollen in their pollen basket. The pollen gatherers and nectar collectors should be identified in consultation with the entomologist. The observations should be repeated atsame timings for three days and reported.
5. In order to study the pollinator activity & variability of pollinators in isolation distance experiment, a local entomologist may be involved for identification and taking the observations on insect pollinators and nectar collectors.

   Expected output: The isolation distance will be worked out in mustard hybrid seed production formaintaining genetic purity of seed and enhancing seed quality

Table1.1: Flowering and seed setting behavior in parental lines of mustard

Isolation distances/ Parental lines	Field emergence (%)	Days to		Duration of flowering	Extent of selfing in female lines on bagging	Plant height at (cm)		Seed set (%)	Seed yield/ plant (g)	Test weight (g)
		First flowering	50% flowering			30 DAS	Harvest			
Pollen parent (Male parent)										
-										
Female parent (Female parent)										
D1 (600m)										
D2 (650m)										
D3 (700m)										
..										
..										
..										
D8 (1000m)										
Mean										

Table 1.2: Observations on pollinator activity at different isolation distances in mustard

Isolation distances/ Parental lines	Honeybee/other pollinators			
	Pollen gatherers		Nectar collectors	
	FN	AN	FN	AN
	(8-9/9-10AM)	(2-3/3-4 PM)	(8-9/9-10AM)	(2-3/3-4 PM)
Pollinator line (Male parent)				
-				
CMS line (Female parent)				
D1 (600m)				
D2 (650m)				
D3 (700m)				
..				
..				
..				
D8 (1000m)				
Mean				

Experiment 2: 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 attributesunder organic production systems

Year of start: 2018-19

Crop	Centre	Cultivars Selected
Paddy (10)	ICAR RC NEHR Manipur	Chakhao Amubi, Chakhao Poireiton and Chakhao Angouba
	AAU, Jorhat	Srimanta, Ghandhari, JR-16 and Bharati
	IGKV, Raipur	Dubraj, Badshabhog and Vishnubhog
	IISS, Mau	KN3, BK101, BK102 and Kiran
	PJTSAU, Hyderabad	Chittimuthyalu, Navara, Mysore Mallika and Kueli Pathaliya
	UAS, Bengaluru	Hemashri, Ratna Chodi, Rajamudi and Muthina Sanna
	ICAR RC NEHR Arunachal Pradesh	Chakhao Amubi, Chakhao Poireiton and Chakao Angouba
	ICAR RC NEHR Meghalaya	Chakhao Amubi, Chakhao Poireiton and Chakhao Angouba
	ICAR RC NEHR Mizoram	Chakhao Amubi, Chakhao Poireiton and Chakhao Angouba
	ICAR RC NEHR Nagaland	Chakhao Amubi, Chakhao Poireiton and Chakhao Angouba
Maize (7)	GBPUAT, Pantnagar	Pant Sankul Makka 3, Shweta and Kanchan
	UAS, Dharwad	CI4, CL-1426-2 and GPM-114
	ICAR RC NEHR Manipur	Megha Maize 1, Megha Maize 2 and SKMC 3
	ICAR RC NEHR Arunachal Pradesh	Megha Maize 1, Megha Maize 2 and SKMC 3
	ICAR RC NEHR Meghalaya	Megha Maize 1, Megha Maize 2 and SKMC 3
	ICAR RC NEHR Mizoram	Megha Maize 1, Megha Maize 2 and SKMC 3
	ICAR RC NEHR Nagaland	Megha Maize 1, Megha Maize 2 and SKMC 3
Ragi (4)	UAS, Bangalore	Indaf -9, ML-365, GPU-66 and KMR-630
	PDKV, Akola	BFM-19-1, BFM-19-1-5, BFM-19-14-3 and Phule Nachani
	ICAR RC NEHR Sikkim	Sikkim Ragi 3043, Sikkim Ragi 3014 and VL-Mandua 373
	ICAR RC NEHR Nagaland	Sikkim Ragi 3014, VL-Mandua 373 and VL-Mandua 379

TREATMENT DETAILS	
Treatments: Nutrient Managementand cultivars	**Replications:** Four

Factor 1: Nutrient management

N1-Control (No Fertilizer & Manure)

N2- State Recommended Dose of NPK Fertilizer (Inorganic)

N3- Organic practices

Factor 2: Cultivar - A set of 3 local/ traditional/ Organic varieties (minimum), which are widely cultivated in the region

Sowing method		**Direct sowing** - 20x10 cm (Paddy and Ragi) and 60 x 20cm (Maize: sown at 3- 4 cm depth)
Design		Factorial Randomized Block Design
Plot size	**Gross plot size**	3m × 5.0 m =15.0 m^2
Spacing between plots (Plot border)		One meter
Seed treatment		Seed treatment with biocontrol agents *viz., Trichoderma harzianum* or *Pseudomonasfluorescens*@10g/kg of seed
Plant protection (As prophylactic measure)		Uniform application of botanicals i.e., Neem oil (@ 5 ml/liter of water) to all the plots. Spray of commercially available *T. harzianum* Emulsifiable concentrate @ 2 ml/liter *P. fluorescens* Emulsifiable concentrate@5ml/ liter or Combination of *P. fluorescens* + *Bacillus subtilis* @ 5 gm/liter water as a prophylactic measure. Application schedule of *P. fluorescens* (Paddy) i. Boot emergence stage ii. 50% panicle emergence stage iii. Pre-harvest stage (15 days prior to harvest) iv. Application schedule of combination of P. fluorescens + B. subtilis (Maize and Ragi) i. 45 DAS ii. 60 DAS iii. 90 DAS

Observations to be recorded

Paddy and Ragi	**Maize**
i. **Location details of experimental plot (including GPS coordinates), along with photographs – report will not be accepted in case the GPS photographs are missing**	i. **Location details of experimental plot (including GPS coordinates), along with photographs – report will not be accepted in case the GPS photographs are missing**
ii. Seed Germination (%) - **before sowing**	ii. Seed Germination (%) - **before sowing**
iii. Field emergence (%) - **30 DAS**	iii. Field emergence (%) - **30 DAS**
iv. Plant stand establishment/m^2 - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**	iv. Plant stand establishment/m^2 - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
v. Plant height at 30 days and at harvest(cm)	v. Plant height at 30 days and at harvest (cm)
vi. Days to first flowering and 50% flowering	vi. Days to first flowering and 50 % flowering
vii. No. of tillers/m^2	vii. No. of cobs/ plant
viii. Seed yield/plant (g) - **5 plants/ replication**	viii. Seed yield/ plant (g) - **5 plants/ replication**
ix. Seed yield/ plot - **plot size needs to be mentioned**	ix. Seed yield/ plot - **plot size needs to be mentioned**
	x. Seed yield (q/ha)

x. Seed yield (q/ha)	xi. 100 seed weight (g)
xi. 1000 seed weight (g)	xii. Raw and Graded seed yield (q/ha)
xii. Raw and Graded seed yield (q/ha)	xiii. Seed Quality - Seed germination, Pure Live seed (%) and Vigour index I
xiii. Seed Quality - Seed germination, Pure Live seed (%) and Vigour index I	xiv. Net monetary returns (Rs.)
xiv. Net monetary returns (Rs.)	xv. Benefit Cost ratio (BCR) - Annexure I
xv. Benefit Cost ratio (BCR) - Annexure I	

Guidelines:

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

ii. The soil fertility status of the experimental plot in all the three treatments should be estimated for parameters like texture, bulk density, pH, EC, organic carbon content, available N, P, K and Zn at pre- and post-experiment stages.

iii. **The nutrient composition of the organic nutrient sources (in case of N3- for N, P, K, Zn andother nutrients, if any) and the spore concentration (cfu/g) of bio-agents (Rhizobium, PSB, KSB, *T. harzianum, P. fluorescens, B, subtilis* etc.) should be analyzed/ furnished before use/ field application. The nutrient management dose in case of N3 (Organic practices) should be optimized accordingly so as to provide same level of nutrients as being suppliedthrough inorganics fertilizers (N2 - State Recommended Dose of NPK fertilizer).**

iv. The organic sources of NPK *viz.,* Neem cake, FYM/ Vermicompost should be applied to experimental plots as per treatment schedule, at least 20 days prior to sowing and the nitrogen supplied through these sources should be calculated. Alternatively, the bio- fertilizers *viz.,* Azospirillum, PSB and KSB should be mixed with FYM/ Vermicompost atthe time of last ploughing.

v. Adequate care should be taken to avoid the flow of water from inorganic field to organic experimental site/plots.

vi. No other crop should be grown in subsequent season in the experimental site/plots of organic seed production technology.

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

Table 2.1: Effect of organic nutrient management on plant growth and seed yield attributes in paddy / ragi

Treatments / Parameters	Field emergence (%)	Field stand establishment/ m^2	Plant height at (cm)		Days to		No. of tillers / m 2	Seed yield/ plant(g)	See d yield (q/ ha)
			30 DAS	Harvest	First flowering	50% flowering			
Varieties (V)									
V1									
V2									
V3									
V4									
Mean									
SEm±									
CD									
CV(%)									
Nutrient Management treatments (N)									
N1									
N2									
N3									
Mean									
SEm±									
CD									
CV (%)									
Interaction effects									
V1N1									
V2N1									
V3N1									
V4N1									
V1N2									
V2N2									
V3N2									
V4N2									
V1N3									
V2N3									
V3N3									
V4N3									
Mean									
SEm±									
CD									
CV (%)									

Table 2.2: Effect of organic nutrient management on seed quality parameters and economic indicators in paddy/ ragi

				Seed quality		

Treatments/ Parameters	Seed yield (q/ha)	1000 seed weight (g)	Raw and Graded seed yield (q/ha)	Germination (%)	Pure live seed	Vigour index-I	Net monetary returns (Rs.)	Benefit Cost ratio
Varieties(V)								
V_1								
V_2								
V_3								
V_4								
Mean								
SEm±								
CD								
CV (%)								
Nutrient Management treatments (N)								
N_1								
N_2								
N_3								
Mean								
SEm±								
CD								
CV (%)								
Interaction effects (VXN)								
V_1N_1								
V_2N_1								
V_3N_1								
V_4N_1								
V_1N_2								
V_2N_2								
V_3N_2								
V_4N_2								
V_1N_3								
V_2N_3								
V_3N_3								
V_4N_3								
Mean								
SEm±								
CD								
CV (%)								

Table 2.3: Effect of organic nutrient management on plant growth and seed yield attributes in maize

Treatments/ Parameters	Location details (Including GPS coordinates)	Seed germination (%) (Before sowing)	Field emergence (%)	Plant stand establishment/ m^2	Plant height at (cm)		Days to		No. of cobs /m2	Seed yield/ plant (g)	Seed yield/ plot
					30 DAS	Harvest	First flowering	50% flowering			
Varieties (V)											
V_1											
V_2											
V_3											
V_4											
Mean											
SEm±											
CD											
CV(%)											
Nutrient Management treatments (N)											
N_1											
N_2											
N_3											
Mean											
SEm±											
CD											
CV (%)											
Interaction effects (VXN)											
V_1N_1											
V_2N_1											
V_3N_1											
V_4N_1											
V_1N_2											
V_2N_2											
V_3N_2											
V_4N_2											
V_1N_3											
V_2N_3											
V_3N_3											
V_4N_3											
Mean											

SEm±											
CD											
CV (%)											

Table 2.4: Effect of organic nutrient management on seed quality parameters and economic indicators in maize

Treatments/ Parameters	Seed yield (q/ha)	100 seed weight (g)	Raw and Graded seed yield (q/ha)	Seed quality			Net monetary returns (Rs.)	Benefit Cost ratio
				Germination (%)	Pure live seed	Vigour index-I		
Varieties(V)								
V_1								
V_2								
V_3								
V_4								
Mean								
SEm±								
CD								
CV (%)								
Nutrient Management treatments (N)								
N_1								
N_2								
N_3								
Mean								
SEm±								
CD								
CV (%)								
Interaction effects (VxN)								
V_1N_1								
V_2N_1								
V_3N_1								
V_4N_1								
V_1N_2								
V_2N_2								
V_3N_2								
V_4N_2								
V_1N_3								
V_2N_3								
V_3N_3								
V_4N_3								
Mean								
SEm±								
CD								
CV (%)								

Experiment 3: Optimization of seed rate for enhancing seed yield and recovery of pure live seed

Year of start: 2022-23

Objective: To determine the optimum seed rate for maximizing seed yield and quality.

Assumptions: Assured irrigation along with recommended dose of fertilizers

Crops	Centre	Varieties selected
Chickpea	**Small Seeded -** UAS, Bengaluru; UAS, Raichur; PJTSAU, Hyderabad and MPKV, Rahuri	Super Annigeri 1 and Phule Vikrant (Phule G0405)
	Medium Seeded - VNMKV, Parbhani; RARI, Durgapura; PDKV Akola and ICAR-IARI, New Delhi	Jaki 9218 and Pusa Parvathi/ BG 3043
	Large seeded - CCSHAU, Hisar; PAU, Ludhiana; JNKVV Jabalpur and ANDUAT, Faizabad	Jawahar Gram 24 and HC-3
Groundnut	**Small Seeded -** TNAU, Coimbatore; PJTSAU, Hyderabad and MPKV, Rahuri	GJG 32 (ICGV 03043) and Phule Bharti (JL 776)
	Medium Seeded - OUAT, Bhubaneshwar; UAS, Dharwad and VNMKV, Parbhani	DH 257 and VRI 10 (VG 17008)
	Large seeded - RARI, Durgapura; CSAUAT, Kanpur; and PAU, Ludhiana	Raj Mungfali 4 (RG 638) and Gujarat Groundnut HPS 2

Chickpea

Treatments (Seed rates):

Small seeded (100 seed weight: <20g)	Medium seeded (100 seed weight: 20-25g)	Large seeded (100 seed weight: 25g)
S_1: **75 kg/ha** (Recommended Seed Rate/ RSR) - Control	S_1: **100 kg/ha** (Recommended Seed Rate/ RSR) - Control	S_1: **120 kg/ha** (Recommended Seed rate/ RSR) - Control
S_2: **67.5 kg/ha** (10% less than RSR)	S_2: **90 kg/ha** (10% less than RSR)	S_2: **108 kg/ha** (10% less than RSR)
S_3: **60 kg/ha** (20% less than RSR)	S_3: **80 kg/ha** (20% less than RSR)	S_3: **96 kg/ha** (20% less than RSR)
S_4: **52.5 kg/ha** (30% less than RSR)	S_4: **70 kg/ha** (30% less than RSR)	S_4: **84 kg/ha** (30% less than RSR)
S_5: **45 kg/ha** (40% less than RSR)	S_5: **60 kg/ha**(40% less than RSR)	S_5: **72 kg/ha** (40% less than RSR)

Treatment	**Factor 1. Seed rate** (S_1 to S_5): Five different seed rates in each category as mentioned above **Factor 2. Varieties**: Two varieties of respective group as mentioned above Total No. of treatments: 10
Replications	3
Design	Factorial Randomized Block Design
Plot Size (meter)	5.0 x 2.4
Spacing (cm)	30 (Row to Row), plant to plant spacing to be adjusted according to the seed rate- 8 rows of 5 meter
Total plots	30 (Area- 360 m^2, excluding bunds, channels etc.)

Note:

i. The germination percentage of seed (in lab) used for sowing in field should be recorded and communicated along with the report. It will enable us to compare the germination percentage in laboratory with the field emergence percentage.
ii. Apply FYM @5 t/ ha, 10 to 15 days prior to sowing supplemented with 20:40:20:20 kg/ha N:P:K:S dose, respectively based on soil test or State Recommended Dose of Fertilizer.
iii. Seed treatment with Thiram + Bavistin (2:1) @ 3 g/kg of seed before sowing.
iv. 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.

Observations to be recorded

- Location details of experimental plot (including GPS coordinates), along with photographs - **Mandatory, report will not be accepted in case the GPS photographs are missing.**
- Seed Germination (%) - **before sowing**
- Field emergence (%) - **30 DAS**
- Plant stand establishment/m^2 - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
- Plant height at 30 DAS and at harvest (cm)
- Days to 50% flowering
- Days to pod formation
- No. of pods/plant
- Seed yield per plant (g) - **5 plants/ replication**
- Seed yield per plot (kg) – **Plot size needs to be mentioned**
- Seed yield (q/ha)
- 100 seed weight (g)
- Raw and Graded seed yield (q/ha)
- Seed quality parameters: Seed germination, Vigor indices, Pure live seed [(Physical Purity % X Germination %) /100] and Seed health (% infection in blotter method)
- Net monetary returns (Rs.) and Benefit Cost ratio

Expected Output: The optimized seed rate for different seed size groups in chickpea

Table 3.1: Effect of differential seed rates on plant growth and seed yield attributes in Chickpea

Treatments	Location details (including GPS coordinates)	Seed germination (%) (Before sowing)	Field emergence (%)	Plant stand establishment/ m^2	Days to 50% flowering	Days to pod formation	Plant height (cm)		No. of pods/ plant	Seed yield/ plant (g)	Seed yield /plot (kg)	Seed yield (q/ha)
							30 DAS	Harvest				
Seed rate (S)												
S_1												
S_2												
S_3												
S_4												
S_5												
Mean												
SEm±												
CD												
CV (%)												
Varieties (V)												
V_1												
V_2												
Mean												
SEm±												
CD												
CV (%)												
Interaction (S × V)												
S_1V_1												
S_1V_2												
S_2V_1												
S_2V_2												
S_3V_1												
S_3V_2												
S_4V_1												
S_4V_2												
S_5V_1												
S_5V_2												
Mean												
SEm±												
CD												
CV (%)												

Table 3.2: Effect of differential seed rates on seed quality and economic indicators in Chickpea

Treatments	Raw and Graded seed yield (q/ha)	Test weight 100 seeds (g)	Seed quality			Pure live seed	Seed health (% infection in blotter)	Net monetary returns (Rs.)	Benefit Cost ratio
			Germination (%)	Vigor Index I	Vigor Index II				
Seed rate (S)									
S_1									
S_2									
S_3									
S_4									
S_5									
Mean									
SEm±									
CD									
CV(%)									
Varieties (V)									
V_1									
V_2									
Mean									
SEm±									
CD									
CV(%)									
Interaction (S × V)									
S_1V_1									
S_1V_2									
S_2V_1									
S_2V_2									
S_3V_1									
S_3V_2									
S_4V_1									
S_4V_2									
S_5V_1									
S_5V_2									
Mean									
SEm±									
CD									
CV (%)									

Groundnut		
Treatment details		
Small seeded (100 seed weight: < 35g)	Medium seeded (100 seed weight: 35-60g)	Large seeded (100 seed weight: > 60g)

S_1: 100 kg/ha (Recommended Seed rate/ RSR) - Control	**S_1: 150 kg/ha** (Recommended Seed rate/ RSR) - Control	**S_1: 180 kg/ha** (Recommended Seed rate/ RSR) - Control
S_2: 90 kg/ha (10% less than RSR)	**S_2: 135 kg/ha** (10% less than RSR)	**S_2: 162 kg/ha** (10% less than RSR)
S_3: 80 kg/ha (20% less than RSR)	**S_3: 120 kg/ha** (20% less than RSR)	**S_3: 144 kg/ha** (20% less than RSR)
S_4: 70 kg/ha (30% less than RSR)	**S_4: 105 kg/ha** (30% less than RSR)	**S_4: 126 kg/ha** (30% less than RSR)
S_5: 60 kg/ha (40% less than RSR)	**S_5: 90 kg/ha** (40% less than RSR)	**S_5: 108 kg/ha** (40% less than RSR)

Treatments	**Factor 1. Seed rate** (S_1 to S_5): Five different seed rates in each category as mentioned above **Factor 2. Varieties**: Two varieties of respective group as mentioned above Total No. of treatments: 10
Replications	3
Design	Factorial Randomized Block Design
Plot Size (meter)	5.0 x 2.4 (For small and medium seeded varieties) 5.0 x 2.7 (For large seeded varieties)
Spacing (cm)	• 30 cm (Row to row in case of small and medium seeded varieties) - 8 rows of 5 m • 45 cm (Row to row in case of large seeded varieties) - 6 rows of 5 meter Plant to plant spacing to be adjusted according to the seed rate.
Total plots	30 (Total area - 360 m^2 in case of small and medium seeded varieties and 405 m^2 in case of large seeded varieties, excluding bunds, channels etc.)
Season	**Kharif**

Note:

i. Germination percentage of seed sown should be recorded (in laboratory) at the time of sowing and communicate along with the report. It will enable us to compare the germination percentage in laboratory with the field emergence percentage.
ii. Apply FYM 10 - 12 t/ ha, 10 to 15 days prior to sowing, supplemented with 20:60:30 kg/ha N:P:K dose (RDF), respectively and 25 kg/ha of Zinc Sulphate based on soil test or State Recommended Dose of Fertilizer.
iii. Seed treatment with Thiram + Bavistin (2:1) @3g/kg of seed before sowing.
iv. Weeding, inter culture, irrigation, plant protection etc. can be followed as per the standard package of practice for raising a healthy seed crop.

Observations to be recorded

- Location details of experimental plot (including GPS coordinates), along with photographs - **Mandatory, report will not be accepted in case the GPS photographs are missing**
- Seed Germination (%) - **before sowing**
- Field emergence (%) - **30 DAS**
- Plant stand establishment/m^2 - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
- Plant height at 30 DAS and at harvest (cm)
- Days to 50% flowering
- Days to pod formation
- No. of pods/plant
- Seed yield per plant (g) - **5 plants/ replication**
- Seed yield per plot (kg) – **Plot size needs to be mentioned**
- Seed yield (q/ha)
- 100 seed weight (g)

- Raw and Graded seed yield (q/ha)
- Seed quality parameters: Seed germination, Vigor indices, Pure live seed [(Physical Purity % X Germination %) /100] and Seed health (% infection in blotter method)
- Net monetary returns (Rs.) and Benefit Cost ratio

Expected Output: The optimized seed rate for different seed size groups in groundnut

Table 3.3: Effect of differential seed rates on plant growth and seed yield attributes in Groundnut

Treatments	Location details (including GPS coordinates)	Seed germination (%) (Before sowing)	Field emergence (%)	Plant stand Establishment/ m^2	Days to 50% flowering	Days to pod formation	Plant height (cm)		No. of pods/ plant	Seed yield/ plant (g)	Seed yield /plot (kg)	Seed yield (q/ha)
							30 DAS	Harvest				
Seed rate (S)												
S_1												
S_2												
S_3												
S_4												
S_5												
Mean												
SEm±												
CD												
CV(%)												
			Varieties (V)									
V_1												
V_2												
Mean												
SEm±												
CD												
CV(%)												
Interaction (S × V)												
S_1V_1												
S_1V_2												
S_2V_1												
S_2V_2												
S_3V_1												
S_3V_2												
S_4V_1												
S_4V_2												
S_5V_1												
S_5V_2												
Mean												
SEm±												
CD												
CV(%)												

Table 3.4: Effect of differential seed rates on seed quality and economic indicators in Groundnut

Treatments	Raw and Graded seed yield (q/ha)	Test weight 100 seeds (g)	Seed quality			Pure live seed	Seed health (% infection in blotter method)	Net monetary returns (Rs.)	Benefit Cost ratio
			Germination (%)	Vigor Index I	Vigor Index II				
Seed rate (S)									
S_1									
S_2									
S_3									
S_4									
S_5									
Mean									
SEm±									
CD									
CV (%)									
Varieties (V)									
V_1									
V_2									
Mean									
SEm±									
CD									
CV (%)									
Interaction (S × V)									
S_1V_1									
S_1V_2									
S_2V_1									
S_2V_2									
S_3V_1									
S_3V_2									
S_4V_1									
S_4V_2									
S_5V_1									
S_5V_2									
Mean									
SEm±									
CD									
CV(%)									

Experiment 4: PGPR mediated seed coating for quality seed production

Year of start: 2022-23

Objective: To study the effect of seed coating with PGPR formulations on seed yield and quality

Crops	Centers
Maize (4)	ICAR-IARI, New Delhi; TNAU, Coimbatore; PJTSAU, Hyderabad; and RPCAU, Bihar
Soybean (4)	ICAR-IARI, New Delhi; MPKV Rahuri; UAS, Bengaluru and JNKVV, Jabalpur
Chickpea (4)	ICAR-IARI, New Delhi; MPKV, Rahuri; PDKV, Akola; and RARI, Durgapura

MAIZE	
No. of treatments	6
No. of replications	4
Design	RBD (Randomized Block Design)
Plot Size (m)	5.0 x 3.0 (15 m^2)
Spacing (cm)	75 x 25
Total plots	24 (Area - 360m^2)
Sowing: Direct seed sowing@20kg seed/ha; Spacing of 75x 25cm; prepare ridges at 75cm spacing	

Seed requirement

100 seed wt.- 33g (approx.)

