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Annual Report

2015-16

भाकृअनुप
ICAR

भा.कृ.अनु.प.–भारतीय बीज विज्ञान संस्थान
ICAR-Indian Institute of Seed Science

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ICAR-INDIAN INSTITUTE OF S E E D SCIENCE, MAU

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SECRETRIAL ASSISTANCE
Ramnayan Yadav

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Preface

Seed is the *numero uno* input for productive agriculture and it determines the response of all other inputs viz., irrigation, fertilizer and plant protection chemicals etc. Indian Council of Agricultural Research (ICAR) launched the All India Coordinated Research Project on seeds as National Seed Project in 1979 and subsequently based on the overall progress and ever growing importance of seed in modern agriculture, the ICAR further upgraded the Project Coordination Unit of the then National Seed Project to the status of the Project Directorate in X Plan and named it as Directorate of Seed Research (DSR). Directorate of Seed Research started operating since 31 December 2004 from Kushmaur village in the district of Maunath Bhanjan, UP. Having proven its contribution in a decade long journey in the areas of quality seed production and seed technological research, the Council in its Governing Body meeting in 2016 has further upgraded the Directorate of Seed Research to Indian Institute of Seed Science (IISS).

ICAR-IISS, Mau has made significant contributions in the areas of promoting quality seed production in the adjacent region, skill development through imparting training on quality seed production and demonstrations of useful technologies such as line sowing, zero tillage, seed priming & treatment and growth hormone spray etc. at farmers' fields. On research front, its significant achievements include genetic purity testing through molecular markers (3 patents have been filed), seed priming technologies to boost the seed vigour & seed yield and also to overcome the adverse effect of soil salinity in the region, bio-priming, conservation tillage practices for quality seed production and devising agro-techniques for reducing the seed rate in wheat without affecting the seed yield and quality.

ICAR launched All India Coordinated Research Project on seed i.e. 'National Seed Project' in 1979-80, which in due course became one of the flagship projects of ICAR itself. The National Seed Project has been strengthened very well over the years which in turn developed state of art facilities both in respect of infrastructure and capacity building in seed realm. At present, the Breeder Seed Production (BSP) programme is operating at 41 centres and Seed Technology Research (STR) in 24 centres at various SAUs and ICAR institutes across the country. *In toto* 365 staff including scientific (109), technical (219), administrative (14) and auxiliary (23) are engaged in implementation of project across the country. In augmenting seed sector, launch of AICRP – NSP (Crops) was instrumental which has led to sea change in the seed sector as witnessed by increase from a meager breeder seed production of 3914 quintals during 1981–82 to a level of 128312.76 quintals during 2014-15 and during 2015-16 it is anticipated to reach 124841.67 quintals, surpassing the indents received both from DAC&FW and state governments. Under Seed Technology Research (STR) component technologies have been evolved to solve various issues faced by seed growers and seed industries. Some of the salient achievements of seed technology are optimization of isolation

requirements, genetic purity tests, seed quality enhancement, seed health care, processing, packaging, value addition and safe storage etc.

Visualizing the achievements of AICRP –NSP (Crops) and realizing the importance of strengthening seed production infrastructure facilities and also to provide a boost to Seed Replacement Rate (SRR) and Varietal Replacement Rate (VRR) in the country, ICAR had launched ICAR Seed Project on "Seed Production in Agricultural Crops & Fisheries" during X five year plan for field crops, horticulture and fisheries. The project has resulted in enhanced supply of seeds including planting material and fish seeds. Production of foundation seed during 2014-15 (86942 quintals) shown 67.43 % increase over base year i.e. 51925 quintals in 2005-06 whereas, certified/TFL seed production has increased from 96413 quintals during 2005-06 to 110501 quintals during 2014-15 which accounts for 15 % increase over base year. With respect to participatory seed programme, quality seed production increased from 32303 quintals during 2005-06 to 248269 quintals during 2014-15 registering 668 % increase over base year. Under ICAR Seed Project, on an average of 350 Trainings/ Field days/ Seed days per annum have been conducted by diverse cooperating centres for diverse stakeholders of seed domain.

It is a matter of great pleasure for me to present Annual Report 2015-16 of ICAR- Indian Institute of Seed Science, Mau. I place on record my heart felt gratitude to Dr. T. Mohapatra, Hon'ble Secretary DARE & Director General ICAR and Dr. S. Ayyappan, Former Secretary DARE & DG, ICAR for their genial support and dynamic leadership to this institute to excel in the arena of seed science research. I also express my sincere thanks to Dr. J.S. Sandhu, Deputy Director General (Crop Science), for his incessant guidance and support for all the endeavours. My sincere thanks are also due to Dr. J. S. Chauhan, ADG (Seed) and staff of the Seed Unit, Crop Science Division, ICAR for their support in smooth conductance of research and development of the institute. I convey my thanks to all the staff members of ICAR-IISS, Mau who have worked with sincerety for coordination of network projects as well as for execution of *in-house* research projects. My special thanks to Dr. Dinesh K. Agarwal, Dr. S. P. Jeevan Kumar and other editorial team members for very well compiled and timely published Annual Report. I have a firm belief and trust that in years to come ICAR-IISS, Mau would excel in seed science research and would provide national leadership in attaining seed security for the country.

Maunath Bhanjan

Date : 31.05.2016

(S. Rajendra Prasad)
Director

Introduction

Subeejam Sukshetre Jayate Sampadhyate (Good Seed in Good Soil Yields Abundantly), the often quoted verse from *Manu Smriti* is self revealing. Sustained food grain production in the country despite of abnormal weather conditions for last couple of years could largely be credited to the use of quality seed of improved varieties/ hybrids, improved farming practices along with ingenuity and industry of Indian farmers. Progress in seed research, production and development has been spectacular and brought about visible growth in the activities/enterprise that provides inputs-services-supplies to the seed industry. Launching of AICRP – NSP (Crops) was a phenomenal milestone in Indian seed sector which has led to a sea change, as witnessed by increase from a meager breeder seed production of 3914 quintals during 1981 – 82 to a level of 128312.76 q in 2014-15. The breeder seed production during 2015-16 (*Kharif*, 2015 and *Rabi*/Summer 2015-16) is anticipated to reach 124841.67q against the indent of 122304.49q. The breeder seed production has amended the availability of quality seeds in subsequent generations in the seed multiplication chain and also resulted in increased Seed Replacement Rate (SRR) of various crops.

The Indian Institute of Seed Science, Mau is the leading coordination unit of seed science research and quality seed production in the country marching ahead with renewed vigour to face the challenges and harness the domestic and global opportunities for the welfare of seed growers, farmers and other stake holders in seed supply chain. It is working with a missionary zeal to secure country's food and nutritional security through ensuring the seed security. Indian Institute of Seed Science is a unique institute of ICAR, engaged exclusively in coordination and conduction of seed science research countrywide. Besides its mandate for undertaking seed production and seed technology research, the institute is deemed to undertake training and capacity building in this important sector of agriculture. At present the country is experiencing gradual increase in seed replacement rate (SRR), which needs to be increased substantially in the years to come for improved productivity and production of agricultural crops. As per the recommendations of Quinquennial Review Team (QRT); creation of centre of excellence across best performing seed technology research centres, exposure visits and advanced training of the scientists in reputed labs (both national & international), strong maintenance breeding and sufficient recurring contingency for testing of genetic purity using molecular tools was emphasized during XII plan. Seed technology research in respect of seed entomology, pathology, physiology and molecular biology would develop appropriate technological backstopping, which would help the seed industries, farmers and other entrepreneurs for quality

seed production and their perpetuation at large scale for the great cause of productive agriculture in the country. The programmes undertaken at IISS are focused at increasing the Seed Replacement Rate (SRR) and Varietal Replacement Rate (VRR) in crops through increased seed production, standardization of improved seed production technology in different crops, enhancing the quality of seeds, standardization of seed testing procedures and deciphering the mechanism of seed germination, dormancy, vigour and longevity at molecular level especially at genomic and proteomic levels.

Vision

To ensure the quality seed security to the farmers through technological intervention and sustainable agriculture.

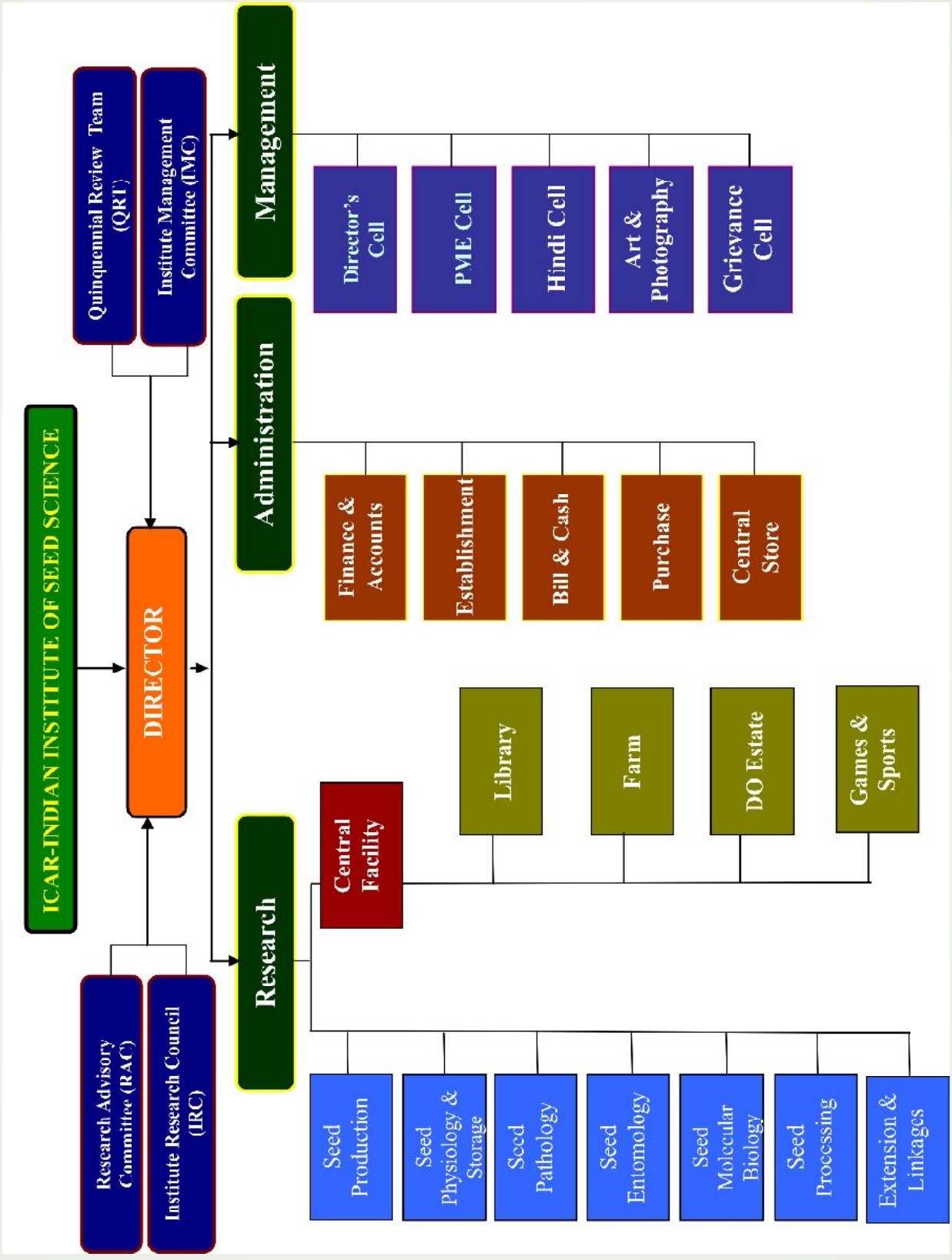
Mission

Enhancing genetic and physical characteristics of seed for increased productivity, quality and sustainability.

Mandate

- To conduct basic, applied, strategic and anticipatory research in diverse fields of seed science and technology.
- To function as apex centre for coordination of breeder seed production activity and seed technology research under AICRP-NSP.
- To function as apex centre for coordination of quality seed production activity of field crops under ICAR Seed Project.
- To have liaison with PPV&FR Authority and supporting research for protection of new varieties of crop plants under PPV&FR act.
- To undertake Human Resource Development (HRD) through imparting training to the field staff, scientists, farmers and different stakeholders in the field of seed production, testing and certification in different crops.

Organogram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Director's Cell
PME Cell
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Grievance Cell
Administration
Finance & Accounts
Establishment
Bill & Cash
Purchase
Central Store
Research
Central Facility
Library
Farm
DO Estate
Games & Sports
Seed Production
Seed Physiology & Storage
Seed Pathology
Seed Entomology
Seed Molecular Biology
Seed Processing
Extension & Linkages

Executive Summary

Significant achievements have been registered by Indian Institute of Seed Science, Mau in quality seed production as well as research during 2015-16 by conducting basic, applied, strategic and anticipatory research in seed science and technology and in effective coordination and monitoring of nationwide network projects, as envisaged in its mandate. During the current year, anticipated breeder seed production under AICRP-NSP (Crops) amounted to 124841.67 quintals, surpassing the indents received both from DAC&FW and state governments in addition to 5.76 lakh quintals of quality seed production of field crops under the project 'Seed production in agricultural crops'.

At present in Indian Institute of Seed Science, Mau 21 scientists have been working on 22 *in house* research projects. With the limited infrastructure and small farm, the institute at its farm has produced 38.00 quintals of breeder seed of paddy varieties such as IR 36, IR 64, MTU 7029 and BPT 5204; 122.00 quintals of foundation & TFL seed of paddy; approximately 20.00 quintals of breeder seed of wheat varieties such as HD 2733, HD 2059 and HI 1563; 80.00, 5.00 and 5.00 quintals of quality seed of wheat, lentil and mustard, respectively. These seeds were processed in institute's own processing unit and sold to the farmers and other Government organizations in the locality to popularize quality seeds in bringing farm prosperity.

Field and laboratory experiments conducted at the institute during the year generated invaluable scientific information and development of user-friendly agro-techniques. The salient research achievements during 2015-16 in ICAR-IISS, Mau are as under:

- Assessment of genetic purity is one of the most important quality control components in seed production. Simple Sequence Repeat (SSR) marker RM228 was found to be able to differentiate DRRH3 rice hybrid from 23 major paddy hybrids and its parental lines cultivated in India and it was revalidated for 46 major rice varieties cultivated in Uttar Pradesh as well. In addition, some other markers such as RM 505, RM 519, RM 565, RM 169, RM 286 and RM 251 were developed to assess the genetic purity of thirty two rice varieties.
- In the project entitled "QTL mapping for seed vigour in rice (*Oryza sativa* L.)", F_2 population has shown 3:1 ratio of segregation pattern (based on prominent basal leaf: sheath colour). Further, the generated 800 F_2 plants have been advanced (through SSD method) to F_3 RILs population.
- In a study to delineate physiological, biochemical and anatomical changes during seed ageing in soybean, 30 genotypes of soybean were screened for their storage potential. Kalitur, MACS 1416, DSB 21, EC 18761 and CO1 were recorded as genotypes with good storability, while DS 228, JS 71-05, MAUS 61, NRC 93 and DSB24 with poor storability. The genotypes

with good storability were found to be deteriorating slowly as a result of lower lipoxygenase activity and lipid peroxidation, higher antioxidants and antioxidative enzymes activity and better cell membrane integrity. Anatomical changes after 10 months storage revealed that the integrity of cell membrane and turgidity of cotyledon and embryonic axis cells were maintained in good storer genotype as that of fresh seed.

- The major limitation in storing groundnut produce/seeds is the deterioration of seeds by Reactive Oxygen Species (ROS) which include superoxide, hydroxyl radical, hydrogen peroxide and singlet oxygen. Furthermore, it has been hypothesized, that the changes may take in lipid composition. To evaluate the changes, the collected groundnut genotypes such as TMV-2, K-6, K-9, ICGV-9114, ICGV-00348, Dharani and TAG-24 were subjected to GC-MS, FT-IR, respectively. Further analysis is being carried out.
- For Improving hybridization efficiency and seed set, floral characteristics and floral behavior of finger millet among cultivated, wild accessions from 5 different species of genera *Eleusine (africana, indica, tristachya, multiflora and jaegeri)* were studied. Wide variations were observed in flowering behaviour of *Eleusine* species. Wide differences in flowering period were observed in cultivated *E. coracana* when compared to rest of the wild species. Wild species took more days (7 - 10) to attain full blooming than the domesticated *E. coracana* (3 - 4). The time of anther dehiscence is early in wild species (1.30 AM – 4.00 AM) with peak anther dehiscence around 2.30 AM, where as in domestic cultivars it is between 3.00 AM – 6.00 AM, with a peak anther dehiscence around 4.00 AM.
- Hybrid seed setting has increased by 4-6% by exogenous application of experimental chemicals over control. This increase in yield can be attributed by increase in the panicle exsertion (4-6%), stigma exsertion (4-10%), spikelet opening angle (2-4°) and flag leaf angle (2-5°). Further, expression analysis of flowering associated gene (*GS3*) among the two PRH10 and DRRH2 rice hybrids is being carried out under these chemical spray regime.
- The priming effect of GA_3 for seed yield was found significant in almost all the varieties of chickpea except BGD 72. The seed recovery in bio- priming was found higher than GA_3 priming in almost all the varieties. In case of bio-priming for Pusa 362, the seed recovery was higher (76.58%) than GA_3 priming (73.17%). Considering all varieties, GA_3 primed varieties showed higher return of seed yield.
- In an experiment to study the effect of paddy straw derived smoke water treatment on seed quality parameters, rapid uptake of water coupled with swift mobilization of seed reserve (carbohydrates) were found to be correlated with the increase in germination rate and seedling vigour under the smoke water treatment.
- In the project "Hydropolymers: as regulatory switch for germination and smart delivery system in hybrid seed production of maize", nano fibre synthesis with the use of biodegradable polymer system was carried out at CIRCOT, Mumbai. Nano spinning with cellulose acetate was tried at electro-

spinning facility, CIRCOT and promising results with reference to nano fibres production were recorded.