1 plot - 4 rows, 5m each i.e. 25 plants per row and 4x 25 plants/plot i.e.100 plants/plot. We need to sow at least 30 seeds/ row (assuming 80% field emergence)

Hence, seed requirement/ plot (one replication/ treatment) = 4 x 30 = 120 seeds (40g)Total seed requirement for each treatment (three replications) = 40g x 3 =120g seed

Note:

1. Apply FYM 10 t/ha, 10-15 days prior to sowing, supplemented with 165:75:75 kg/ ha N: P: K dose, respectively based on soil test or State Recommended Dose of Fertilizer
2. Apply Zinc Sulphate@25kg/ha
3. Full doses of P, K and Zn should be applied as basal. Nitrogen is split applied at four dosages as:

S. No.	Crop Stage	Nitrogen (%)
1.	**Basal (before sowing)**	**20**
2.	**V4 (four leaf stage)**	**25**
3.	**V8 (eight leaf stage)**	**30**
4.	**VT (tasseling stage)**	**25**

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

Seed Treatments:

- T_1: Recommended practice (Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg seed and 100% RDF)
- T_2: Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg seed (75%N + Full dose of P, K)
- T_3: BF1-4 Cyanobacterium consortium (75% N + Full dose of P, K)
- T_4: Thiram @ 3 g/kg seed + Gaucho @ 10 ml/kg in combination with BF1-4 Cyanobacterium consortium (75% N + Full dose of P, K)
- T_5: *Anabaena* sp. + *Providencia* sp (75% N + Full dose of P, K)
- T_6: *Anabaena* sp. + *Providencia* sp in combination with Thiram @3g/kg seed + Gaucho@10 ml/ kg seed (75% N + Full dose of P, K)

Fertilizer requirements:

Fertilizer nutrient	Dose (kg/ha)	Fertilizer requirement (per ha)	Dose for one plot of 10m²	Fertilizer requirement with 100% RDF for one plot of 15 m²(g)	Fertilizer requirement with 75% N for one plot of 15m²(g)
N	165	358.7 kg Urea (165 kg N)	358.7 g Urea (165g N)	538g Urea	405g Urea
P	75	468.75 kg SSP (75 kg P)	468.75 g SSP (75 g P)	703g SSP	703g SSP
K	75	125 kg MOP (75 kg K)	125 g MOP (75 g K)	187.5g MOP	187.5g MOP
$ZnSO_4$	25	25 kg $ZnSO_4$ (21 kg Zinc)	25 g $ZnSO_4$ (21 g Zinc)	37.5g $ZnSO_4$	37.5g ZnSO4

Treatments	Treatment details	Fertilizer through soil application for one plot of 15 m²
T_1	Recommended practice (Thiram@ 3 g/kg seed + Gaucho @ 10 ml/kg seed and 100% RDF) - **Control**	538g Urea + 703g SSP + 187.5g MOP + 37.5g $ZnSO_4$ (100% RDF)
T_2	Thiram@3g/kg seed + Gaucho @ 10 ml/kg seed (75%N + Full dose of P, K)	405g Urea + 703g SSP + 187.5g MOP + 37.5 g $ZnSO_4$ (75% N)
T_3	BF1-4 Cyanobacterium consortium (75%N + Full dose of P, K)	405g Urea + 703g SSP + 187.5g MOP + 37.5 g $ZnSO_4$ (75% N)
T_4	Thiram @ 3g/kg seed + Gaucho @ 10 ml/kg in combination with BF1-4 Cyanobacterium consortium (75% N + Full dose of P, K)	405g Urea + 703g SSP+ 187.5g MOP + 37.5g $ZnSO_4$ (75% N)
T_5	*Anabaena* sp. + *Providencia* sp (75% N + Full dose of P, K)	405g Urea + 703g SSP + 187.5g MOP + 37.5g $ZnSO_4$ (75% N)

T_6	*Anabaena* sp. + *Providencia* sp in combination with Thiram@3g/kg seed + Gaucho@10ml/kg seed (75% N + Full dose of P, K)	405g Urea +703g SSP + 187.5g MOP + 37.5g $ZnSO_4$ (75% N)

Note: 100% RDF means application of 100% NPK and Zn. Urea: 46%N; SSP: 16% P and 11% S; MOP: 60% K; $ZnSO_4$: 21%Zn

Observations to be recorded:

- **Location details of experimental plot (including GPS coordinates), along with photographs - Mandatory, report will not be accepted in case the GPS photographs are missing**
- Seed Germination (%) - **before sowing (to be conducted by the centre supplying seed)**
- Field emergence (%) - **30 DAS**
- Plant stand establishment/m^2 - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
- Plant height at 30 days and at harvest (cm)
- Leaf chlorophyll - **30 DAS and full bloom stage (SPAD value)**
- Days to first flowering and 50 % flowering
- Seed yield/ plant (g) - **5 plants/ replication**
- Seed yield/ plot - **plot size needs to be mentioned**
- Seed yield (q/ha)
- 100 seed weight (g)
- Raw and Graded seed yield (q/ha)
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Vigour Index - I = Germination percent x Average seedling length of 10 seedlings (cm)
- Vigour Index - II = Germination percent x Average dry weight of 10 seedlings (mg)
- Net monetary returns (Rs.) and Benefit Cost ratio (Annexure I)

Soybean	
Variety	**JS 20-116**
No. of treatments	**6**
Replications	**4**
Design	**RBD (Randomized Block Design)**
Plot Size (m)	**5.0 x 2.7**
Spacing (cm)	**45 x 5**
Total plots	**24 (Area - 324 m^2)**
Sowing: Direct sowing @ 70 kg seed/ha, Direct sowing; depth of sowing: 4-5cm	

Seed requirement
100 seed wt.-10g (approx.)
1 plot - 6 rows, 5m each i.e.,100 plants/row and 6 x100 plants/plot i.e., 600 plants/plot
We need to sow at least 200 seeds/ row
Hence, seed requirement for one replication = 6 x 200 = 1200 seeds (120g)
Total seed requirement for four replications = 1200 x 4 seeds (480g seed for each treatment)

Note:

i. Apply FYM @ 5 t/ ha, 10 to 15 days prior to sowing supplemented with 20:60:20 kg/ha N: P: K:S dose, respectively based on soil test or State Recommended Dose of Fertilizer
ii. Apply Zinc Sulphate @ 25 kg/ ha
iii. 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.

Seed Treatments:

- T_1: Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with Rhizobium and 100% RDF) - Control
- T_2: Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with Rhizobium and 75% N + Full dose of P, K)
- T_3: *Anabaena Rh* (75% N + Full dose of P, K)
- T_4: *Anabaena Rh* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K)
- T_5: BF1-4 Cyanobacterium consortium (75% N + Full dose of P, K)
- T_6: BF1-4 Cyanobacterium consortium in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K)

Fertilizer requirements:

Fertilizer nutrient	Dose (kg/ha)	Fertilizer requirement (per ha)	Dose for one plot of 10m^2 (g)	Fertilizer requirement with 100% RDF for one plot of 11.25 m^2 (g)	Fertilizer requirement with 75% N for one plot of 11.25 m^2 (g)
N	20-25	50 kg Urea (23 kg N)	50	56.25g Urea	42.5g Urea
P	60	375 kg SSP (60 kg P)	375	422g SSP	422g SSP
K	35-40	62.5 kg MOP (37.5 kg K)	62.5	70.5g MOP	70.5g MOP
$ZnSO_4$	25	25 kg $ZnSO_4$ (21% Zinc)	25	28.2g $ZnSO_4$	28.2g $ZnSO_4$

Treatments	Treatment details	Fertilizer through soil application for one plot of 10 m^2
T_1	Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium* and RDF) - Control	56.25g Urea+ 422g SSP + 70.5g MOP + 28.2g $ZnSO_4$ (100% RDF)
T_2	Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium* and 75% N + Full dose of P, K*)*	42.5 g Urea+ 422g SSP + 70.5g MOP + 28.2g $ZnSO_4$ (75% N)
T_3	*Anabaena Rh* (75% N + Full dose of P, K)	42.5g Urea+ 422g SSP + 70.5g MOP + 28.2g $ZnSO_4$ (100% RDF)
T_4	*Anabaena R*h in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K)	42.5g Urea+ 422g SSP + 70.5g MOP + 28.2g $ZnSO_4$ (75% N)
T_5	BF1-4 Cyanobacterium consortium (75% N + Full dose of P, K)	42.5g Urea+ 42 SSP + 70.5 g MOP + 28.2g $ZnSO_4$ (100% RDF)
T_6	BF1-4 Cyanobacterium consortium in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K)	42.5g Urea+ 422g SSP + 70.5 g MOP + 28.2g $ZnSO_4$ (75% N)

Note: 100 % RDF means application of 100% NPK and Zn. Urea: 46% N; SSP: 16% P and 11% S; MOP: 60% P; $ZnSO_4$: 21% Zn

Observations to be recorded:

- Location details of experimental plot (including GPS coordinates) along with photographs- **Mandatory, report will not be accepted in case GPS photographs are missing**
- Soil nutrient analysis (pre and post experiment)/ Tissue analysis: Soil chlorophyll, SOC, seed proteins, pH, EC, bulk density, organic C, CN ratio, Available N, P, K etc.
- Seed Germination (%) - before sowing **(to be conducted by the centre supplying seed)**
- Field emergence (%) - **30 DAS**
- Plant stand establishment/m^2 area - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
- Plant height at 30 DAS and at harvest (cm)
- Leaf chlorophyll - F**irst bloom stage and budding stage (SPAD value)**
- Number of nodules/ effective nodules per plant (DAS) - **30 DAS after sowing**
- Days to first flowering and 50% flowering
- Days to pod formation
- Acetylene reduction assay (ARA) - **Determination of biological nitrogen fixation in the nodules**
- No. of pods/plant
- Seed yield/ plant (g) - **5 plants/ replication**

- Seed yield/ plot - **plot size needs to be mentioned**
- Seed yield (q/ha)
- 100 seed weight(g)
- Raw and Graded seed yield (q/ha)
- Seed quality parameters: Seed germination, Vigour indices and Seed health
- Vigour Index - I = Germination percent x Average seedling length of 10 seedlings (cm)
- Vigour Index - II = Germination percent x Average dry weight of 10 seedlings (mg)
- Net monetary returns (Rs.) and Benefit Cost ratio (Annexure I)

CHICKPEA	
No. of treatments	**6**
Replications	**4**
Design	**RBD (Randomized Block Design)**
Plot Size (m)	**5.0 x 1.8**
Spacing (cm)	**30 x 10**
Total plots	**32 (Area- 288 m^2)**
Sowing: Direct sowing @ 60-80 kg seed / ha, Direct sowing; depth of sowing: 6-8 cm	
Seed requirement 100 seed wt.- 25 g (approx.) 1 plot - 6 rows, 5 m each i.e., 50 plants/ row and 6x50 plants/ plot i.e., 300 plants/ plot. We need to sow at least 100 seeds/ row Hence, seed requirement for one replication = 6 x 200 = 600 seeds (150g) Total seed requirement for four replications = 150 x 4 seeds (600g seed for each treatment)	
Note: i. Apply FYM @5 t/ ha, 10 to 15 days prior to sowing supplemented with 20:40:20kg/ha N: P: K, respectively based on soil test or State Recommended Dose of Fertilizer. ii. Apply Zinc Sulphate@25 kg/ ha iii. 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. iv. Chickpea is generally grown as a rainfed crop, but two irrigations, one each at branching and pod filling stages, are recommended for higher yield.	

Seed Treatments:

i. T_1: Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium* and 100% RDF) - **Control**
ii. T_2: Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium and* 75% N + Full dose of P, K)
iii. T_3: *Anabaena Rh* (75% N + Full dose of P, K)

iv. T_4: Anabaena Rh in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K)
v. T_5: BF1-4 Cyanobacterium consortium (75% N + Full dose of P, K)
vi. T_6: BF1-4 Cyanobacterium consortium in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K)

Fertilizer requirements:

Fertilizer nutrient	Dose (kg/ha)	Fertilizer requirement (per ha)	Dose for one plot of 10m^2(g)	Fertilizer requirement with 100% N for one plot of 9.0m^2 (g)	Fertilizer requirement with 75% N for one plot of 9.0 m^2(g)
N	18-20	100 kg DAP (18 kg N)	100	90 g DAP	68 g DAP
P	40-45	100 kg DAP (46 kg P)	100	90 g DAP	68 g DAP + 80 g SSP
K	20	33.5 kg MOP (20 kg K)	33.5	30.25 g MOP	30.25 g MOP
$ZnSO_4$	25	25 kg $ZnSO_4$ (21% Zinc)	25	22.5g $ZnSO_4$	22.5g $ZnSO_4$

Treatments	Treatment details	Fertilizer through soil application for one plot of 10 m^2
T_1	Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium* and RDF) - Control	90 g DAP + 30.25 g MOP + 22.5g ZnSO4 (100% RDF)
T_2	T_2: Recommended practice (Thiram + Bavistin (2:1) @3g/kg in combination with *Rhizobium* and75% N + Full dose of P, K)	68 g DAP + 80 g SSP + 30.25 g MOP + 22.5g ZnSO4 (75% N)
T_3	*Anabaena Rh* (75% N + Full dose of P, K)	68 g DAP + 80 g SSP + 30.25 g MOP + 22.5g ZnSO4 (75% N)
T_4	*Anabaena Rh* in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K)	68 g DAP + 80 g SSP + 30.25 g MOP + 22.5g ZnSO4 (75% N)
T_5	BF1-4 Cyanobacterium consortium (75% N + Full dose of P, K)	68 g DAP + 80 g SSP + 30.25 g MOP + 22.5g ZnSO4 (75% N)
T_6	BF1-4 Cyanobacterium consortium in combination with Thiram + Bavistin (2:1) @3g/kg (75% N + Full dose of P, K)	68 g DAP + 80 g SSP + 30.25 g MOP + 22.5g ZnSO4 (75% N)

Note: 100% RDF means application of 100% NPK along with 100% Zn^{DAP}: 18% N + 46 % P; SSP: 16% P; MOP: 60% P; $ZnSO_4$: 21% Zn

Observations to be recorded:

- Location details of experimental plot (including GPS coordinates) along with photographs **- Mandatory, report will not be accepted in case GPS photographs are missing**
- Soil nutrient analysis (pre and post experiment)/ Tissue analysis: Soil chlorophyll, SOC, seed proteins, pH, EC, bulk density, organic C, CN ratio, Available N, P, K etc.
- Seed Germination (%) - before sowing **(to be conducted by the centre supplying seed)**
- Field emergence (%) - **30 DAS**
- Plant stand establishment/m^2 area - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
- Plant height at 30 DAS and at harvest (cm)
- Leaf chlorophyll - F**irst bloom stage and budding stage (SPAD value)**
- Number of nodules/ effective nodules per plant (DAS) - **30 DAS after sowing**
- Days to first flowering and 50% flowering
- Days to pod formation
- Acetylene reduction assay (ARA) - Determination of biological nitrogen fixation in the nodules
- No. of pods/plant
- Seed yield/ plant (g) - **5 plants/ replication**
- Seed yield/ plot - **plot size needs to be mentioned**
- Seed yield (q/ha)
- 100 seed weight(g)
- Raw and Graded seed yield (q/ha)
- Seed quality parameters: Seed germination, Vigour indices and Seed health (% infection in blotter method) Vigour Index - I = Germination percent x Average seedling length of 10 seedlings (cm) Vigour Index - II = Germination percent x Average dry weight of 10 seedlings (mg)
- Net monetary returns (Rs.)
- Benefit Cost ratio (Annexure I)

Expected output: Identification of suitable PGPR strains for seed quality enhancement, which canfacilitate adoption of organic seed production practices.

Table 4.1: Effect of PGPR seed coating on plant growth and seed yield attributes in Maize

Treatments	Location details	Soil nutrient analysis	Seed germin	Field	Plant stand	Plant height at(cm)	Leaf Chlorophyll	Days to first	Days to 50%	No. of

	(Including GPS coordinates)	Pre	Post	ation (%) (before sowing	emergence (%)	Establishment/ m^2	30 DAS	Harvest	content (30 DAS and full bloom stage) (SPAD value)	flowering	floweri ng	cobs / plant
T_1												
T_2												
T_3												
T_4												
T_5												
T_6												
Mean												
SEm±												
CD(p=0.05)												
CV (%)												

Table 4.2: Effect of PGPR seed coating on seed quality parameters and economic indicators in maize

Treatments	Seed yield		Seed yield (q/ha)	Raw and Graded seed yield (q/ha)	Test weight 100 seeds (g)	Seed quality			Seed health (% Infection)	Net monetary returns (Rs.)	Benefit Cost ratio
	plant (g)	plot (kg)				Germination (%)	Vigor index I	Vigor index II			
T_1											
T_2											
T_3											
T_4											
T_5											
T_6											
Mean											
SEm±											
CD(p=0.05)											
CV(%)											

Table 4.3: Effect of PGPR seed coating on plant growth and seed yield attributes in soybean

Treatments	Location details (Including GPS coordinates)	Soil nutrient analysis		Seed germination (%) (before sowing	Field emergence (%)	Plant stand Establishment/ m^2	Plant Height (cm) at		Number of nodules/ effective nodules per plant	Acetylene reduction assay (ARA)	Leaf Chlorophyll content (SPAD value)	Days to Flowering	
		Pre	Post				30 DAS	Harvest				First	50%

T_1													
T_2													
T_3													
T_4													
T_5													
T_6													
Mean													
SEm±													
CD (p=0.05)													
CV (%)													

Table 4.4: Effect of PGPR seed coating on seed quality parameters and economic indicators in soybean

Treatments	No. of pods / plan t	Seed yield		Seed yield (q/ha)	Raw and Graded seed yield (q/ha)	Test weight 100 seeds (g)	Seed quality			Seed health (% infecti on)	Net monetary returns (Rs.)	Benefit Cost ratio
		plant (g)	plot (kg)				Germination (%)	Vigor index I	Vigor index II			
T_1												
T_2												
T_3												
T_4												
T_5												
T_6												
Mean												
SEm±												
CD(p=0.05)												
CV (%)												

Table 4.5: Effect of PGPR seed coating on plant growth and seed yield attributes in chickpea

Treatments	Location details (Including GPS coordinates)	Soil nutrient analysis		Seed germination (%) (before sowing	Field emergence (%)	Plant stand Establishment/m^2	Plant Height (cm) at		Number of nodules/ effective nodules plant	Acetylene reduction assay (ARA)	Leaf Chlorophyll content (SPAD value)	Days to Flowering	
		Pre	Post				30 DAS	Harvest				First	50%
T_1													
T_2													
T_3													
T_4													
T_5													

T_6													
Mean													
SEm±													
CD(p=0.05)													
CV (%)													

Table 4.6: Effect of PGPR seed coating on seed quality parameters and economic indicators in chickpea

Treatments	No. of pods/plant	Seed yield		Seed yield (q/ha)	Raw and Graded seed yield (q/ha)	Test weight 100 seeds (g)	Seed quality			Seed health (% infection)	Net monetary returns (Rs.)	Benefit Cost ratio
		lant (g)	plot (kg)				Germination (%)	Vigor index I	Vigor index II			
T_1												
T_2												
T_3												
T_4												
T_5												
T_6												
Mean												
SEm±												
CD(p=0.05)												
CV (%)												

Experiment 5: Evaluation of liquid bio-fertilizers in enhancing seed yield and quality

Rationale: Liquid biofertilizers consists of living microorganisms that enhance soil properties and increase plant growth and yield. Liquid biofertilizers have been used in different crops and out yield chemical or carrier-based fertilizers in terms of plant growth. However, more research is required to overcome the limitations for better climate adaptation, longer shelf life, better liquid inoculants etc.

Objective: To evaluate the effectiveness of liquid biofertilizers on seed yield and quality

Crops	Centres	Cultivars selected
Soybean (7)	VNMKV, Parbhani	JS 20-116
	JNKVV, Jabalpur	JS 20-98
	ICAR-IISS, RS, Bengaluru	JS-335
	GBPUAT, Pantnagar	PS 1225
	MPKV, Rahuri	Phule Durva
	PAU, Ludhiana	NRCSL1

	UAS, Bangalore	JS-20-116
Chickpea (4)	CSAUAT, Kanpur	KGD 1168
	GBPUAT, Pantnagar	Pant Gram 5
	PAU, Ludhiana	PBG10
	MPKV, Rahuri	Phule Vikrant
Wheat (5)	VNMKV, Parbhani	Trimbak
	JNKVV, Jabalpur	JW 33-36
	CSAUAT, Kanpur	K 1317
	NDUAT, Faizabad	DBW222, HD2967
	OUAT, Bhubaneswar	KW 101

Expected outcome: Identification of the suitable liquid biofertilizer on the basis of crop, seasonand soil type across the country and promotion of organic seed production

S. No.	Soybean	Chickpea	Wheat
T_1	Control (No spray)	Control (No spray)	Control (No spray)
T_2	State Recommended package of fertilisers		
T_3	Jawahar EM culture @ 20ml/kg seed	Jawahar EM culture @ 20ml/kg seed	Jawahar EM culture @ 20 ml/ kg seed
T_4	Jawahar PSB @ 20 ml/kg seed	Jawahar PSB @ 20 ml/kg seed	Jawahar PSB @ 20 ml/kg seed
T_5	Jawahar KSB @ 20 ml/kg seed	Jawahar KSB @ 20 ml/kg seed	Jawahar KSB @ 20ml/kg seed
T_6	Jawahar *Azospirillum* @ 20 ml/kg seed	Jawahar *Azospirillum* @ 20 ml/kg seed	Jawahar *Azospirillum*@ 20 ml/kg seed
T_7	Jawahar *Pseudomonas* @ 20 ml/kg seed	Jawahar *Pseudomonas* @ 20 ml/kg seed	Jawahar *Pseudomonas* @ 20 ml/ kg seed
T_8	Jawahar Rhizobium culture @ 20 ml/kg seed	Jawahar Rhizobium culture @ 20 ml/kg seed	-
T_9	-	Jawahar Trichoderma culture @ 20 ml per kg seed	-

Observations to be recorded (Soybean/ Chickpea):

- Location details of experimental plot (including GPS coordinates) along with photographs **- Mandatory, report will not be accepted in case the GPS photographs are missing**
- Soil nutrient analysis (pre and post experiment)/ Tissue analysis: Soil chlorophyll, SOC, seed proteins, pH, EC, bulk density, organic C, CN ratio, Available N, P, K etc.
- Seed Germination (%) - before sowing **(to be conducted by the centre supplying seed)**
- Field emergence (%) - **30 DAS**

- Plant stand establishment/m^2 area - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
- Plant height at 30 DAS and at harvest (cm)
- Leaf chlorophyll - F**irst bloom stage and budding stage (SPAD value)**
- Number of nodules/ effective nodules per plant (DAS) - **30 DAS after sowing**
- Days to first flowering and 50% flowering
- Days to pod formation
- Acetylene reduction assay (ARA) - Determination of biological nitrogen fixation in the nodules
- No. of pods/plant
- Seed yield/ plant (g) - **5 plants/ replication**
- Seed yield/ plot **- plot size needs to be mentioned**
- Seed yield (q/ha)
- 100 seed weight(g)
- Raw and Graded seed yield (q/ha)
- Seed quality parameters: Seed germination, Vigour indices and Seed health (% infection in blotter method)

  Vigour Index - I = Germination percent x Average seedling length of 10 seedlings (cm)

  Vigour Index - II = Germination percent x Average dry weight of 10 seedlings (mg)

- Net monetary returns (Rs.)
- Benefit Cost ratio (Annexure I)

Observations to be recorded (Wheat):

- Location details of experimental plot (including GPS coordinates) along with photographs **- Mandatory, report will not be accepted in case the GPS photographs are missing**
- Soil nutrient analysis (pre and post experiment)/ Tissue analysis: Soil chlorophyll, SOC, seed proteins, pH, EC, bulk density, organic C, CN ratio, Available N, P, K etc.
- Seed Germination (%) - before sowing **(to be conducted by the centre supplying seed)**
- Field emergence (%) - **30 DAS**
- Plant stand establishment/m^2 area - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
- Plant height at 30 DAS and at harvest (cm)
- Leaf chlorophyll - **First bloom stage and budding stage (SPAD value)**
- Days to first flowering and 50% flowering

- Days to tiller formation
- No. of tillers/plant
- Seed yield per plant (g) -5 hills / replication
- Seed yield per plot (kg)- **plot size needs to be mentioned**
- Seed yield (q /ha) - whole plot basis
- 1000 seed weight (g)
- Raw and Graded seed yield (q/ha)
- Seed quality parameters: Seed germination, Vigour indices and Seed health (% infection in blotter method)

  Vigour Index - I = Germination percent x Average seedling length of 10 seedlings (cm)

  Vigour Index - II = Germination percent x Average dry weight of 10 seedlings (mg)

- Net monetary returns (Rs.)
- Benefit Cost ratio (Annexure I)

Table 5.1: Effect of liquid bio-fertilizers on plant growth and seed yield attributes in soybean

Treatments	Location details (Including GPS coordinates)	Soil nutrient analysis		Field emergence (%)	Plant stand establishment/m^2	Number of nodules/ effective nodules per plant	Acetylene reduction assay (ARA)	Leaf Chlorophyll content (SPAD value)	Plant height at(cm)		No. of pods / plant
		Pre	Post						30 DAS	Harvest	
T_1											
T_2											
T_3											
T_4											
T_5											
T_6											
T_7											
T_8											
Mean											
SEm±											
CD (p=0.05)											
CV (%)											

Table 5.2: Effect of liquid bio-fertilizers on seed quality parameters and economic indicators in soybean

Treatments	Seed yield		Seed yield (q/ha)	Raw and Graded seed	Test weight 100 seeds	Seed quality			Seed health (%	Net monetary returns (Rs.)	Benefit Cost ratio
	plant (g)	plot (kg)				Germination (%)	Vigor index I	Vigor index II			

				yield (q/ha)	(g)				infecti on)		
T_1											
T_2											
T_3											
T_4											
T_5											
T_6											
T_7											
T_8											
Mean											
SEm±											
CD(p=0.05)											
CV (%)											

Table 5.3: Effect of liquid bio-fertilizers on plant growth and seed yield attributes in chickpea

Treatments	Location details (Including GPS coordinates)	Soil nutrient analysis		Field emergence (%)	Plant stand establishment/m^2	Days to		Leaf Chlorophyll content (SPAD value)	Plant height at(cm)		No. of tillers / plant
		Pre	Post			First Flowering	50% Flowering		30 DAS	Harvest	
T_1											
T_2											
T_3											
T_4											
T_5											
T_6											
T_7											
Mean											
SEm±											
CD (p=0.05)											
CV (%)											

Table 5.4: Evaluation of liquid bio-fertilizers on seed quality parameters and economic indicators in chickpea

Treatments	Seed yield		Seed yield (q/ha)	Raw and Graded seed yield (q/ha)	Test weight 1000 seeds (g)	Seed quality			Seed health (% infecti on)	Net monetary returns (Rs.)	Benefit Cost ratio
	plant (g)	plot (kg)				Germin ation (%)	Vigor index I	Vigor index II			
T_1											
T_2											

T_3										
T_4										
T_5										
T_6										
T_7										
Mean										
SEm±										
CD(p=0.05)										
CV (%)										

Table 5.5: Effect of liquid bio-fertilizers on plant growth and seed yield attributes in Wheat

Treatments	Location details (Including GPS coordinates)	Soil nutrient analysis		Field emergence (%)	Plant stand establishment/m^2	Number of nodules/ effective nodules per plant	Acetylene reduction assay (ARA)	Leaf Chlorophyll content (SPAD value)	Plant height at(cm)		No. of pods / plant
		Pre	post						30 DAS	Harvest	
T_1											
T_2											
T_3											
T_4											
T_5											
T_6											
T_7											
T_8											
T_9											
Mean											
SEm±											
CD (p=0.05)											
CV (%)											

Table 5.6: Effect of liquid bio-fertilizers on seed quality parameters and economic indicators in Wheat

Treatments	Seed yield		Seed yield (q/ha)	Raw and Graded seed yield (q/ha)	Test weight 1000 seeds (g)	Seed quality			Seed health (% infection)	Net monetary returns (Rs.)	Benefit Cost ratio
	plant (g)	plot (kg)				Germination (%)	Vigor index I	Vigor index II			
T_1											
T_2											
T_3											
T_4											

T_5										
T_6										
T_7										
T_8										
T_9										
Mean										
SEm±										
CD(p=0.05)										
CV(%)										

Experiment 6: Enhancing seed yield and quality in off season soybean through applicationof plant growth regulators

Rationale: Generally, the time of planting varies depending on the climatic conditions of the region and the variety to be grown; early or late planting reduces crop yield significantly. Besides,many seed lots may fail to meet the requisite germination standards due to the heavy rains duringharvesting, resulting in severe shortage of quality seeds for planting in the next season. In such situations, contingency seed production is very much essential, especially in the off-season. Hence,there is a need to identify the suitable planting time for promoting quality seed production duringthe off-season.

Crop	**Centers**
Soybean (8)	PJTSAU, Hyderabad; UAS, Dharwad; VNMKV, Parbhani; UAS, Bengaluru; JNKVV, Jabalpur; MPKV, Rahuri, PDKV, Akola and UAS, Raichur

The best planting window period for the off-season sowing of soybean was identified in the previous Seed Production and Certification experiments which is given below:

S. No.	**Place**	**Variety**	**Best planting window for off-season cultivation of soybean**
1.	PJTSAU, Hyderabad	ASB-50	3rd to 4th week of September
2.	UAS, Dharwad	DH-256	1st to 4th week of November
3.	VNMKV, Parbhani	MAUS-725	1st to 4th week of November
4.	UAS, Bengaluru	JS-335	1st week of December
5.	JNKVV, Jabalpur	JS 20-98	3rd to 4th week of December

6.	MPKV, Rahuri	Phule Durva and Phule Sangam	3rd week of January
7.	PDKV, Akola	PDKV Amba and Suvarna Soya	-NA-
8.	UAS, Raichur	JS 335	-NA-

Plant growth regulator treatments

- **T1**- Control
- **T2**-Salicylic Acid @ 400ppm
- **T3**- Salicylic Acid @ 400ppm
- **T4**-Thiourea@400ppm
- **T5**-Thiourea@800 ppm
- **T6**- NAA@400ppm
- **T7**- NAA@800ppm

Spray Schedule

S1- Flowering stage

S2- Vegetative stage

S3- Both Flowering and vegetative stage

Observations to be recorded:

- Location details of experimental plot (including GPS coordinates) along with photographs - **Mandatory, report will not be accepted in case GPS photographs are missing**
- Soil nutrient analysis (pre and post experiment)/ Tissue analysis: Soil chlorophyll, SOC, seed proteins, pH, EC, bulk density, organic C, CN ratio, Available N, P, K etc.
- Seed Germination (%) - before sowing
- Field emergence (%) - **30 DAS**
- Plant stand establishment/m^2 area - **Number of plants emerging in 1 m^2 area to be recorded at 30 DAS**
- Plant height at 30 DAS and at harvest (cm)
- Leaf chlorophyll - F**irst bloom stage and budding stage (SPAD value)**
- Number of nodules/ effective nodules per plant (DAS) - **30 DAS after sowing**
- Days to first flowering and 50% flowering

- Days to pod formation
- Acetylene reduction assay (ARA) - Determination of biological nitrogen fixation in the nodules
- No. of pods/plant
- Seed yield/ plant (g) - **5 plants/ replication**
- Seed yield/ plot - **plot size needs to be mentioned**
- Seed yield (q/ha)
- 100 seed weight(g)
- Raw and Graded seed yield (q/ha)
- Seed quality parameters: Seed germination, Vigour indices and Seed health (% infection in blotter method)

  Vigour Index - I = Germination percent x Average seedling length of 10 seedlings (cm)

  Vigour Index - II = Germination percent x Average dry weight of 10 seedlings (mg)
- Net monetary returns (Rs.) and Benefit Cost ratio (Annexure I)

Table 6.1: Effect of Plant growth regulators seed yield attributes in off season soybean

Treatments	Location details (Including GPS coordinates)	Soil nutrient analysis		Seed germination (%) (before sowing	Field emergence (%)	Plant stand Establishment/m^2	Number of nodules/ effective nodules per plant	Acetylene reduction assay (ARA)	Leaf Chlorophyll content (SPAD value)	Plant height at(cm)		No. of pods / plant
		Pre	Post							30 DAS	Harvest	
PGR Treatment (T)												
T_1												
T_2												
T_3												
T_4												
T_5												
T_6												
T_7												
Mean												
SEm±												
CD(p=0.05)												
CV (%)												
Spray Schedule (S)												
S_1												
S_2												
S_3												
Interactions (TxS)												
T_1S_1												

T_1S_2												
T_1S_3												
T_2S_1												
T_2S_2												
T_2S_3												
T_3S_1												
T_3S_2												
T_3S_3												
T_4S_1												
T_4S_2												
T_4S_3												
T_5S_1												
T_5S_2												
T_5S_3												
T_6S_1												
T_6S_2												
T_6S_3												
T_7S_1												
T_7S_2												
T_7S_3												
Mean												
SEm±												
CD(p=0.05)												
CV (%)												

Table 6.2: Effect of Plant growth regulators on seed quality parameters and economic indicators in off season soybean

Treatments	Seed yield		Seed yield (q/ha)	Raw and Grade seed yield (q/ha)	Test weight 100 seeds (g)	Seed quality			Seed health (% infection)	Net monetary returns (Rs.)	Benefit Cost ratio
	plant (g)	plot (kg)				Germination (%)	Vigor index I	Vigor index II			
PGR Treatment (T)											
T1											
T_2											
T3											
T4											
T5											
T6											
T7											
Mean											
SEm±											

CD(p=0.05)										
CV (%)										
Spray Schedule (S)										
S_1										
S_2										
S_3										
Interactions (TxS)										
T_1S_1										
T_1S_2										
T_1S_3										
T_2S_1										
T_2S_2										
T_2S_3										
T_3S_1										
T_3S_2										
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T_5S_1										
T_5S_2										
T_5S_3										
T_6S_1										
T_6S_2										
T_6S_3										
T_7S_1										
T_7S_2										
T_7S_3										
Mean										
SEm±										
CD(p=0.05)										
CV (%)										

Annexure I

Performa for Calculating Expenditure, Income and BC Ratio for STR Experiments

S. No.	Particulars	Amount (Rs./ha)
A	**Expenditure / Cost**	
1	Recurring cost of imposing the treatment (T1, T2, T3….Tn) (materialistic cost only *i.e.* chemicals, packaging materials, otherphysical inputs etc.)	
2	Additional labour cost on imposing treatments	
3	Salary component (as per man-days spent for imposing treatments)	

4	Miscellaneous cost	
	Sub total	
5	Interest on working capital (@ 12% per annum for total above, adjusted accordingly as per duration of experiment)	
	Total Expenditure / cost (A)	
B	**Gross income by imposing the treatment**	
1	Seed yield in particular treatment (q/ha)	
2	Price / sale value of seed (Rs./q)	
	Gross Income by imposing the treatment (B)	
C	**Gross income in control (T0)**	
1	Seed yield in control (q/ha)	
2	Price / sale value of seed (Rs./q)	
	Gross Income in control (C)	
D	**Increase in Gross income by imposing the treatment (B - C)**	
E	**Increase in Net income by imposing the treatment (D - A)**	
F	**BC ratio for imposing the treatment (D/A)**	

Note:

1. The above information needs to be calculated for individual/every treatment
2. Expenditure, income etc. may be calculated on per quintal basis for storage experiment

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B. Seed Physiology, Storage, and Testing

Date: 24.04.2024 & 02.05.2024

Chairman	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Convener	:	**Dr. Shiv Kumar Yadav** Principal Investigator/Principal Scientist, ICAR-IARI, New Delhi
Co-Convener	:	**Dr. Udaya Bhaskar K.** Co-Principal Investigator/Sr. Scientist ICAR-Indian Institute of Seed Science Regional Station, Bengaluru

The Technical Programme of 'Seed Physiology, Storage & Testing' for the year 2024-25 has been formulated based on the deliberations of the findings of the experiments and suggestions made during the pre-workshop meeting held on 24.04.2024 and technical sessions of the 39th AGM of AICRP on Seed (Crops) held during May 2-3, 2024 at UAS, Bengaluru. The experiment-wise recommendations finalized out of the results of six experiments conducted in 'Seed Physiology, Storage and Testing' component of STR during 2023-2024 are given below;

Recommendations

Experiment 1: To reaffirm the validity periods of certified seeds for field crops according to IMSCS regulations, cooperating centers have determined the validity period for castor crops. This period has been established as 11 months from the date of the initial test, based on the average results across cooperating centers, excluding outliers. In contrast, for millet crops, the experiment is ongoing, as 2023-24 marks the first year of initiation of the experiment.

Experiment 2: Hybrid purity testing using molecular markers in public-sector hybrids of field crops. The molecular markers referenced below have been validated and can serve as supplementary tools to support GOT in these hybrids. They are particularly useful for in-house testing to ensure genetic purity.

Crop	Hybrid	Recommended Markers for Hybridity Testing
Castor	ICH-66	mRcDOR-07
Maize	PMH-10	Umc 1627; Umc 1786, PHI080, Bnlg1297
	PMH-1	Umc 2069, Umc 2170, Bnlg 1036, Bnlg1297
	MAH-14-5	Umc 1288, Umc 1594, Bnlg 1185
Paddy	JRH-19	RM 228

Pearl millet	Phule Adishakti	PSMP2089
Sunflower	KBSH 41	ORS 513, ORS 613,
	KBSH 44	ORS 716
	KBSH 53	ORS 621, ORS 811

Experiment 3: Physiological studies and the development of priming technologies aimed at enhancing the planting value of seeds in field crops under both optimal and sub-optimal conditions have been adeptly validated and demonstrated. The treatments proposed for recommendation as technologies are listed below.

Crop	**Treatments**
Chickpea	✓ Coating on hydro-primed seeds (6h @ 20^{O}C) with BioNPK + Drought Alleviating Bacteria (50 ml of formulation in 500 ml water + sugar or sucrose @ 10% for half acre) ✓ Coating with T. harzianum (CFU – 2 X 10^{6}per gm) @ 15g/kg seed
Pigeon pea	✓ Hydro-primed seeds for 10h @ 25^{O}C
Field pea	✓ Coating on hydro-primed (10 hrs. at 20^{0}C) seeds with biogrow ✓ Coating on hydro-primed (10 hrs. at 20^{0}C) seeds with DAB + Biogrow

Regarding the validation of priming technologies in delineated crops, the following standardized treatments will proceed in designated centres in the technical programme for the year 2024-25.

Crop	**Treatments to be validated**
Barley	• Pre-chilling for 7 days at 5°C • Thermopriming for 6 hours at 35°C • Hydropriming for 6 h using a 1:1 ratio • Priming with 10 ppm Ethrel at 25°C
Oats	• GA_3 @600ppm • Seed halo-priming with $CaCl_2$ @1.5% for 24 h • Thermo priming treatment of 40^{o}C for 36 h • Hydropriming for 24 h at 20°C • Priming with 200 ppm GA_3 • Hydro priming followed by pre-chilling treatment for 7 days @ 4^{0}C
Pearl millet	• Halopriming with 0.5% NaCl for 12h • 1.0% KNO_3 for 12h • Hydropriming for 8hr • Biopriming with *T. viride*
Sunflower	• Hydropriming for 10h • Biopriming with *T. viride* • Thermopriming at 35°C for 6 h

	• Hydropriming at a 1:1 ratio for 16 h • Hydropriming for 24 h at 20°C • Hydropriming at a 1:1 seed-to-solution ratio for 8 h • Thermopriming at 40°C for 12 h • Prechilling treatment at 7°C for 7 days

The following treatments will proceed in designated centres regarding demonstrations of validated priming technologies in delineated crops in the technical programme for the year 2024-25.

Crop	**Demonstration of validated priming technologies**
Maize (LT Stress)	• Hydropriming (30h @ 25^{O}C) followed by dry dressing with *Trichoderma harzianum* (@15 g/kg seed) • Seed coating on hydro-primed seeds with cold adaptive PGPB • Seed priming with GA_3 followed by DAB + Biophos
Paddy (Organic)	• Organic Trichojal @5ml/kg seed
	• Organic Metajal @ 5ml /kg seed
Paddy (LT Stress)	• Seed coating with cold adaptive PGPB

Experiment 4: Demonstrations of the technologies mentioned below in the delineated crops have been proposed in the technical programme for the year 2024-25.

Crop	**Treatment to be demonstrated**
Chickpea	Spraying Cycocel @ 1000 ppm at the vegetative stage followed by the anthesis stage
Finger millet	• Salicylic acid 800 ppm at vegetative and anthesis stages • Salicylic acid 400ppm at vegetative and anthesis stages • Thiourea @ 400 ppm at vegetative stage • KCl 1% at vegetative and anthesis stages

Regarding the objective, standardization of the treatments for mitigating the adverse effects of heat stress in soybean, is proposed to be shifted to the Seed Production and Certification component.

Experiment 5: Cataloguing of weed seed images with passport information on seed characteristics for identification is in progress with delineated cooperating centres in the technical programme for the year 2024-25.

Experiment 6: Experimentation, which began in 2023-24, will continue this year as well. The storability of biofortified varieties has been reported to be on par with check varieties at designated cooperating centers. However, for quality mustard varieties, a decline in seed

quality parameters was observed and is currently being validated for further confirmation in this endeavour.

Technical Programme of 2024-25

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 stands in farmers' fields by supplying quality seeds with achievable germinability from producers. Under current law, certification tags issued to seed lots are valid for 9 months from the date of the first test and can be revalidated for an additional 6 months, provided they maintain viability at or above IMSCS standards on the test date. This regulation has caused practical issues for those involved in seed trade as well as for end-users. Therefore, it is necessary to assess the germinability period of various crops at different locations to determine how long they can actually maintain viability at or above IMSCS standards, along with their vigour status during varying storage periods. The findings of this experiment are expected to provide scientific evidence that could inform a revision of the validity periods, if necessary.

Objective: To study the planting values of seeds to examine the prescribed periods of validity of seed lots of field crops (initiated in millets: 2023-24).

Crops	**Centres**
Pearl millet#	CCSHAU, Hisar; JAU, Junagadh and MPKV, Rahuri
Sorghum#	PDKV, Akola; TNAU, Coimbatore; VNMKV, Parbhani; and ICAR-IIMR, Hyderabad
Finger millet#	UAS, Dharwad; UAS, Bengaluru; OUAT, Bhubaneswar; BSKKV, Dapoli and PJTSAU, Hyderabad
Barnyard millet#	JNKVV, Jabalpur; UAS, Raichur; MPKV, Rahuri and RPCAU, Pusa Centre
Foxtail millet#	UAS, Raichur; SKNAU, Jobner and JNKVV, Jabalpur
Proso millet (New Crop)	TNAU, Coimbatore; RPCAU, Pusa Centre; *UAS, Dharwad; *UAS, Bengaluru; GBPUAT, Pantnagar; SKNAU, Jobner and SHUATS, Prayagraj
# Expt. To be continued with already supplied seeds ***Also to supply the Seeds to cooperating centres**	

Technical Programme:

Materials:

Seed lots: It is presumed that;

- For all the millet crops except proso millet, the cooperating centres will continue the experimentation and record the observations until germination per cent maintains ≥IMSCS. The centres that get the packed seeds of proso millet in 700-gauge polythene from the identified centre, had to divide a lot of each variety into two equal parts, packed in Cloth or Jute bags (as per crop-specific recommendation) and HDPE bags (all crops) and stored at ambient conditions of respective centres.
- Date of harvesting, Date of first test, Moisture content (%), Germination (%) and validity period (in case of revalidated lots) have been noted as made known to all the cooperating centres by the identified centre* who supplied the seed and or known from where the fresh/revalidated lots were procured, **if not the identified centres kindly ascertain the same to respective cooperating centres.**

Observations to be recorded on seed lots:

The centre will continue to test periodically the stored seed lots and revalidated seed (if germinable ≥IMSCS) lots for;

1. First count (%) and Germination (%) as per ISTA and vigour indices (Abdul Baki and Anderson, 1973) at one-month interval for at least 24 months from the date of harvesting or at least 18 months of storage or till the germination (%) of seed lots comes below the IMSCS.
2. The moisture content (MC) may be taken at three months interval.
3. The seed lots will also be tested for field emergence and final plant stand establishment just before the normal sowing time of respective crops (i.e., once a year at crop-specific centres). The final plant stand establishment will be recorded/ taken after six weeks of sowing for cotton and all cereal crops, whereas it will be 3-4 weeks after sowing of groundnut and pulses. OR
4. If the germination (%) has fallen or is expected to fall below IMSCS in the subsequent months if it is a month other than the normal sowing month, then seedling emergence in trays/pots must be tested immediately when the last time the seed lot(s) met the standard germination. As per IMSCS, 2013, the minimum germination percentage is 75% in delineated millet crops.

Kindly note the following for recording the observations and reporting;

1. In this experiment, the storage period is the most important factor that should always be considered an independent variable (germination will be the dependent variable) when analysing the data.
2. Observations will be recorded on a minimum of four replications of 100 seeds each, except SMC, which will be estimated on a dry weight basis as per ISTA recommendations.

3. When calculating vigour indices, the average/mean length in centimetres and wet/dry weight in grams of 10 randomly selected seedlings on the day of the 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. Many centres don't have cold seed storage facilities, and such amenities are largely lacking in the seed trade. Hence, the experiment was designed to study storability under ambient conditions. Please be sure that you have kept the seed lots in a safe, cool/shaded, and dry place.
6. The climate data, fortnightly mean minimum and maximum temperature (^{0}C) and RH %, from the start of storage until the termination of the experiment should be furnished and must be used to explain the results for the period of storage at respective participating centres.
7. This experiment must be reported with an explanation of the concluding table after writing the results for each crop by every cooperating centre as given below.

Observations that MUST be reported are germination (%) as per ISTA, Moisture content (%) as per ISTA, and fortnightly mean minimum and maximum temperature (^{0}C) and RH %.

Format of the table for providing the concluding information of experiment 1

Name of your Centre		
Name of the 1st Crop allotted		
Name of the varieties supplied & used for storage studies	NameofVar.1	NameofVar.2
Month of harvest, if available		
Date of first test (MUST)		
Germination (%) Status at the time of First test(MUST)		
Max. Number of months for which the variety-maintained germination above IMSCS in Jute/Cloth Bag		
Max. Number of months for which the variety-maintained germination above IMSCS in HDPE Bag		

Numberofdaysforwhichthetemperatureremained≥35°Cduring storage	
NumberofdaysforwhichtheRHremained≥70%duringstorage	
Please add a similar table to provide details of the second crop, if allotted.	

Max. numbers of months to be calculated from the FIRST TEST date.

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

Year of Start: 2011- 2012

Rationale: Traditionally, genetic purity testing is conducted through Grow-out Tests (GOT) based on morphological assays, which are time-consuming, labor-intensive, and space-demanding. Despite these drawbacks, GOT remains the most commonly used and internationally accepted method for genetic purity testing. However, the application of molecular marker analysis technology has shown significant potential in cultivar identification and hybrid purity testing of crops. Detecting loci in parental inbred lines and their corresponding F_1 hybrids is a crucial step in the genetic purity testing of hybrids (F_1). Molecular markers tightly linked to important agricultural traits can greatly facilitate hybrid purity testing. SSR markers, in particular, offer advantages such as co-dominant inheritance, easy scoring of alleles, reproducibility, and accessibility to laboratories. Therefore, this experiment was designed to identify hybrid-specific SSR markers and validate them to determine hybrid purity.

Objectives:

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

Crops	**Centres (*Centre/s to supply seeds and Protocol only)**
#1 Identification of microsatellite markers for establishing hybridity in additional/new hybrids	
Paddy	JNKVV, Jabalpur; RPCAU, Pusa Centre and ICAR-IISS, RS Bengaluru
Maize	UAS, Bengaluru; PAU, Ludhiana and PJTSAU, Hyderabad
Pearl Millet	CCS HAU, Hisar and AAU, Anand
2 & 3 To validate the identified markers for establishing hybridity in different hybrids of various field crops & assess the efficiency of molecular markers in comparison with GOT	
Maize	ICAR-IISS, Mau; AAU, Jorhat and PJTSAU, Hyderabad (*SKUAST, Srinagar; PAU, Ludhiana and *UAS, Bengaluru)
Sunflower	JNKVV, Jabalpur; TNAU, Coimbatore and KAU, Pattambi (*UAS, Bengaluru)
Cotton	TNAU, Coimbatore and ICAR-IISS, RS, Bengaluru (*PDKV Akola)

Castor	JNKVV, Jabalpur; MPKV, Rahuri and NAU, Navsari (*ICAR-IIOR, Hyderabad)
Sorghum	PAJANCOA & RI, Karaikal; MPKV, Rahuri and VNMKV, Parbhani (*ICAR-IIMR, Hyderabad)
*The Centres to provide seeds of hybrids, parental lines and/or the protocols.	

Details of the hybrids mentioned below proceed for validation with identified SSR markers

Crops	**Names of Hybrids**
Maize	PMH 13 & PMH 14 SMH-3 (KDM-125 and KDM-116) SMH-5 (BML-6 and IML-187) Palam Sankar Makka-2 HEMA
Sunflower	KBSH-78 KBSH-79
Cotton	PDKV Suvarna PKV DH-1
Castor	DCH 519 (M 574 and DCS 78)
Sorghum	AKSH-644 (AKMS- 30A & AKR-524) AKSH-727 (AKMS- 30A & AKR-545)

The centers shall try identifying the markers to test the genetic purity for newly developed hybrids in any of the crops mentioned above by their institute/university.

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

Technical Programme:

Materials:

The details of identified markers, protocols followed and seeds of hybrids with parental lines shall be shared among the centres as indicated above. The cooperating 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 the public domain will be used as standard

profiles. Also, 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 PDKV, Akola (Contact person: Dr. A.A. Akhare, 9881880083; atulakhare@yahoo.com) for cotton; by ICAR-IIMR, Hyderabad (Contact person: Dr. Sooganna, 9540331656; sooganna@millets.res.in) for Sorghum; by ICAR-IIOR, Hyderabad (Contact person: Dr. J. Jawarharlal, 9160451473; spac.iior@icar.gov.in) for Castor; SKUAST, Srinagar (Contact person: Dr Aflaq Hamid, 7889617904; falak19@gmail.com) UAS, Bengaluru (Contact person: Dr. Nethra Nagarajappa, 9900244735; nethraharsha@gmail.com); PAU, Ludhiana (Contact person: Dr. Navjyot Grewal, 9915151165; navjyot_grewal@yahoo.com)for Maize; UAS, Bengaluru (Contact person: Dr. Nethra Nagarajappa, 9900244735; nethraharsha@gmail.com) for Sunflower. In addition to seeds of newly released hybrids and their parental lines from cooperating 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, to identify unique molecular markers.