- Uses of various types of chemicals and growth regulators are very costly and needs special skill to use them and may cause natural hazards, whereas botanicals are relatively cheaper, easily available to the farmers, safe to handle and can easily be prepared. In a study on botanicals for enhancing seed quality a number of plant species such as *Oscimum tenuiflorum* (Tulsi), *Azadirachta indica* (Neem), *Dalbergia sisso* (Shisam), *Carissa carandas* (Karonda), *Bambuseae* (Bans), *Ficus sycomorus* (Pakad), *Syzygium cumini* (Jamun) were found effective for paddy.
- Nine field demonstrations on enhancement of wheat seed yield through GA_3 spraying in standing crop were conducted on farmer's field in 05 selected villages under extension programme (Model Village Scheme) near by IISS, Mau. On the basis of data recorded the average increase in wheat grain yield is estimated up to 10 percent over untreated control.
- In an experiment on bio-priming under pot culture and soil application, *Brevibacterium halotolerans*, *Bacillus methylotropicus* and *Bacillus aerophilus* increased upto 10-15% seed germination in comparison to control in paddy. Better root and shoot length, hence, better vigour index have also been observed in case of *Brevibacterium halotolerans* treated seeds in comparison to control.
- A total of 300 bacterial strains were isolated from rhizosphere, endosphere and phylloplane of rice, wheat and mustard from various places of different agro-climatic zones of India. All the strains were tested for the bio-control assay against several pathogens causing diseases in rice, wheat and mustard. A total of 35 bacterial strains were found potential against *Fusarium oxysporum* sp. *ciceri, Ustilaginoidea virens, Magnaporthe oryzae, Drechslera teramera* and *Sclerotium rolfsi* pathogens.
- In a study on estimation of economic threshold level of important insect pests in paddy and mustard seed crops, yield, seed yield & seed recovery percentage were found to be inversely proportional to aphid density. Study further revealed that seed yield was more affected than general yield with the increasing aphid density.
- In a study on development of resistance among storage insect pests against commonly used insecticide deltamethrin, bioassay results showed that 1.2 mg (discriminating dose) killed all susceptible *S. oryzae* insects, while the discriminating dose killed only 80.5%, 72.2%, 92.2%, 70.5% and 68.2% of *S. oryzae* insects from Coimbatore, Palakkad, Bangalore, Bellary and Secunderabad populations respectively. Biochemical assay results demonstrated that deltamethrin resistant Secunderabad population showed significant ($p<0.05$) increases in CYP450- PNOD (3.0-fold) and GST-CDNB activities (1.4-fold) compared to the susceptible strain. Consequently, it is deduced that CYP450s together with GSTs seem to be involved in resistance development to deltamethrin insecticide in secunderabad population of *S. oryzae*.

- In a survey of paddy growers among certified seed growers of paddy in Karimnagar district of Telangana, non-availability of labour as opined by 58 percent of the farmer respondents was the most important constraint hindering the adoption of paddy seed production technology. The other reasons constraining seed production technology were lack of irrigation water, lack of awareness / knowledge, non-availability of basic seed, marketing of product, small holding size and high cost of cultivation.
- Weed Seed Repository of ICAR-IISS, Mau is being enhanced through regular collection, documentation and display of weed seeds. Already 32 species of *Kharif* weeds from farm land of institute have been collected during 2014 and further 25 more species have been added to collection during 2015-16.

During the year 2015-16, in addition to *in house* research projects, ICAR-IISS, was also actively engaged in coordination and monitoring of following network projects:

1. AICRP – National Seed Project (Crops)
2. Seed production in agricultural crops

Project wise salient findings/ achievements

AICRP-National Seed Project (Crops)

I. Breeder seed production

The progress of breeder seed production of improved varieties with superior genetics and distribution is taking place at an incredibly faster pace, as witnessed in increased breeder seed production of 128312.76q as against the indent of 112152.07q in 2014-15 (*Kharif*, 2014 and *Rabi*/ Summer 2014-15). The breeder seed production during 2015-16 (*Kharif*, 2015 and *Rabi*/Summer 2015-16) is anticipated to reach 124841.67q against the indent of 122304.49q. The breeder seed production has amended the availability of quality seeds in subsequent generations in the seed multiplication chain and also resulted in increased Seed Replacement Rate (SRR) of various crops.

II. Seed Technology Research

Research highlights of experiments conducted in different disciplines / divisions *viz.*, Seed Production & Certification; Seed Physiology, Storage and Testing; Seed Pathology; Seed Entomology and Seed Processing under AICRP-NSP (Crops) STR component during 2015-16 at different cooperating centers are given below:

- Investigations on standardization of isolation distance for hybrid seed production in wheat revealed the pollen flow from contaminator line (red glumed) resulting in seed set on tester line (white glumed) which was upto 8m and 4m in downward and upward wind direction respectively.
- The effect of various pre-sowing interventions for enhancing seed quality, health, yield and storability suggested that in chickpea, seed treatment with leaf extract (*Lantana camara* 10%) recorded higher germination (95%) while seed priming with vitavax powder @ 0.25% for 8 h recorded significantly lower wilt incidence (6.67%) and higher number of pods (120.87 per plant) and seed yield (1995.30 kg/ha).

- Effect of pinching/ foliar sprays in Sun hemp (*Crotolaria juncea*) shown that number of pods/plant (91.57), seeds/ pod (8.27), seed yield/plot (1.541 kg) and seed yield/ha (770.50 kg), were significantly higher with pinching of terminal bud at 65 days after sowing along with foliar application of DAP (2%)+Micro nutrient mixture (ZnSO4 0.5%+Boric acid 0.3%)+NAA @ 40 ppm.
- In a bid to standardize the techniques to mitigate effects of elevated temperature, investigations in sorghum (*cv*. CSH 14) revealed that two foliar sprays (vegetative & seed filling stages) of salicylic acid (400 ppm) exhibited significantly superior seed setting (98.27 %), 100 seed weight (2.29 g), seed yield (26.66 q/ha) and germination (87.66%) under first sowing condition (standard sowing date). In second sowing condition (late sown, flowering & seed set coincides high temperature stress) also two foliar spray (vegetative & seed filling stages) of salicylic acid (400 ppm) recorded significantly superior seed setting (93.33%), seed yield/plant (26.21g), seed yield (24.55 q/ha).
- In Finger millet (*cv*. ML 365), priming of seeds with 2% (KH_2PO_4) for 6h (1:1 w/ v) followed by seed treatment with carbendazim @2.5g/kg, transplanting (21 days old seedling) and application of organic and inorganic fertilizers along with borax spray (125 kg neem + 1250 kg vermicompost + 50 kg urea + 50 kg SSP and 50kg MOP per ha + top dressing urea at 3-4 weeks after transplanting + 2% Borax during flowering) exhibited significantly higher seed yield (61.50g/ plant; 3.31kg/plot and 55.20q/ha) over the control (direct sowing & normal package of practice) (24.80g/ plant;1.20kg/plot and 20.04q/ha).
- In onion, mustard and rapeseed, all seed encrustation treatments had detrimental effect which significantly reduced seed germination, field emergence and final plant stand over hydro-priming and control.
- Seedling length, primary and secondary root length, root volume, root and shoot weight and root density were found to be good seed vigour traits in rice hybrid seed resulting in higher number of tillers and leaf area index and higher yield.
- In maize hybrid, SVI I and SVI II were found to be concurrent with few root parameters (root volume, root-shoot ratio). Further, 1000 seed weight is positively correlated with seed vigour and seed yield.
- SSR markers RM 234, RM 228, RM 279, RM 237 and RM 84 have been found to be unique for JRH 5 rice hybrid which can be employed for ascertaining genetic purity.
- RM 234 and RM 279 were identified as the specific SSR markers for paddy hybrid JRH 8 and JRH 9, respectively.
- RM 228 is found to be unique SSR marker for DRRH 3 rice hybrid which can identify any potential contaminant from PSD 1, PSD 3, PRH 10, NDRH 2 and thirty two popular rice varieties.
- Pulsed Electromagnetic Field (PEMF) treatment @ 50 Hz & 100 Hz improves germinability and vigour in tomato and green gram, respectively.
- The seeds of soybean stored in super grain bags along with desiccant beads (Zeolite beads @ 0.15kg/1.5kg of seed

& silica gel @ 0.30kg/1.5kg of seed) recorded maximum seed quality attributes even after 4 months of storage with least infection of storage insects.

- Dry dressing of seed with elemental and metal oxide nanoparticles *viz*., silver and ferrous oxide @ 1250mg/kg of seed recorded better germination, vigour indices and other physiological attributes of seed quality in maize.
- Hydro priming (with thiram @ 0.25%) and biopriming (*T. viride* @10g/kg seed) for six hours resulted in higher field emergence and speed of germination in popular desi chickpea cultivar Pusa 547.
- Priming with 2.5% solution of KNO_3 (1:2 w/v) improves seed yield by 3.3-14.5% in different crops (wheat, pearl millet, sorghum, mungbean, pigeonpea and chickpea).
- Seed treatment with HYT-D @ 3ml/kg seed significantly improves necessary seed quality parameters for higher field emergence, yield attributing traits and seed yield in maize, paddy, soybean and pearlmillet.
- A total of 25 demonstrations of seed priming technology were organized at farmers' field across the centers during 2015-16 and farmers were convinced upon low cost technological intervention for maximizing grain yield (7.5-10% advance in grain yield).
- Standard blotter method is best suited technique for the detection of *Macrophomina phaseolina, Fusarium oxysporum, Colletotrichum dematium* (*Colletotrichum truncatum*) associated with soybean, mungbean, urdbean and sesame seeds.
- PCR based detection technique for detection of chilli anthracnose fungus *Colletotrichum truncatum* (Ccap F; Ccap R.); *Colletotrichum gloeosporioides* (Cboncoll F; Cboncoll R.); *Colletotrichum coccoides* (Cco 1NF1; Cco2NR1) associated with seed have been validated.
- False smut (*Ustilaginoidea virens*) is a potential threat in paddy seed production. Field experiment conducted at 03 centers revealed that, foliar application of propiconazole @ 0.1% at boot stage resulted in maximum disease control.
- Critical monitoring on new emerging seedborne diseases indicated presence of septoria blotch of wheat (*Septoria nodorum*) at Anantnag and Baramulla districts of Jammu & Kashmir and rice bunt (*Tilletia barclayana*) at Thanjavur district of Tamil Nadu.
- Investigations on analysis of farmers' saved seed samples indicated alarming association of Karnal bunt of wheat (*Tilletia indica*) in Punjab, Haryana, Himachal Pradesh, and Uttarkhand; *Macrophomina phaseolina, Fusarium oxysporum* with soybean in Madhya Pradesh, Maharashtra and Rajasthan and *Aspergillus flavus* with groundnut in Gujarat, Maharashtra, Odisha and Andhra Pradesh.
- Effective management of cumin blight (*Alternaria burnsii*) has been achieved through three application of Azoxystrobin (0.25%) at 10 days interval resulting in minimum disease intensity (8.87%) and minimum association (3.95%) of *Alternaria burnsii* in harvested cumin seeds.

- Bio-priming of safflower seeds with *Trichoderma harzianum* + *Pseudomonas fluorescens* @ 05 g each resulted in least association (10.00%) of *Fusarium carthamii* with enhanced seed germination (92.00%) and disease control (77.78%).
- Among various newer insecticides evaluated along with standard chemical (Deltamethrin) against major storage insect-pests damaging cereals and pulse seeds, Emamectin benzoate (Proclaim 5SG) @ 2 ppm (40.0 mg/kg seed), Spinosad (Tracer 45 SC) @ 2 ppm (4.4 mg/kg seed) were on par with Deltamethrin (Decis 2.8 EC) @1.0 ppm and provided maximum control against storage upto 6-9 months. On the other hand, Profenofos (Curacron 50 EC) @ 2ppm (0.004ml/kg seed), Chlorfenapyr (Intrepid 10 EC)@2ppm (0.02ml/kg seed), Rynaxypyr (Coragen 20 SC) @ 2ppm (0.01ml/kg seed) and Novaluron (Rimon 10 EC) @ 5ppm (0.05ml/kg seed) were effective to some extent but not as effective as Emamectin benzoate, Spinosad or Deltamethrin.
- Paddy seeds treated with Flubendiamide (Fame 480 SC) (4.2 mg/kg seed), Emamectin benzoate (Proclaim 5SG) @ 2 ppm (40.0 mg/kg seed), Spinosad (Tracer 45 SC) @ 2 ppm (4.4 mg/kg seed), Deltamethrin 2.8 EC (0.04ml /kg seed) and stored in moisture impervious bags like super grain bags maintained seed germination above IMSCS with minimum insect infestation upto 9 months period.
- Among 1667 samples of farmers saved seed evaluated for seed health status revealed that about 66.50% seed samples were having germination above IMSCS but large proportion (39.40%) of seed samples were infested with storage pests. About 26.10% samples were having insect damage beyond seed certification standard. The intensity of damaged seed usually varied from 0.25-5.0%.
- Bee pollination plays major role in improving quantity of seed produced in berseem. Apart from seed yield, parameters like seed germination and vigour improved substantially due to bee pollination. In case of pigeon pea, other pollinators like leaf cutter bee, carpenter bee play major role in pollination.
- CO_2 concentration of 50% (v/v) provide effective protection against *Khapra* beetle in wheat, groundnut beetle in groundnut and pulse bruchid in green gram and pigeon pea without affecting seed quality upto 6-9 months storage.
- Effectiveness of CO_2 treatment in 200L capacity containers for storage of green gram seed has been successfully demonstrated at TNAU, Coimbatore. UAS, Bengaluru and ANGRAU, Hyderabad also demonstrated efficacy of modified atmosphere storage in management of storage insects of paddy.
- Various botanicals i.e., *Acorus calamus* TNAU formulation @ 10 ml/kg seed, neemazal 10000ppm @1.5ml/kg seed, pongamia oil @ 5ml/kg of seed and citronella oil @ 5 ml/kg of seed were tested along with emamectin benzoate and deltamethrin. Results revealed that *Acorus calamus* TNAU formulation treated seeds recorded maximum germination and least insect damage upto six months of storage in paddy, wheat, chickpea, pigeon pea, mung bean, field pea and black gram.

- Three types of insecticide impregnated bags like (a) Treated bag, no lamination, no liner; (b) Treated bag, non-treated lamination, non-treated liner and (c) Treated bag, treated lamination, treated liner were tested along with untreated bag (same fabric i.e. PP Bag) and gunny bag as control. Insecticide impregnated bags were highly effective in management of storage insects of wheat, paddy, maize, chickpea and green gram and maintained seed germination above IMSCS upto 8-10 months of storage.
- Optimum sieve size for processing pigeonpea variety Bahar and Amar was found to be 4.75 mm (R) against recommended 4.00 mm (R) with maximum seed recovery (87-88 %).
- Wheat varieties *viz*., K-9162, K-1006, K-402 and AB-39 showed better seed recovery of 84 to 93% with sieve size of 2.5 mm(O) as against recommended 2.3 mm (O) sieves.
- In mungbean varieties Basanti, Satya and MH-421 grading by 2.4 mm (R) sieve size [existing size-2.6 mm (R)] found effective and economical with maximum seed recovery (79.32, 77.11 and 78.94% respectively) and seed parameters above IMSCS.
- For size grading sunhemp seeds, sieve size of BSS 8 can be used for obtaining the maximum seed recovery and germination.
- The use of combine harvester at 15 cm height of cutter bar from ground level and at 12% moisture content along with 500 rpm drum speed is found most economical and effective for maintaining seed quality during harvesting and threshing of soybean.
- In case of soybean (JS 335), mechanical drying at 30°C for moisture content to fall to a level of 6.00% was found highly economical recording germination (88.0%), 1000 seed weight (86.5g), vigour index-I (3036), mechanical damage (6.0%) and physical purity (98.0%).

ICAR-Seed Project : Seed Production in Agricultural Crops

During the year 2014-15, total production of quality seed including all classes was 576252 quintals against the target of 399175 quintals. Production comprises 97982 quintals of breeder seed, 175622 quintals of foundation seed, 128465 quintals of certified seeds, 140006 quintals of truthfully labelled seed and 34176 quintals of planting material of field crops. In addition, 2018 lakhs planting material and 8.48 lakh tissue culture plantlets were produced against the targets of 204.80 and 3.67 lakhs, respectively.

कार्यकारी सारांश

वर्ष 2015–16 की अवधि में भारतीय बीज विज्ञान संस्थान ने गुणवत्तायुक्त बीज उत्पादन एवं बीज प्रौद्योगिकी संबंधी अनेक आधारभूत, व्यवहारिक, सामरिक एवं अपेक्षित शोध कार्यों में संलग्न रहते हुए अति महत्वपूर्ण राष्ट्रव्यापी परियोजनाओं का सफल एवं प्रभावी संचालन एवं समन्वयन कार्य संपादित किया। इस अवधि में राष्ट्रीय बीज परियोजना के अन्तर्गत प्रजनक बीजों का उत्पादन 124841.67 कुन्तल जो कि कृषि एवं सहकारिता तथा राज्य सरकारों की माँग से ज्यादा थी। इसके अतिरिक्त भारतीय कृषि अनुसंधान परिषद के बीज परियोजना के अन्तर्गत विभिन्न कृषि फसलों की 5.76 लाख क्विंटल बीज का भी उत्पादन हुआ।

वर्तमान में संस्थान में 21 स्थापित वैज्ञानिकों द्वारा कुल 22 घरेलू शोध परियोजनाएं चलायी जा रही हैं। सीमित संसाधनों एवं छोटे फार्म होने के साथ ही अपने फार्म पर 38 क्विंटल ग्रेडेड प्रजनक बीज धान प्रजातियों जैसे आई आर–36, आई आर–64, एमटीयू 7029 तथा बीपीटी 5204 का उत्पादन किया। आधारीय एवं विश्वसनीय बीजों के 122.00 क्विंटल बीज भी इन प्रजातियों के पैदा किये गये। गेहूँ में विभिन्न प्रजातियों जैसे एचडी 2733, एचडी 2059 एवं एचआई 1563 के 20 क्विंटल प्रजनक बीज का उत्पादन हुआ। साथ ही 80.00, 5.00 एवं 5.00 क्विंटल गेहूँ, सरसों एवं जौ के गुणवत्तायुक्त बीजों का उत्पादन हुआ। ये सभी बीज संस्थान के बीज विधायन संयंत्र द्वारा विधायित करके किसानों एवं अन्य सहकारी समूहों को बेचे गए जिससे गुणवत्तायुक्त बीजों की महत्ता को लोग समझें ताकि उनके प्रक्षेत्र आय में वृद्धि हो सके।

संस्थान में प्रक्षेत्र एवं प्रयोगशालाओं में किए गए विभिन्न प्रयोगों द्वारा बहुमूल्य वैज्ञानिक सूचनाएं एवं कृषि तकनीकों का विकास हुआ, मुख्य शोध उपलब्धियां जो वर्ष 2016 में अर्जित की गयी वे निम्नानुसार है।