Methodology:

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

1. Genomic DNA extraction by CTAB/modified CTAB method (Taylor et al., 1995; Liu et al., 2003) or Kit method.
2. Quantification of DNA and assessment of DNA quality for each sample on 1.2% agarose gel.
3. PCR analysis using unique markers (e.g., Paddy-Nandakumar et al., 2004; Sundaram et al., 2008; Maize-Mingsheng et al., 2010; Pearl millet-Nagawade et al., 2016; Sunflower-Antonova et al., 2006; Pallavi et al., 2011; and Cotton-Dongre et al., 2011). The protocols may need further standardization for detection of mixtures or off-types using the serial dilution of DNA as template DNA for PCR-based detection.
4. The results of molecular marker analysis will be compared with the Grow-Out Test: Size of working sample for GOT; The minimum population required for taking the observations shall be 400 plants when minimum genetic purity of 99% is required; however, it will also depend on the maximum permissible off-type plants prescribed for the species under consideration in the Indian Minimum Seed Certification Standards. The number of seeds required to raise the crop to obtain the required number of plants shall depend on the seed sample's germination percentage; hence, the seed rate should be adjusted accordingly. Grow-out tests shall be conducted in specified areas recommended for the hybrid or in off-season nurseries. The standard sample of a hybrid (control) is 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, emphasising the period from flowering to ripening. All plants must be examined, keeping in view the distinguishing characters described for the hybrid, both in the test crop and 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 and off-type plants found should be recorded. Calculation and interpretation of the results: The percentage of other cultivars, species, or aberrants 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. If 99, 95, 90, and 85% purity, respectively, is targeted, the reject numbers will be 8, 24, 44, and 64 for a sample size of 400 plants.

5. For validation studies, two-dimensional DNA sampling strategies may be adopted for purity assay, as 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.
6. Every centre must work out the cost-effectiveness (C: B ratio) for GOT vis-à-vis molecular markers, taking all cost components into account, and MUST include this information in the report.

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 is a pre-sowing treatment that induces a physiological state, allowing seeds to germinate more efficiently under optimal conditions and enhancing emergence even under adverse agro-climatic conditions. Priming involves soaking seeds in predetermined amounts of water, hormone solutions, osmotic agents, and salts, followed by drying them back to their initial moisture content. Additionally, physical treatments such as heat, cold, and UV exposure can also improve germination and serve as seed enhancement strategies. Primed seeds are expected to exhibit faster, more vigorous, and synchronized germination, particularly under stress conditions. A deeper understanding of the metabolic events during priming and subsequent germination will help optimize the use of this simple and cost-effective technology. Any positively tested technology should be validated across different locations before recommending it for up-scaling. Therefore, this experiment was designed with the following objectives;

Objectives:

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

1. Standardization of priming technologies (New Crops)	
Crops	**Centres**
Sorghum	OUAT, Bhubaneswar; TNAU, Coimbatore; VNMKV, Parbhani and SHUATS, Prayagraj
Soybean	GBPUAT, Pantnagar; MPKV, Rahuri; JNKVV, Jabalpur and PDKV, Akola
Wheat	CCS HAU, Hisar; CSKHPKV, Palampur; PAU, Ludhiana; RPCAU Pusa; ICAR-IISS, Mau; SKNAU, Jobner and SHUATS, Prayagraj
2. Validation of standardized priming technologies for low-temperature stress (LTS) / Organic condition	
Barley	ICAR-IISS, Mau; JNKVV, Jabalpur and PAU, Ludhiana
Oat	OUAT, Bhubaneswar; CSKHPKV, Palampur; JNKVV, Jabalpur and RPCAU Pusa Center
Pearl millet	PDKV, Akola; JAU, Junagadh and CCSHAU, Hisar
Sunflower	UAS, Raichur; PJTSAU, Hyderabad and UAS, Bangalore
3. Demonstration of validated priming technologies to be repeated in a minimum of 500sqm for validated treatment along with control/s in the specified stress conditions	
Maize (LTS)	SKUAST, Kashmir, Srinagar
Paddy (LTS)	SKUAST, Kashmir, Srinagar
Paddy (Org. Co.)	GBPUAT, Pantnagar; PAJANCOA&RI, Karaikal and AAU, Jorhat

Note: Every centre MUST work out the cost-effectiveness (B/C ratio) for the best treatment (significantly better than others) and any other that is at par with the best, if any (i.e. maximum two treatments) in comparison with control in validation experiment and of validated treatment in comparison with control and in demonstration experiment taking all components of cost into account for all crops and to be reported.

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

Year of start: 2024-25 (for new crops)

Technical programme:

Materials:

Each centre will use four location-specific seed lots, i.e., **the fresh and one-year-old seed (within the acceptable limits of germination) of each of the two most popular varieties (preferably one tolerant and other susceptible to the sub-optimal condition of their locality) will be taken**, as germinability and other vigour parameters of high quality (Fresh) seeds may not significantly be improved by seed priming technologies. In case of non-availability of aged seeds of the same variety, the fresh seeds will be aged by giving recommended accelerated ageing treatments for creating the other (old) lot(s).

Treatment details for standardization:

It is important to first know and/or identify the stress you would like to address in the target crop/s at your centre and decide the treatments accordingly. Therefore, all the treatments listed are NEITHER to be tried in every crop NOR for all the stress conditions. The soaking (in water or solutions or carriers) of seeds of Sunflower, Barley, Pearl millet, and Oat is to be done at fixed temperatures: 25°C, 20°C, 30°C and 20°C, respectively. For standardization of priming technologies for enhanced planting value of seed under sub-optimal conditions in field crops, treatment/s as decided for each crop and stress will be standardized in comparison with 2 controls: 1.) Control (Untreated) and 2.) Control (Crop and location-specific recommended seed treatment(s) as per package of practices);

Hydropriming: soaking in pure water without allowing emergence and re-drying to original moisture content (for moisture/ drought stress). Standardization for soaking duration and amount of water will be done.

Matri-conditioning (Solid matrix priming: SMP): Seeds are mixed and incubated with a wet solid water carrier for a certain period and subsequently separated from the matrix, rinsed, and dried back (for moisture/ drought stress). Standardization for solid water carrier, amount of water to be added to carrier and duration of soaking will be done.

Osmopriming: Soaking seeds in osmotic solution (polyethylene glycol (PEG) - 6000) with low water potential instead of pure water without allowing emergence and re-drying to original moisture content (for moisture/ drought stress). Standardization for concentration of osmotic solution, amount of osmotic solution and duration of soaking will be done.

Halopriming: soaking seeds in various salt solutions (to decrease saline intolerance). Standardization for concentration of salt solution, amount of salt solution and duration of soaking will be done.

Thermopriming/Heat treatment: exposing seeds to temperature not exceeding 45°C, with free air circulation (to increase heat tolerance and kill pathogens). Standardization for temperature and duration of exposure will be done.

Pre-chilling: Keeping the imbibed seeds at a temperature of 5 to 10°C for a period of 5 to 7 days. Standardization for temperature and duration of exposure will be done.

Hormopriming: Seed imbibition occurs in the presence of plant growth regulators (PGR), which have a direct impact on seed metabolism and can be used to mitigate any type of stress.

Standardization will be done for the concentration of the PGR solution, the amount of PGR solution, and the duration of soaking.

Biopriming involves seed imbibition together with bacterial inoculation (specifically for biotic stress). Standardization of the concentration/dose of inoculants and duration of soaking will be done.

NB: The initial moisture content of the seeds MUST be recorded, and the treated seeds shall have to be dried back to the original moisture content. Under normal/standard (ISTA recommended) growing/testing (no stress) conditions, the control (untreated seeds) could be significantly better over stress-treated seeds. Therefore, adept care is to be taken during the conduct of the experiment and reporting of results. The treated and dried seeds, along with the seeds of both the controls, MUST be evaluated for seed quality parameters under standard (ISTA recommended) conditions as well as the targeted stress conditions. The treatment combination giving significantly better values of quality parameters ONLY under stress conditions will be taken as standardized treatment.

Methodology

A. Hydropriming – All the centres shall standardize the duration of soaking and optimal amount of water in which seeds be soaked for hydropriming. It is important to record initial moisture content, where you also have the weights (g) of seeds in all treatment combinations before start of soaking.

1. The seeds are to be soaked at fixed temperatures as mentioned above for respective crops in different ratios of seed weight (g) to volume (ml) of solution or water (Wt. of seed /Vol. of water; 1:1/2 (or less) to 1:1.5 (or more) for variable durations and then evaluated under standard test conditions to know the best period of soaking and amount of water. Start removing the seeds from all treatment combinations for testing after 3h of soaking and continue removing at an interval of not more than 2 hours. Further soaking MUST be stopped once any signs of radicle emergence are noticed. In the last 2-hour interval (lag) where the instances of radicle emergence were observed, the time interval for optimal soaking (priming) was further adjusted (fine-tuned). Soak the fresh seeds separately and keep them for the total period before observing the radicle emergence. after that, start removing seeds for testing at an interval of not more than 1/2 hour (Total time before the last lag + 30min, one hour, one and half hour).
2. The seeds removed from water/solutions for drying can still be found absorbing water if not wiped properly and or put on germination paper/s with water. It can be observed based on gain in weight and or volume or sometimes we can hear some cracking sound. After completing each soaking interval, we need to remove the seeds from the water (all priming combinations) and wipe them all thoroughly with filter paper. Spread them uniformly on a roll of towel paper for 5 minutes and transfer them to dry on the other layer of two rolls of towel paper. This MUST be done to ensure that seeds are not gaining weight/

absorbing water after the period for which they were to be primed/the optimal soaking time and amount of water.

3. The seeds MUST be dried back to initial moisture (air-drying in the shade (~25°C for a minimum of 48h) or in a drying cabinet at 35 ± 1°C). Drying under a fan must be done in the shade by spreading seeds uniformly and individually on germination/ roll towel papers. Drying the treated seeds till initial moisture levels can be ascertained by weighing the dried seeds should match the initial weight (g) of seeds in all treatment combinations taken before the start of soaking. After drying, seeds are subjected to estimate quality attributes as per ISTA. In this case, soaking (priming) stress treatment was given and can also give good results under any other stress (salt/heat) situations.
4. An apt analysis of evaluation/testing data of dried seeds from all treatment combinations will identify the best combination (Interaction) of duration (Factor 1) and amount of water (Factor 2).

B. Other priming/seed quality enhancement (SQE) treatments –The period, temperature and drying specified above may be the same for all other (Halo/Osmo/SMP etc.) priming treatments except for making solutions of different concentrations. Moreover, the soaked and dried seeds (from all combinations) are to be evaluated under standard test (Control) conditions as well as under target stress condition/s (all treatment combinations) to find out the best combination at maximum stress. Various priming/pre-sowing seed treatments are related with tolerance to various stresses by modulating hormone homeostasis together with alterations of ion uptake and accumulation between shoots and roots, e.g. seeds primed with ascorbic acid, salicylic acid, GA_3 and kinetin with salt tolerance; exogenously supplied phytohormones with salinity stress; polyamines-priming and spermidine pre-treatment with drought tolerance etc. have been reported in various crops. The broad procedure for conduct of various priming/seed quality enhancement (SQE) treatments have been mentioned below;

i. Osmopriming –The polyethylene glycol (PEG), mannitol, sorbitol and glycerol etc. compounds can be used to prepare solutions of required osmotic potential. Polyethylene glycol (PEG) is a polymer of ethylene oxide with a molecular weight of less than 50,000. PEG has the following structure: -(CH2-CH2-O)n-. The large molecular size of PEG prevents its penetration into the seed, thus avoiding the induction of potential cytotoxic effect and reduction of osmotic potential within the seed. PEG can also be effectively used in the pot-culture experiment. Plants can be grown in pot culture by following normal cultural practices till the desired stage. Then PEG solution can be used to irrigate the soil. Consider the soil moisture for applying the desired level of PEG, as soil moisture will dilute the PEG solution applied. Regularly monitor the soil moisture content through the volumetric method and soil water potential through the tensiometric method. The most commonly used PEG -6000 shall ONLY be used for standardization with and testing in PEG solutions of various concentrations as given table below;

Table: Osmotic potential of PEG - 6000 at 25^{0}C (Michael & Kaufmann, 1973)

*PEG 6000 (g/kg)	Osmotic potential		PEG 6000 (g/kg)	Osmotic potential	
	Bars	MPa		Bars	MPa
50	-0.5	-0.05	250	-7.3	-0.73
100	-1.5	-0.15	300	-10.3	-1.03
150	-3.0	-0.30	350	-13.7	-1.37
200	-4.9	-0.49	400	-17.6	-1.76

NB: These relationships can vary depending on the source of the specific PEG used.

***Precautions:** Do not use different lots of PEG in one experiment and MUST measure the final solution's osmotic potential. It is also worth noting that the values of water potential, together with the duration of the priming treatment, should always need to be adjusted to species, cultivars, and even seed lots.

For emergence studies, the drought/moisture stress could be created by calculating and thus controlling the water supply in trays/pots/field so as to maintain the moisture content ≥ 20% to ≤ 40%. For moisture stress studies in laboratory, soaking seeds in PEG 6000 solutions of desired levels of osmotic potential (ψ) at 25^{o}C and testing them in solution/s prepared by adding required quantifies of PEG 6000 for desired levels of (ψ) water availability to be used; e.g. soaking in water stress equivalent to Permanent Wilting Point (-1.5MPa), available water equivalent to 75% of Field Capacity (-0.39MPa), available water equivalent to50% of Field Capacity (-0.76MPa) available water equivalent to 25% of Field Capacity (- 1.15MPa) and drying.

Imposition of moisture stress

Both soil and plant water status need to be quantified at desired intervals during the entire experimental period using a gravimetric method and tensiometric method (for soil moisture and Relative water content measurement (for plant water status measurement)

1. Fill the tension-meter cup with the water and insert the tension-meter inside the soil up to 30 cm in depth.
2. Tensio-metric soil water potential was measured daily.
3. Install tensiometer in triplicates for each experiment.
3. Periodically refill the cup of the tension-meter.
4. Plant will face extreme stress in case of sandy loam soil at or above 55 Kpa.
5. Schedule irrigation in accordance with the stress levels required and soil moisture availability (as reflected from tension-metric reading)

Gravimetric approach for imposition of moisture stress

Materials: Post or battery containers, garden soil, sand and manure, mobile weighing devices, seed/plant material, rain-out-shelter (ROS) or polythene sheet covered on net house

Procedure:

1. Weight the empty pots and record the accurate weight for each pot (A)
2. Fill the pots with soil: farmyard manure mixture in the ratio of 2:1:1: or 2:1 ratio of soil: farmyard manure mixture. While filling the pots, makes sure that the soil mixture is not compacted
3. Weight the pot along with soil (B) and deduct the empty pot weight to obtain the dry soil weight (C) C=B-A
4. Carefully flood the pot with water (not splashing the soil from the pot). Allow it for overnight to drain excess water and attain field capacity (FC).
5. Take the pot weight after saturation (D) and deduct empty pot weight (A) to get full soil weight (E) at field capacity. E=D-A
6. Subtract the dry soil weight from the full soil weight to get the amount of water required to attain 100% FC (E-C).
7. Sow seeds of the crop under investigation in the pots. Maintain two to four seedlings in each pot and water regularly to maintain the moisture level at desired level of FC viz. 100% FC, 75%% FC, 60% FC etc. Ensure to protect the pots from rains or any other source of water by keeping them under rain out shelter (ROS).
8. At four or six-leaf Stage or at good foliage, impose drought stress by withholding irrigation (please refer the diagrammatic representation given below). Weight the pots at regular intervals to monitor water status at different FCs. Replenish the water every time by adding the required amount of water depending on the loss of water occurred previously and also based on the set FC value. The amount of water to be replenished to maintain the required FC in the containers can be arrived at based on the formula given below.

To maintain 100% FC, X ml of water is required. Therefore, to maintain Y% FC, it is

$$Y\%\ FC = \frac{Y\% \times X \text{ ml of water}}{100\%}$$

For example, the amount of water required to maintain 100% FC= 200ml Therefore, the amount of water required to maintain 80% FC= $\frac{80 \times 200\text{ml}}{100}$=160ml

NB: The pot size relative to plant size is important.

The plants under different treatments are to be grown for a week or longer depending on the crops. During this period, soil water potential (Mpa) and osmotic potential (Mpa) are measured with Dew Point Potentiometer and Osmometer, respectively. Similarly, Relative water content (RWC %) is quantified according to Bars and Weatherly (1962) to assess the tissue water status and Electrical conductivity (EC %) is quantified to assess the stress-induce cell damage.

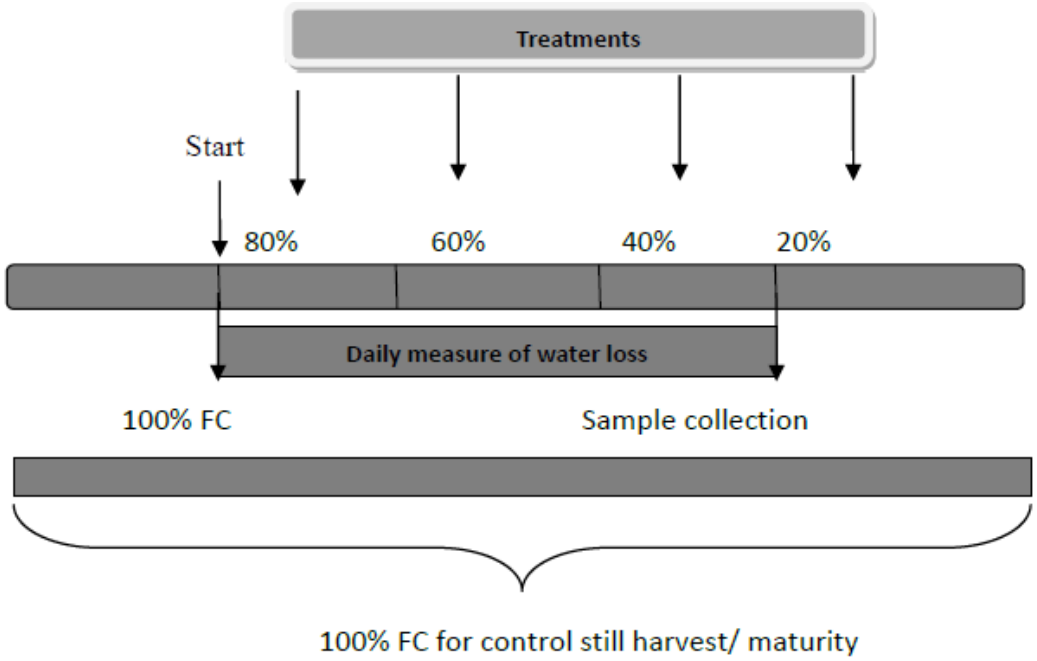


Figure: Diagrammatic representation of gravimetric approach followed for imposing precise levels of moisture stress/drought.

ii. Halopriming– Depending upon the crop, location of centre (soil) and target stress, solutions of different concentrations of the inorganic salts such as $CaCl_2$, NaCl, or KCl, or KNO_3, or K_3PO_4, or KH_2PO_4, or $MgSO_4$, or $ZnSO_4$could be used for priming the seeds. The priming/Osmopriming with any of these salts alone or in combinations with different concentrations needs to be tried. The dried seeds from all treatment combinations along with both the controls shall be tested under standard test conditions as well as under target stress condition/s at would be required for standardization. For example, testing primed seeds in 0.2% of Potassium nitrate (KNO_3) solution: The germination substratum to be moistened with a 0.2 percent solution of KNO_3, prepared by dissolving 2 g KNO_3 in one litre of water. The substratum is saturated at the beginning of the test. After putting 100X4 seeds keep them incubator and use water for moistening it after that, if required.

Preparing the solutions of required Electrical conductivity (EC): Though there are several methods for the preparation of solutions with specified Electrical conductivity (EC). Some suggests the easiest way is to use the relationship: 640mg per liter of either NaCl or $CaCl_2$= 1ds/m. you could also use the molar concentration of either salt to make your calculation, remembering that 10mM of NaCl or $CaCl_2$ =1ds/m. We need to homogenize the water after dissolution of salts and test EC. However, subtract the EC of original water from the EC to be developed to calculate the quantity of salts to be added. Given below are probable quantities of NaCl + $CaCl_2$ salts to be used for preparation of solutions of different ECs.

Table: EC of different salt solutions at 20^0C (1dS/m=1 mmho/cm)

*Solution	EC (dS m^{-1})	Weight(g) of NaCl	+	Weight(g) of CaCl2	EC (dS m^{-1})

10 mM NaCl	1.0	0.59g	+	1.12g	2
100 mM NaCl	9.8	1.17g	+	2.22g	4
500 mM NaCl	42.2	1.75g	+	3.33g	6
10mM KCl	1.2	2.34g	+	4.44g	8
10mM $CaCl_2$	1.8	2.63g	+	4.99g	9
10mM $MgCl_2$	1.6	2.92g	+	5.55g	10
50mM $MgCl_2$	8.1	***Strongly recommended to use trial and error method**			

The trays/pots/fields with >2 to <6dSm conductivity of the saturation extract of soils may be considered good to study the salinity. Prepare salt solution of desired EC using NaCl and $CaCl_2$ for salts stress studies in the laboratory.

Methods of imposing salinity stress

- Conducting experiments in naturally salt affected soils to assess salt tolerance of genotype is more reliable and easier to perform.
- Care should be taken to avoid variation in salinity levels within a field.
- In pot culture experiments, a mixture of NaCl, Na_2SO_4 and $CaCl_2$ in 2:1:1 ratio, resulting in Na: Ca and Cl: SO4in 4:1 ratio should be mixed with the soil or added through nutrient solution.
- The EC of soil solution needs to be measured to quantify the salinity level. Often only NaCl at required concentration (Table above) is used along with nutrient solution to impose salt stress on the plant.

Though there are several methods for the preparation of solutions with specified Electrical conductivity (EC). Some suggests the easiest way is to use the relationship: 640mg per liter of either NaCl or $CaCl_2$= 1ds/m. you could also use the molar concentration of either salt to make your calculation, remembering that 10mM of NaCl or $CaCl_2$ =1ds/m. We need to homogenize the water after dissolution of salts and test EC. However, subtract the EC of original water from the EC to be developed for calculation of the quantity of salts to be added. Given below are probable quantities of NaCl + $CaCl_2$ salts to be used for preparation of solutions of different ECs.

iii. Thermopriming/Heat treatment – Exposure of seeds to different temperatures (30, 35, 40, and 45°C) for different periods (6, 12, 24, 36 and 48 hr) and testing of all treatment combinations and both the controls under standard test conditions as well as under heat stress condition/s (above the standard temperature with an increment of 5°C till 45°C) would be required for standardization. E.g. standard temperature for testing barley germination is 20°C so the testing of all treatment combinations for standardization at higher temperatures would be done at 25°C, 30°C, 35°C, 40°C, and 45°C, whereas for standardization at lower temperatures testing would be done at 15°C, and 20°C.

iv. Pre-chilling –The replicates of seeds shall be placed in contact with the moist substratum and kept at a low temperature for an initial period before they are removed to the standard temperature for germination. Seeds are kept at a temperature between 5°C and 10°C for an initial period of up to seven days. In some cases, it may be necessary to extend the pre-chilling period or to re-chill. The pre-chilling period is not included in the germination test period.
Use germinators set at different temperatures (Say between 15^{o}C to 40^{o}C) or sowing dates to be adjusted (prepone/postpone) as per the prevailing climate (mean temperature of ≤16^{o}C for cold stress and ≥37°C for heat stress) at respective centres for temperature stress studies.

v. Hormopriming – The regulators commonly used for hormopriming are: abscisic acid (ABA), auxins, gibberellins, kinetin, ethylene, polyamines, and salicylic acid (SA). Each of these has specific role in crops and action differs with concentrations. For example; Gibberellic Acid (GA_3) method is recommended for *Avena sativa, Hordeum vulgare, Secale cereale,* and *Triticum aestivum* for seed quality enhancement by breaking the dormancy. Where, the germination substratum may be moistened with a 500-ppm solution of GA_3, prepared by dissolving 500 mg GA_3 in one litre of water. When the dormancy is weaker, 200 ppm may be enough. When it is stronger, up to 1000 ppm solution may be used. Depending upon the required effect the regulator/s and their concentrations need to be tried for standardization.

vi. Biopriming – Application of biopriming agents is very critical. Hydration of seeds infected with pathogens during priming can result in a stronger microbial growth and consequently impair plant health. However, applying antagonistic microorganisms during priming is an ecological approach to overcome this problem. Moreover, some bacteria used as bio control agents are able to colonize rhizosphere and support plant in both direct and indirect way after germination stage. Biopriming could be a much more effective approach to disease management than other techniques such as pelleting and film coating, if devised, designed and tested sensibly. Biopriming with plant growth-promoting bacteria (PGPB), *Pseudomonas fluorescens* isolates, rhizobacteria etc. has been reported to enhance plant growth and resistance. For standardization effect of various biopriming/ bio control agents needs to be evaluated under different stress conditions. For example: seed coating (on hydroprimed seeds and on dry seeds) can be done with T. harzianum (CFU – 2 X 106per g) @ 15 g / kg seed by mixing 15g in 50 ml of water and applied on 1 kg of seed uniformly. Shade drying the seeds for 20 – 30 minutes before testing/sowing; Seed coating (on hydroprimed seeds and on dry seeds) with cold adoptive PGPB and seed coating (on hydroprimed seeds and on dry seeds) can be done with T. viride (CFU – 2 X 109per g) @ 10 g / kg seed by mixing 10g in 50 ml of water and applied on 1 kg of seed uniformly. Shade drying the seeds for 20 – 30 minutes before testing/sowing. CFUs in any of the microbial consortium must be confirmed before treatment. Everyone must follow the guidelines for coating and testing of microbial consortia as supplied by the developer.

vii. Matri-conditioning (Solid matrix priming: SMP) – The basic rule in SMP is to use solid medium that allows seeds to hydrate slowly and simulates natural imbibition process occurring in the soil. The vermiculite, perlite, peat moss, coir or peat, charcoal, sand, clay, and some commercially offered substrate such as Celie or Micro Cell are exemplary solid carries that could be applied in solid matrix priming. However, any materials that possess specific physical and chemical features such as; low matrix potential, minimal water solubility, high water holding capacity and surface area, no toxicity to seeds, and ability to adhere to seed surface can be utilized as matrices. In order to obtain the best priming performance, time of treatment and optimal water content must be determined separately for each matrix. Thus, use of matrices and their combinations to be standardized.