- बीज उत्पादन में बीजों की गुणवत्ता नियंत्रण हेतु आनुवांशिक शुद्धता का आकलन एक महत्वपूर्ण पहलू है। एसएसआर मार्कर आरएम 228, संकर धान डीआरआरएच–3 को 23 मुख्य संकर धान प्रजातियों एवं उनके पैतृक लाइनों से अलग करने में प्रभावी पाया गया हैं। ये एसएसआर मार्कर उत्तर प्रदेश में उगायी जाने वाली 46 धान प्रजातियों के पुर्नमूल्यांकन में प्रयोग किया गया हैं। इसके अतिरिक्त कुछ और भी मार्कर जैसे आरएम 505, आरएम 19, आरएम 565, आरएम 169, आरएम 286 एवं आरएम 25 को विकसित किया गया जो कि 32 धान प्रजातियों की आनुवांशिक शुद्धता की जाँच में उपयोगी पाये गये।
- घरेलू परियोजना जिसका शीर्षक ''धान में बीज ओज हेतु क्यूटीएल मैपिंग के अन्तर्गत'' एफ2 (F2) आबादी में 3 अनुपात 1 का पृथक्करण पाया गया। 800 एफ2 पौधों को एफ3 आबादी में एसएसडी विधि द्वारा आगे बढ़ाया गया।
- सोयाबीन में बीज उम्र परिवर्तन के दौरान कार्यिकी, जैव–रासायनिक और संरचनात्मक बदलाओं का अध्ययन किया गया, जिसमें सोयाबीन के 30 जिनोटाइप्स मुख्यतः Kalitur, Macs 1416, और Co1 को उच्च भण्डारण क्षमता जबकि DS 288, NRC 93 और DSB 24 को निम्न भण्डारण क्षमता के लिए छाँटा गया। उच्च भण्डारण क्षमता वाले जीनोटाइप्स, Liponygenase और लिपिड पेराक्सिडेशन की कम गतिविधियों तथा उच्च एंटीआक्सीडेंट और एन्टीआक्सीडैटिव एन्जाइम एवं बेहतर अखण्ड कोशिका झिल्ली के कारण मंदता से क्षरित हुये। दस महीने के भण्डारण पश्चात् संरचनात्मक परिवर्तन अध्ययन से पता चलता है कि कोशिका झिल्ली और बीज पत्र एवं भ्रूण ध्रुव

कोशिका की अखण्डता, अच्छे भण्डारण वाले जीनोटाइप्स में नये बीज की तरह लम्बी अवधि तक गुणों को संचित रखते हैं।

- मूँगफली उत्पादन/उत्पादित बीज के भण्डारण में प्रमुख बाधा प्रतिक्रियाशील आक्सीजन प्रजातियो (ROS) जिनमें सुपर आक्साइड, हाइड्राक्सिल रैडिकल, हाइड्रोजन पराक्साइड, सिंगलेट आक्सीजन आदि प्रमुख रूप से क्षय के कारण हैं। और यह भी परिकल्पना की गयी है कि लिपिड संरचना में परिवर्तन हो सकते हैं।
- रागी में संकरण क्षमता एवं बीज दानों का स्थापन बढ़ाने हेतु 05 देशी एवं विदेशी स्पीशीज का अध्ययन किया गया, जिनमे पुष्पण एवं परागण तथा बीज दानों के स्थापन में काफी विभिन्नता पायी गयी।
- धान की संकर प्रजातियों में बीज दानों का 4–6 बढ़ाव प्रतिशत प्रायोगिक रसायन के बाहरी प्रयोग से किया जा सकता है।
- चने की विभिन्न प्रजातियों में जीए–3 द्वारा प्रारंभन चने की उपज बढ़ाने में सार्थक स्तर तक उपयोगी पाया गया है। परन्तु यह प्रभाव बीजीडी 72 प्रभेद में नगण्य है। सीड रिकवरी के संदर्भ में राइजोबियम द्वारा जैव प्राइमिंग करना अधिक उपयोगी पाया गया।
- धान के पुआल द्वारा तैयार स्मोकवाटर से गेहूँ के बीजों के जमाव एवं ओज में धनात्मक प्रभाव पाया गया।
- धान में बीजों की गुणवत्ता में परिवर्तन करने हेतु विभिन्न वानस्पतिक जैसे तुलसी, नीम, शीशम, करौंदा, बांस पाकड़ एवं जामुन के पत्तियों के रस उपयोगी पाये गये।
- गेहूँ में बीज उपज बढ़ाने हेतु GA_3 का पर्णिय छिड़काव प्रक्षेत्र प्रदर्शन के रूप में चयनित पाँच गांवों में सम्पन्न किए गए। जिसके परिणाम के आधार पर यह निष्कर्ष निकाला गया कि GA_3 के छिड़काव द्वारा बीज उपज में औसतन 10 प्रतिशत वृद्धि की जा सकती है।
- एक प्रयोग में ब्रेवीवैक्टीरियम हेलोटोलेरेन्स, बेसिलस मिथाइलोट्रोपीकस नामक जीवाणु से जैव प्रारंभन किया गया जिसमे जमाव एवं बीज ओज के दृष्टिकोण से ब्रेवीवैक्टीरियम हेलोटोलेरेन्स सबसे उपयोगी पाया गया।
- भारत के विभिन्न जलवायु क्षेत्रों से कुल 300 जीवाणुविक प्रभेद धान, गेहूँ और सरसो के राइजोस्फीयर से एकत्रित किये गये। ये सभी जीवाणु प्रभेद धान, गेहूँ एवं मक्का में लगने वाले विभिन्न रोगों के नियंत्रण में जाँचे गये जिसमें कुल 35 जीवाणु प्रभेद फ्यूजेरियम आक्सीस्पोरम, स्पेसीज साइसेराई, यूस्टीलैगीनोआइडीया वाइरेन्स, मैगनापस्थी ओराइजी, ड्रेसीलेरा टेरामेरा एवं स्क्लेरोशियम राल्फसी के विरूद्ध नियंत्रण करने में उपयोगी पाये गये।
- धान एवं सरसो में उपज, बीज उपज एवं बीज परता पर एफीड (माहू कीट) की सघनता के प्रभाव का अध्ययन किया गया जिसमे एफीड (माहू कीट) की सघनता का बीज उपज एवं बीज परता से व्युत्क्रमानुपाती संबंध पाया गया।
- कीटनाशक डेल्टामेथरीन को धान के भण्डारण कीटों को क्रमशः 80.5, 72.2, 92.2, 70.5 एवं 68.2 प्रतिशत क्रमशः कोयम्बतूर, पालाक्काड़, बंगलोर, बेलारी एवं सिकन्दराबाद में नियंत्रित करते पाया गया।
- तेलंगाना के करीम नगर जिले में धान के बीज उत्पादन में प्रमुख बाधा, श्रमिकों की उपलब्धता में कठिनाई को पाया गया। इसके अलावा अन्य कारक जैसे सिंचाई, वैज्ञानिक ज्ञान की कमी, आधार बीज की अनुपलब्धता, बाजार की सुविधाएं उपलब्ध न होना, किसानों की जोत छोटी होना एवं मंहगी खेती भी बीज उत्पादन के कम अपनाये जाने के मुख्य कारण हैं।

- भारतीय बीज विज्ञान संस्थान में स्थापित खरपतवार बीज संग्रहण में लगातार खरपतवारों की संख्या में वृद्धि हो रही है। वर्ष 2014–15 में खरीफ मौसम की खरपतवार की 32 प्रजातियां एकत्रित की गयी थीं जो कि वर्ष 2015–16 में 25 और प्रजातियों के एकत्र हो जाने से कुल संख्या 57 हो गयी।

भारतीय बीज विज्ञान संस्थान, मऊ 2015–16 में घरेलू अनुसंधान परियोजनाओं के संचालन के साथ ही निम्न राष्ट्रीय स्तर के नेटवर्क प्रोजेक्ट्स के समन्वयन और निगरानी में सक्रिय एवं संलग्न रहा है।

1. अखिल भारतीय समन्वित शोध परियोजना– राष्ट्रीय बीज परियोजना (फसल)
2. कृषि फसलों में बीज उत्पादन– भा.कृ.अनु.प. की बीज परियोजना

परियोजनावार प्राप्त शोध उपलब्धियां निम्नानुसार हैं:

अखिल भारतीय समन्वित शोध परियोजना– राष्ट्रीय बीज परियोजना (फसल)

I. प्रजनक बीज उत्पादन

समुन्नत प्रजातियों के अच्छे आनुवंशिकता वाले प्रजनक बीजों का उत्पादन 128312.76 क्विंटल उसके निर्धारित लक्ष्य 112152.07 क्विंटल के विरूद्ध उत्पादित हुआ (खरीफ 2014 एवं रबी ग्रीष्म 2014–15) वर्ष 2015–16 में प्रजनक बीज का उत्पादन निर्धारित लक्ष्य 122304.49 क्विंटल के विरूद्ध 124841.76 क्विंटल अनुमानित है। प्रजनक बीजों के उत्पादन वृद्धि के कारण बीज बदलाव दर विभिन्न फसलों में बढ़ रही है।

II. बीज प्रौद्योगिकी अनुसंधान

इसके अंतर्गत विभिन्न अनुभागों यथा– बीज उत्पादन एवं प्रमाणीकरण, बीज कार्यिकी, भण्डारण एवं परीक्षण, बीज रोग विज्ञान, बीज कीट विज्ञान एवं बीज विधायन के अंतर्गत विभिन्न सहयोगी केन्द्रों पर प्रयोग किये गये जिसका अनुभागवार परिणाम निम्नानुसार है :

- गेहूँ में संकर बीज उत्पादन हेतु पृथक्करण दूरी का मानकीकरण किया गया जिसमें सर्वाधिक बीज स्थापन हेतु 8 मीटर एवं 4 मीटर नीचे और ऊपरी वायु की दिशा में उपर्युक्त पाया गया।
- चने में जमाव पूर्व लगाए गये उपचारों में लैन्टाना कैमारा (10 प्रतिशत) जमाव के दृष्टिकोण से सर्वाधिक उपयोगी पाया गया है। जबकि उकठा रोग के नियंत्रण के लिये विटावैक्स पाउडर 0.2 प्रतिशत द्वारा 8 घंटे के लिए उपचार प्रभावी पाया गया।
- विभिन्न फसलों में गुणवत्ता सुधार हेतु बीज फिल्म कोटिंग पॉलीमर पर अध्ययन किया गया। जिसमें धान में पॉलीमर (डीस्को एजीएसपीआरईडी एल–200 थाइरम कार्बोसिन धान के विभिन्न उपज मानकों एवं उपज हेतु सार्थक स्तर पर उपयोगी पाया गया। उपर्युक्त उपचार मक्का, ज्वार, अरहर एवं सोयाबीन में भी उपयोगी पाये गये। भण्डारण की अवधि में भी यह उपचार बीज गुणवत्ता को बनाए रखने में सफल पाये गये।
- सनहेम्प में बुआई के 65 दिन के उपरांत शीर्ष कलिका की पिंचिंग साथ में डाई अमोनियम फास्फेट का 2 प्रतिशत पर्णीय छिड़काव सूक्ष्म पोषक तत्वों के प्रयोग करने से बीज उपज में सार्थक स्तर तक वृद्धि पायी गयी है।
- ज्वार में बढ़ते तापक्रम के प्रभाव को कम करने के लिए 2 पर्णीय छिड़काव क्रमशः वानस्पतिक अवस्था पर एवं बीज भरने की अवस्था में सैलिसिलिक अम्ल का 400 पीपीएम प्रयोग करने से तापक्रम का प्रभाव कम होता है और बीज उपज में वृद्धि होती है। विलंब से बुवाई की दशा में यह उपचार उपयोगी पाया गया है।
- फिंगर मिलेट प्रजाति एमएल 365 में KH_2PO_4 के 2 प्रतिशत घोल के द्वारा बीज प्रारंभन तत्पश्चात् कार्बेन्डाजीम द्वारा बीज उपचार साथ में कार्बनिक उर्वरकों का उपयोग एवं बोरेक्स स्प्रे बीज उपज हेतु उपयोगी पाया गया।

- संकर धान की प्रजातियों में पौध की लम्बाई प्राथमिक एवं द्वितीय जड़ों की लम्बाई, जड़ घनत्व, जड़ एवं तने का भार, ज्यादा किल्लों एवं पूर्ण क्षेत्रफल उपज के लिए उत्तरदायी हैं।
- संकर मक्के में बीज ओज–1 या बीज ओज–2 का कुछ जड़ संबंधी लक्षणों तथा जड़ घनत्व, जड़–तना का अनुपात से धनात्मक संबंध है। साथ ही 1000 बीज का वजन का धनात्मक संबंध भी बीज ओज एवं बीज जमाव से पाया गया है।
- एसएसआर मार्कर आरएम 234, 228, 289, 237 एवं 84, संकर धान जेआरएच 5 के लिए अतुलनीय पाये गये जो कि आनुवंशिक शुद्धता के लिए प्रयोग में लाये जा सकते हैं।
- आरएम 234 एवं 289 की पहचान विशिष्ट एसएसआर मार्कर के रूप में की गयी है जो संकर धान जेआरएच 8 एवं 9 हेतु क्रमशः उपयोगी पाये गये हैं।
- आरएम 228, विशिष्ट एसएसआर मार्कर संकर धान प्रजाति डीआरआरएच 3 हेतु विशिष्ट पाया गया।
- पल्स इलेक्ट्रोमैगनेटिक फील्ड द्वारा 50 एवं 100 हर्ट्ज की दर से किये गये उपचार में क्रमशः टमाटर एवं मूँग में जमाव हेतु 50 हर्ट्ज टमाटर के लिए और 100 हर्ट्ज मूँग के लिए उपयोगी पाया गया।
- सोयाबीन के बीजों को सुपर ग्रेन बैग के साथ डेसीकेन्ट बीड मिलाकर रखने पर बीज गुणवत्ता कारकों को 4 माह तक बनाए रखने में सफलता मिली और भण्डारण कीट का भी प्रकोप कम पाया गया।
- मक्के के बीज पर तात्विक एवं धात्विक आक्साइड नैनो पार्टिकील से सूखी ड्रेसिंग करने से जमाव और बीज ओज में बढ़ोत्तरी पायी गयी।
- चने की पूसा 547 प्रजाति में जल प्रारंभन (थीरम 0.25 प्रतिशत के साथ) एवं जैव प्रारंभन (ट्राइकोडर्मा विरीडी) करने पर जमाव दर में वृद्धि होती है।
- पोटैशियम नाइट्रेट के 2.5 प्रतिशत घोल द्वारा बीज प्रारंभन करने से गेहूँ, बाजरा, ज्वार, मूँग, अरहर एवं चने में 3.3 से 14.5 प्रतिशत तक की वृद्धि पायी गयी।
- मक्का, धान, सोयाबीन एवं बाजरा में एचवाईटी–डी की 3 मिली/किग्रा बीज की दर से बीजोपचार करने से बीज गुणवत्ता कारकों एवं बीज उपज में वृद्धि पायी गयी है।
- बीज प्रारंभन तकनीकी पर 25 प्रक्षेत्र प्रदर्शन किसानों के क्षेत्र पर किए गए और इस तकनीक से 7.5 – 10 प्रतिशत तक का उपज में वृद्धि पायी गयी। इस प्रकार किसानों द्वारा इस तकनीक को कम खर्च वाली तकनीकी के रूप में मान्यता दी गयी।
- स्टैण्र्डड ब्लॉटर विधि माइक्रोफोमिना फेजियोलिना, फ्यूजेरियम आक्सीस्पोरम, कोलेटोट्राइकम डीमैसियम के निर्धारण हेतु सोयाबीन, मूंगबीन, उरदबीन एवं तिल बीजों में उपयोगी पाया गया।
- मिर्च के एन्थ्रक्नोज कवक के निर्धारण हेतु पीसीआर आधारित निर्धारण विधि उपयोगी पायी गयी।
- धान के बीज उत्पादन में फाल्स स्मट रोग सर्वाधिक क्षति पहुँचाने वाला कारक है। जिसके नियंत्रण हेतु प्रोपीकोनाजोल / 0.1 प्रतिशत का पर्णीय छिड़काव बाली आने से पूर्व करने से रोग का नियंत्रण हो जाता है।
- सघन निगरानी के परिणामस्वरूप गेहूँ में सेप्टोरिया ब्लोच एवं राइस वन्ट क्रमशः अनंतनाग एवं बारामुल्ला (जे एण्ड के) तांजोवुर, तमिलनाडु में पाये गये।
- किसानों द्वारा संचित बीजों में गेहूँ का करनाल बन्ट पंजाब, हरियाणा एवं हिमांचल प्रदेश से आये बीजों में ज्यादा पाया गया।

- माइक्रोफोमिना, फैजोलीना, फ्यूजेरियम आक्सीस्पोरम, जो कि सोयाबीन में मध्य प्रदेश, महाराष्ट्र एवं राजस्थान में सर्वाधिक पाया गया। मूँगफली में गुजरात, महाराष्ट्र, उड़ीसा एवं आन्ध्र प्रदेश में एस्परजीलस का प्रकोप किसानो द्वारा संचित बीजों पर अधिक पाया गया।
- सोयाबीन की पॉड ब्लाइट (फली रोग) के नियंत्रण हेतु कार्बेन्डाजीम और मैन्कोजेब 0.3 प्रतिशत का दो बार पर्णीय छिड़काव क्रमशः पॉड फार्मेशन एवं कटाई से पूर्व करने से 62 प्रतिशत रोग का नियंत्रण पाया गया।
- कुसुम के बीजों में जैव प्रारम्भन (टी. हाइजिआनम सिऊडोमोनास फ्यूजेरियम कारथेमी द्वारा रोग नियंत्रित हो जाता है और जमाव भी प्रभावित नहीं होता है।
- विभिन्न नवीन कीटनाशकों में इमामेक्टिन बेन्जोएट, भण्डार कीटों के नियंत्रण में डेल्टामेथ्रीन एवं स्पाइनोसैड के समतुल्य प्रभावी पाया गया।
- लूबेन्यिामाइड, इमामेक्टिन बेंजोएट, स्पानोसैड एवं डेल्टामेथरीन द्वारा उपचारित धान के बीज सुपर ग्रेन बैग में 9 माह तक रखने से अच्छे जमाव के साथ कीटों का न्यूनतम प्रकोप भी पाया गया।
- किसानों द्वारा संचित 1667 नमूनों में 39.04 प्रतिशत कीटों से प्रभावित पाये गये। लगभग 26.1 प्रतिशत नमूने बीज प्रमाणीकरण मानक से ऊपर कीटो से प्रभावित पाये गये।
- बरसीम में बीज उत्पादन में सुधार हेतु मधुमक्खियों द्वारा परागण बहुत महत्वपूर्ण है जिस पर न केवल बीज उपज बढ़ती है बल्कि बीजों के गुणवत्ता कारक भी सुधरते हैं। अरहर में मधुमक्खियों के अलावा लीफ कटर भी परागण में सहायक हैं।
- खपरा बीटल के नियंत्रण में कार्बनडाईऑक्साइड का 50 प्रतिशत (आयतन/आयतन) बहुत प्रभावी है जो कि गेहूँ, मूँगफली तथा दालों में ब्रुचिड के नियंत्रण में प्रभावी पाया गया।
- कार्बनडाईऑक्साइड उपचार के प्रभाविता में 200 लीटर क्षमता के कन्टेनर सफलतापूर्ण प्रदर्शन कोयम्बतूर, बंगलोर तथा हैदराबाद में किया गया।
- विभिन्न वानस्पतिकों का जैसे एकोरस कैलामस, टीएनएयू फार्मूलेशन 10 मिली/किग्रा बीज, नीमजाल 10000 पीपीएम 1.5 प्रतिशत बीज, पोगामिया ऑयल 5 मिली/किग्रा बीज एवं सिट्रोनेला, 5 मिली/किग्रा बीज का परीक्षण इमामेक्टिन बेन्जोएट के साथ किया गया जिसमें टीएनएयू फार्मूलेशन विभिन्न फसलों में 6 माह तक प्रभावी पाया गया।
- मूँग एवं उरद में इमामेक्टिन बेंजोएट का 1 मिली/लीटर की दर से फलियों की परिपक्वता अवधि में छिड़काव करने से कीटों का नियंत्रण प्रभावी ढंग से होता है।
- तीन प्रकार के कीटनाशक एवं इम्प्रेगनेटेड बैग का भण्डारण कीटों के नियंत्रण पर विभिन्न फसलों जैसे गेहूँ, धान, मक्का, मूँग पर अध्ययन किया गया। तत्पश्चात् यह पाया गया कि ये सारे बैग 8–10 माह तक न्यूनतम बीज प्रमाणीकरण मानकों के अनुरूप जमाव दे रहे हैं।
- अरहर प्रजाति बहार एवं अमर के विधायन हेतु उपर्युक्त चलनी आकार 4.75 मिमी संस्तुत चलनी आकार 4.00 मिमी की तुलना में पाया गया है जिसमें बीज परता 87–88 प्रतिशत तक प्राप्त होता है।
- मूंग प्रजातियों बसन्ती, सत्या एवं एमएच 421 को 2.4 मिमी चलनी आकार से ग्रेडिंग करने से क्रमशः 79.32, 77.11 एवं 78.94 प्रतिशत बीज परता पायी गयी जो कि संस्तुत चलनी आकार 2.6 मिमी से अच्छा है।
- सोयाबीन के कटाई एवं मड़ाई हेतु कम्बाइन, हार्वेस्टर के कटरबार की ऊँचाई भूमितल से 15 सेमी, 12 प्रतिशत नमी एवं 500 आरपीएम ड्रम स्पीड का रहना आर्थिक दृष्टिकोण से उपर्युक्त पाया गया है।