Observations:

Seeds of the all crops after treatments are to be tested along with both the controls under specific stress conditions (Drought/moisture, salinity and temperature) as mentioned above. Effect of the treatments on biotic stress (fungal infections) is also to be recorded. For additional studies, if interested, on biotic (fungal) stress sowing in sick plots and or inoculating with the target fungus can be done. Following observations are to be recorded in all treatment combinations.

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

Sub. Experiment II (Objective 2): Validation of standardized priming technologies for enhancing planting value of seed under optimal and sub-optimal conditions in selected field crops

Crops	**Treatments to be validated**
Barley	1. Pre-chilling for 7 days at 5°C; 2. Thermopriming for 6 h at 35°C 3. Hydropriming for 6 h using a 1:1 ratio 4. Priming with 10 ppm Ethrel at 25°C for 4h
Oats	1. GA_3 @600ppm 2. Seed halo-priming with $CaCl_2$@1.5%for 24 h 3. Thermo priming treatment of 40^o C for 36 h 4. Hydropriming for 24 h at 20°C 5. Priming with 200 ppm gibberellic acid 6. Hydro priming followed by pre-chilling treatment for 7 days @ 4^0C

Pearl millet	1. Halopriming with 0.5% NaCl for 12h 2. 1.0% KNO_3 for 12h 3. Hydropriming for 8h (1:1 ratio) 4. Biopriming with *T. viride*
Sunflower	1. Hydropriming for 10 h 2. Biopriming with *T. viride* 3. Thermopriming at 35°C for 6 h 4. Hydropriming at a 1:1 ratio for 16 h 5. Hydropriming for 24 h at 20°C 6. Thermopriming at 40°C for 12 h 7. Prechilling treatment at 7°C for 7 days

Laboratory observations (before and after treatments):

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

Field observations: To be observed in a minimum of 5 randomly selected plants or panicles/cobs /rep/treatment

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

Following are to be observed only for control and one significantly better treatment and any other treatment at par with it.

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

Sub. Experiment III (Objective 3): Demonstration of validated priming technologies for low-temperature stress during seedling establishment in Maize and Paddy

Crops	**Demonstration of validated priming technologies**
Maize (LT Stress)	Hydropriming (30h @ 25^{O}C) followed by dry dressing with *Trichoderma harzianum* (@15 g/kg seed) Seed coating on hydro-primed seeds with cold adaptive PGPB Seed priming with GA_3 followed by DAB + Biophos
Paddy (Organic)	Organic Trichojal @5ml/kg seed /lit. and
	Organic Metajal @ 5ml /kg seed /lit.
Paddy (LT Stress)	Seed coating with cold adaptive PGPB

Treatments:

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

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

The Coordinating Unit, ICAR-IISS, Mau, will supply microbial consortia (Biophos, Drought-Alleviating Bacteria (DAB), cold-adoptive Plant Growth–Promoting Bacteria (PGPB), etc.) for priming and abiotic stress mitigation, and AAU, Anand, will make available organics, Trichojal, Metajal & Beauverijal for treatment. The methodology for microbial consortia treatments will be followed as mentioned below.

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

1. Dosage for 1/2 acre sowing area: Dilute 50 ml of formulation in 500 ml water. Add sugar or sucrose @ 10%. This quantity is sufficient to treat seeds required ½ acre.
2. Dilute required quantity of specific formulation as per seed requirement of particular plot size @ 1:10 ratio (microbial formulation: water) and add sugar or sucrose @ 10 % of final volume.
3. The bacterial suspension is then sprinkled on the seeds and the seeds are slowly but thoroughly mixed to have a uniform coating. Leave it for 30 minutes
4. Then the seeds are spread uniformly for drying on a gunny bag or cement floor in shade for 30-45 minutes avoiding direct sunlight.
5. In case of direct seeded paddy, the seeds may be treated while in transplanted paddy, root dip treatment should also be given.

Laboratory observations (before and after treatments):

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

Field observations:

1. Final plant stand establishment (%) after 5 weeks - (Observations to be taken on seedlings/plants in control as well as treatment plots at randomly selected 4 places in 5-meter row lengths)
2. Plant height (cm) of 5 plants each at randomly selected 4 places in plots.
3. Total number of pods/plants in 5 plants each at randomly selected 4 places in plots.
4. Total number of seeds/pods in 5 pods/plant each at randomly selected 4 places in plots.
5. Per plant yield in 5 plants 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 - MUST

Experiment 4: Influence of terminal heat stress on seed set, seed yield and quality in field crops

Year of start: 2017-18

Rationale: Climate change is rapidly altering weather patterns, which can disrupt food availability, reduce access to food, and affect food quality. Heat stress, characterized by high temperatures, will be the primary abiotic constraint under current and future climate change scenarios. Although heat impacts productivity at all stages of crop growth, the damage is particularly severe during the reproductive phase, especially the seed filling stage. This can lead to significant yield losses and reduced seed quality by decreasing seed size and number, ultimately affecting the commercial trait of '1000 seed weight.' To mitigate these effects, various strategies can be employed to improve seed yield and quality under high-temperature stress. A well-integrated approach combining genetic and agronomic management may enhance heat tolerance. Recently, there has been a focus on quick and cost-effective methods to achieve satisfactory yields under heat-stress conditions, which are anticipated to become more common. One pragmatic approach involves the exogenous application or spraying of heat stress-alleviating compounds, inorganic salts, natural and synthetic plant growth regulators, and stress signaling molecules. These substances have specific properties and roles that can improve yields and germination in various agricultural and horticultural crops.

Objective:

1. To demonstrate the standardized treatments for mitigation of adverse effects of heat stress in chickpea and finger millet

Crops	Centres
Chickpea	CCS HAU Hisar; SKNAU, Durgapura; CSAUAT, Kanpur; UAS, Raichur; UBKV, Pundibari and ICAR-IISS, RS, Bengaluru
Finger millet	ICAR-IISS, RS, Bengaluru; UAS, Dharwad; PDKV, Akola and PJTSAU, Hyderabad

Crop	Treatment to be demonstrated
Chickpea	Cycocel @ 1000 ppm at vegetative followed by anthesis stage
Finger millet	1. Salicylic acid 800 ppmat vegetative and anthesis stages 2. Salicylic acid 400ppmat vegetative and anthesis stages 3. Thiourea @ 400 ppm at vegetative stage 4. KCl 1%at vegetative and anthesis stages

Material: One most popular variety recommended for normal dates of sowing will be taken for the study.

Methodology for Sowing: Each cooperating centre shall sow the crop in at least 500 Sqm blocks each. One/two block/s would serve as untreated/recommended (control/s) and other would be treated/sprayed twice; Vegetative (35-40 days after sowing or transplanting) + Anthesis stage (Days to anthesis will vary from crop to crop and location to location).

Treatment for demonstrations:

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

Observations recorded:

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

- Days to pod / ear formation -50% of plants each at randomly selected 4 places in plots
- Plant height (cm) of 5 plants each at randomly selected 4 places in plots at physiological maturity.
- Total number of pods per plant in 5 plants each at randomly selected 4 places in plots at physiological maturity.

- Time taken to reach harvest maturity--50% of plants each at randomly selected 4 places in plots
- Total number of seeds per pod / ear in 5 of each plant at randomly selected 4 places in each plots.
- Per plant yield in 5 plants each at randomly selected 4 places in plots.
- 1000 seed weight of seed produced (4 replications from each plot)
- Plot yield (kg)
- Harvest Index
- Benefit-cost ratio - MUST
- Evaluation of quality (as per ISTA) of seed produced

NB: Every centre MUST calculate the cost-effectiveness (C/B ratio) of the validated treatment compared with the control in a demonstration experiment, considering all crop cost components.

Experiment 5: Development of Digital Weed Seed Atlas: Ready Reckoner for Weed Seed Identification

Year of start: 2023-24

Rationale: Weed seeds, as concomitant admixtures, always impact the physical purity of seed lots. The collection of seeds, along with illustrations and descriptions of seed morphology, has been invaluable for identifying unknown seeds. Accurate identification of crop and weed seed contaminants is essential for correctly labeling seeds in the seed trade. This identification is crucial for seed quality analysis related to the Orange International seed lot certificate, the Blue International seed sample certificate, routine seed quality analysis, seed certification, and ISTA accreditation of seed testing laboratories. However, in the Indian context, there are limited resources available to assist seed analysts in identifying weed seed contaminants in seed lots. The development of a digital weed seed atlas is one such initiative. This atlas will include digital seed images and species descriptions based on morphological keys, which will effectively supplement seed analysis, facilitate easy identification, and significantly improve the efficiency of seed testing laboratories. Consequently, it will enhance the efficacy of the Indian seed quality assurance regime. Therefore, the development of a weed seed atlas was deemed necessary.

Methodology

Gross Seed Morphological Keys for Seed Identification

Use of seed morphological keys as identification cues enable cataloguing in this endeavour. Apart from these morphological characteristics, seed anatomical (internal morphology) and seedling morphological information generated pertaining to these species can supplement the identification process.

In dicotyledonous seeds, the most useful clues for recognition of seeds were usually the shape, size, and peculiarities of the surface (testa ornamentation), attached appendages

and their nature, colour, surface irregularities, including pittings, grooves, and other types of sculpturing. Among monocots, most useful characteristics include gross morphology of spikelet; floret; nature of upper and lower glumes; rachilla and its position; nature and shape of lemma and palea; presence/absence of sterile florets in a spikelet; shape and colour of caryopsis; nature of attached appendages (awns, bristles, spines); surface ornamentations on lemma and palea or caryopsis, etc. would serve as most critical features for identification of species.

Below referred illustration clearly indicates the metric and characteristic cues information to be recorded for each targeted weed seed species.

Example: *ISTA Universal List of Species: Cuscuta spp.*

ISTA Universal List

Cuscuta spp. *(Convolvulaceae)*
Seed.

General shape: oval to round

Normal size: 0.8-1.5 mm L x 0.8-1.5 mm W x 0.8-1.5 mm D

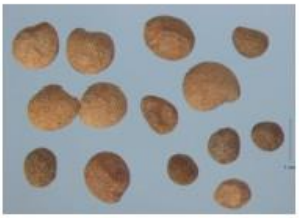
Color: yellow to brown.

Texture: finely to coarsely rough, granular or reticulate.

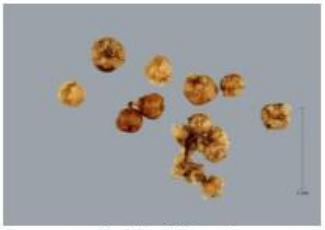
Distinguishing features: seed globular and slightly angular in cross section. The seed has two flattened, ventral faces and a convex, dorsal face. The hilum is a rather big smooth, lighter area in the corner of the seed.

Embryo: embryo coiled in one or two rotations.

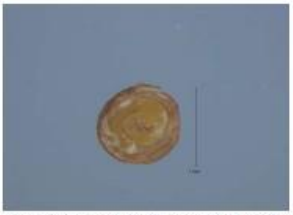
Note: parasitic plants



Seeds of *Cuscuta* spp.



Fruits of *Cuscuta* spp.



Cross section of seed showing embryo and nutritive tissue

Images by SNES-GEVES

Work Plan:

- The cooperating centres shall collect the prevalent weeds from the fields (including farmers' fields) of respective crop/s assigned to the centres and characterize them so that anybody can identify the weed seeds based upon the description given with photographs by each centre. The cooperating centres shall also create a weed seed herbarium for which they will retain at least 2500 seeds and send the same numbers of seeds of each of weed species to the PI and Coordinating unit.

- Cataloguing of crop-associated weeds (Initially objectionable weed species and weeds associated with major crop species will be targeted, annexure below), herbarium preparation of referred weed plants, and digitalization of various phases of dispersal unit right from maturation on mother weed plant until being associated with unprocessed seed.
- Capturing of high-resolution images depending on the availability of necessary equipment, if not enabling digitalization at a centralized facility by the collection of requisite samples.
- Digital database preparation, validation, and making it available in the public domain for further improvement.

List of crops with delineated centres for preparation of digital weed seed atlas

Crops	Centres
Barley	CSKHPAU, Palampur; CCSHAU, Hisar; GBPUAT, Pantnagar; IIWBR, Karnal
Paddy	JNKVV, Jabalpur; OUAT, Bhubaneswar; PAJANCOARI, Karaikal; PAU, Ludhiana; PJTSAU, Hyderabad; UAS, Dharwad; AAU, Jorhat; ICAR-IARI, New Delhi
Wheat	PAU, Ludhiana; CSKHPAU, Palampur; CCSHAU, Hisar; GBPUAT, Pantnagar; IIWBR, Karnal; SHUATS, Prayagraj
Maize	PAU, Ludhiana; IIMR, Ludhiana; IARI, NewDelhi; UAS, Bangalore; UAS, Dharwad; PJTSAU, Hyderabad
Sorghum	UAS, Bangalore; UAS, Dharwad; TNAU, Coimbatore; SKNAU, Jobner; IIMR, Hyderabad
Pearl millet	SKNAU, Jobner; ICAR-CAZRI, Jodhpur;
Chickpea	JNKVV, Jabalpur; UAS, Bengaluru; GBPUAT, Pantnagar; UAS, Dharwad
Black gram	TNAU, Coimbatore; MPKV, Rahuri
Green gram	GBPUAT, Pantnagar; UAS, Dharwad
Pigeonpea	UAS, Bengaluru; PDKV, Akola; PJTSAU, Hyderabad; JNKVV, Jabalpur
Castor	JAU, Junagadh; ICAR-IIOR, Hyderabad
Groundnut	UAS, Bengaluru; TNAU, Coimbatore; ICAR-DGR, Junagarh
Mustard	CCSHAU, Hisar; GBPUAT, Pantnagar; JNKVV, Jabalpur
Safflower	MPKV, Rahuri; UAS, Bengaluru; SKNAU, Jobner and VMMKV, Parbhani
Soybean	JNKVV, Jabalpur; PDKV, Akola; ICAR-IISR, Indore; ICAR-IISS, RS, Bengaluru and VNMKV, Parbhani
Sunflower	UAS, Bengaluru; OUAT, Bhubaneshwar
Cotton	ICAR-CICR, Nagpur; PDKV, Akola; MPKV, Rahuri
Berseem	ICAR-IGFRI; PAU, Ludhiana
Lucerne	ICAR-IGFRI; SKNAU, Jobner
Oats	CSKHPAU, Palampur; CCSHAU, Hisar; PAU, Ludhiana

Plan of Action:

- ✓ Preparation of descriptors of weed plants and seeds associated with major crops
- ✓ Collection of requisite samples of weed seeds
- ✓ Cataloguing of referred weed seeds
- ✓ Capturing of high-resolution images (Geo Tagged/GPS Mapped)
- ✓ Digitalization of various phases of dispersal unit right from maturation on mother weed plant until being associated with unprocessed seed.
- ✓ Sharing the collected/generated information/images/samples with coordinating unit/PI
- ✓ Preparation of digital database and making it available in the public domain by the coordinating unit and PI.

Experiment 6: Evaluation of seed quality attributes and storage potential of bio-fortified varieties in major field crops

Year of start: 2023-24

Technical programme:

Rationale: Recognizing the importance of nutritional quality, the research efforts of NARES have led to the development and release of numerous bio-fortified varieties of various crops. These bio-fortified varieties are enriched with a diverse profile of nutrients and play a crucial role in enhancing nutritional security. The recent initiative, the 'National Nutrition Strategy' by NITI Aayog, Government of India, aims to further promote the use of these bio-fortified varieties to achieve a 'Kuposhan Mukt Bharat' (Malnutrition-Free India). However, information on the influence of bio-fortification on seed quality attributes, particularly seed storability with enhanced nutrients in fortified varieties, is limited. Therefore, it is proposed to evaluate the seed quality status and storage potential of bio-fortified varieties in major crops such as rice, wheat, maize, pearl millet, mustard, etc.

Crops	Biofortified varieties source centers	Centers
Rice	NRRI, Cuttack and ICAR-IIRR, Hyderabad	PAJANCOARI, Karaikal; PJTSAU, Hyderabad; PAU, Ludhiana; OUAT, Bhubaneswar and UAS, Dharwad
Wheat	ICAR-IIWBR, Karnal; PAU, Ludhiana; and ICAR-IARI, New Delhi	PAU, Ludhiana; PDKV, Akola; ICAR-IIWBR, Karnal; GBPUAT, Pantnagar and JNKVV, Jabalpur
Maize	ICAR-IARI, New Delhi and ICAR-VPKAS, Almora	UAS, Bengaluru; MPKV, Rahuri; TNAU, Coimbatore and CSKHPAU, Palampur

Pearl millet	CCSHAU, Hisar; MPKV, Rahuri and VNMKV, Parbhani	CCSHAU, Hisar; VNMKV, Parbhani; SKNAU, Jobner and JAU, Junagadh
Mustard	ICAR- IARI, New Delhi	GBPUAT, Pantnagar; ICAR-IARI, New Delhi; UBKV, Pundibari and ICAR-CAZRI, Jodhpur
Quantities of seeds to be supplied/procured: Rice, Wheat: 2 kg (1 kg each in poly-lined & cloth/jute bag container); Maize: 3kg (1.5kg each in the respective container); Pearl millet: 1kg (500 g each in the respective container); Mustard: 1kg (500 g each in the respective container) *Rice and Pearl millet: ICAR-IISS Mau will coordinate the supply of seed.* *Wheat: PAU, Ludhiana will coordinate the supply of seed.* *Maize (Dr. Sudipta Basu) and Mustard (Dr. Sangita Yadav): ICAR-IARI, New Delhi will coordinate the supply of seed.*		

Materials:

Freshly harvested seeds of all the bio-fortified varieties released by institutes/SAUs to be procured from the concerned institute/SAU by respective cooperating centres. The centres may seek help of Project Cooperating Unit, ICAR-IISS, Mau, if required, in pursuing the procurement of bio-fortified varieties. The cooperating centres shall also take at-least one non-fortified popular variety/hybrid (as control) of selected crops and will use for the evaluation of initial seed quality and storability till the germination % reaches below IMSCS.

Referred experiment shall be continued from the previous year.

Observations to be taken:

- Initial Seed quality traits will be evaluated in fresh seeds, and germination/vigour indices observations will be taken at two months intervals, till germination reaches below IMSCS or for a period of maximum 24 months.
- Seed moisture content (%) [Initial and thereafter for every three months]
- First count, Germination %, and Vigour Indices [Monthly intervals]
- Field emergence (%) (during the time of planting window and /or during the preceding month when germination falls below IMSCS)
- Seed Health {Insect infestation (%); Live and dead insects found (No./Kg of seed) and cataloguing of infested insects // seed pathogen infection identification (if any)}

Experiment 7: Studies on seed dormancy and alleviation strategies in minor millets

Year of start: 2024-25

Rationale: Seed dormancy is a critical physiological trait that significantly affects the germination potential and subsequent crop establishment in minor millets. Understanding the mechanisms underlying dormancy is pivotal for developing effective alleviation strategies.

By elucidating these mechanisms, we aim to identify protocols that can alleviate dormancy, thereby unlocking the potential for enhanced germination rates. The outcomes of this research are anticipated to benefit various stakeholders involved in the seed sector, including seed analysts responsible for certification and farmers at the production interface. Improved understanding and implementation of dormancy alleviation protocols can lead to increased germination levels, ensuring optimal planting values and ultimately boosting productivity. This study is essential as it addresses a gap in current knowledge regarding dormancy mechanisms specific to minor millets. By exploring novel alleviation strategies, we seek to provide practical solutions that enhance seed performance under diverse environmental conditions. Ultimately, our findings aim to contribute to sustainable agricultural practices by optimizing seed utilization and promoting reliable crop establishment in minor millets. **Therefore, this preliminary experiment has been designed for the following objectives;**

Objectives:

1. To study the mechanism/nature and duration of seed dormancy in proposed minor millets
2. To standardize/validate seed dormancy alleviation protocols in minor millet crops

Technical programme:

Material:

Crop	Quantity (kg) per variety per centre	Varieties to be supplied	Supplying centre	Cooperating Centres
Proso millet	0.100	TNAU 145 or 164; and TNAU 202	ICAR-IIMR, Hyderabad	TNAU, Coimbatore; BSKKV, Dapoli; AAU, Jorhat; RPCAU, Pusa; UAS, Raichur; ICAR-IISS, RS, Bangalore
		Konkan Satwik	BSKKV, Dapoli	
		ATL 1, ATL 2	TNAU, Coimbatore	
		GPUP 25, GPUP 28, GPUP 32	UAS, Bangalore	
		DHPM 2769	UAS, Dharwad	
		HB 1	UAS, Raichur	
Kodo millet	0.100	CKMV 2 or 3	ICAR-IIMR, Hyderabad	PAJANCOA&RI, Karaikal; UAS, Bengaluru; JNKVV, Jabalpur; OUAT, Bhubaneshwar
		ATL 1, ATL 2 and TNAU 86	TNAU, Coimbatore	

		JK 9-1, JK 137, JK 155	JNKVV, Jabalpur	
		RK 390-25	UAS, Bangalore	
Brown Top millet	0.100	HBR 2	UAS, Raichur	UAS, Bengaluru; TNAU, Coimbatore; UAS, Raichur
		GPUBT 2	UAS, Bangalore	

Note: In addition to the above, centres can use their location-specific cultivars to proceed with multiplication and record observations starting from two weeks before physiological maturity.

Methodology:

Sowing: The plot size is 2 × 1.8 m for each cultivar, suitable for harvesting fresh seeds and recording data after anthesis.

Determining of dormancy:

Genotypes/cultivars must be observed right before the onset of physiological maturity to understand dormancy behaviour, which can be assessed by cultivar-specific visual cues and maximum dry matter accumulation. At an interval of 4 to 5 days from 2 weeks before physiological maturity until a period of maximum germination % of the lot is achieved, observations are to be recorded (where the onset of germination/dormancy switch inter alia can be noticed). These observations will tentatively proceed for two months (or the time till it starts germinating, whichever is earlier), during which time the dormancy class, level, and type of delineated cultivar seed lot can be known. Later, monthly observations of cultivar lots can be taken until the germination standard (75%) falls below IMSCS.

For the initial months of germination % observation, 25 seeds in 4 replications can be taken. Subsequently, after attaining the maximum germination level of the particular lot, monthly germination observations may proceed on 100 seeds in 4 replications. While recording germination, all segments, viz. normal seedlings, abnormal seedlings, hard seeds, fresh ungerminated seeds, and dead seeds, should be meticulously recorded to understand the dormancy mechanism in this endeavour.

Observations to be recorded in addition to the above-mentioned

1. Seed fresh and dry weight right from 2 weeks before physiological maturity till harvest maturity (on 25 seeds oven dried at 103 ^{0}C for 17 h expressed in g) at an interval of 3 to 4 days, where seeds are to be collected from tagged ears.
2. While evaluating the germination percentage, if significant dormancy is observed, based on the class of dormancy, scarification (water soaking for 24-48h or Hot water treatment) / stratification (5^{0}C for 24h to 48h) / physical (50 ^{0}C dry heat 2 to 7 days) / hormonal and chemical treatments (GA_3@ 500 ppm / Thiourea @ 0.5 % / KNO_3 @ 1 %) can be followed.

However, referred alleviation protocols can be validated subsequently and are for pre-evaluation purposes only.

3. Temperature and RH data are to be collected from the anthesis until harvesting. Ambient temperature and RH should also be collated for storage conditions.

Please note that after preliminary experimentation for determining all five classes of seed dormancy (physiological dormancy (PD), morphological dormancy (MD), morpho-physiological dormancy (MPD), physical dormancy (PY), and combinational dormancy (PY + PD)), the following observations will typically be required:

1. **Germination Testing:** Germination percentage over time and the initial time to start germination (lag phase) will be required to be noted.
2. **Seed Coat Permeability:** Assessment of seed coat permeability by conducting water imbibition tests and the time taken for water absorption or seed coat rupture to be recorded.
3. **Temperature Requirements:** Determine optimal germination temperature range and germination testing at different temperatures to identify dormancy responses.
4. **Hormonal Response:** Apply exogenous hormones (e.g., gibberellins) to assess germination stimulation and recording the response in terms of germination percentage and time.
5. **Light Requirements:** Conduct germination tests under light and dark conditions and observe differences in germination percentage and speed under each condition.
6. **Embryo Development:** Required to monitor embryo growth and development during germination and record stages of embryo growth relative to germination progress.
7. **Seed Structure Examination:** Assessment of seed structure under a microscope to identify morphological features (e.g., embryo morphology, presence of structures causing physical dormancy) recording the observations related to seed coat thickness, presence of impermeable structures, etc.
8. **Imbibition Kinetics:** Measure water uptake kinetics by seeds as well to record time and extent of seed swelling or change in size during imbibition.
9. **Seed Viability:** Conducting viability tests (e.g., tetrazolium test) to assess the physiological status of seeds would be vital and correlating it with germination percentage.
10. **Combination of Treatments:** Application of combinations of treatments (e.g., scarification followed by hormonal treatment) to assess interactions between dormancy types and studying the combined effects on germination behaviour.

After establishing the type of seed dormancy, specific treatment for breaking it effectively and corresponding observations will be required.

Treatments for Seed Dormancy Breaking and recording corresponding observations:

1. **Scarification (**Mechanical abrasion**):** Record time taken for scarified seeds to germinate compared to untreated seeds.
2. **Stratification (**Cold treatment**):** Germination percentage and time after stratification period and temperature.
3. **Priming (**Controlled hydration and dehydration, osmotic solutions (e.g., PEG)**):** Germination percentage, speed, and uniformity compared to untreated seeds.
4. **Chemical Treatments (GA, Ethylene etc.):** Assess germination percentage, speed, and seedling vigor post-treatment.

5. **Temperature Treatments (**Exposure to alternating or fluctuating temperatures**):** Determine optimal temperature regime and record germination response.
6. **Smoke Treatment (**Mimicking natural fire cues**):** Monitor germination behavior after smoke exposures.
7. **Light Treatments** (specific light)**:** Conduct germination tests under light and dark conditions to determine light sensitivity.
8. **Seed Coat Removal (Testa Disruption;** Physical or chemical removal**):** Assess impact on germination performance and seedling establishment.

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

S No	Particulars	Amount (Rs./ha)
A	**Expenditure/ Cost**	
1	Recurring cost of imposing the treatment (T1,T2,T3….Tn) (materialistic cost only *i.e.* chemicals, packaging materials, other physical inputs etc.)	
2	Additional labour cost on imposing treatments	
3	Salary component (as per man-days spent for imposing treatments)	
4	Miscellaneous cost	
	Subtotal	
5	Interest on working capital (@12%per annum for total above, Adjusted accordingly as per duration of experiment)	
	Total Expenditure/cost(A)	
B	**Gross income by imposing the treatment**	
1	Seed yield in particular treatment (q/ha)	
2	Price/sale value of seed (Rs./q)	
	Gross Income by imposing the treatment(B**)**	
C	**Gross income in control(T0)**	
1	Seed yield in control (q/ha)	
2	Price/sale value of seed (Rs./q)	
	Gross Income in control(C)	
D	**Increase in Gross income by imposing the treatment (B-C)**	
E	**Increase in Net income by imposing the treatment (D- A)**	
F	**BC ratio for imposing the treatment(D/A)**	

Note:

1. The above information needs to be calculated for individual/every treatment
2. Expenditure, income etc. may be calculated on per quintal basis for storage experiment

Guidelines pertinent to adept reporting

•It was decided that the reports only with few tables without any write up and conclusions and just copying from the TP and mentioning the crop stage/in progress/will take it up next season will not be accepted for inclusion in reports.

•It is also reiterated that every cooperating centre shall conduct the experiments allocated STRICTLY as per the technical programme of the year. It has been decided that all the centres to send the complete reports of the results obtained/storage data recorded till 31st March, 2024 or completion of Rabi experiment/s, whichever is earlier. The last date for receiving mails with the reports including conclusions of all the allotted experiments for 2023-24 appended (ONLY ONCE) will depend on the dates of AGM and shall be communicated by the ICAR-IISS, Mau. It has also been decided that all centres shall present "ONLINE" the salient achievements of all the experiments allocated during the year 2023-24 before the SPST group during 15 to 20 April, 2024. Please don't combine results/conclusion of all crops allotted to your centre in a particular experiment.

Kindly;

a. Note that many observations have been mentioned in TP to be recorded in different experiments, but every observation may not have the direct relevance to the targeted outcome. Objective of considering the additional observations than actually required to meet the purpose is that the experimentation could also result in good publications of the scientists and their students working in SPST experiments under STR.

b. Take/involve your centre/self only in those experiments where you are comfortable conducting them in terms of facilities and expertise, please.

c. Understand fully the experiment by critically reading the Technical Programme! Is it standardization, validation or demonstration experiment?

d. Report the outcome of results only in line with the Technical Programme. It is very important to address the problematic data, if there are deviations in results than the expected and or established facts, discuss the issue with peers and or PI, don't report it but redo the experiment, as may be needed.

e. Note that there is no need to mention the details of standard methodologies of observations that are to be recorded strictly as per technical programme. However, you must mention if you have done some necessary modifications in standard protocol/s or used any new method/s for taking any planned observation/s, giving reasons. For example you are reporting germination (Initial, Final & Towel Paper); the explanation of particularly Towel Paper, if it is different will be required.

f. Note that no conclusions can be drawn only on mean tables and you must first understand the requirement of data analysis.

g. Prepare appropriate table of means separately for each parameter studied and MUST mention the CD & CV values for all factors and their interactions. Don't forget to give tables/figures/plates a suitable, clear, descriptive title and number. Then properly describe results of each parameter referring to each table number separately in body of text.

h. Note that the best treatment in standardization or validation experiments could only be one, but you can recommend more if they are at par with the best.

i. Look what are you reporting/sending? Those who have not been allotted any experiment please don't report previous year's results for sake of reporting. The reports of experiments that were allotted to center/s, 1-2 years back and reported this year doesn't have any meaning than to create confusion.

j. Note that all the observations in every crop/experiment to be recorded on minimum four replications of 100 seeds each, except SMC, which will be estimated on dry weight basis as per ISTA recommended methods.

k. Note that while calculating vigour indices, average/mean length in centimetres and wet/dry weight in grams of 10 randomly selected seedlings on the day of final count should be taken. The formula to be used uniformly by all the centres; SVI-I= Mean Total Seedling Length (cm) X Germination (%) and SVI-II= *Mean Seedling Dry Wt. (g) X Germination (%). *All centres shall take the weight of 10 properly dried seedlings in grams (g seedlings-10) from each replication of all treatment combinations.

l. Note that the files should be saved separately for each experiment allotted to your centres with name of centre, experiment. Sub-experiment number in TP of SPST and crop e.g. IARI New Delhi- Content Page, IARI New Delhi- Expt. 1. Lentil, IARI New Delhi- Expt. 1. Mustard & IARI New Delhi- Expt. 4.1. Wheat). Similarly, every centre shall have to share the raw data in separate excel file/s/sheet/s for each experiment. The excel sheet for feeding data of each experiment will be made available by the PI.

m. There will be as many files as the numbers of experiments and numbers of crops in each experiment. Please mention in tabular form the contact details of all concerned Scientist/s with SPST experiment/s on first page, details of experiments allotted and conducted under SPST at your centre on second page and note on recommendation of technology, if any on third page of Content Page file (As per the formats given below).

First Page of Content Page File from Each Centre

Contact details of all concerned Scientist/s with SPST experiment/s

Name of the Centre	
Name of the Lead Scientist associated	
Contact Details of the Lead Scientist associated	
Names of the Other Scientists associated, if any	
Contact of the Other Scientists associated, if any	
Name of the Nodal Officer/ Special Officer Seeds	

Contact Details of the Nodal Officer/Special Officer Seeds	
Name of the Director/Director Research of Institute/University	
Contact Details of the Director/ Director Research of Institute/University	

Second Page of Content Page File from Each Centre Brief note on recommendation of technology, if any

1) Title of the technology:
2) Introduction of the problem addressed:
3) Inventor(s) Name and contact details of Scientist/s involved from your centre:
4) Brief Description of the technology (Technique/Methodology):
5) Cost of development of technology:
6) Readiness of technology for commercialization:
7) Challenges associated with the technology, if any:
8) Commercial potential of technology (Please include advantages over the existing):
9) Geographical potential:
10) IP to be filed (if any):
11) Proposed Terms & Conditions for Commercialization:

Third Page of Content Page File from Each Centre
Details of experiments allotted and conducted under SPST at (Name of Your Centre)
Example:

Sr. No.	Sr.No. as per TP	Crop (e.g.)	Allotment Year as per TP	Year of Conduct	Season of Conduct	*Status of Expt. At Centre	Date of Submission of full Report of Expt.
1.	**1.**	**Sorghum**					
2.	**1.**	**Proso millet**					
3.	**4.3**	**Chickpea**					
4	**4.3**	**Finger millet**					
5.	**5**	**Kodo millet**					

**If the status is indicated as "in progress" here, there is no need to prepare a separate file for that experiment and submit it, please.*

Also note the important points below:

• Adherence to the time for reporting is must and be prepared for making centre wise presentations on salient findings during the year under report.

• Reports for sake of reporting are discouraged:

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

• Uniformity in reporting:

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

• Submission of highlights and Slides:

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

• Relook at the report before you submit:

It is advised to all the centres to see the report of previous year/s. Also look out for legends/ headings of Table/s. DO refer the table number individually in the body of text of the results. Similarly for headings of figures and plates, the repetition of same data in chart/diagram causes confusion only, moreover photos/plates without any significance are meaningless. Avoid copying tables directly from excel, if you have do please check, rows and columns are proper. Do see the data for uniformity before and after decimal in the tables (No need to have more than four figures in total!). Write C.D. (p=0.05) and SEd± etc. uniformly. Mark the critical value of 'r' at 5% and at 1% with ‘*’ or ‘**’. Providing monthly mean weather data without

indicating its effect on results is useless. Explain the abbreviation/s used there in the tables. Running the Spell Check is a must before submission.

•Confirmation by each centre:

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

List of Co-operating Scientists

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29	SHUATS, Prayagraj	Dr. Prashant Kumar Rai	Asst. Director (S&F)	prashant.rai81@gmail.com	7905058905

C. Seed Pathology

Date: 26.04.2024 & 02.05.2024

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

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

Technical programme 2024-25

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

Objectives:

1) Identification and documentation of important seed borne diseases.
2) Monitoring of emerging diseases of seed borne nature.
3) Detection of seed borne viruses of pulses and soybean
4) Identification of disease prone areas (state wise)

Year of start: 2021-22

Status: Continued for 2023-24

Crop (a): Paddy - Bunt, Bacterial Leaf Blight, False smut, Dirty Panicle/Grain discolouration, Bakanae/ Foot rot, Bacterial Panicle Blight, Brown spot, Udbatta

Centres: AAU, Jorhat; SKUAST, Srinagar; TNAU, Coimbatore; CSKHPAU, Palampur; PAJANCOA, Karaikal; MPKV, Rahuri; ICAR-IARI, New Delhi; DRPCAU, Pusa; PAU, Ludhiana; CCSHAU, Hisar; PJTSAU, Hyderabad; AAU, Anand; GBPUA&T, Pantnagar; OUAT, Bhubneshwar; IARI (RS), Karnal, RARS, Pattambi; ICAR-NEH: Manipur Center and SHUATS, Prayagraj (18).

Methodology

- **Detection Technique:** Standard NaOH seed soak method (0.2%) has to be followed for detection of bunt infection in rice samples. Minimum seed sample size is 100 from all the sources by covering the popularly grown rice varieties. Mention the range of bunt infection for each location.
- **Disease scoring:** Recording the diseases in farmers' fields and seed production plots and score the diseases as per the SES scale for rice crop. (https://www.clrri.org/ver2/uploads/SES_5th_edition.pdf). Minimum number of fields to be visited is 50 per location.
- Meteorological data should be incorporated for correlation studies.
- Seed-borne pathogens responsible for seed discoloration have to be reported.
- Impact of seed borne fungi on germination (normal seedlings) and seedlings with

primary infection (part of abnormal seedlings category) and seed rot has to be reported.

- Correlation of associated pathogens with seed germination (normal seedlings) and seedlings with primary infection (part of abnormal seedlings category) is specified separately.
- Monitoring of any other seed borne disease of importance as per centre has to be recorded.

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

1) *Observe for the incidence of unreported pathogens and diseases of seed-borne nature.*
2) *Information on symptoms, causal organism and factors affecting development of the particular diseases (all about epidemiology) is to be supplemented with photographs.*
3) *Sensitization drive of farmers shall be made at hot spots for the management of rice bunt with awareness for safe storage and significance of replacement of varieties.*
4) *Prepare a map depicting the surveyed locations*
5) *Provide the photographs showing the associated seed-borne pathogens.*
6) *Compile and prepare the disease distribution map of the state*

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

Centres: CCSHAU, Hisar; PAU, Ludhiana, GBPUAT, Pantnagar; CSKHPAU, Palampur; RARI, Durgapura; IARI New Delhi; MPKV, Rahuri; IARI (RS), Karnal and SHUATS, Prayagraj (9).

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 Karnal bunt disease of wheat with awareness for safe storage and replacement of varieties.

Methodology:

- **Detection Technique:** Standard NaOH seed soak method (0.2%) has to be followed for bunt in seed samples. Minimum seed sample size is of 100 from all the sources by covering the popularly grown wheat varieties.
- For ear cockle, visual observation and standard water soak method has to be followed.
- Recording of loose smut incidence under field conditions by GOT.
- Recording of head smut incidence under field conditions as per standard rating scale.

Note:

1) *Sensitization drive of farmers shall be made at hot spots for the management of Karnal bunt of wheat with awareness for safe storage and significance of replacement of varieties.*
2) *Prepare a map depicting the surveyed locations*
3) *Provide the photographs showing the associated seed-borne pathogens.*

4) *Compile and prepare the disease distribution map of the state*

Crop (c): Soybean- Purple seed stain, Pod rot, Anthracnose, *Phomopsis* blight, Downy mildew

Centre: RARI, Durgapura; JNKVV, Jabalpur; MPKV, Rahuri; VNMKV, Parbhani and PJTSAU, Hyderabad (5)

Methodology

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

Note

1) *Prepare a map depicting the surveyed locations of the state.*
2) *Provide the photographs showing the associated seed-borne pathogens of significance.*
3) *Compile and prepare the disease distribution map of the state*

Crop (d): Groundnut - Seed rot, Collar Rot and Stem rot

Centre: AAU, Anand; MPKV, Rahuri; RARI, Durgapura; JNKVV, Jabalpur; TNAU, Coimbatore; OUAT, Bhubaneshwar (6)

Methodology:

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

Note

1) *Prepare a map depicting the surveyed locations.*
2) *Provide the photographs showing the associated seed-borne pathogens of significance.*
3) *Compile and prepare the disease distribution map of the state*

Crop (e): Chickpea: Wilt, Collar rot, Dry Root rot, Grey Mould, *Ascochyta* blight

Centre: MPKV, Rahuri; RARI, Durgapura; JNKVV, Jabalpur and ICAR-IARI, New Delhi (4)

Methodology:

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

Note

1) *Prepare a map depicting the surveyed locations.*
2) *Provide the photographs showing the associated seed-borne pathogens.*
3) *Compile and prepare the disease distribution map of the state*

Crop (f): Ragi - Seed borne diseases/mycoflora

Year of start: 2020-21

Centre: PJTSAU, Hyderabad; MPKV Rahuri; JNKVV Jabalpur; TNAU, Coimbatore; IISS (RS) Bengaluru (5)

Methodology:

- A minimum number of seed sample size is 100 from all the sources by covering the popularly grown ragi varieties. Reporting the range of infection.

Note

1) *Prepare a map depicting the surveyed locations*
2) *Provide the photographs showing the associated seed-borne pathogens.*
3) *Compile and prepare the disease distribution map of the state*

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

Objective: To determine the health status of seed samples from the farmers own saved seeds
Year of start: 2000
Status: Continued for 2024-25

Crop (a): Wheat

Centres: CCSHAU, Hisar; PAU, Ludhiana; GBPUAT, Pantnagar; CSKHPAU, Palampur; RARI, Durgapura; RPCAU, Pusa; MPKV, Rahuri; IARI (RS) Karnal; RARS, Pattambi; ICAR-NEH: Manipur Center and SHUATS, Prayagraj (11).

Methodology:

- **Detection Technique:** Standard NaOH seed soak method (0.2%) has to be followed for detection of Karnal bunt in seed samples. Minimum seed sample size is 100 from all the sources by covering the popularly grown wheat varieties.
- For ear cockle, visual observation and standard water soak method has to be followed.
- Incidence of loose smut is to be recorded under field conditions by GOT.

Note:

1) *Sensitization drive of farmers shall be made at hot spots for the management of Karnal bunt of wheat with awareness for safe seed storage and significance of replacement of varieties.*
2) *Prepare a map depicting the seed sample locations.*
3) *Provide the photographs showing the associated seed-borne pathogens.*
4) *Compile and prepare the disease distribution map of the state*
5) *Information of storage conditions.*

Crop (b): Soybean

Centre: RARI, Durgapura; JNKVV, Jabalpur; MPKV, Rahuri; VNMKV, Parbhani and PJTSAU, Hyderabad (5)

Methodology

- A minimum of 100 seed samples from all the sources by 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* sp., *Diaporthe* sp.) in farmers own saved seed shall be recorded based on the observations of 400 seeds / sample.
- Symptoms of SMV has to be recorded both in field and seed samples.
- Impact of seed borne fungi on germination- Normal seedlings, abnormal seedlings with primary infection and seed rot has to be reported.
- Correlation of associated seed-borne pathogens with seed germination, normal seedlings and seedlings with primary infection is specified separately.

Note

1) *Prepare a map depicting the seed sample locations.*
2) *Provide the photographs showing the associated seed-borne pathogens.*
3) *Compile and prepare the disease distribution map of the state.*
4) *Information of storage conditions.*

Crop (c): Rice

Centres: AAU, Jorhat; TNAU, Coimbatore; CSKHPAU, Palampur; PAJANCOA, Karaikal; MPKV, Rahuri; ICAR-IARI, New Delhi; DRPCAU, Pusa; PAU, Ludhiana; CCSHAU, Hisar; PJTSAU, Hyderabad; AAU, Anand; SKAUST, Srinagar; OUAT, Bhubaneshwar; IARI (RS), Karnal; RARS, Pattambi and ICAR-NEH: Manipur Center (16)

Methodology

- **Detection Technique:** Standard NaOH seed soak method (0.2%) has to be followed for bunt in rice seed samples. Minimum seed sample size is 100 from all the sources by covering the popularly grown rice varieties. Reporting the range of infection for each location.
- Seed borne pathogens responsible for seed discoloration have to be reported.
- Impact of seed borne fungi on germination- Normal seedlings, abnormal seedlings with primary infection and seed rot has to be reported.
- Correlation of associated seed borne pathogens on seed germination, normal seedlings and seedlings with primary infection is specified separately.

Note

1) *Prepare a map depicting the seed sample locations.*
2) *Provide the photographs showing the associated seed-borne pathogens.*
3) *Compile and prepare the disease distribution map of the state.*
4) *Provide the information of the crop (upland or lowland).*
5) *Information of storage conditions.*

Crop (d): Groundnut

Centre: AAU, Anand; MPKV, Rahuri; RARI, Durgapura; JNKVV, Jabalpur; TNAU, Coimbatore and OUAT, Bhuvneshwar (6)

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 by covering the popularly grown varieties.
- Impact on seed germination: Normal seedlings, abnormal seedlings with primary infection and seed rot have to be reported.
- Correlation of associated seed borne pathogens with seed germination, normal seedlings and seedlings with primary infection is specified separately.

Note

1) *Prepare a map depicting the seed sample locations*
2) *Provide the photographs showing the associated seed-borne pathogens.*
3) *Compile and prepare the disease distribution map of the state*
4) *Provide the information of the crop (upland or lowland).*
5) *Information of storage conditions.*

Crop (e): Chickpea

Centre: MPKV, Rahuri; RARI, Durgapura; JNKVV, Jabalpur and ICAR- IARI, New Delhi (4)

Methodology:

- Seed health has to be determined by employing standard blotter method (ISTA, 1996) and visual inspection of seeds.
- A minimum number of seed sample size is 100 from all the sources by covering the popularly grown chickpea varieties. Reporting the range of seed borne infection.
- Impact on seed germination- Normal seedlings, abnormal seedlings with primary infection and seed rot has to be reported.
- Correlation of associated seed borne pathogens on seed germination, normal seedlings and seedlings with primary infection is specified separately.

Note

1) *Prepare a map depicting the seed sample locations.*
2) *Provide the photographs showing the associated seed-borne pathogens.*
3) *Compile and prepare the disease distribution map of the state.*
4) *Provide the information of the crop (upland or lowland).*
5) *Information of storage conditions.*

Crop (f): Ragi

Year of start: 2020-21

Centre: PJTSAU, Hyderabad; MPKV, Rahuri; JNKVV, Jabalpur; TNAU, Coimbatore; IISS (RS) Bengaluru (5)

Methodology:

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

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

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

Objective: To work out the efficacy of different techniques for the detection of seed-borne pathogens of significance prevalent in a particular region.

Year of start: 2008
Status: Continued for 2024-25

Centres: GBPUA&T, Pantnagar; ICAR-IARI, New Delhi; JNKVV, Jabalpur; PJTSAU, Hyderabad; SKUAST, Srinagar and TNAU, Coimbatore; AAU, Jorhat (7)

Protocol: Protocol and seed material (Sesame) will be supplied by TNAU, Coimbatore; and the protocol and seed material(mustard) by PJTSAU, Hyderabad.

Note:

- *Provide the photographs showing the associated pathogens.*
- *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.*

Experiment 4: Management experiments

New experiment 4a: Exploring new generation systemic fungicide molecules for false smut free seed production in rice

Objectives:

1) To test the efficacy of novel systemic fungicide molecules on the growth and sporulation of false smut pathogen and seed quality parameters in rice under *in vitro* conditions.
2) To test the efficacy of novel systemic fungicide molecules against rice false smut disease under field conditions.

Year of start: 2022-23

Status: Continued for 2024-25

Crop: Paddy

Centre: TNAU, Coimbatore; PJTSAU, Hyderabad; PAJANCOA, Karaikal; ICAR-IARI, New Delhi; AAU, Jorhat; OUAT, Bhubaneshwar, GBPUA&T, Pantnagar; JNKVV, Jabalpur; PAU, Ludhiana; ICAR RC NEH, Manipur Centre and IARI RS, Karnal (11)

Materials and Methods:

The **best performing/efficient three fungicides** under *in vitro* conditions were forwarded/ selected for field studies.

Treatment details

S. No.	Fungicide	Dosage (g or ml/lit of water)
1.	Trifloxystrobin 25% + Tebuconazole 50% WG	0.4
2.	Fluopyram 17.7% + Tebuconazole 17.7% SC	1.0
3.	Picoxystrobin 12% +Propiconazole 7% SC	2.0
4.	Propiconazole 25EC (Standard check)	1.0
5.	Untreated control	--

Variety: Any local popular susceptible variety

Design: Randomized Block Design (RBD)

Plot size: 20 m^2

Replications: Five

The fungicides will be applied as seed treatment and foliar spray at recommended dose. Each fungicide will be sprayed twice, first at panicle initiation stage and second at early flowering stage /50% flowering. Disease incidence and severity will be assessed at the time of harvest as per the SES for rice (https://www.clrri.org/ver2/uploads/SES_5th_edition.pdf).

Data to be recorded:

1. Percent false smut infected panicles per m^2
2. Per cent false smut infected spikelets per panicle
3. Per cent Disease severity (Per cent smutted panicles per m^2 × Per cent smutted balls per panicle)
4. Grain yield
5. Cost benefit ratio

Disease incidence (percent false smut infected panicles/m^2 and infected spikelets/panicle) and severity will be calculated by using the International Rice Research Institute's Standard Evaluation System.

Experiment 4(b): Development of eco-friendly low-cost input / indigenous technology for the production of disease-free soybean, chickpea and groundnut seeds.