- सोयाबीन प्रजाति जेएस 335 के मेकानिकल ड्राइंग (30 डिग्री सेल्सियस पर) नमी को 6 प्रतिशत तक लाने में प्रभावी पाया गया है।
- सोयाबीन में ही सूर्य, छाया एवं मेकानिकल ड्राइंग (30 एवं 35 डिग्री सेल्सियस) जमाव एवं बीज ओज–1 को उच्च स्तर तक 6 माह के भण्डारण तक बनाये रखने हेतु उपर्युक्त पाया गया।

भा.कृ.अनु.प. बीज परियोजना

वर्ष 2014–15 में निर्धारित लक्ष्य 3,99,175 क्विंटल के विरूद्ध 5,76,252 क्विंटल विभिन्न श्रेणी के गुणवत्तायुक्त बीजों का उत्पादन हुआ। जिसके अंतर्गत 97,982 क्विंटल प्रजनक बीज, 1,75,622 क्विंटल आधारीय बीज, 1,28,465 क्विंटल सत्यापित बीज, 1,40,006 क्विंटल विश्वसनीय बीज, 34,176 क्विंटल प्लांटिंग मैटेरियल पैदा हुये। इसके अतिरिक्त 2018 लाख प्लांटिंग मैटेरियल एवं 8.48 लाख टिसू कल्चर प्लांटलेट्स क्रमशः 204.8 एवं 3.67 लाख निर्धारित लक्ष्य के विरूद्ध पैदा हुये।

1 Research Programmes and Achievements

1.1 Indian Institute of Seed Science, Mau

1.1.1 Seed Molecular Biology

1.1.1.1. Assessment of genetic purity in major crops including hybrids through molecular tools and techniques

Assessment of genetic purity is one of the most important quality control components in seed production. Traditionally, it has been the practice to carry out a grow-out test (GOT), based on morphological traits, for assessment of genetic purity of seeds. GOT is time consuming, space demanding and often does not allow the unequivocal identification of genotypes. A total of 100 rice SSR markers were selected covering all 12 chromosomes of the rice genome. Out of which 31 markers were analysed, of which 31% (31) markers were found to amplify a total of 512 different alleles. Out of which, 26% of the bands were found to be monomorphic in nature and indicated the substantial homogeneity in rice genome. Only one marker was found to produce polymorphism ranging 60% with an average of 1.66 allelic variants per SSR locus. In the present study, SSR marker RM228 was found to be able to differentiate DRRH3 rice hybrid from 23 major paddy hybrids and its parental lines cultivated in India and the same was revalidated among 46 major rice varieties cultivated in Uttar Pradesh (Fig.1).

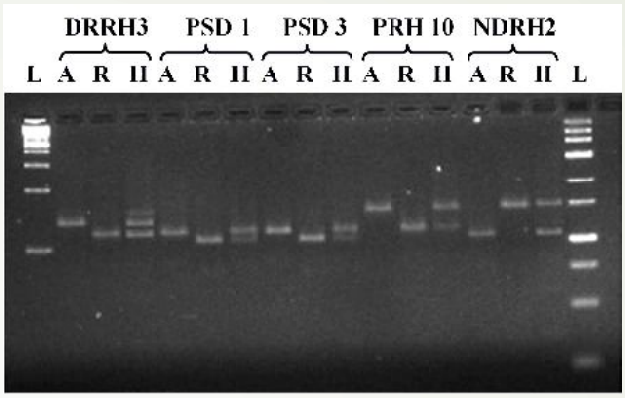


Fig. 1: Molecular characterisation of rice hybrids using SSR Marker (RM228)

- In addition, some other markers such as RM 505, RM 519, RM 565, RM 169, RM 286 and RM 251 were identified to assess the genetic purity of thirty two rice varieties cultivated and processed in IISS farm (Fig.2).

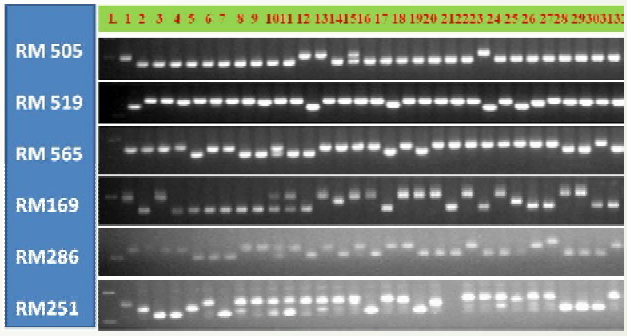


Fig. 2: Molecular Characterisation of rice varieties cultivated at IISS, Mau

It is also mentionable that there is ample scope to identify more rice hybrids through use of rice specific SSR markers.

As of now three patents have been filed at patent office, New Delhi and to protect the IPR issues at international level PCT applications have been filed.

Indian Patents

- Indian Patent Application Number 179/Del/2014 titled "*Three way Matrix Sampler*" dated 24 Jan. 2014.
- Indian Patent Application Number 180/Del/2014 titled "*Three way Matrix gun*" dated 24 Jan. 2014.
- Indian Patent Application Number 181/Del/2014 titled "*Three way Sampling Method*" for assessing genetic purity of parental seed of hybrids dated 24 Jan. 2014.

PCT Details

- Three way matrix sampling device for seeds and a method thereof (wo2015162625).
- Three way matrix sampling device for leaves and a method thereof (wo2015162626).
- Three way sampling method for assessing genetic purity of seed lots and crop plants (wo/2015/162627).

1.1.1.2. QTL mapping for seed vigour in rice (*Oryza sativa* L.)

In the project to study the QTL for seed vigour, the F_1 were advanced to F_2 population and segregation pattern was recorded. The present investigation revealed that F_2 population showed 3:1 ratio of segregation pattern for basal leaf sheath colour confirmed through Chi-square (X^2) goodness of fit test (Table 1 & Fig. 3). The nomenclature and tagging of a total of 800 F_2 plants (randomly selected plants from the crosses IR36/GP 74 and IR64 /GP 74) have been done prior to harvest of F_2 population.

Fig. 3: F_2 segregated population

Similarly, crossing among F_2 plants (among diagonally selected F_2 plants from the crosses IR36/GP 74 and IR64 /GP 74) were attempted during *kharif*-2015 and generated F_1 sibling population. Further, the generated 800 F_2 plants and F_1 sibling were sown during off-season (*Rabi*-2015-16) at regional station, ICAR-IISS, GKVK campus, Bengaluru to advance the generation

Table 1: Segregation of basal leaf sheath colour in F_2 population which derived from a cross IR 36 X GP 74 & IR 64 X GP 74

Test	Cross	Class	Leaf: sheath colour	Non colour	χ2
Chi-square (χ2) goodness of fit test	IR 36 X GP 74	Observed	281	139	0.66
		Expected	288.75	131.25	-
	IR 64 X GP 74	Observed	296	124	0.58
	-	Expected	288.75	131.25	-

(through SSD method) to F_3 RILs population and F_2 sibling population, respectively.

The germination test (05th Interval) was conducted using 155 germplasm lines of rice. The study revealed that, variance due to genotypes was significant for vigour traits. TZ test was carried out to test viability of identified two low vigour lines (GP-100 and GP-74) and three high vigour cultivars (IR 36, IR 64 and BPT-5204). The results showed that all germplasm lines except GP-100 recorded viability.

Observations recorded and analysed for ten quantitative traits among 155 germplasm lines of rice revealed that the variance due to genotype was significant for all the traits studied indicating the presence of large variations in the germplasm. Test weight ranged from 8.90 to 32.90 g with the mean of 23.35g among the lines studied. Correlation of test weight with plant height, panicle length and flag leaf length was found to be positive and significant and showed a negative correlation with number of panicles and number of tillers.

Rapid Identification of Rice Germplasms Using Chemical Tests

Chemical tests namely phenol, modified phenol, potasium hydroxide and sodium hydroxide were carried out to develop additional descriptors to differentiate the rice germplasms. Phenol test showed differentiation of 155 germplasms (Table 2) of which 34, 23, 33 and 17 were dark brown, brown, light brown and black colour, respectively whereas, the rest of germplasms (48) showed no colour/reaction; these non-reactive germplasms were subjected to modified phenol test where 5, 1, 1 and 41 germplasms recorded light brown, dark brown, black colour and no reaction respectively. Similarly, the 34, 23, 33 and 17 germplasms were treated with modified phenol test and showed differentiation in colour response (Table 3).

Table 2: Varietal identification of 155 rice germplasms based on Phenol test

Total number of germplasm lines of rice	No reaction (NR)	Light brown (LB)	Brown (B)	Dark black (DB)	Black (BL)
	GP-2,4,16,17, 18,26,27,33, 34,35,37,39, 41,42,43,44, 48,49,51,60, 61,62,65, 70,71,74,76, 77,78,82,84, 87, 92,93,94, 95, 99,103, 106,107,109,119,121, 128, 131,132, 144, and146	GP-1,3,5,6,15,20, 24,25,28,30,31, 32,40,54,55,56, 58,59,66,69,75, 79,111,130,136, 139,140,143,147 ,151,153,154 and 155	GP13,19,47,53, 57,63,68,73, 81, 97,100,102,104, 114,117,122, 123, 124, 125, 126, 134, 138 and 152	GP-4,7,9,10,12,21, 22,29,36,46,50, 52,67,72,83,85, 86,88,90,91,96, 98,101, 108,112, 113,116,127,129,137,141,142, 145 and 148	GP-8,11,23,38,45, 64,80,89,105, 110,115,188,120, 133, 135,149 and 150
	NR: 48	LB: 33	B: 23	DB: 34	BL: 17

GP-germplasm, No reaction (NR), Light brown (LB), Brown (B), Dark black (DB), Black (BL)

Table 3: Varietal identification of 155 rice germplasms based on modified Phenol test

Phenol test	No reaction (NR)	Light brown (LB)	Brown (B)	Dark Black (DB)	Black (BL)
A total of **48** germplasm lines **No reaction (NR)** with phenol test are subjected to modified phenol test	**GP-**2,14,16,17,18,26, 27,33,34,37,41,42, 43,48,49,51,60, 61, 62,65,70,71,74,76,7 7,78,82,84,87,94,95, 99,103,106,107,121, 128,131,132,144, and 146	GP-33,92,93, 109 and 119	None	**GP-**35	**GP-**44
Total	**41**	**05**	**-**	**01**	**01**
A total of **33** germplasm lines **Light brown (LB)** with phenol test are subjected to modified phenol test	None	**GP-**1,6,32,54, 55,59,66, 69,75,130 and 153	**GP-**15,20,24,25, 28,30,40,58, 111, 136,140, 143, 147, 151, 152, 154 and 155	**GP-**3,5,31,56, 79 and 139	None
Total	**-**	**11**	**16**	**06**	**-**
A total of **23** germplasm lines **Brown (B)** with phenol test are subjected to modified phenol test	None	None	**GP-**63,68,97,100, 102,104,114,117, 134 and **152**	**GP-**13,19,47, 53, 57,73,81, 122,123,124, 125, 126,138	None
Total	**-**	**-**	**09**	**13**	**-**
A total of **34** germplasm lines **Dark black (DB)** with phenol test are subjected to modified phenol test	**GP-**21 and 36	**GP-**46 and 112	None	**GP-**4,85,98, 101, 129, 141,142,145 and 148	**GP-**7,9,10,12,22,29, 50,52,67,72,83,8 6,88,90,91,96,10 8,113,116,127 & 137

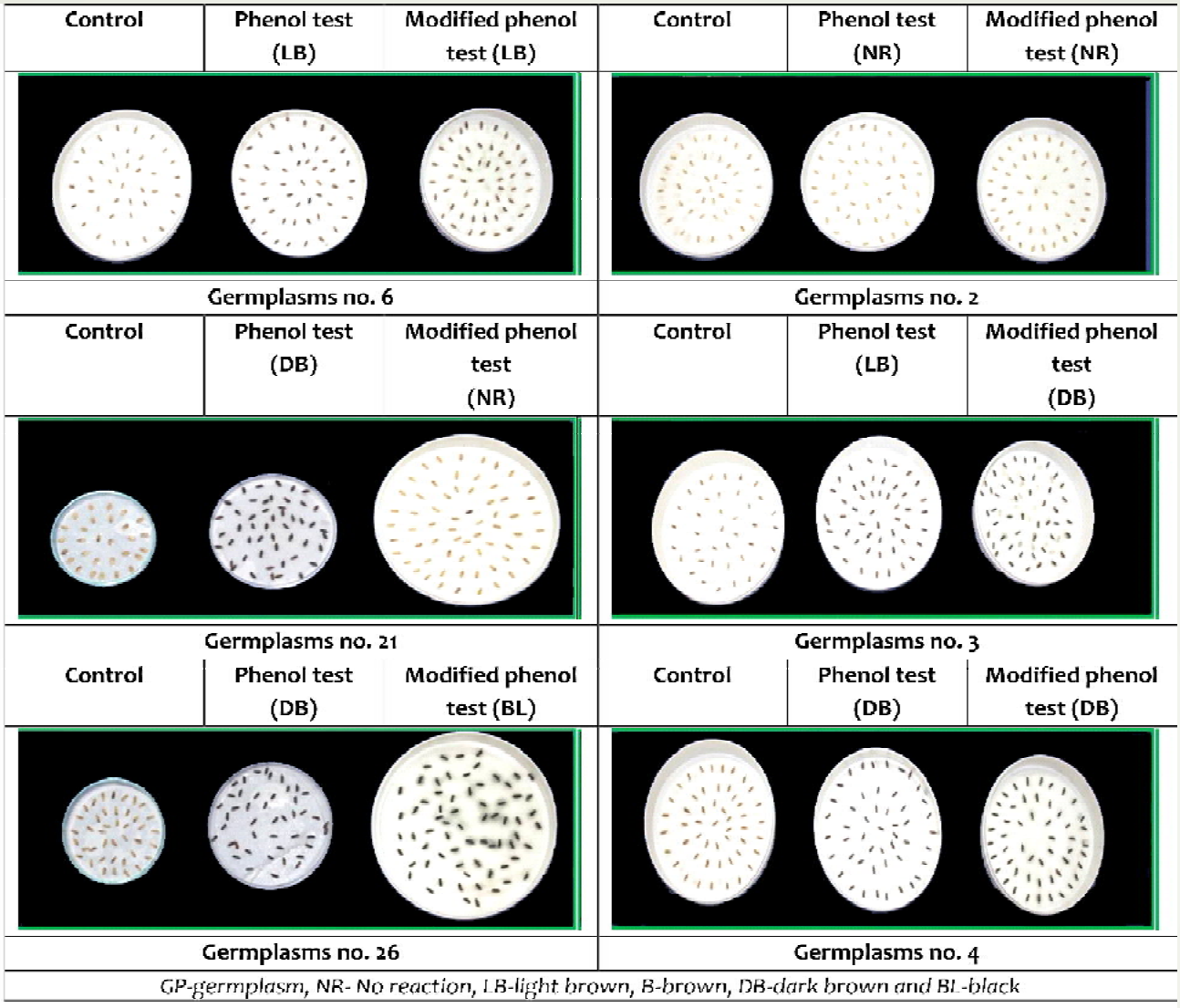


Fig. 4(a& b): Colour reactions of rice germplasms with Phenol and modified Phenol test

Similarly, the selected germplasm lines responded differently to potassium hydroxide test (Fig. 5). Amidst 155 germplasm lines, the response of 82

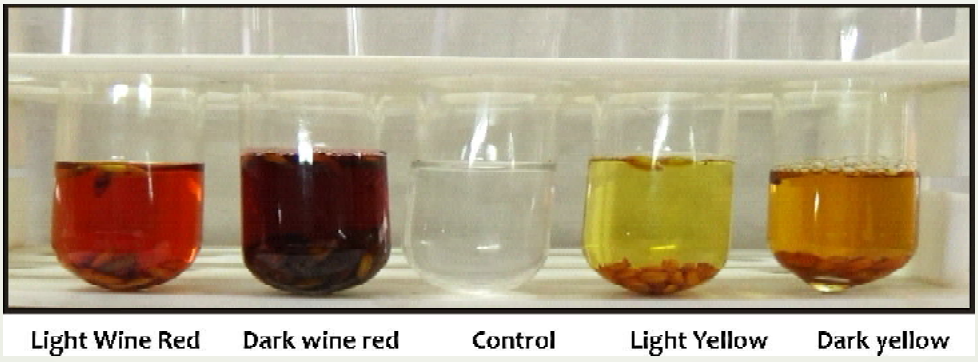


Fig. 5: Colour variation of rice germplasms treated with Potassium Hydroxide (KOH) test

Fig. 6: Image of Sodium Hydroxide test (NaOH test)

germplasms recorded light yellow, 25 germplasms dark yellow, 32 germplasms light wine red and 13 germplasms exhibited dark wine red in colour.

In case of sodium hydroxide test (Fig. 6), 144 germplasms were light yellow and 11 germplasms exhibited wine red colour.

A comprehensive key is being developed for rapid germplasm identification and these tests are highly stable, reliable, low cost and are least influenced by environment.

1.1.1.3. Molecular mapping of quantitative trait loci (QTL) for bruchids resistance in chickpea (*Cicer arietinum* L.)

Bruchids are the major storage insect pest of the chickpea which cause considerable economic losses under storage. Deploying genetic resistance through marker assisted breeding could be a viable option. In this project, molecular mapping of quantitative trait loci (QTL) for bruchids resistance in chickpea (*Cicer arietinum* L.) is being taken up.

In 2015-16 *Rabi*, 238 lines comprising of 215 chickpea accessions and 23 varieties from International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad were field grown under two replications for maintenance and evaluation. Three chickpea accessions found to be resistant against three species of bruchid namely *Callosobruchus chinensis*, *C. maculatus*, *C. analis* and the susceptible lines were sown under staggered planting in pots in net house for hybridization for developing mapping population (RILs). The development of mapping population through hybridization is in progress.

A number of cross combinations involving bruchid resistance and susceptible lines and some other combinations were also attempted.

G 42 X G 61	G 38 X G 42
G 42 X G 155	G 38 X G 61
G 106 X G 61	G 38 X G 106
G 106 X G 42	G 38 X G 155
G 155 X G38	G 155 X G 106

1.1.2 Seed Physiology Storage and Testing

1.1.2.1. Studies on gibberellins in regulation of source-sink relations in wheat under different moisture regime

Plant growth regulators including auxin, gibberellins, cytokinins and ABA have the prominent role in the regulation of source-sink relationship at structural, function and molecular level but the role of gibberellins

are very specific as it enhances source and sink potential through increasing photosynthetic enzymes, increasing leaf area for higher interception of photosynthetically active radiation and enhancing nutrient use efficiency. At a certain concentration, GA_3 has been shown to be beneficial for the physiology and metabolism of many plants under abiotic stress, since it may provide a mechanism to regulate the metabolic process as a function of sugar signaling and antioxidative enzymes. Thus, by manipulation of GA biosynthesis pathway or the exogenous application of an adequate quantity of GA_3 at an appropriate time, plant source-sink potential can be regulated to get maximum yield under both optimum and limiting environmental conditions.

Wheat (*Triticum aestivum*) is the most important cereal crop of the world and about 2/3rd of the world population lives on wheat grain. The physiological basis of dry matter production depends on the source–sink relationship, where the source is the potential capacity for photosynthesis and sink is the potential capacity to store. In few studies, it have been concluded that under most of the conditions grain growth in wheat was apparently more sink than source-limited. Keeping the above views in mind the present investigation was conducted.

The experiment was initiated with three treatments of foliar spraying of gibberellic acid including control on two varieties of wheat and two moisture levels in strip plot design replicated three times at IISS farm during *rabi* season. Among the varieties, HI 1563 displayed the higher value for germination, speed of germination, seedling length, vigour index-I and vigour index-II over Raj 3765.

On the basis of observations recorded at the harvest, it was evident that spraying of GA_3 at the time of anthesis significantly increased the number of seed/spike, biological yield, 1000 seed weight and grain yield over control. The influence of GA_3 @ 100 ppm was more as compared to GA_3 @ 50 ppm. The values obtained in seed number, 1000 seed weight and grain yield were higher under normal moisture condition. Variety HI 1563 displayed the higher mean values over Raj 3765 in almost all the characters studied (Fig. 7).

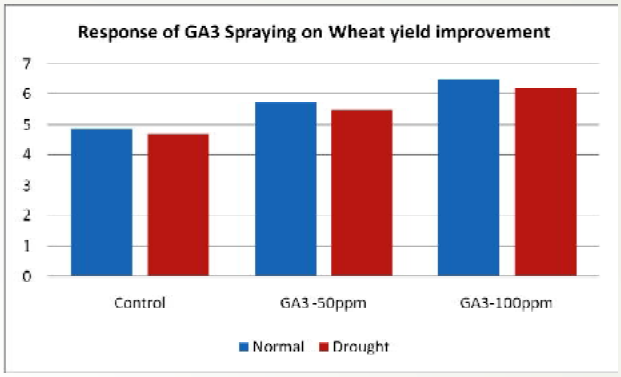


Fig. 7: Response of GA_3 spraying on source- sink-manipulation in wheat (Kg/Plot)

Findings of present experimentation clearly demonstrated that exogenous application of GA_3 (100 ppm) at anthesis stage through foliar spray gives encouraging results for the improvement of total dry matter production and its translocation towards the sink in terms of enhancement in 1000 grain weight and grain yield under both, normal and deficient moisture conditions.

Demonstration on enhancement of wheat seed yield through GA_3 spraying in standing crop

Nine field demonstrations on enhancement of wheat seed yield through GA_3 spraying in standing crop were conducted on farmer's field in 05 selected villages under extension programme (Model Village Scheme) nearby ICAR-IISS, Mau. On

the basis of data, the average 10 percent increase in wheat grain yield was recorded over untreated control. Details of demonstrations conducted are mentioned below in Table-4.

germination rate and seedling vigour. The biologically active compounds present in smoke are emerging as potential growth regulators in agriculture and horticulture. In the present study, different parameters

Table 4: Field demonstration on enhancement of seed yield through source – sink manipulation by GA_3 spraying in wheat

S. No.	Farmers name	Address	Variety	Date of Sowing	Date of harvesting	Date of GA_3 spraying	Total production (in kg)	
							General (area: 500m²)	Treated (area: 500m²)
1.	Mr. Bageesh Chandra Mishra	Pakhiepur, Kushmaur	Kundan	04/12/14	17/04/15	19/01/15	**160.0**	**172.0**
2.	Mr. Devendra Prasad Singh	Kushmaur	PBW 502	06/12/14	12/4/15	21/1/15	**144.5**	**162.0**
3.	Mr. Akhilesh Yadav	Kushmaur	PBW 373	20/12/14	25/04/15	30/1/15	**105.0**	**117.2**
4.	Mr. Budhu Yadav	Onhaich	PBW 502	04/12/14	25/04/15	18/1/15	**180.5**	**196.7**
5.	Mr. Girja Chauhan	Onhaich	HD 2967	12/11/14	11/04/15	02/1/15	**182.5**	**197.0**
6.	Mr. Bechu Singh	Onhaich	PBW 502	10/12/14	16/04/15	23/01/15	**171.4**	**184.2**
7.	Mr.Ganga Singh	Naghara, Pinjada	CBW 38	18/12/14	17/04/15	25/01/15	**154.2**	**163.2**
8.	Mr. Kailash Singh	Chvran, Pinjada	HD 2733	10/12/14	20/04/15	22/01/15	**117.4**	**132.6**
9.	Mr. Ram Chandra Diwedi	Mehra-bandha, Pinjada	PBW 502	12/11/14	20/04/15	01/01/15	**192.6**	**205.1**
10.	Mr.Jai Nath Singh	Paniyara	PBW 343	08/11/14	12/04/15	27/12/14	**190.4**	**209.8**
11.	Mr. Chandrika Yadav	Paniyara	PBW 343	15/11/14	12/04/15	03/01/15	**120.6**	**136.2**
12.	Mr. Ramesh Yadav	Paniyara	DBW 17	27/12/14	24/04/15	30/01/15	**90.7**	**105.2**

1.1.2.2 Enhancing Seed Quality in Rice and Soybean with Smoke Water

Higher germination rate and seedling vigour are the important characteristics of the quality seeds which ensure good crop stand and in turn yield. Various factors that affect seed germination include the factors inherent to the seed as well as the external stimulants (chemicals) and the environment. Various seed priming methods have been practiced till date in order to achieve higher

related to germination and seedling vigour such as - imbibition kinetics, mobilization of seed reserves- carbohydrates were studied with the previously standardised dilutions/ concentrations of paddy straw and wheat straw derived smoke water and double distilled water as control.

Improved water imbibition was observed in rice seeds (GP-74, a low vigour rice germplasm line) upon smoke water treatment which followed triphasic manner

with the smoke water treated seeds showing slightly higher water uptake than the control seeds. Highest water uptake was observed in paddy straw derived smoke water treated seeds (70.58%) followed by those treated with in wheat straw derived smoke water (66.78%).

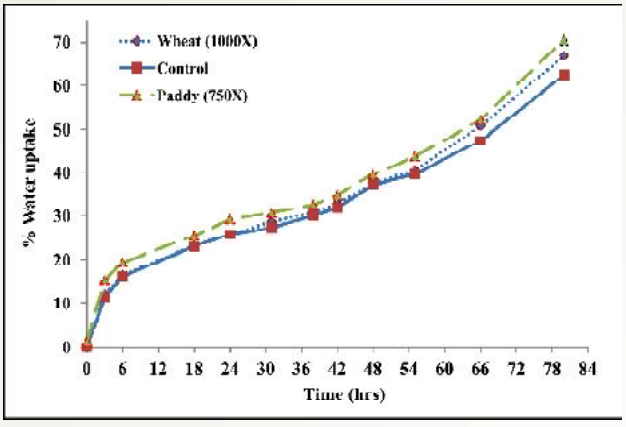


Fig. 8: Imbibition kinetics (triphasic) of rice seeds

The observed increase in the water uptake by seeds in turn can enhance their germination rate. The water uptake in seeds treated with paddy straw derived smoke water was consistently at a higher rate throughout the study period and this could be attributed to the up regulation of *aquaporins* [(integral membrane proteins that regulate the movement of water across membrane) (Fig.8)]. Further, reviewing the expression kinetics of *aquaporin* genes in smoke water treated seeds will delineate the possible role of *karrikins* in up regulation of these genes.

Promotion of germination and seedling vigour by smoke water can also be due to its effect on improved seed reserve mobilization. The mobilization of seed carbohydrates during germination was examined by studying the activity of α and β amylase.

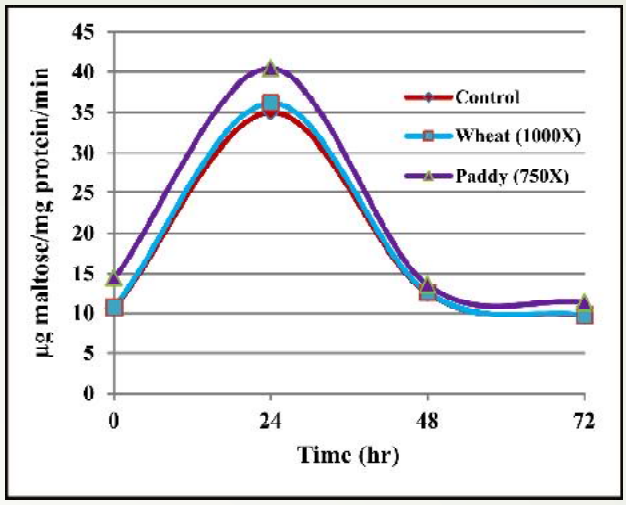


Fig. 9 (i): β-amylase activity in GP-74 rice grermplasm line seeds following imbibition

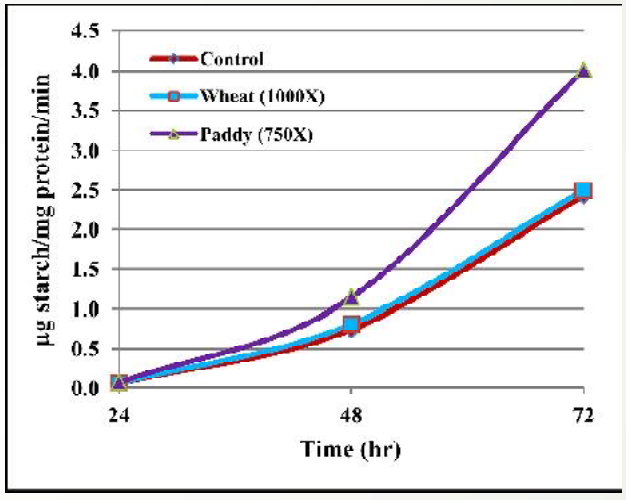


Fig. 9 (ii): α-amylase activity in GP-74 rice grermplasm line seeds following imbibition

β-amylase activity was higher (36.39% over control) during the initial phase (0 h to 24 h) following imbibition with paddy straw derived smoke water [Fig.9 (i) and (ii)]. The activity declined and reached basal levels at 48 h. However, the β-amylase activity recorded in case of wheat straw derived smoke water treatment was non-significant in relation to the activity observed in that of control. A steep increase in α-amylase activity from 48 h after imbibitions was recorded in paddy straw derived smoke water treatment. At 72 h, α-amylase activity was 66% higher than that of control. The

result were non-significant with the wheat straw derived smoke water.

These observations *i.e.*, rapid uptake of water coupled with swift mobilization of seed reserve (carbohydrates) can be correlated with the increase in germination rate and seedling vigour in the paddy straw derived smoke water treated seeds. Further, the effect of smoke water on promotion of seed germination and seedling growth under sub-optimal conditions (heat/ drought/ salinity stress) will be studied under lab conditions.

1.1.2.3 Studies on the impact of priming agents on the improvement of physiological parameters and their relationship with seed yield in chickpea (*Cicer arietinum* L.)

Objectives

- To increase crop stand through seed priming.
- To assess the effect of GA_3 priming and *Rhizobium* coating on quality and seed yield in chickpea.
- To assess the effect of growth regulators on the improvement of physiological parameters linked with increase in seed yield.

Priming Agents Used

- GA_3 @ 100 ppm for 8-12 hours
- Culture of *Rhizobium ciceri* obtained from NBAIM, Mau

Under this study, it was found that seed priming significantly influenced all the quantitative traits among the chickpea varieties. The interaction effect of variety and priming was found significant for the traits grains/plant and grain weight/plant. GA_3 priming showed significant influence on maturity in case of four varieties KGD 11, JG 11, Pusa 362 and Pusa 1088. Highest grain weight/plant was observed in the Kabuli variety Pusa 1088. Significant effect of GA_3 on grain weight/plant was found in the variety KGD 11 and Pusa 1088, but bio and hydro-priming showed no significant effect on grains/plant. The significant effect of GA_3 in increasing test weight was observed for the varieties KGD 11, JG 11, BGD 72, RSG 807 and CSJK 21. The priming effect of GA_3 for seed yield was found significant in almost all the varieties except BGD 72. The seed recovery in bio- priming was found higher than GA_3 priming in almost all the varieties. In case of bio-priming of Pusa 362, the seed recovery was higher (76.58%) than GA_3 priming (73.17%). Considering all varieties, GA_3 primed varieties showed higher return for seed yield.

1.1.3 Seed production & certification

1.1.3.1. Devising agro-techniques for reducing the seed rate of wheat

In the light of low national average yield of wheat as compared to agriculturally advanced countries like U.K., USA and China and ever increasing human population of the country, wheat production in India is required to be enhanced to 109 million tonnes by 2025 AD from the present level of 92.46 million tonnes. Among various approaches to achieve this, larger coverage of wheat area under quality seed sowing appears to be effective as quality seed alone can enhance crop productivity by 15-20%. Area coverage under quality seed can be enhanced either through increased production of quality seed or by reducing the seed rate for sowing of wheat. As enhanced seed production would require additional resources, reducing seed rate appears to be more feasible for achieving greater spread of quality seeds.

Recommended seed rate for wheat sowing varies from 100 to 120 kg/ha. However, sowing with seed drills effectively saves 25-30% of the seed by uniform placement of seeds at proper distance and depth in the soil. Further, if effective tillers/ hill could be raised to 3-4 from existing 1-2 through the use of growth regulators, at par yields can be achieved even at half of the recommended seed rate. This would effectively enhance the seed replacement rate to enable us to raise wheat production in country. Seed rate for wheat is recommended to be 100-120 kg/ha in order to ensure optimum crop stand and remunerative yield. In view of poor seed replacement rate (32 %) for wheat, seed rate is required to be effectively reduced through suitable agro-techniques capable of ensuring synchronous effective tillering in greater number under crop conditions.

An experiment was conducted during the winter (*Rabi*) season, to assess the effect of seed rate on growth, seed yield and yield attributes and seed quality for wheat crop. It was laid out in Split Plot Design (SPD) with three replications. There were 27 treatment combinations comprised of three seed rates (50, 75 and 100 kg/ha) and three genotypes (HD 2733, PBW 550 & PBW 502) in the main plots. In sub-plots, three treatments *viz*., control, 100 ppm GA_3& 100 ppm IAA were taken. The net plot size was 5.0 m x 4.0 m respectively. The recommended dose of NPK fertilizer for wheat crop was 120:60:50:25 kg/ha, using urea (46% N), diammonium phosphate (46% P_2O_5& 18% N), murate of potash (62% K_2O) and zinc sulphate (21 %) as a source of fertilizers. Full dose of P, K and $ZnSO_4$along with half of N were applied as a basal at the time of sowing and remaining N was applied in 2 splits at crown root initiation (CRI) and ear initiation (EI) stages of the crop during the year of experimentation. The first irrigation was given at 20-25 days after sowing and the second at 40-45 days after sowing.Thereafter, the fields were irrigated at the interval of 15-20 days until the end of the season for a total of six irrigations. All the other recommended package of practices were adopted during the crop growth period. Ten plants were chosen randomly from the centre row of each plot to determine the growth parameter, yield and yield attributes and seed quality parameters respectively. The prevailing prices of inputs and outputs were used to work out net returns, benefit: cost ratio.

Effect on growth parameters

Maximum plant height (81.97 cm) was observed at 100 kg/ha seed rate with spacing (22.5x10 cm) as compared to 75 and 50 kg/ ha seed rate with spacing (22.5x7.5 and 22.5x5.0 cm) at harvesting stage. But the higher values for traits *viz*., tillers/plant at harvest (6.76), number of tillers/ meter row length (70.92), spike length (12.08 cm) and seed weight/spike (2.10 g) were recorded at 50 kg/ha than 75 and 50 kg/ha seed rate. The maximum spikelets /spike (21.92) were observed at 75 kg/ha seed rate with spacing (22.5x7.5 cm) as compared to 50 and 100 kg/ ha seed rate. Seed treated with IAA and GA_3 significantly increased the growth and yield attributes (plant height, number of tillers/ plant and number of tillers/meter row length and spike length) over control (Table 5).

Table 5: Growth and yield attributes of wheat affected by different seed rate, genotypes and growth regulators

Treatments	Plant height (cm)	No. of tillers/ plant	No. of tillers/ m row length	Spike length (cm)	Seed weight /spike (g)	Test weight (g)
Seed Rate (kg/ha)						
50 kg/ha	77.22	6.76	70.92	12.08	2.10	38.38
75 kg/ha	79.10	6.24	61.11	11.44	1.99	37.34
100 kg/ha	81.97	6.16	56.18	11.27	1.83	36.86
Sem±	1.01	0.17	1.36	0.14	0.05	0.87
LSP P=0.05	3.01	0.51	4.07	0.42	0.16	NS
Genotypes						
HD 2733	75.93	6.04	55.93	10.92	1.80	37.69
PBW 550	79.40	6.19	64.19	11.90	1.93	36.74
PBW 502	82.96	6.92	68.09	11.97	2.19	38.15
Sem±	1.01	0.17	1.36	0.14	0.05	0.87
LSP P=0.05	3.01	0.51	4.07	0.42	0.16	NS
Growth Regulators						
Control	77.71	5.23	59.69	10.99	1.92	36.75
GA_3	79.41	6.92	63.72	11.70	2.01	38.15
IAA	81.17	7.00	64.80	12.09	1.98	37.68
Sem±	0.61	0.35	0.95	0.20	0.02	0.25
LSP P=0.05	1.76	1.01	2.73	0.56	0.05	0.72

Effect on yield and its attributes

It is evident from the data that 75 kg/ha seed rate with spacing (22.5x7.50 cm) registered a favourable effect on seed yield (43.10 q/ha) and harvest index (38.19) as compared to 100 kg/ha and 50 kg/ha seed rate. Seed treatment with IAA significantly increased the seed yield (43.17 q/ha), straw yield (71.95q/ha) and biological yield (115.12q/ha) as compared to other treatments (GA_3 and control). On the basis of results obtained over the years, it is concluded that 75 kg/ha seed rate and growth regulator IAA may be recommended to farmers to enhance the seed yield with reduced quantity of seeds (Table 6).