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

Year of start : 2022-2023

Crop : Soybean, chickpea and groundnut

Variety : Local

Centres and Pathogens

S. No.	Crop	Pathogen	Centres
1.	Soybean	*Macrophomina phaseolina*	JNKVV, Jabalpur; VNMKV, Parbhani, MPKV, Rahuri and GBPUA&T, Pantnagar, AAU, Jorhat, RS Bangalore (06)
2.	Chickpea	*Fusarium oxysporum, Rhizoctonia bataticola*	JNKVV, Jabalpur; MPKV, Rahuri; RARI, Durgapura; PAU, Ludhiana; AAU, Anand and GBPUA&T, Pantnagar, RS Bangalore (07)
3.	Groundnut	*Sclerotim rolfsii, Aspergillus flavus*	MPKV, Rahuri; RARI, Durgapura; AAU, Anand and OUAT, Bhubaneshwar (04)

Methodology

Third Year (2024-25)

Objective: To validate the bioagents and organic products for the production of disease-free seed under pot condition

Materials and methods:

Seed material: Susceptible variety

Bioagent and organic formulations: As listed in treatment details

Techniques adopted: Pot culture

Seed treatment details (Pathogen: As per the centre)

Treatment No.	Treatment	Technique to be adopted	Doses

T_1	*Trichoderma asperellum**	Seed treatment	10 g /kg seed in 100 ml water
T_2	*Pseudomonas fluorescens**	Seed treatment	10 g /kg seed in 100 ml water
T_3	Beejamrit	Seed treatment	10 ml /kg seed in 100 ml water
T_4	Jeevamrit	Seed treatment	10 ml /kg seed in 100 ml water
T_5	Herbal Kunapjal	Seed treatment	10 ml /kg seed in 100 ml water
T_6	*Trichoderma asperellum**	Seed treatment and foliar spray	Same doses of foliar spray at 30, 45 and 60 DAS
T_7	*Pseudomonas fluorescens**	Seed treatment and foliar spray	Same doses of foliar spray at 30, 45 and 60 DAS
T_8	Beejamrit	Seed treatment and foliar spray	Same doses of foliar spray at 30, 45 and 60 DAS
T_9	Jeevamrit	Seed treatment and foliar spray	Same doses of foliar spray at 30, 45 and 60 DAS
T_{10}	Herbal Kunapjal	Seed treatment and foliar spray	Same doses of foliar spray at 30, 45 and 60 DAS
T_{11}	Chemical check (Carboxin 37.5% WS + Thiram 37.5%WS)	Seed treatment	3 g/kg seed
T_{12}	Control		

Methodology

Seeds prior inoculated with respective test pathogen @ 10^6 conidia/ml, allowed to air dry for 24 hours will be treated with test formulations and allowed for drying under shaded conditions. Next day, the seeds will be sown in earthen pots of 5 kg capacity filled with sterilized soil. The foliar sprays shall be done at 30 and45 with respective formulations in specified doses.

Observations:

Germination percentage

Observations to be recorded:

Per cent germination, per cent seedling mortality and per cent disease incidence will be recorded at 15, 30, 45 and 60 days after sowing. Shoot length (cm), root length (cm) and dry weight (g/plant) will be recorded at 30 days after sowing under controlled conditions.

Kunapjal will be supplied to every participating centre by Pantnagar.

Experiment 5: Development of seed health standards for Alternaria leaf spot disease in safflower.

Objectives:

- 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: 2023-24

Crop: Safflower

Disease: Alternaria leaf spot

Pathogen: *Alternaria carthami*

Design: CRD

Replication: Four

Treatment: Six

Centres: MPKV, Rahuri; JNKVV, Jabalpur; GBPUA&T, Pantnagar, PAU, Ludhiana, PJTSAU, Hyderabad (05)

NOTE: MPKV, Rahuri will send harvested product to respective centres for laboratory analysis of samples.

Treatment Details.

Treatment No	Treatments	Percent
1	1000 Breeder seeds + 00 Inoculated seed with *Alternaria carthami*	0%
2	999 Breeder seeds + 01 Inoculated seed with *Alternaria carthami*	0.1%
3	998 Breeder seeds + 02 Inoculated seed with *Alternaria carthami*	0.2%
4	995 Breeder seeds + 05 Inoculated seed with *Alternaria carthami*	0.5%
5	990 Breeder seeds + 10 Inoculated seed with *Alternaria carthami*	01%
6	00 Breeder seeds +1000 Inoculated seed with *Alternaria carthami*	100%

Methodology:

1. Collect the treatment wise harvested seed of safflower from STRU, MPKV, Rahuri center
2. Test the treatment wise seeds using blotter test to assess the recovery of *Alternaria carthami*
3. For laboratory test use four replications.
4. Use 1000 seeds for each replication
5. Data sheet provided separately to the corresponding centre shortly

Observation to be recorded –

A. Laboratory Assay

1. Per cent Seed Infection of *Alternaria carthami*

Data sheet –

Treatment No	Treatments	Per cent Seed Infection
1	1000 Breeder seeds + 00 Inoculated seed with *Alternaria carthami*	
2	999 Breeder seeds + 01 Inoculated seed with *Alternaria carthami*	
3	998 Breeder seeds + 02 Inoculated seed with *Alternaria carthami*	
4	995 Breeder seeds + 05 Inoculated seed with *Alternaria carthami*	
5	990 Breeder seeds + 10 Inoculated seed with *Alternaria carthami*	
6	00 Breeder seeds +1000 Inoculated seed with *Alternaria carthami*	

Crop: For other disease respective centres shall decide for crop and diseases to develop seed health standard

Target Diseases: To be decided by centres from amongst disease for which field standards are available.

Centres proposed: JNKVV, Jabalpur; MPKV, Rahuri; PAU, Ludhiana; GBPUAT, Pantnagar and ICAR-IARI, New Delhi (05)

Experiment 6: Systematic studies for evaluation of alternative chemicals for effective management of seed-borne pathogens of major crops

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

Year of start: 2021-22

Status: Continued for 2024-25

Crops: Paddy, Pigeon pea, Green gram, Black gram, Groundnut, Soybean

I. Project title: Effect of seed dressing fungicides on seed and seedling associated pathogens of Paddy

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

Centres and pathogens

Centre	Disease	Pathogen
AAU, Anand; OUAT, Bhubneshwar	Blast	*Pyricularia grisea*
RPCAU, Pusa; TNAU, Coimbatore; PAJANCOA, Karaikal; GBPUA&T, Pantnagar; AAU, Jorhat, JNKVV, Jabalpur, Karnal, OUAT Bhubaneswar, PJTSAU, Hyderabad	Brown spot	*Helminthosporium oryzae*
RPCAU, Pusa; MPKV, Rahuri, Karnal, GBPUA&T, Pantnagar	False smut	*Ustilaginoidea virens*
RPCAU, Pusa; MPKV, Rahuri; PAU, Ludhiana; IARI, New Delhi, Karnal	Sheath rot	*Sarocladium oryzae*
CCSHAU, Hisar; IARI (RS), Karnal; PAU, Ludhiana	Bakanae	*Fusarium moniliforme*

Materials and methods:

Seed material: Susceptible rice variety

Fungicides: As listed in treatment details

Techniques adopted: Pot culture

Seed treatment details (Pathogen: As per the centre)

1. Seed treatment with pathogen+Propiconazole 13.9%+Difenconazole 13.9% EC (Taspa) @ 1ml/kg seed
2. Seed treatment with pathogen+Azoxystrobin 18.2% + Difenconazole 11.4% SC (Amistar top) @ 1ml/kg seed
3. Seed treatment with pathogen+Picoxystrobin 6.78% +Tricylcazole 20.33% SC (Galileo Sensa) @ 1ml/kg seed
4. Seed treatment with pathogen+ Trifloxystrobin @25% + Tebuconazole 50% WG (Nativo) @ 0.5g/kg seed
5. Seed treatment with pathogen + Carbendazim 50% WP (Standard Check) @ 2 gm/kg seed

Methodology

Pots of 5 kg capacity filled with sterilized soil and seeds were prior inoculated with test pathogen @ 10^6 conidia/ml and allowed to air dry for 24 hours. Further seeds were again treated with test fungicides and allowed for drying under shaded conditions. Next day, the seeds will be sown by maintaining pathogen treated and untreated controls.

Field Emergence (%)

The field emergence test was conducted by randomly selecting hundred seeds from each treatment in two replications and sown at 4 – 5 cm depth in the well-prepared seedbed with adequate moisture content. The number of seedlings that emerged above the ground after

the prescribed days after sowing was evaluated and considered normal seedlings. Field emergence was expressed as a percentage.

$$\text{Field emergence (\%)} = \frac{\text{Number of seedlings germinated on eight day}}{\text{Total number of seeds sown}} \times 100$$

Observations to be recorded:

Per cent emergence, per cent seedling mortality and per cent disease incidence will be recorded at 15, 30 and 45 days after sowing. Shoot length (cm), root length (cm) and dry weight (g/plant) will be recorded at 45 days after sowing under controlled conditions.

II. Project title: Effect of seed dressing fungicides on seed and seedling associated pathogens of pigeon pea

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

Centres and Pathogens

Centre	Disease	Pathogen
PJTSAU, Hyderabad; TNAU, Coimbatore; MPKV, Rahuri, VNMKV Parbhani, IISS, RS Bangalore	Wilt	*Fusarium udum*
MPKV, Rahuri	Root rot	*Macrophomina phaseolina*

Materials and methods:

Seed material: Susceptible redgram variety

Fungicides: As listed in treatment details

Techniques adopted: Pot culture

Seed treatment details (Pathogen: *Fusarium udum* and *Macrophomina phaseolina*)

1. Seed treatment with pathogen+ Thiophanate methyl 45% + Pyraclostrobin 5% FS (Xelora)@ 1ml/kg seed
2. Seed treatment with pathogen+ Penflufen 13.28% +Trifloxystrobin 13.2% FS (Ever Golxtend) @ 1ml/kg seed
3. Seed treatment with pathogen+ Carbendazim 50% WP (Standard check) @ 2gm/kg seed

Methodology

Pots of 5 kg capacity filled with sterilized soil and redgram seeds were prior inoculated with test pathogen (*Fusarim udum* and *M. phaseolina*) @ 10^6 conidia/ml and allowed to air dry for 24 hours. Further seeds were again treated with test fungicides and allowed for drying under shaded conditions. Next day, the seeds will be sown by maintaining pathogen treated and untreated controls.

Field Emergence (%)

The field emergence test was conducted by randomly selecting hundred seeds from each treatment in two replications and sown at 4 – 5 cm depth in the well-prepared seedbed with adequate moisture content. The number of seedlings that emerged above the ground after the prescribed days after sowing was evaluated and considered normal seedlings. Field emergence was expressed as a percentage.

$$\text{Field emergence (\%)} = \frac{\text{Number of seedlings germinated on eight day}}{\text{Total number of seeds sown}} \times 100$$

Observations to be recorded:

Per cent emergence, per cent seedling mortality and per cent disease incidence will be recorded at 15, 30 and 45 days after sowing. Shoot length (cm), root length (cm) and dry weight (g/plant) will be recorded at 45 days after sowing under controlled conditions.

III. Project title: Effect of seed dressing fungicides on seed and seedling associated pathogens of green gram and black gram

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

Centres and pathogens

Centre	Disease	Pathogen
A. Green gram		
PJTSAU, Hyderabad; TNAU, Coimbatore; MPKV, Rahuri; VNMKV, Parbhani; PAJANCOA, Karaikal; AAU, Anand; OUAT, Bhubaneshwar; CCSHAU, Hisar; AAU, Jorhat; PAU, Ludhiana, RARI Durgapura	Root rot	*Macrophomina phaseolina*
B. Black gram		
PJTSAU, Hyderabad; TNAU, Coimbatore; PAJANCOA, Karaikal; PAU, Ludhiana, RARI Durgapura	Root rot	*Macrophomina phaseolina*

Materials and methods:

Seed material: Susceptible green gram and black gram variety

Fungicides: As listed in treatment details

Techniques adopted: Pot culture

A. Seed treatment details for green gram (Pathogen: *Macrophomina phaseolina*)

1. Seed treatment with pathogen+ Penflufen 13.28% + Trifloxystrobin 13.2% FS (Ever Golxtend) @ 1ml/kg seed
2. Seed treatment with pathogen+ Pyraclostrobin 5% + Metiram 55% WG (Cabriotop) @ 1g/kg seed

3. Seed treatment with pathogen+ Carbendazim 50% WP (Standard check) @ 2g/kg seed

B. Seed treatment details for black gram (Pathogen: *Macrophomina phaseolina*)

1. Seed treatment with pathogen+ Penflufen + Trifloxystrobin (Ever Golxtend) @ 1ml/kg seed
2. Seed treatment with pathogen+ Pyraclostrobin 5% + Metiram 55% WG (Cabriotop) @ 2g/kg seed
3. Seed treatment with pathogen+ Carbendazim 50% WP (Standard check) @ 2gm/kg seed

Methodology:

Pots of 5 kg capacity filled with sterilized soil and greengram/blackgram seeds were prior inoculated with test pathogen (*M. phaseolina*) and allowed to air dry for 24 hours. Further seeds were again treated with test fungicides and allowed for drying under shaded conditions. Next day, the seeds will be sown by maintaining pathogen treated and untreated controls.

Field Emergence (%)

The field emergence test was conducted by randomly selecting hundred seeds from each treatment in two replications and sown at 4 – 5 cm depth in the well-prepared seedbed with adequate moisture content. The number of seedlings that emerged above the ground after the prescribed days after sowing was evaluated and considered normal seedlings. Field emergence was expressed as a percentage.

$$\text{Field emergence (\%)} = \frac{\text{Number of seedlings germinated on eight day}}{\text{Total number of seeds sown}} \times 100$$

Observations to be recorded:

Per cent emergence, per cent seedling mortality and per cent disease incidence will be recorded at 15, 30 and 45 days after sowing. Shoot length (cm), root length (cm) and dry weight (g/plant) will be recorded at 45 days after sowing under controlled conditions.

IV. Project title: Effect of seed dressing fungicides on seed and seedling associated pathogens of groundnut

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

Centres and Pathogens

Centre	Disease	Pathogen
PJTSAU, Hyderabad; TNAU, Coimbatore; PAJANCOA, Karaikal; AAU, Anand; OUAT, Bhubaneshwar; MPKV, Rahuri, RARI Durgapura	Seed & collar rot	*Aspergillus niger*
PJTSAU, Hyderabad; AAU, Anand	Stem rot	*Sclerotium rolfsii*

Materials and methods:

Seed material: Susceptible groundnut variety

Fungicides: As listed in treatment details

Techniques adopted: Pot culture

Seed treatment details (Pathogen: *Aspergillus niger* and *Sclerotium rolfsii*)

1. Seed treatment with pathogen+ Penflufen 13.28% + Trifloxystrobin13.2% FS (Ever Golxtend) @ 1ml/kg seed
2. Seed treatment with pathogen+ Thiophanate methyl 45% + Pyraclostrobin5% FS (Xelora) @ 1ml/kg seed
3. Seed treatment with pathogen+ Carboxin 37.5% WS + Thiram 37.5% WS (Vitavax power) @ 3gm/kg seed

Methodology

Pots of 5 kg capacity filled with sterilized soil and groundnut seeds were prior inoculated with test pathogen (*A.niger* and *Sclerotium rolfsii*) and allowed to air dry for 24 hours. Further seeds were again treated with test fungicides and allowed for drying under shaded conditions. Next day, the seeds will be sown by maintaining pathogen treated and untreated controls.

Field Emergence (%)

The field emergence test was conducted by randomly selecting hundred seeds from each treatment in two replications and sown at 4 – 5 cm depth in the well-prepared seedbed with adequate moisture content. The number of seedlings that emerged above the ground after the prescribed days after sowing was evaluated and considered normal seedlings. Field emergence was expressed as a percentage.

$$\text{Field emergence (\%)} = \frac{\text{Number of seedlings germinated on eight day}}{\text{Total number of seeds sown}} \times 100$$

Observations to be recorded:

Per cent emergence, per cent seedling mortality and per cent disease incidence will be recorded at 15, 30 and 45 days after sowing. Shoot length (cm), root length (cm) and dry weight (g/plant) will be recorded at 45 days after sowing under controlled conditions.

V. Project title: Effect of seed dressing fungicides on seed and seedling associated pathogens of Soybean

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

Centres and Pathogens

Centre	Disease	Pathogen
PJTSAU, Hyderabad; MPKV, Rahuri; GBPUA&T, Pantnagar; JNKVV, Jabalpur; PAU, Ludhiana; AAU, Jorhat; IISS, RS Bangalore; VNMKV, Parbhani	Charcoal rot	*Macrophomina phaseolina*

PJTSAU, Hyderabad; MPKV, Rahuri; GBPUA&T, Pantnagar, JNKVV, Jabalpur; VNMKV, Parbhani	Anthracnose	*Colletotrichum dematium*

Materials and methods:

Seed material: Susceptible soybean variety

Fungicides: As listed in treatment details

Techniques adopted: Pot culture

Seed treatment details (Pathogen: *Macrophomina phaseolinal* and *Collectotrichum dematium*)

1. Seed treatment with pathogen+ Thiophanate methyl 45% + Pyraclostrobin 5% FS (Xelora) @ 1ml/kg seed
2. Seed treatment with pathogen+ Penflufen + Trifloxystrobin (Ever Golxtend) @ 1ml/kg seed
3. Seed treatment with pathogen + Carboxin 37.5% WS + Thiram 37.5% WS (standard check) @ 3 gm/kg seed

Methodology

Pots of 5 kg capacity filled with sterilized soil and soybean seeds were prior inoculated with test pathogen (*Macrophomina phaseolina* and *Collectotrichum dematium*) @ 10^6 conidia/ml and allowed to air dry for 24 hours. Further seeds were again treated with test fungicides and allowed for drying under shaded conditions. Next day, the seeds will be sown by maintaining pathogen treated and untreated controls.

Field Emergence (%)

The field emergence test was conducted by randomly selecting hundred seeds from each treatment in two replications and sown at 4 – 5 cm depth in the well-prepared seedbed with adequate moisture content. The number of seedlings that emerged above the ground after the prescribed days after sowing was evaluated and considered normal seedlings. Field emergence was expressed as a percentage.

$$\text{Field emergence (\%)} = \frac{\text{Number of seedlings germinated on eight day}}{\text{Total number of seeds sown}} \times 100$$

Observations to be followed:

Per cent emergence, per cent seedling mortality and per cent disease incidence will be recorded at 15, 30 and 45 days after sowing. Shoot length (cm), root length (cm) and dry weight (g/plant) will be recorded at 45 days after sowing under controlled conditions.

NOTE: Any midterm corrections can be made in technical programme as per need of the experimentation and suggestions.

List of Co-operating Scientists

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20	ANDUAT, Ayodhya	Dr. Divya Singh	Scientist	ds39772@gmail.com	7786900363
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D. Seed Entomology

Date: 23.04.2024 & 03.05.2024

Chairman	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Convener	:	**Dr. Amit Bera** Senior Scientist, ICAR-CRIJAF, Barrackpore
Co-Convener	:	**Dr. Anjitha George** Co-Principal Investigator/Sr. Scientist ICAR-Indian Institute of Seed Science Regional Station, Bengaluru
Co-Convener	:	**Dr. Arvind Nath Singh** Co-Principal Investigator/PS & Head Crop Protection Division ICAR-Indian Institute of Vegetable Research Varanasi

Technical programme 2024-25

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

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

Year of start: 2006
All STR 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 sample's specific location should be recorded through GPS. Information on category of farmer (Large, medium and small as per land holding) should also be taken. **Centres with both entomologist and pathologist should work in collaboration. Assigning sample number before seed health test will help to correlate insect infestation and fungal infection (if any) after getting results of seed health test by both entomologist and pathologist.** 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 Demonstration of 'Efficacy of commercially available Neem products against storage insect-pests during storage under ambient condition'

Year of start: 2023

Crop	Centre	Packaging Size
Wheat	MPKV, Rahuri	40Kg
Paddy	AAU, Jorhat	30kg
Cowpea	TNAU, Coimbatore	4kg
Green gram	OUAT, Bhubaneswar; UAS, Dharwad	8kg
Chickpea	IISS, Mau	30kg
Sorghum	PDKV, Akola	5kg
Pigeon pea	PJTSAU,Telengana	4kg
Black gram	PAJANCOA, Karaikal	8 kg
Field pea	CSAUAT, Kanpur	24 kg

Objectives

1. To demonstrate the efficacy of commercial Neem formulations against major storage insect-pests damaging seeds and storability of treated seeds.

Special Note: This experiment will be continued in its existing format. **Fresh set of treatments will not be initiated during 2024-25 as decided by the expert committee during plenary session since no deviation was observed from previous years' regular experiment. Recording of observation will be continued at least up to 12 months for the experiment initiated during 2023-24.** Centres should report the results as soon as storage duration completes.

Observation to be recorded

- Seed germination, seed moisture
- Insect infestation (% kernel damage and types of insects)

- 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. **Benefit Cost ratio should also be worked out for each treatment.**

Experiment 3: Demonstration of 'Studies on the effect of insecticidal seed treatment on seed viability during storage under ambient condition'.

Year of start: 2023

Crop	Centre	Packaging Size
Wheat	IISS, Mau	40Kg
Paddy	PJTSAU, Telangana	30kg
Pigeon pea	PDKV, Akola	4kg
Cowpea	UAS, Bangalore; UAS, Dharwad	4kg
Green gram	TNAU, Coimbatore	8 kg
Chickpea	MPKV, Rahuri;	30kg
Pearl millet	JAU, Junagadh	2kg
Sorghum	SKNAU, Jobner	5kg
Black gram	PAJANCOA, Karaikal	8 kg
Field pea	CSAUAT, Kanpur	24 kg

Objectives:

1. To demonstrate the efficacy of spinetoram against major storage insect-pests damaging seeds and storability of treated seeds.

Special Note: This experiment will be continued in its existing format. **However fresh set of treatments will not be initiated during 2024-25 as decided by the expert committee during plenary session since no deviation was observed from previous years' regular experiment. Recording of observation will be continued at least up to 12 months for the experiment initiated during 2023-24. Centres should report the results as soon as storage duration completes.**

Observation to be recorded

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

Benefit cost ratio should also be worked out for each treatment.

Experiment-4: Studies on the effect of Entomopathogens and inert dust on storage insect pests and seed quality during storage under ambient condition.

Objectives:

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

Crop	Centre	Test insect
Maize	TNAU, Coimbatore; RPCAU, Dholi	*S. oryzae*
Wheat	CSAUAT, Kanpur; RPCAU, Dholi	*S. oryzae*
Paddy	PJTSAU, Hyderabad; PAJANCOA, Karaikal; RPCAU, Dholi; AAU, Jorhat; OUAT, Bhubaneswar	*R. dominica*
Cowpea	UAS, Bangalore; UAS, Dharwad	*C. maculatus*
Black gram	UAS, Bangalore; PAJANCOA, Karaikal; AAU, Jorhat	*C. maculatus*
Chickpea	MPKV, Rahuri; JAU, Junagadh; PDKV, Akola	*C. maculatus*
Green gram	TNAU, Coimbatore; SKNAU,Jobner; OUAT, Bhubaneswar; CCSHAU, Hisar	*C. maculatus*
Pearl millet	JAU, Junagadh; SKNAU,Jobner	*R. dominica*
Sorghum	MPKV, Rahuri; NAU, Navsari	*R. dominica*
Pigeon pea	PDKV, Akola; UAS, Dharwad; NAU, Navsari	*C. maculatus*
Field pea	CSAUAT, Kanpur	*C. maculatus*

A. Treatment:

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

B. Packaging Material: HDPE bags

Replications: 3 **Design:** CRD

Methodology: One kg of freshly harvested certified seed with very high percentage of germination and low moisture content (<10%) will be taken for each treatment and treated with the appropriate dose of entomopathogens and seeds will be shaken manually for approximately 2 minutes to achieve uniform distribution of the conidial powder with the seed mass. Seeds will be packed and kept in room under ambient temperature. The temperature and relative humidity of the room will be recorded on standard weekly basis.

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

Observation to be recorded at every three months interval:

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

Experiment 5: Studies on efficacy of plant based neutral silica on storage insects and seed quality during storage under ambient condition

Objectives:

1. To evaluate the effect of **plant-based silica** against major storage insect-pests damaging seeds.
2. Study of the storability of treated seeds.

Year of modification: 2023

A. Treatments:

T_1 - Neutral silica @ 2500 ppm (2.5g/Kg)
T_2 - Neutral silica @ 3000 ppm (3 g/Kg)
T_3 - Neutral silica @ 3500 ppm (3.5g/Kg)
T_4 - Diatomaceous earth @ 5g/kg seed
T_5- Deltamethrin@1 ppm
T_6- Untreated control

B. Packaging Material: HDPE bags

Replications: 3 **Design:** CRD

Crop	Centre
Wheat	IISS, Mau; RPCAU, Dholi
Paddy	TNAU, Coimbatore; PJTSAU, Hyderabad; AAU, Jorhat; OUA&T, Bhubaneswar
Pearl millet	JAU, Junagadh; SKNAU,Jobner
Sorghum	NAU, Navsari
Black gram	UAS, Bangalore; UAS, Dharwad; PAJANCOA, Karaikal; UAS, Raichur
Cowpea	PDKV, Akola; UAS, Dharwad
Chickpea	MPKV, Rahuri; JAU, Junagadh
Green gram	UAS, Bangalore; AAU, Jorhat; CSAUAT, Kanpur
Pigeon pea	PJTSAU, Hyderabad; PDKV, Akola
Field pea	CSAUAT, Kanpur; RPCAU, Dholi
Vegetable cow pea	IIVR, Varanasi

Methodology: Freshly harvested certified seed with very high percentage of germination and low moisture content (<10%) will be taken for each treatment. One kg seeds for each replication of the treatment will be treated with the required quantity of test material. After uniform mixing, seed should be packed in HDPE bags and kept in room under ambient condition. The temperature and relative humidity of the room will be recorded on weekly basis. Control will also be kept under ambient conditions.