Table 6: Yield and yield attributes of wheat affected by different seed rate, genotypes and growth regulators

Treatments	No. of seeds/ spike	No. of Spikelets / spike	Seed yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest Index
Seed Rate (kg/ha)						
50 kg/ha	56.43	21.01	37.96	64.01	101.97	37.19
75 kg/ha	53.40	21.92	43.10	69.52	112.61	38.19
100 kg/ha	52.77	20.89	41.24	73.84	115.08	35.76
Sem±	1.09	0.17	0.90	1.23	1.80	0.52
LSP P=0.05	3.25	0.51	2.71	3.68	5.38	1.56
Genotypes						
HD 2733	49.40	21.40	37.99	63.92	101.91	37.18
PBW 550	53.89	20.73	40.89	72.19	113.08	36.14
PBW 502	59.32	21.70	43.41	71.26	114.67	37.83
Sem±	1.09	0.17	0.90	1.23	1.80	0.52
LSP P=0.05	3.25	0.51	2.71	3.68	5.38	NS
Growth Regulators						
Control	49.91	20.40	36.54	65.18	101.72	35.97
GA_3	57.24	22.05	42.58	70.24	112.83	37.74
IAA	55.46	21.37	43.17	71.95	115.12	37.44
Sem±	1.35	0.29	1.30	1.25	2.53	0.33
LSP P=0.05	3.88	0.84	3.72	3.57	7.27	0.96

Seed quality parameters

Seed quality parameters *i.e.* germination %, root length, shoot length, seedling length, seedling dry weight and vigour index I & II differed significantly among different treatments (Table 7). Significant improvement in the seed quality parameters *viz*. root length (23.24 cm), shoot length (14.11 cm), seedling length (37.21cm) and vigour index I (3365.50) were recorded with crop raised at 50 kg/ha as compared to 75 and 100 kg/ha seed rate. No significant differences were observed for traits *viz*., germination %, seedling dry weight (g) and vigour index II. The seeds treated with IAA significantly increased the seed quality parameters *viz*., germination (98.07 %), root length (23.80cm), shoot length (14.96 cm), seedling length (38.20cm), seedling dry weight (0.212 g) and vigour index I and II (3742.8 and 20.84) as compared to control (Fig. 10).

Table 7: Effect of seed rate, genotypes and growth regulators of wheat on seed quality parameters

Treatments	Germination %	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling dry weight (g)	Vigour index I	Vigour index II
Seed Rate (kg/ha)							
50 kg/ha	97.00	23.24	14.78	37.21	0.207	3617.5	20.1
75 kg/ha	95.15	22.46	14.11	36.37	0.203	3462.1	19.3
100 kg/ha	95.93	21.89	13.79	35.48	0.201	3420.9	19.3
Sem±	0.63	0.38	0.28	0.42	0.003	56.43	0.30
LSP P=0.05	NS	1.13	0.84	1.26	NS	169.17	NS
Genotypes							
HD 2733	97.78	23.35	14.50	37.39	0.214	3664.8	20.99
PBW 550	94.00	21.93	13.99	35.39	0.190	3342.8	17.88
PBW 502	96.30	22.30	14.18	36.29	0.206	3492.9	19.90
Sem±	0.635	0.376	0.28	0.42	0.003	56.43	0.30
LSP P=0.05	1.90	1.13	NS	1.26	0.009	169.17	0.91
Growth Regulators							
Control	92.63	20.12	13.27	32.90	0.188	3052.6	17.44
GA_3	97.37	23.66	14.45	37.96	0.210	3705.1	20.48
IAA	98.07	23.80	14.96	38.20	0.212	3742.8	20.84
Sem±	1.05	0.74	0.31	1.06	0.005	137.21	0.66
LSP P=0.05	3.00	2.12	0.88	3.03	0.014	393.54	1.90

Performance evaluation of high yielding sorghum cultivars in eastern India under staggered planting in the spring season

Objectives

1. To assess the performance and stability of sorghum cultivars across environments under staggered plantings in spring season of eastern India.
2. To identify best genotype and planting date suitable to be planted in the spring season.

The performance of summer sorghum across three dates of sowing during summer 2015 at Mau, indicated that there were no significant developmental differences in terms of days to flowering and maturity (Table 8). For fodder yield there were no significant differences among the three dates of sowing, but in terms of plant height there were significant differences between the three dates of sowing. Among the three dates of sowing, 18 March sowing recorded the highest plant height (2.0m) at Mau. Due to poor seed setting there was no grain yield recorded during the last two dates of sowing in March. Among the grain sorghum cultivars based on their developmental performance, CSV 17 and Phule Anuradha were the earliest both in terms of days to flowering and maturity. The plant height of more than 2.0 m was an indicator of the photosensitive nature of the cultivars CSH 13, CSV 27, Phule Anuradha and Phule

Fig. 10: Field and lab view of wheat experiment on seed quality parameters

Revati. The green fodder yield among the sorghum cultivars ranged from 42 tonnes in CSV 17 to 182 tonnes per hectare in CSH 13. Similarly the plant height ranged from 1.1 m (CSV 17) to 2.4m (Phule Revati) among the sorghum cultivars. The interaction effect of dates of sowing and sorghum cultivars was not found significant.

Table 8: Plant stand, growth and fodder yield of summer sorghum in Mau

Treatments	Stand after thinning ('000 ha^{-1})	Days to 50% flowering	Days to maturity	Plant height (cm)	Fresh fodder yield (kg ha^{-1})	Dry fodder yield (kg ha^{-1})
Date of sowing						
16-Feb-2015	202.51	100	137	174	113873	27331
03-Mar-2015	213.78	103	144	189	112924	27080
18-Mar-2015	212.28	100	139	201	120624	28922
C.D. (5%)	7.32	14	12	12	31425	7539
F (Prob)	0.00	0.75	0.23	0.00	0.76	0.76
Sorghum cultivars						
CSH 14	211.99	100	138	149	108178	25965
CSH 16	212.57	102	140	150	104523	25088
CSH 13	209.94	108	142	225	181526	43567
CSV 17	206.14	87	134	111	41518	9912
CSV 27	210.53	110	144	234	147947	35439
PhRevati	206.14	107	144	244	123389	29620
PhAnuradha	209.36	95	139	204	103567	24854
C.D. (5%)	6.33	9	5	15	21116	5043
F (Prob)	0.26	0.00	0.00	0.00	0.00	0.00
C.V. (%)	3.16	9.18	3.76	8.14	19.07	18.99

Fig. 11 (a): First date of Sowing (16 February, 2015)

Fig. 11 (b): Second date of Sowing (03 March, 2015)

Fig. 11 (c): Third date of Sowing (18 March, 2015)

Highlights

- There were no significant differences (mean of 7 cultivars) in terms of developmental crop growth phases across three dates of sowing of 16th Feb., 03rd Mar. and 18th Mar. during the summer season.
- The mean dry fodder yield of 22 tonnes and fresh fodder yield of 88 tonnes per hectare was recorded across three dates of sowing.
- The mean grain yield was 4.7 tonnes per hectare (mean of 3 dates & 7 cultivars).
- The sorghum variety CSV 17 was the earliest to flower (80 days) and mature (124) days among the seven grain sorghum cultivars.

- There were significant differences in grain yield among the sorghum cultivars which could be grouped into three different ranges.
- The *Kharif* hybrids CSH 14 and 16 produced grain yield of about 7.0 tonnes per hectare.
- The second best performance was by CSH 13 with a grain yield of 5.65 tonnes per hectare.
- The third group were the *Kharif* varieties (CSV 17 and CSV 27) with a grain yield of about 4.5 tonnes per hectare.
- The *Rabi* varieties Phule Revati and Phule Anuradha, which are photosensitive were the low yielders with yield of < 2.3 tonnes per hectare.
- The highest average fresh (> 100 tonnes per hectare) and dry fodder yields (30 tons per hectare) were recorded by CSH 13, CSV 27 and Phule Revati sorghum cultivars.

1.1.3.2. Impact of genotypes and conservation tillage on seed quality and productivity of wheat in the eastern-UP

The research project was started during *Rabi* 2012-13 with 18 treatment combinations of three tillage operations (Zero tillage (FIRB), Conventional tillage (CT) and Furrow Irrigated Raised Bed (FIRB) with six genotypes (PBW 502, KRL-213, HD-2733, HD-2967, DBW-39 and PBW-550) in a split plot design with three replications.

The experiment was conducted during 2014-15 with some minor modification in technical programme. The genotype KRL 210 was replaced with PBW 502, due to poor performance during last two years of experimentation. The wheat crop was raised under ZT after spray of Glyphosate @ 0.5 kg *a.i.* ha^{-1} before sowing (2 days) at proper moisture, while CT/FIRB was sown as farmers' practices. CT wheat was sown with a tractor drawn seed drill using a seed rate @ 100 kg/ha with spacing of 22.5 cm and under FIRB seed rate @ 75 kg with 2 rows of wheat (30 cm apart), while as under ZT plots, the crop was sown without any preparatory tillage using zero-till seed drill with seed rate @ 100 kg/ha with a spacing of 22.5 cm. The recommended dose of N: P: K, 120:50:40 kg ha^{-1} was applied through urea, di-ammonium phosphate and MOP. Full dose of P and K along with half of N were applied as a basal and remaining N was applied in two splits at crown root initiation (CRI) and ear initiation (EI) stages.

Results

It was found that ZT practice significantly enhances the yield attributes (biological, seed and straw yield) as well as harvest index as compared to CT and FIRB. The wheat genotype HD 2967 recorded significantly higher biological, seed and straw yield as compared to other genotypes (Table 9 & 10).

Table 9: Seed yield of wheat affected by different tillage practices and genotypes in rice-wheat rotation

	Seed yield (q/ha)				Straw yield (q/ha)			
Treatments	**2012-13**	**2013-14**	**2014-15**	**Mean**	**2012-13**	**2013-14**	**2014-15**	**Mean**
Tillage methods								
ZT	48.4	48.1	47.4	48.0	55.5	55.2	51.9	54.2
CT	47.0	46.6	42.4	45.3	55.9	55.6	49.8	53.8
RB	31.5	35.2	32.3	33.0	41.6	43.9	44.2	43.2
SEm	1.30	0.86	0.57	0.67	2.52	1.30	0.65	0.66
LSD P=0.05	5.1	3.4	2.3	2.6	9.9	5.1	2.5	2.6
Genotypes								
KRL 213	44.6	44.6	40.7	43.3	44.8	54.2	46.3	48.4
HD 2733	42.5	42.2	39.2	41.3	54.9	49.9	45.0	49.9
PBW 550	39.3	42.6	38.1	40.0	46.7	50.3	49.6	48.9
HD 2967	46.2	48.2	45.3	46.6	55.8	55.4	53.0	54.7
KRL 210	38.6	36.6	41.3	38.8	55.2	48.0	49.5	50.9
DBW 39	42.7	45.8	39.3	42.6	48.4	51.5	48.6	49.5
SEm	1.51	0.90	1.17	0.69	2.62	1.44	1.13	1.14
LSD P=0.05	4.4	2.6	3.4	2.01	7.6	4.1	3.3	3.3

Table 10: Biological yield and harvest index of wheat affected by different tillage practices and genotypes in rice-wheat rotation

	Biological yield (q/ha)				Harvest index			
Treatments	**2012-13**	**2013-14**	**2014-15**	**Mean**	**2012-13**	**2013-14**	**2014-15**	**Mean**
Tillage methods								
ZT	103.8	103.3	99.3	102.1	46.8	46.4	47.7	47.0
CT	102.9	102.2	92.2	99.1	45.9	45.8	45.9	45.9
RB	73.1	79.1	76.5	76.2	43.4	44.5	42.2	43.4
SEm	3.71	1.74	0.61	1.18	0.74	0.67	0.62	0.31
LSD P=0.05	14.6	6.8	2.4	4.6	NS	NS	2.4	1.2
Genotypes								
KRL 213	89.3	98.8	87.0	91.7	49.7	45.0	46.4	47.0
HD 2733	97.4	92.1	84.2	91.2	43.5	45.4	46.3	45.0
PBW 550	86.0	92.9	87.7	88.9	46.5	46.1	43.3	45.3
HD 2967	102.0	103.5	98.3	101.3	45.6	46.5	45.8	46.0
KRL 210	93.8	84.6	90.8	89.7	40.6	43.2	45.3	43.0
DBW 39	91.1	97.2	87.9	92.1	46.4	47.0	44.4	45.9
SEm	3.21	1.64	1.49	1.43	1.57	0.83	1.00	0.66
LSD P=0.05	9.3	4.8	4.3	4.1	4.5	2.4	NS	1.9

The highest cost of cultivation was recorded under CT followed by FIRB and lowest in ZT. Gross return, net return and B: C ratio was found to be highest under ZT followed by CT and FIRB.

Based on above findings, it was concluded that zero tillage along with variety 2967 is the most suitable combination for eastern region of India for higher seed yield of wheat (Table 11).

Table 11: Economics of wheat seed production affected by different tillage practices and genotypes in rice-wheat rotation

Cost of Cultivation (Rs. ha^{-1})		Net Return (Rs. ha^{-1})				B:C			
Treatments	**Mean**	**2012-13**	**2013-14**	**2014-15**	**Mean**	**2012-13**	**2013-14**	**2014-15**	**Mean**
Tillage methods									
ZT	23309	68745	82175	74980	75300	2.92	3.45	3.32	3.23
CT	30705	59135	72024	58675	63278	1.91	2.30	1.96	2.06
RB	27723	33351	48792	43010	41718	1.19	1.73	1.60	1.50
Genotypes									
KRL 213	27246	55849	68018	58044	60637	2.09	2.51	2.27	2.29
HD 2733	27246	55063	66957	55067	59029	2.03	2.47	2.14	2.22
PBW 550	27246	47790	63919	55133	55614	1.79	2.36	2.15	2.10
HD 2967	27246	61318	73620	68167	67702	2.28	2.71	2.66	2.55
KRL 210	27246	48745	64059	60215	57673	1.84	2.37	2.34	2.18
DBW 39	27246	53697	69407	56705	59936	2.01	2.55	2.21	2.26

* Net return was based on MSP+20% extra for seed and prevailing market price of straw(1 qt^{-1}),
** Benefit cost ratio based on net return.

1.1.3.3 Effect of various bioactive chemicals on traits favouring out crossing and their molecular characterization in hybrid rice (*Oryza sativa* L.)

Under this *in-house* project, the revalidation of bioactive molecules on two hybrid parental lines PRH10 and DRRH2 (A and R line) were treated with two bioactive molecules with six different chemical combinations *viz.*, T1 (Control), T2 (GA_3, 50 ppm), T3 (Chemical X, 1mM), T4 (Chemical X, 2mM), T5 (T2+T3) and T6 (T2+T4) during 5-10% panicle emergence stage to study the morpho-physiological effect in response to different bioactive chemicals during *Kharif*-2015 at ICAR-IISS, Mau. After treating with bioactive molecules, the various floral traits contributing out-crossing were recorded. The present study revealed that hybrid seed setting was increased by 4-6% in both hybrids in all treatments over control. This increase in yield can be attributed to increase in the panicle exsertion (4-6%), stigma exsertion (4-10%), spikelet opening angle (2-4°) and flag leaf angle (2-5°). Among the treatments, T6 showed higher seed setting (4-6%) and stigma exsertion (6-10%) over control. Both the bioactive chemicals and their studies could help to increase the seed setting upto 4-6%, hence, further revalidation and standardization of bioactive molecules will be needed (Fig. 12 a,b,c & d).

Fig. 12(a) : Nursery bed

Fig. 12 (b): Roughing

Fig. 12(c) : Transplanting

Fig. 12(d) : Panicle temperature measurement using Infrared Thermometer

Pollen storage at 4 ^{0}C, -20 ^{0}C and - 80 ^{0}C and viability testing

In this study, the pollens were collected in two different forms *i.e.* as a whole anther and an intact panicle from the male parents of both the hybrid. These pollens were placed in an air tight container along with desiccant (silica beads) to reduce the excess moisture and were stored at 4 ^{0}C, -20 ^{0}C and -80 ^{0}C in ambient as well as deep freezer, respectively. The stored pollens were tested for their viability at regular interval of 30 days after storage. The investigation has revealed that pollen viability decreased by 45-50% at 4 ^{0}C, 20-25% at -20 ^{0}C and 15-18% at -80 ^{0}C among one month stored pollens (Table 12). Further investigation is under progress.

Table 12: Pollen viability percentage in R (male) lines of parents PRH10 and DRRH2 under different storage condition

Hybrid	Parental Lines	Initial Viability (%)	Reduction of pollen viability (%) after one month of storage		
PRH10	R Line	88	at 4°C	at -20°C	at -80°C
DRR2	R Line	90	45-50	20-25	15-18

The expression analysis of flowering associated gene in response to different bioactive chemicals in hybrid rice

Further, expression analysis of flowering associated gene (*GS3*) among the two PRH10 and DRRH2 rice hybrids was being carried out under these chemical spray regime. For expression analysis, leaf samples have been collected from PRH10 and DRRH2 (A and R line) of rice hybrids and stored at deep freezer. The RNA isolation procedure has been standardized and the gene specific primers have been generated in primer-3 design (http://simgene.com/Primer3 Servlet) software. The list of primers is given below (Table 13). Further investigation is under progress.

1.1.3.4 Improving hybridization efficiency in castor through exogenous application of plant growth regulators

In a bid to meet delineated objectives, two castor hybrids were taken at two different locations i.e. in conventional area of cultivation (castor hybrid GCH 7 at SK Nagar, Gujarat) and unconventional area of cultivation (castor hybrid GCH 6 at ICAR-IISS, Mau). Seed quality of the parental lines were evaluated before sowing and treatments *viz*. GA_3 (200 & 300 ppm), Brasinosteriod (10 µM), Mepaquat chloride (100 & 200 ppm), Nutrigold (0.5%) and control (distilled water) were applied for evaluation of hybridization efficiency.

Table 13: Lists of primers used for RT-PCR analysis

Sl.	Name of Gene	RT-PCR primer sequence	No. of Nucleotides
1.	*Actin* (N)	Forward: TACACTCGCGCATGCTATTC	20
		Reverse: GCACCTGAACCTTTCTGCTC	20
2.	*GS3* (N)	Forward: ATGGCAATGGCGGCGGCGCCCCGGCCCAA	29
		Reverse: TCACAAGCAGGGGGGGCAGCAACGA	25
3.	*GS3* (Old)	Forward: TGAGATCAAAACTAGCTACTACCAGCTAGA	30
		Reverse: CATGGCAATGGCGGCGGCGCCCCGGCCCAA	30
4.	*Actin* (Old)	Forward: TCCATCTTGGCATCTCTCAG	20
		Reverse: GTACCCGCATCAGGCATCTG	20
5.	*GS3*_DSR1	Forward: CACTCTCTCCCTTCCATCATTAC	23
		Reverse: GCTTGGTGCTTTGCTTTGA	19
6.	*GS3*_DSR2	Forward: TCATGAACCAAAGGAGGGAAG	21
		Reverse: GTAGGTCTCTGGAAGCCAAATAG	23

Observations such as number of spikes per plant, spike length, internode length, plant height, number of nodes up to base of primary spike and number of ISF /Plant were recorded. Observations on pollen viability of ISF and revertants inferred poor viability status. Data regarding seed yield and effect of exogenous application shall be taken in due course of crop growth.

1.1.3.5. Hydropolymers : As regulatory switch for germination and smart delivery system in hybrid seed production of maize

In this project, nano fibre synthesis with the use of biodegradable polymer was carried out at CIRCOT, Mumbai. Standardization of cellulose acetate polymer for electro spinning of nano fibres was done and the nano fibres synthesized were depicted in Fig 13.

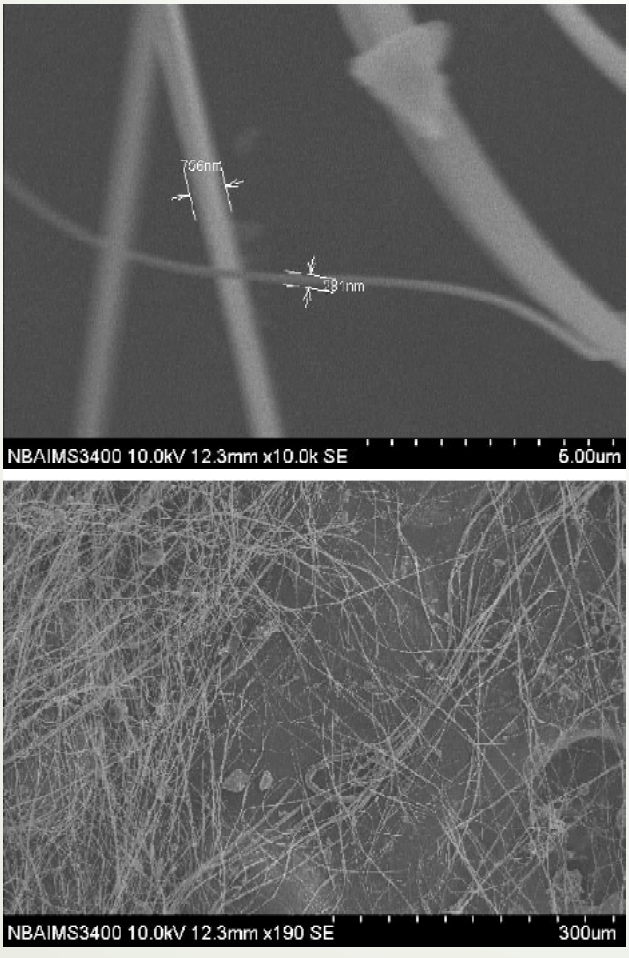


Fig. 13: SEM images of Nano fibres synthesized for seed coating

Scanning Electron Microscopy facility of ICAR - NBAIM, Mau was utilized for characterization of synthesized nano fibres.

1.1.4 Seed protection

1.1.4.1. Bio-priming for seed-borne disease management and seed quality enhancement of rice and chickpea

In the present study, validation of IAA production, siderophore production, phosphate solublization activity etc. for previously identified nine potential bacteria for bio-priming was carried out during 2015-16 at ICAR-IISS, Mau. A talc based bio-formulation was prepared and used in germination test and bio-priming of seed. In Blotter paper and Ragdoll paper germination tests (ISTA 2007), bio-primed seed of rice variety (BPT-5204) treated with *Prolinoborus fasciculus* (RRB-7) and *Brevibacterium halotolerans* (RRB-31) showed better germination (98%) as compared to control (92%). Seeds treated with *Bacillus methylotropicus* (RRB-10), *Brevibacterium halotolerans* (RRB-31 and CRB-B) showed better root length 25.12 cm, 22.08 cm, 24.85 cm respectively in comparison to control 18.75 cm. While seed treated with *Prolinoborus fasciculus* (RRB-7), *Bacillus methylotropicus* (RRB-34) and *Brevibacterium halotolerans* (RRB-38) showed higher shoot length 7.20 cm, 7.50 cm, 7.70 cm respectively in comparison to control 5.70 cm.

Under pot culture experiment bio-priming and soil application with *Brevibacterium halotolerans, Bacillus methylotropicus* and *Bacillus aerophilus* increased seed germination upto 10-15% in

comparison to control, better root and shoot length and, hence, better vigour index has been observed in case of *Brevibacterium halotolerans* treated seeds in comparison to control.

AMAAS project : Role of potential microorganisms in seed and crop health of rice, wheat and mustard

Under AMAAS project, a total of 300 bacterial strains were isolated from rhizosphere, endosphere and phylloplane of rice, wheat and mustard from various places of different agro-climatic zones of India. All the strains were tested for the bio-control assay against several pathogens causing diseases in rice, wheat and mustard. Dual culture test for antagonistic activity were performed for screening of potential strains within isolated bacterial strains. A total of 35 bacterial strains were found potential against *Fusarium oxysporum* sp. *ciceri*, *Ustilaginoidea virens*, *Magnaporthe oryzae*, *Drechslera teramera* and *Sclerotium rolfsi* pathogens.

Further, four potential bacterial strains were identified for control of paddy diseases, two (URR7 and LWR19) were against *Magnaporthe oryzae* (blast of rice) and other two (BRR10 and BRR15) were against *Ustilaginoidea virens* (false smut of rice). These strains were chosen for pot and field trial analyses using susceptible rice variety Pusa Sugandh (PS-5) with five different treatments *i.e.* bio-priming with bacteria, biopriming with bacteria and pathogen, biopriming with consortia, root dipping and soil application. Seed and seedling quality parameters and other quantitative attributes were recorded during *kharif*-2015 at ICAR-IISS, Mau. The present investigation revealed that under the pot trial, treatment with biopriming and soil application along with bacterium LWR 19 strain showed higher root length, shoot length and germination per cent as compared to biopriming with bacteria & pathogen and control (Fig 14a). Further, in field trial, no positive results were found because of incongenial weather conditions (Fig. 14 b).

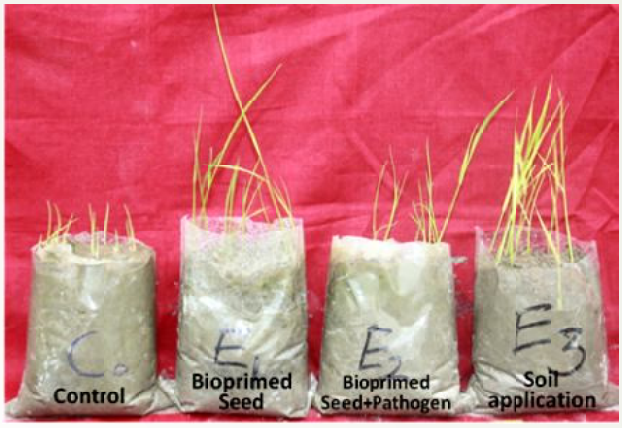


Fig. 14 (a): Poly bag trial of rice (PS-5) treated with LWR19 strain

Fig. 14 (b): Field trial of rice (PS-5) treated with URR7, LWR19, BRR10 and BRR15 strain

1.1.4.2. Biochemical characterization of insecticide resistance in major stored insect pests and their management

Various novel insecticides *viz.*, emamectin benzoate, spinosad and indoxacarb were evaluated against *R.dominica* and *T.castaneum*. Cent per cent

mortality was recorded with the dosage of 0.5, 0.07 and 0.5 per cent of emamectin benzoate, spinosad and indoxacarb against *R.dominica*. Similarly, *T. castaneum* recorded 100 per cent mortality with the dosage of 1.2, 1.2 and 2 per cent of emamectin benzoate, spinosad and indoxacarb respectively (Table 14).

Table 14: Evaluation of novel insecticides

	Emamectin benzoate	Spinosad	Indoxacarb
R.dominica	0.5%	0.07%	0.5%
T.castaneum	1.2%	1.2%	2%

To study insecticide resistance, deltamethrin was examined by bioassay using a discriminating dosage technique with impregnated filter papers. Mortality percentages were determined. In addition, esterase, glutathione S-transferase, and cytochrome P450 monooxygenase activities were also determined in this study to analyze detoxification mechanism(s) of tested insecticide in *S. oryzae*.

Bioassay results of deltamethrin showed that 1.2 mg (discriminating dose) killed all laboratory cultured susceptible *S. oryzae* insects, while the discriminating dose killed only 80.5%, 72.2%, 92.2%, 70.5% and 68.2% of *S. oryzae* insects from Coimbatore, Palakkad, Bangalore, Bellary and Secunderabad populations, respectively (Table 15).

Table 15: Mortality percentages of *S. oryzae* populations that treated with discriminating doses of deltamethrin

Insecticide	Population	Discri-minating dose (mg/disc)	Mortality (%)
Deltamethrin	Coimbatore	1.2	80.5
	Palakkad	1.2	72.2
	Bangalore	1.2	92.2
	Bellary	1.2	70.5
	Secunderabad	1.2	68.2
	Susceptible	1.2	100

Tables 16, 17 and 18 illustrate biochemical assay results of CYP450-PNOD, GST-CDNB, and EST-PNPA activities of *S. oryzae* strains, respectively. It was previously reported that insecticides from different classes might be metabolized by cytochrome P450 monooxygenases in insects. Recently, it has also been reported that CYP450s may have role in resistance development in stored-grain pests against insecticides. Additionally, GSTs can metabolize

Table 16: CYP450-PNOD activities of *S. oryzae* populations

Population	Sample size (N)	CYP450-PNOD specific activity[a]
Susceptible	10	48.5±10.3
Palakkad	10	145.5 ±9.2
Bangalore	10	130.8±8.1
Bellary	10	151.6±13.5
Secunderabad	10	158.8*±16.8

[a]pmole/min/mg protein±Standard error of mean; *Value significantly different from the susceptible population ($p<0.05$) with Student t-test.

Table 17: GST-CDNB activities of *S. oryzae* populations

Population	Sample size (N)	GST-CDNB activity[a]
Susceptible	10	59.6±6.9
Palakkad	10	82.4±6.4
Bangalore	10	110.8±2.1
Bellary	10	112.6±3.5
Secunderabad	10	124.9*±5.5

[a]nmole min-1 mg protein-1±Standard error of mean; *Value significantly different from the susceptible population ($p<0.05$) with Student *t*-test.

organophosphate insecticides and decrease oxidative stress by detoxifying lipid peroxides and oxidized DNA bases induced by increased insecticide metabolism. Biochemical assay results demonstrated that deltamethrin resistant Secunderabad population showed significant ($p<0.05$) increases in CYP450- PNOD (3.0-fold) and GST-CDNB activities (1.4-fold) compared to the susceptible strain (Table 16 and Table 17). However, EST-PNPA activity was not changed significantly ($p<0.05$) in resistant population compared to the susceptible population (Table 18).

Table 18: EST-PNPA activities of *S. oryzae* populations

Population	Sample size (N)	EST-PNPA activity$_a$
Susceptible	10	59.6±6.9
Palakkad	10	65.4±6.4
Bangalore	10	63.8±2.1
Bellary	10	72.6±3.5
Secunderabad	10	85.9*±5.5

$_a$nmole min-1 mg protein-1±Standard error of mean; *Value significantly different from the susceptible population ($p<0.05$) with Student-t test.

Consequently, it is concluded that CYP450s together with GSTs seem to be involved in resistance development to deltamethrin insecticide in Secunderabad population of *S. oryzae*. It showed 1.3-fold and 2.2-fold more EST-PNPA and GST-CDNB activity, respectively compared to the susceptible population (Table 17 and Table 18). As esterases might be involved in organophosphate, carbamate, and pyrethroid resistance in insects, increased EST-PNPA activity along with increased GST-CDNB activity could be related with resistance to other insecticide(s) from organophosphates or insecticide(s) from different chemical classes in population of *S. oryzae*.

Evaluation of *Uscana* sp. (Trichogrammatidae) against *Callosobruchus* sp. on storability of pigeon pea seed

The observations and results of the experiments showed that increase in parasitoid (*Uscana* sp.) number is directly proportional to increased level of parasitization. The 100% parasitization was observed in treatment (T4) where 80 *Uscana* sp were released. Lowest egg parasitization was noticed in the treatment (T1) with 41.33 per cent. Treatment T2 and T3 recorded parasitization percentage of 68.00 and 91.33 respectively. Nil parasitization was observed in Control (T5) with no *Uscana* sp released.

Exit hole of bruchid was observed in all the treatments. The cent percent seed infestation was observed in T5 (control). Lowest infestation of seed was noticed in T4 (1.33 per cent) followed by T3 (15.00 per cent). Highest seed infestation with 65.33 and 58.33 per cent was observed in T1 and T2 respectively (Table 19).

The germination of pigeonpea seeds was highest (93%) in T4. There was drastic reduction in germination % after infestation and it was 72.67 per cent with T5 (control), while treatments T1, T2 and T3 recorded 80.67, 85.67 and 89.00 % value respectively (Table 19). The insect infestation reduced the germination by 15 per cent (initial germination being 95 %).

Table 19: Parasitization effect of *Uscana* sp. on eggs of *Callosobruchus maculatus* in Pigeon pea seed

Treatment	Parasita-zation (%)	Seed infestation (%)	Moisture content (%)	Germinat ion (%)	Root length (cm)	Shoot length (cm)	Seedlin g length (cm)	Vigour Index
T1 (20 *Uscana* sp)	41.33 (6.43)	65.33 (8.08)	14.00 (3.74)	80.67 (8.98)	8.17	7.30	15.47	1247.81
T2(40*Uscana* sp)	68.00 (8.25)	58.33 (7.64)	12.33 (3.51)	85.67 (9.26)	10.67	8.50	19.17	1642.1
T3(60*Uscana* sp)	91.33 (9.56)	15.00 (3.87)	12.38 (3.52)	89.00 (9.43)	14.02	8.73	22.75	2024.75
T4(80*Uscana* sp)	100.00 (10.00)	1.33 (1.15)	10.83 (3.29)	93.00 (9.64)	16.07	10.00	26.07	2424.51
T5(control)	0.00 (0.00)	100.00 (10.00)	17.28 (4.16)	72.67 (8.52)	7.07	6.17	13.24	962.01
Sem±	0.41	1.14	0.55	0.99	0.46	0.22		
CD (0.05)	2.04	5.65	4.70	4.88	2.27	1.10		

*Observations based on mean values of three replications.
*Figures in parenthesis are square root transformed values.

1.1.4.3 Estimation of economic threshold level of important insect pests in paddy and mustard seed crop

To study the effect of *Lipaphis erysimi* density on the quality parameters of mustard seed an experiment was conducted with six treatments consisting of six different *Lipaphis erysimi* densities. Mustard was grown in 18 plots of size 2x2 meter. Before the flowering stage, each plot was covered with nylon mesh cages to avoid natural infestation. Ten random plants were tagged in each plot. The required populations of insects were maintained at tagged plants under the nylon mesh. Observations related with yield and seed recovery were recorded. Table 20 and Fig 15 revealed that yield, seed yield & seed recovery percentage were found to be inversely proportional to aphid density. It is apparent from Fig 15, that seed yield is more affected than general yield with increasing aphid density.

Table 20: Effect of *Lipaphis eysimi* on the seed parameters in mustard

Insect density (Per Plant)	Yield/Plant (g)	Seed/ Plant (g)	Undersized (g)	Seed recovery (%)	Seed germination (%)
0.0	11.13	11.02	0.10	97.95	91.33
10	10.35	10.18	0.16	97.05	88.66
20	10.59	10.33	0.26	94.93	88.66
30	8.94	8.63	0.30	93.39	90.66
40	8.14	7.79	0.35	91.75	88.66
50	6.95	6.44	0.51	86.32	88.66
CD (5%)	2.06	2.04	0.189	-	NS

Fig. 15: Seed yield *vis-à-vis* aphid density

1.1.5 Seed economics & policy research

1.1.5.1. Impact assessment of quality seed production: addressing scope and efficiency of certified seed production among seed growers

The list of certified seed growers of paddy in Karimnagar district has been obtained from Telangana State Seed Certification Agency, Hyderabad. Karimnagar District, Telangana was chosen and survey has been conducted among one hundred farmers of paddy (commercial grain producer and certified seed producer). Primary data were collected by personal interview with the respondents using a well-structured and pre-tested interview schedule. Data on various socio-economic parameters, input used in the grain and seed production of paddy and their costs and returns were collected for the agricultural year 2013-14. Analysis of survey data report is as follows :

Land holding

The data pertaining to average land holding of sample paddy farmers have been given in Table 21. The analysis of data shows that majority of seed farmers belongs to small category (1-2 ha) followed by semi-medium (2-4 ha) and marginal (< 1 ha) category. The overall average land holding size of paddy seed farmers was 2.04 ha followed by grain farmers (1.27 ha) and district average (1.03 ha).

Table 21: Average land holding of sample paddy farmers

Land holding particulars	Karimnagar district*	Sample paddy farmers		
		Grain farmers	Seed farmers	Overall
Marginal (< 1 ha)	0.43 (66.19)	0.59 (42)	0.66 (26)	0.62(34)
Small (1-2 ha)	1.38 (21.25)	1.29 (34)	1.42 (36)	1.36 (35)
Semi-medium (2-4 ha)	2.65 (9.56)	2.11 (20)	2.42 (26)	2.28 (23)
Medium (4-10 ha)	5.50 (2.72)	4.10 (4)	4.88 (10)	4.66 (7)
Large (10 ha and above)	15.85 (0.28)	0 (-)	12.00 (2)	12.00 (1)
Average/ Total	1.03 (100)	1.27 (100)	2.04 (100)	6.59 (100)

Source: Handbook of Statistics, Karimnagar district- 2011, CPO, Karimnagar
Note: Figures within the parentheses are percentage of farmers belonging to respective group.

Cropping pattern

The study area is dominated by paddy, cotton and maize. Cropping pattern of the study area has been presented in Fig.16. The area under different crops shows that paddy ranked 1st (46.98% of gross cropped area) followed by cotton (28.99%), maize (11.23%), pulses (3.46%), oilseeds (2.32%) and others (7.02%). The cropping intensity of the study area was 159.