Observations

Residual toxicity: Take out 100 g of treated seed, release 10 adult insects *Rhizopertha dominica /Sitophilus oryzae, Callosobruchus chinensis* or important insects depending upon the crop and record mortality after 1, 3, 5 and 7 days after release of test insect 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 content
- Insect infestation (% kernel damage and types of insects)
- 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 6: Studies on the effect of insecticidal seed treatment on seed viability during storage under ambient condition.

Objectives:

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

Year of start: 2023

Crop	Centre
Wheat	IISS, Mau; CCSHAU, Hisar; CSAUAT, Kanpur; ANDUAT, Ayodhya
Paddy	PJTSAU, Telangana; AAU, Jorhat; OUA&T, Bhubaneswar
Pigeon pea	PJTSAU,Telengana; PDKV, Akola
Cowpea	UAS, Bangalore; UAS, Dharwad
Green gram	TNAU, Coimbatore; OUA&T, Bhubaneswar; CSAUAT, Kanpur; UAS, Raichur
Chickpea	MPKV, Rahuri; UAS, Dharwad,
Pearl millet	JAU, Junagadh, SKNAU, Jobner
Sorghum	MPKV, Rahuri; PDKV, Akola
Black gram	TNAU, Coimbatore, UAS, Bangalore; PAJANCOA, Karaikal
Groundnut	JAU, Junagadh
Field pea	CSAUAT, Kanpur
Horse gram	IISS-RS, Bangalore.
Vegetable pea	IIVR, Varanasi

Treatment:

A. Chemical

1. Broflanilide @ 1 ppm (300 SC @3.33 mg /kg seed)
2. Broflanilide @ 2 ppm (300 SC @6.66 mg/kg seed)
3. Broflanilide @ 3 ppm (300 SC @9.99 mg /kg seed)
4. Dinotefuran @ 1 ppm (20SG @5 mg/kg seed)
5. Dinotefuran @ 2 ppm (20SG @10 mg/kg seed)
6. Dinotefuran @ 3 ppm (20SG @20 mg/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: Jute bag of 2 kg capacity

Replications: 3 **Design:** CRD

Methodology: 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 insects)
- Presence / Absence of insects (live and dead)

Benefit cost ratio should also be worked out for each treatment.

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- **Experiment No. 1** on 'Survey & evaluation of seed health status of farmers' saved seed' will be continued in its existing format. Survey should be done following proper sampling procedure. Specific location of sample collection should be recorded through GPS. Centres with both entomologist and pathologist should work in collaboration. Assign sample number before seed health test and try to correlate seed health after getting results of seed health test by both entomologist and pathologist. **Advisories will be prepared based of last 5-8 years survey data for communication to the concerned State Department of Agriculture through SAU wherever quality of farmers' saved seed was found poor.**
- **Experiment 2:** Demonstration of 'Efficacy of commercially available Neem products against storage insect-pests during storage under ambient condition' will be continued in its existing format. **Fresh set of treatments will not be initiated during 2024-25 as decided by the expert committee during plenary session since no deviation was observed from previous years' regular experiment. However, IISS, Mau will repeat the experiment since there was problem of seed germination in chickpea. Recording of observation will be continued at least up to 12 months for the experiment initiated during 2023-24.** Centres should report the results as soon as storage duration completes.
- **Experiment No. 3** on 'Studies on the effect of insecticidal seed treatment on seed viability during storage under ambient condition' will be continued in its existing format. **However fresh set of treatments will not be initiated during 2024-25 as decided by the expert committee during plenary session since no deviation was observed from previous years' regular experiment. Recording of observation will be continued at least up to 12 months for the experiment initiated during 2023-24. Centres should report the results as soon as storage duration completes.**
- **Experiment No. 4** on "Studies on the effect of Entomopathogens and inert dust on storage insect pests and seed viability during storage under ambient condition" will be

continued in existing format. **PJTSAU, Telangana will send required formulations on payment basis**.

- **Experiment No. 5** on '**Studies on efficacy of plant based neutral silica on storage insects and seed quality during storage under ambient condition'** will be continued in existing format and 2 centres, **IIVR, Varanasi for vegetable cowpea and UAS, Raichur for black gram.** Required quantity of Neutral silica will be supplied by IIRR, Hyderabad and PJTSAU, Telangana will coordinate the delivery to different centres.

Experiment 6 on 'Studies on the effect of insecticidal seed treatment on seed viability during storage under ambient condition' will be continued in existing format **with addition of 3 centres i.e. IIVR, Varanasi for vegetable pea, UAS, Raichur for green gram and ANDUAT, Ayodhya for wheat crop**

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

A. For laboratory experiments

S. No.	Items	Amount (Rs.)
A	**Expenditure / Cost**	
1	Recurring cost on imposing the treatment	
a	Cost of packaging material / ton of seed	
b	Cost of insecticide treatment/ ton of seed	
c	Any other cost	
2	Salary component (as per man-days spent for imposing treatments)	
3	Miscellaneous cost	
	Sub total	
4	Interest on working capital (@ 12% per annum for total above, adjusted accordingly as per duration of experiment)	
	Total Expenditure / cost (A)	
B	**Gross income by imposing the treatment**	
1	Price / sale value of seed (Rs./ton)	
2	Price/ value of grain (Rs./ ton)	
	Gross Income by imposing the treatment (B) (B1-B2)	
	BC ratio for selling as seed (B/A)	
C	**Loss due to insect infestation**	
1	Seed damage loss due to insect (enumerate % damage in control to quantum per ton) (Say % damage in control is 15.0%, quantum of damaged seed will be 150 kg/ton)	
2	Monetary loss due to seed damage (Rs./ton) (C1 X B1)	
	BC ratio (considering only seed damage) (C2/A)	

A. For field experiments

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

Note:

1. The above information needs to be calculated for individual/every treatment
2. Expenditure, income etc. may be calculated on per quintal basis for storage experiment

List of Co-operating Scientists

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3	ICAR-IISS, Mau	Dr. Anjitha George	Sr. Scientist & Co-PI	Anjitha.S@icar.gov.in; anjithakitty@gmail.com	8623937913
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5	UAS, Bangalore	Dr. Manja Naik	ASRO (Seed Ento.)	naik_196710@yahoo.com;	7338305680
6	JAU, Jamnagar	Dr. Jyothi R. Sondarya	Asst. Prof.	sondarvajyoti6568@gmail.com;	-
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13	CSAUAT, Kanpur	Dr. CL Maurya	Head, DSST & I/c STR	clmaurya@csauk.ac.in;	9453479077
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E. Seed Processing

Date: 23.04.2024 & 03.05.2024

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

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

Co-Convener : **Dr. P. Shivamma**
Co-Principal Investigator/Scientist
ICAR-Indian Institute of Seed Science
Mau

Special mention:

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

Recommendations:

1. Optimum bottom/ grading sieve size for processing new crop varieties

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 under IMSCS. These modifications are based on the data generated by different centers of AICRP on Seed (Crops) on various crops as per the following table.

Crop / Seed Size (categories)	Variety	IMSC Recommended Sieve Size (mm)	Standardized Sieve Size (mm)
Paddy			
Medium slender	PB 1847	1.80 s	1.90 s
Medium slender	PB 1885	1.80 s	1.80 s
Medium slender	PB 1886	1.80 s	1.80 s
Coarse/ Bold	ASD 21	1.85 s	2.00s
Medium slender	ADT 54	1.80 s	1.50 s
Medium slender	KKL (R) 2	1.70 s	1.70 s
Medium slender	PR 130	1.70 s	1.60 s
Small seeded	DRR Dhan 58	1.70 s	1.55 s
Small seeded	PDKV Ganesh	1.70 s	1.60 s
Medium seeded	PDKV Sakoli (Red Rice 1)	1.80 s	1.40 s
Bold seeded	PDKV Sadhana	1.85 s	1.80 s
Bold seeded	Sakoli 8	1.85 s	1.80 s
Bold seeded	SYE 2001	1.85 s	1.80 s
Small seeded	GNV 1109	1.70 s	1.80 s
Wheat			

Crop / Seed Size (categories)	Variety	IMSC Recommended Sieve Size (mm)	Standardized Sieve Size (mm)
Bold seeded	HI 1654	2.30 s	2.40 s
Bold seeded	HI 1620	2.30 s	2.40 s
Bold seeded	HD 3410	2.30 s	2.40 s
Bold seeded	HD 3390	2.30 s	2.40 s
Bold seeded	PBW 824	2.30 s	2.30 s
Bold seeded	PBW 826	2.30 s	2.30 s
Chickpea			
Medium seeded	BGD 111-1	5.50 r	6.00 r
Medium seeded	PDKV Gulak	5.50 r	5.50 r
Medium seeded	PDKV Harita	5.50r	6.00 r
Medium seeded	PDKV Kanak	5.50 r	6.00 r
Bold seeded	PKV Kabuli-2	6.00 r	7.00 r
Bold seeded	PKV Kabuli-4	6.00 r	8.00 r
Bold seeded	Vishal	6.00 r	7.00 r
Bold seeded	Digvijay	6.00 r	7.00 r
Bold seeded	Phule Vishwaraj	6.00 r	7.00 r
Soybean			
Small seeded	DSb 34	4.00 s	3.75 s
Medium seeded	KDS 753	4.00 s	4.75 s
Medium seeded	KDS 726	4.00 s	4.75 s
Medium seeded	KDS 992	4.00 s	4.75 s
Bold seeded	PDKV Amba	4.00 s	5.00 s
Bold seeded	Suvarna Soya	4.00 s	5.00 s
Maize			
Medium seeded	MAH 14-138	6.40/ 7.00 r	6.50 r
Pigeon pea			
Bold seeded	BRG 5	4.75 r	5.00 r
Medium seeded	KRG 33	4.00 r	3.75 r
Medium seeded	BSMR 853	4.00 r	4.00 r
Medium seeded	PDKV Ashlesha	4.00 r	4.75 r
Bold seeded	Maruti	4.75 r	4.75 r
Bold seeded	AKT 8811	4.75 r	4.75 r
Bold seeded	Phule Trupti	4.75 r	4.75 r
Black gram			
Bold seeded	CO 7	2.80 s	3.20 s
Bold seeded	BDU 12	2.80 s	3.20 s
Bold seeded	TRCRU 22	2.80 s	3.00 s
Green gram			
Medium seeded	TRCRM147	2.80 s	2.60 s
Medium seeded	VBN 4	2.80 s	2.70 s
Dhaincha			
Medium seeded	CSD 137	---	1.8 s
Medium seeded	CSD 137	---	1.60 s
Field bean			
Medium seeded	HA 5	6.50 r	6.00 r

Crop / Seed Size (categories)	Variety	IMSC Recommended Sieve Size (mm)	Standardized Sieve Size (mm)
Finger millet			
Medium seeded	KMR 340	1.40 s	1.20 r
Sunflower			
Medium seeded	CMS 1103 A	2.40 s	2.40 s
Medium seeded	RHA 92	2.80 s	2.80 s
Small Seeded	CMS-38 A	2.40 s	2.00 s
Small Seeded	R-127-1	2.40 s	1.80 s
Small Seeded	RGM-49	2.40 s	1.80 s
Bold Seeded	RSFH-700	2.80 s	2.80 s
Bold Seeded	RSFH-1887	2.80 s	2.80 s

2. Assessment of postharvest deterioration of soybean seed quality

Introduction: Soybean (*Glycine max* (L.) Merril) stands out as the main oil seed (18-22% oil and 38-42% protein content) grown and consumed in the world. Soybean seed is highly susceptible to mechanical injury and damage during harvesting as well as different stages of post-harvest handling, which affects the viability and vigour of seeds during storage. Nearly, 9-10 % of seeds are wasted due to faulty management during harvesting and post-harvest handling *viz.*, threshing, processing (cleaning and grading), transportation and storage. Losses can be minimized by the use of proper harvesting method/ tools, timely harvesting at optimum moisture content (maturity stage), avoiding severe beating during threshing (threshing at optimized drum speed), adopting grading practices and storage conditions. The referred study conducted by identifying the suitable threshing method, optimizing the threshing process parameters and carrying out seed processing with different mechanical graders/ separators and resulted in maintaining the seed germination and improving the seed quality.

Technique/specifications: The study carried out with various independent variables *viz.*, moisture content during harvesting and threshing (≤15% and >15%), method of threshing (Stick beating, multi crop thresher with concave clearance of 20-25mm at 350-450rpm and 500-800 rpm drum speed and combine harvester at 700rpm drum speed) followed by cleaning, size grading, gravity separation, spiral separation and storage and tested for various soybean seed quality parameters at Dr. PDKV, Akola, UAS, Raichur and MPKV, Rahuri.

Salient Findings: Soybean seed threshed mechanically with multi crop thresher moisture level between 12-14% and 15-17% has recorded high and low seed germination percentage, respectively also low mechanical damage at Dr. PDKV, Akola. Manually threshed seed using stick beating with hand at physiological maturity (MC≥15%) recorded better seed quality followed by seeds threshed using multi crop thresher at UAS, Raichur and MPKV, Rahuri also about 90.33% seed germination recorded in the seed sample collected immediately after

manual threshing at UAS, Raichur. Reduced loss in germination percentage was observed when seed threshed at the drum speed of 350-450 rpm and 500-800 rpm recorded 3-5% and 6-10% germination percent loss at Dr. PDKV, Akola. Overall seed processing unit operations improved the seed germination percentage about 2-4% due to upgrading seeds at Dr. PDKV, Akola. Low seed damage, electrical conductivity, seed mycoflora values were low and high in the seeds threshed manually with hand beating at harvest maturity MC≥15% and combine harvester at harvest maturity MC<15%, respectively and the same trend of seed quality was recorded even after 210 days of seed storage recorded at MPKV, Rahuri.

Conclusion: Unlike other seeds that have protected embryonic axis, the embryonic axis of soybean seeds is exposed, which makes them susceptible to physical injuries caused by external agents, this eventually affects their physiological qualities. Therefore, the equipment used for seed threshing and processing needs to be well regulated in order to obtain satisfactory results. Experiment revealed that at harvest maturity MC≥15% seeds threshed with stick beating resulted in 91.42% of seed germination. Mechanically, use of multi crop thresher at concave clearance of 20-25mm at 350-450rpm drum speed at harvest maturity MC<15% resulted in 88.7-86.7% of seed germination. Threshing (manually or mechanically) preceded by seed processes cleaning, size grading, gravity separation, spiral separation improved the seed germination by 2-4%.

Centre involved: Dr. PDKV, Akola, UAS, Raichur and MPKV, Rahuri

Technical programme 2024-25

Experiment 1: Optimum sieve size and type of screen for grading seeds of different crop varieties and hybrids including their parents.

Year of start: 2010-11 (continuous in nature)

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; PAJANCOA & RI, Karaikal; UAS, Raichur; PAU Ludhiana; ICAR-IISS, Mau; SHUATS, Prayagraj
Wheat	:	ICAR-IARI RS, Karnal; PAU Ludhiana; ICAR-IISS, Mau; SHUATS, Prayagraj
Mustard	:	ICAR-IARI New Delhi; ICAR-IISS, Mau
Chickpea	:	MPKV, Rahuri; UAS Dharwad; PDKV, Akola; ICAR-IISS, Mau
Black gram	:	TNAU, Coimbatore; PAJANCOA&RI, Karaikal; UAS Dharwad

Green gram : UAS, Raichur; PAJANCOA & RI, Karaikal; PAU Ludhiana
Pigeon pea : UAS, Bengaluru; UAS, Raichur; PDKV, Akola
Soybean : UAS, Dharwad; UAS, Raichur; MPKV, Rahuri; PDKV, Akola
Maize : UAS, Bengaluru; UAS, Raichur
Field bean : UAS, Bengaluru
Sunflower : UAS, Bengaluru
Linseed : UAS Dharwad
Minor millets : UAS, Bengaluru; UAS, Raichur and TNAU, Coimbatore
(Finger millet, Kodo millet, Barnyard Millet, Foxtail millet)
Forage crops : IGFRI RRS, Dharwad
(Lucerne, *Stylosanthes hamata*, *Desmanthus virgatus*, Guinea grass, *Brachiaria ruziziensis*, Sirato, Fodder Sorghum)
Soybean (Veg.) : UHS Bagalkot
Chilli : UHS Bagalkot

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 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 No. 2: Performance evaluation of solar tunnel dryer for drying of soybean seed

Objectives:

1. Standardization of drying parameters for soybean seed drying in solar tunnel dryer
2. To study the effect of drying on seed quality parameters.

Year of start: 2023-24
Crop: Soybean
Center: Dr. PDKV, Akola, UAS, Raichur and MPKV, Rahuri

Technical Programme
Treatments
I) Varieties: 1. JS 335
2. One ruling variety

II) Drying methods
1. Control (Sun drying)
2. Drying in solar tunnel dryer

III) Moisture content: Existing moisture content (7 seed lots)
IV) Thickness of seed bed: 10 mm
Observations

i. Inside and outside Temperature, ^{0}c
ii. Inside and outside Relative humidity, %
iii. Air velocity at inlets & outlets
iv. Moisture removed, %
v. 100 seed weight, g
vi. Germination Test, g
vii. Vigor index I and II
viii. Physical purity, %

Expected Output: Viability of solar tunnel drying for quick drying of soybean seed
Probable beneficiaries of the outcome of this work: Seed growers, Farm Producer companies, farmers

List of Co-operating Scientists

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Session VI

Plenary Session

Date: 03.05.2024 **Time: 3.00 PM to 4.30 PM**

Chairman	:	**Dr. D.K. Yadava** ADG (Seed), ICAR, New Delhi
Convener	:	**Dr. Sanjay Kumar** Director, ICAR-IISS, Mau
Rapporteurs	:	**Dr. Vishwanath Koti,** SRO, UAS, Bengaluru **Dr. Alok Kumar,** Scientist, ICAR-IISS, Mau

Session was chaired by Dr. D.K. Yadava, ADG (Seeds), ICAR, New Delhi and convened by Dr. Sanjay Kumar, Director, ICAR-IISS, Mau. At the outset, Dr. Sanjay Kumar welcomed the dignitaries present during the plenary session of the AGM of AICRP on Seed (Crops). The session proceedings commenced with presentations of principal investigators of respective STR themes, where the finalized recommendations for 2023-24 and the technical programme for 2024-25 were accentuated upon. In succession, recommendations that emerged from all of the technical sessions were deliberated and consolidated for chalking out the action plan.

The experiment, Optimization of organic seed production systems in selected crops discussed thoroughly Dr. D.K. Yadava and Dr. Sanjay Kumar suggested to develop seed certification standards for organic seed production and not to use hybrids in this experiment. While, in the experiment, Optimization of seed rate for enhancing seed yield and recovery of pure live seed, Dr. Sanjay, suggested to drop wheat from experiment as its response for low seed rate is not appreciable. During presentation of PGPR mediated seed coating for quality seed production experiment, Dr. R. R. Hanchinal, Former Chairperson, PPV&FRA, New Delhi, suggested to have single source of bio fertilizers and Dr. M. Bhaskaran, Former Vice Chancellor, TNOU, Chennai suggested need to sow immediately after treatment. Dr. D.K. Yadava, ADG (Seeds), ICAR, New Delhi suggested to try for soybean production in southern states of India and that should be encourage and need to be enhanced. One new experiment - *i.e*. Studies on Synchronization of crop maturity and dates of pod picking on seed yield and quality of Lucerne was proposed by Principal Investigator and Dr. Vinod, Scientist, IGFRI, RS, Dharwad explained problem associated with Lucerne seed production. Dr. D.K. Yadava, ADG (Seeds), ICAR, New Delhi suggested to conduct pilot trails before going to multiple centres experiments.

Dr. Shiv K. Yadav - Principal Investigator of Seed Physiology and Testing presented total six experiments which are in and recommendations. He also proposed new experiment *viz*.1. Studies on seed dormancy in minor millet-crops, 2. Humanization the reporting of germination percentage with fresh un-germinated and hard seeds for certification purpose. 3. Standardization of seed testing protocols for germination, physical purity and moisture

content in medicinal and aromatic crops and all experiments are thoroughly discussed and accepted for implementation.

Dr. Atul Kumar, Principal Investigator of Seed Pathology presented four experiments and recommendations. While, Dr. Ashwani Kumar, Principal Investigator of seed processing presented continued two experiments and new crops added to seed processing experiments.

Recommendations of different technical sessions were presented *viz*., Dr. Gireesh C, Principal Scientist, ICAR-IISS, RS, Bangalore presented proceeding and six recommendations arrived from inaugural session. Dr. T. Ramanadane, Prof. & Nodal Officer (Seed), PAJANCOA & RI, Karaikal presented proceedings and recommendations of 27th Annual Breeder Seed Review meeting. Dr. S. Kavitha, SRO, Seed Centre, TNAU, Coimbatore presented proceedings and recommendations of session-II. Achievements under Seed Technology Research and quality seed production during 2023-24 by principal investigations and identification of Technology by panel experts. While, proceedings of Technical Session III and IV: Centre wise presentation of Achievements under Quality Seed Production and Seed Technology and Research during 2023-24 was presented by Dr. Anjitha George, Senior Scientist, ICAR-IISS, RS, Bangalore. Proceedings of Session V: Panel discussion on forging collaboration for furthering contemporary seed research and augmenting seed production and its recommendations was presented by Dr. Anandan. A, Principal Scientist, ICAR-IISS, RS, Bangalore.

Felicitation was given to superannuating scientists. Dr. D.K. Yadava, ADG (Seeds), ICAR, New Delhi and Dr. Sanjay, Director, IISS, Mau felicitated the scientists viz., Dr. Basave Gowda, UAS, Bangalore; Dr. Ravindranath Hunje, UAS, Dharwad; Dr. R. S. Shukla, JNKVV, Jabalpur; Dr. A.V. Solanke, MPKV, Rahuri; Dr. I. Meghachandra Singh, ICAR RC NEHR, Manipur Centre; Dr. Udaykumar Gopalrao Kachole, MPKV, Rahuri; Dr. Pravinchandra H. Patel, SDAU, SK Nagar; Dr. Prakash Borah, AAU, Jorhat; Dr. Karam Chand Dhiman, CSKHPKV, Palampur and Dr. Bapusaheb Dattatraya Patil, MPKV, Rahuri. Dr. D.K. Yadava acknowledged the works of these scientists and Dr. Sanjay also appreciated the contributions of these retiring personalities under AICRP on Seed Crops).

The session was ended with vote of thanks by Dr. Madhusudan. K, Organizing Secretary & Special Officer (Seeds), AICRP on Seed (Crops), UAS, Bangalore.

During the detailed deliberations, following action points were emerged:

- Under experiment on optimization of seed rate for enhancing the seed yield and recovery of pure seed under seed production and certification theme of STR component, it is proposed that groundnut be added in place of wheat, considering the needs. **[Action: PI (Seed Production & Certification)]**
- In the experiment aimed at enhancing seed yield and quality of offseason soybean through the application of plant growth regulators, the experimental centers need to identify newly released promising soybean varieties suitable for their respective regions. **[Action: PI (Seed Production & Certification) & Concerned Nodal Officers, AICRP on Seed (Crops)]**

Contacts of Principal Investigators and Co-Principal Investigators
STR – AICRP on Seed (Crops)

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Note: All centres shall communicate the experimental results timely to concerned PIs & Co-PIs with a copy to the Coordination Unit of AICRP on Seed (Crops).

AICRP on Seed (Crops) Monitoring Team for 2024-25
(*Kharif* season: Sept. / Oct. 2024; *Rabi* season: Feb. / Mar. 2025)

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Calendar of Events for QSP & 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 DAC&FW & SAU's	15th January	15th June
3.	Communication of indents by DAC&FW to ICAR Headquarters.	28th February	15th July
4.	Communication of Breeder Seed Production Plan in BSP-1 by Project Coordinator (Crop) to DAC&FW and ADG (Seed), ICAR	15th May	15th September
5.	Communication of the BSP-2 by the concerned Breeder to DAC&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 DAC&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 DAC&FW	15th February	15th July
8.	Communication of the Allocation of Breeder seed by DAC&FW to Director of Agriculture and concerned indenter's	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 DAC&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 on Seed (Crops)			
1.	Communication of technical programme for STR experiment to centres	May of the year	

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- field and storage experiments	31st January	31st July
5.	Submission of Monitoring Team Report to ICAR-IISS, Mau	First week of March	
6.	Annual Group Meeting of AICRP on Seed (Crops)	1st or 2nd week of April/ May	

हर कदम, हर डगर
किसानों का हमसफर
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