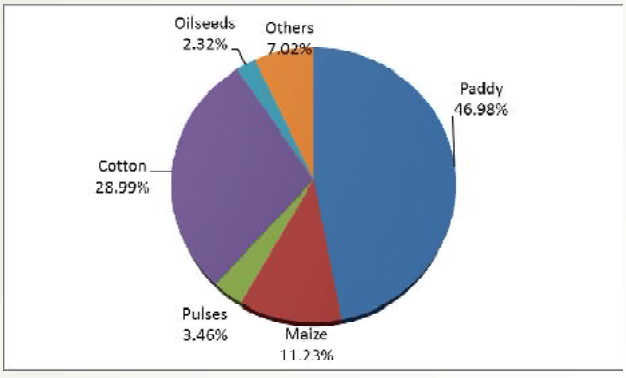


Fig. 16: Cropping pattern of study area

Irrigation

Irrigated area in the study area has been presented in Fig 17. In the Karimnagar district only 73.95 per cent area is irrigated while net irrigated area among paddy grain producer and certified seed producer is 71.00 and 90.60 per cent, respectively. The major source of irrigation was dug wells and canals [(around 79 per cent of irrigated area) (Table 22)].

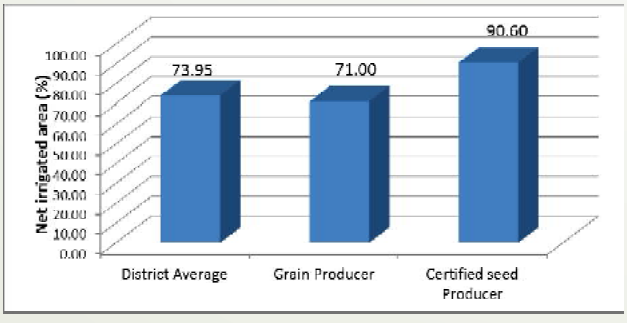


Fig.17: Irrigation scenario in study area

Irrigation source

Table 22: Source-wise average irrigated area (in percentage) of sample paddy farmers

Irrigation source	Karimnagar district*	Sample paddy farmers	
		Grain farmers	Seed farmers
Canals	20.86	14.64	26.38
Tanks	8.72	0.89	3.03
Tube wells	11.99	9.12	12.33
Dug wells	58.43	75.35	58.26
Total	100.00	100.00	100.00

Source: Handbook of Statistics, Karimnagar district-2011, CPO, Karimnagar

Reasons for not producing certified seeds

The factors constraining adoption of paddy seed production technology as perceived by grain producers are presented in Table 23. Non-availability of labour was the most important constraints hindering adoption of paddy seed production technology, as opined by 58 per cent of the farmers respondents. The other reasons constraining seed production technology were lack of irrigation water, lack of awareness / knowledge, non-availability of basic seed, marketing of product, small holding size and high cost of cultivation.

Table 23: Factors constraining adoption of paddy seed production technology

Particulars	Number of farmers	Percentage
Lack of irrigation water	16	32
Lack of awareness / knowledge	22	44
Non-availability of basic seed	23	46
Marketing of product	24	48
Small holding size	24	48
High cost of cultivation	26	52
Non-availability of labour	29	58

Reasons for adopting paddy seed production technology

The major reasons for choosing the seed production are presented in Table 24. Farmers selected enterprises based on several criteria, one of the most important criterions as the surveyed farmers assigned first rank was higher profit. The other reasons for adoption of paddy seed production technology were better yield, suitability of climate, easy marketability of produce and technical know-how.

Table 24: Reasons for adoption of paddy seed production technology

Particulars	Number of farmers	Percentage
Higher profit	38	76
Better yield	32	64
Suitability of climate	26	52
Easy marketability of produce	24	48
Technical know-how	21	42

Paddy varieties

The varieties used by seed growers in the study area for seed production have been presented in Fig 18. The paddy seed production area is dominated by variety BPT- 5204 which covers 31.57 per cent area under paddy seed production. The other varieties used for seed production were MTU- 1010 (29.22 per cent), IR- 64 (10.60 per cent), MTU- 7029 (5.76 per cent), NLR- 34449 (4.58 per cent), IET- 4786 (3.57 per cent), JGL- 1798 (3.38 per cent), ADT- 43 (3.37 per cent) and others (7.95 per cent).

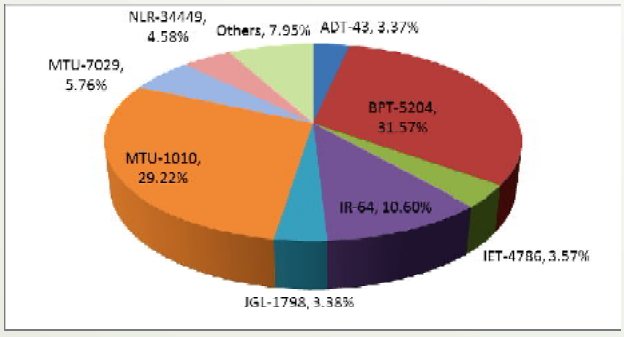


Fig. 18: Area under different varieties used for paddy seed production

Experience of sample farmers in seed production

Experience of farmers in the seed production plays an important role in producing the quality seeds. The experience of sample seed growers in seed production is presented in Table 25. The table shows that 60 per cent farmers had less than five years' experience in the seed production followed by 24 per cent farmers who had 5-10 years' experience and 16 per cent farmers having more than 10 years of experience in seed production.

Table 25: Experience of sample farmers in paddy seed production

Particulars	Number of farmers	Percentage
< 5 years	30	60
5-10 years	12	24
>10 years	8	16

Sources of information to the seed growers

The sources of information about knowledge on quality seed production among the sample seed growers are presented in Table 26. Majority of farmers (76.0 per cent) received information about the quality seed production from Government officials. The other important sources of information to farmers were fellow farmers (46.0 per cent) followed by electronic and print media (40.0 per cent), seed companies (38.0 per cent) and others (32.0 per cent).

Table 26: Sources of information to the seed growers

Sources	Number of farmers	Percentage
Fellow Farmer	23	46
Government officials	38	76
Electronic and print media	20	40
Seed companies	19	38
Others	16	32

Note: Percentage total is more than 100 because the sample farmers have given more than one response

1.1.6 Genetical Studies for improving seed production efficiency and quality

1.1.6.1 Studies on field weathering among soybean genotypes

Humid, tropical environments are conducive to seed deterioration and make the production of high quality soybean seed difficult. Deterioration of seed prior to/at the harvest is usually referred to as "Field Weathering". High temperature, humidity and precipitation play a crucial role in seed quality deterioration prior to harvest. Seed deterioration causes loss of seed quality with time. It is a natural process which involves cytological, physiological, biochemical and physical changes in seeds. These changes reduce viability and ultimately cause death of the seed.

Work progress in 2015-16

Thirteen varieties of soybean *viz.*, JS 335, JS 93-05, JS 95-60, JS 97-52, JS 20-29, JS 20-34, RKS 24, PK 416, PK 472, PS 1024, PS 1029, PS 1092 and PS 1347 subjected to artificial field weathering through wet bag treatments at the time of harvest were evaluated along with control for seed quality parameters (Table 27 & 28).

Table 27: Effect of Field Weathering on Soybean Seed Quality- Under Weathered Condition

Variety	Germination %	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Dry wt. (mg)	SVI-I	SV-II
PS 1029	91.50	18.19	23.00	41.19	0.361	3768.89	3303.15
JS 20-34	91.00	27.04	20.83	47.87	0.427	4356.17	3885.70
JS 97-52	85.00	21.80	27.77	49.57	0.303	4213.45	2575.50
RKS 24	94.00	22.10	23.52	45.62	0.372	4288.28	3496.80
PK 472	79.00	15.45	22.12	37.57	0.454	2968.03	3586.60
PS 1347	80.00	19.44	22.78	42.22	0.398	3377.60	3184.00
PS 1024	87.50	22.44	29.08	51.52	0.399	4508.00	3491.25
JS 95-60	64.50	14.88	20.68	35.56	0.400	2293.62	2580.00
JS 93-05	88.00	19.45	19.48	38.93	0.414	3425.84	3643.20
PK 416	83.50	20.32	23.18	43.50	0.451	3632.25	3765.85
JS 335	90.00	28.66	21.88	50.54	0.36	4548.60	3240.00
JS 20-29	85.00	21.13	20.07	41.20	0.419	3502.00	3561.50
PS 1092	86.00	19.66	23.66	43.32	0.430	3725.52	3698.00

Table 28: Soybean Seed Quality parameters for Control

Variety	Germination %	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Dry wt. (mg)	SVI-I	SV-II
PS 1029	88.50	19.56	24.39	43.95	0.402	3889.58	3557.70
JS 20-34	97.00	19.56	23.26	42.82	0.460	4153.54	4462.00
JS 97-52	96.50	20.73	22.86	43.59	0.280	4206.44	2702.00
RKS 24	98.50	18.03	21.01	39.04	0.314	3845.44	3092.90
PK 472	89.00	16.16	23.68	39.84	0.415	3545.76	3693.50
PS 1347	96.00	14.76	23.22	37.98	0.445	3646.08	4272.00
PS 1024	88.00	15.44	22.86	38.30	0.378	3370.40	3326.40
JS 95-60	94.00	19.96	24.34	44.30	0.476	4164.20	4474.40
JS 93-05	91.00	19.17	23.73	42.90	0.416	3903.90	3785.60
PK 416	83.50	20.41	22.51	42.92	0.447	3583.82	3732.45
JS 335	95.00	17.37	22.28	39.65	0.299	3766.75	2840.50
JS 20-29	94.50	16.36	21.37	37.73	0.402	3565.49	3798.90
PS 1092	97.00	20.88	26.03	46.91	0.378	4550.27	3666.60

To confirm the findings of first year results, a field trial comprising of 15 genotypes of soybean namely JS 335, JS 93-05, JS 95-60, JS 97-52, JS 20-29, JS 20-34, RKS 24, PK 416, PK 472, PS 1024, PS 1029, PS 1092, PS 1347, NRC 86 and NRC 37 were grown with 3 replications in ICAR-IISS, Mau farm as well as pots in the net house in *Kharif* 2015. The same set of material was also raised at ICAR-IISS, Mau regional station Bengaluru in *Kharif* 2015. The phonological observations were recorded among genotypes. The crop raised in the field in Mau suffered to an extent by the outbreak of Yellow Mosaic Virus (YMV), which was more prominent among central zone varieties. These soybean genotypes were subjected to artificial field weathering through wet bag treatments at the time of harvest, and would be evaluated for seed quality parameters along with control after the storage in May 2016 prior to planting season.

1.6.1.2 Improving hybrid seed production efficiency through synchronization of flowering in maize (*Zea mays* L.)

Standardization of seed priming treatments

To standardize treatment duration/ concentration of hydro priming, osmo priming, salicylic acid treatment along with control; germination and vigour I, II tests were carried out for common male parental line (HKI-161) of HQPM-5 and HM-8 (Fig. 19 a&b). Hydro priming for 18 hours showed higher vigour I and II as compared to other treatments. For osmo priming, urea was used as an agent, wherein soaking in 2% urea solution for 12 h showed higher vigour I, II as compared to 1% solution. Among the salicylic acid treatment 100ppm with 12 h of soaking of seeds showed higher germination percentage and vigour I.

Phenotypic evaluation of maize hybrids and their parental lines in *Kharif* 2015

Hybrids namely HQPM -1, HQPM-5, HM- 8, HM-9 and HM-10 were grown in a trial along with their parental lines except for HQPM-1 in a RBD with two replications. Days to 50% tasseling and silking were recorded for hybrids and their parental lines. Male parental line HKI-161 was common for both HQPM-5 and HM-8 hybrids. Days to 50% tasseling and silking was earlier in male parent HKI-161 as compared to female counterparts HKI-163 (HQPM 5) and HKI-1105 (HM-8). Both the hybrids HQPM-5 and HM-8 recorded lesser days to 50% tasseling and silking as compared to parental lines. Floral behaviour of tassel *viz*., tassel angle between main axis and lateral branches, and attitude of lateral branches were recorded for hybrids as well as their parental lines. The hybrid HQPM -5 showed wide and curved while HM-8 showed wide and strongly curved tassel, while HKI-161, the male parent of both the hybrids showed narrow and straight tassel. Both HM -9 and its male parents HKI-1128 showed wide and strongly curved tassel. HM-10 and its both parents showed wide and curved tassel. From the observations it was found that for male parent HKI-161 there is a need to improve the pollen dispersability to increase the hybrid seed yield. For all the hybrids and their parental lines, yield and their related traits were recorded. In addition, germination percentage and vigour I, II indices were also done in lab conditions.

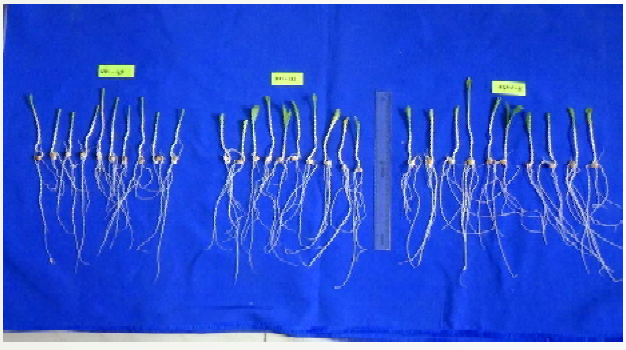


Fig.19(a): Germination test of HQPM-5 and their parental lines

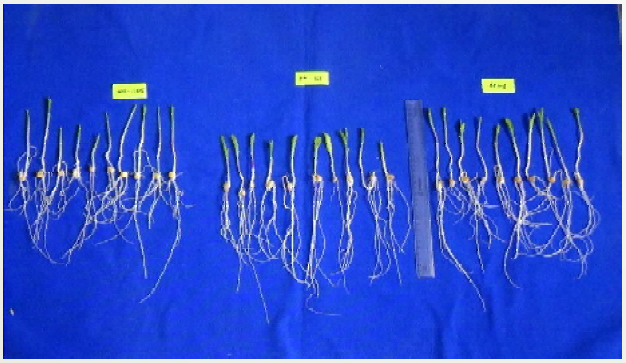


Fig.19(b): Germination test of HQPM-8 and their parental lines

Different planting ratios for hybrid seed production in *Kharif* 2015

To study hybrid seed production potential of both QPM and non QPM hybrids, HQPM-5 and HM-8 were chosen and experiment was conducted in *Kharif* 2015. In this study the male parent HKI-161 is common for both the hybrids. HKI-163 and HKI-1105 are the female parents of HQPM-5 and HM-8, respectively. Male and female lines were grown in 2:5:2 and 2:4:2 ratios in two different locations. Days to 50% tasseling in male parent and days to 50% of silking in female were observed. Among the hybrids, parental lines of HM-8 showed earliness when compared to HQPM-5 parental lines.

In *Kharif* season-2015, among different planting ratios for hybrid HM 8, for the trait grain yield per plant the planting ratio 2:4:2 gave higher mean yield (23.10q) as compared to 2:5:2 ratio (19.17q). Results further revealed that among the different treatments tried under 2:4:2 planting ratio, priming with salicylic acid recorded the highest seed yield 24.55q followed by osmo priming 23.93q and hydro priming 23.13q which were higher than the control 20.80q as sown in Table 29.

Table 29: Performance of maize hybrid HM-8 in different planting ratios of 2:4:2 and 2:5:2 in *Kharif* 2015

Planting Ratios	Treatments	100 seed weight (g)	Number of grains per row	Single plant seed yield (g)	Seed yield (q/ha)
2:4:2	OP	32.17	20.40	35.90	23.93
	SP	31.58	21.67	36.83	24.55
	HP	30.58	19.33	34.70	23.13
	control	28.03	18.33	31.20	20.80
	Average	30.59	19.93	34.65	23.10
2:5:2	OP	28.86	22.20	29.00	19.33
	SP	30.66	23.40	31.05	20.70
	HP	28.22	21.27	28.16	18.77
	control	27.49	20.60	26.80	17.87
	Average	28.80	21.86	28.75	19.17

Table 30: Performance of maize hybrid HQPM-5 in different planting ratios of 2:4:2 and 2:5:2 in *Kharif* 2015

Planting Ratios	Treatments	100 seed weight (g)	Number of grains per row	Single plant seed yield (g)	Seed yield (q/ha)
2:4:2	OP	32.30	17.82	33.92	22.61
	SP	33.37	18.07	35.43	23.62
	HP	32.29	17.30	30.30	20.20
	control	28.37	15.80	28.03	18.69
	Average	31.58	17.24	31.92	21.28
2:5:2	OP	29.64	17.33	27.85	18.57
	SP	30.82	18.60	29.66	19.77
	HP	29.40	16.50	26.12	17.41
	control	27.95	15.20	25.40	16.93
	Average	29.45	16.90	27.25	18.17

Like HM-8, Quality Protein Maize (QPM) hybrid, HQPM-5 also showed that planting ratio 2:4:2 gave higher mean yield (21.28q) as compared to 2:5:2 ratio (18.17q) (Table 30). For different seed priming treatments same trend was observed with the pattern of HM-8.

Rabi experiment in 2015-16

Phenotypic evaluation of maize hybrids and their parental lines in *Rabi* 2015-16

To understand the performance of hybrids and their parental lines in *Rabi* season, an experiment was carried out. Hybrids namely HQPM -1, HQPM-5, HM-8, HM-9 and HM-10 and their parental lines were grown in RBD with two replications. Flowering traits like days to 50% tasseling and silking were recorded for hybrids and their parental lines. Same floral behaviour was observed in both *Kharif* and *Rabi* season respectively (Fig. 20).

Fig. 20: Field view of *Rabi* crop during crop establishment stage

Different planting ratios for hybrid seed production in *Rabi* 2015-16

In this study, HKI-163 and HKI-1105 are female parents of HQPM-5 and HM-8, respectively along with the common male parent HKI 161 which were grown in 2:5:2 and 2:4:2 planting ratios (Fig.21).

Fig. 21: Detasselled female rows with male rows

Spring-summer experiment in 2016

Different planting ratios for hybrid seed production

Fig. 22 : Field view of planting ratio 2:5:2 in spring season (2Rows male: 5Rows female: 2Rows Male)

Same experiment as preceeding *Kharif* and *Rabi* seasons were laid out in spring-summer season as shown in Fig.22.

1.6.1.3 Improving hybridization efficiency, seed set and development of male sterile lines for hybrid seed production in Finger millet (*Eleusine coracana* L. Gaertn)

Floral characteristics and floral behaviour of finger millet were determined among 40 genotypes, which included 20 cultivars with distinct morphological characteristics & maturity durations, 1 partial male sterile line (PS-1) and 19 wild accessions from 5 different species of *Eleusine (africana, indica, tristachya, multiflora and jaegeri)* genera. Wide variations were observed in flowering behaviour of *Eleusine* species. Flowering proceeded from top of the panicle to downwards among all the strains studied. Emergence of inflorescence from flag leaf was alike among 5 species of genus *Eleusine*, except for the species *E. multiflora*, which showed extra early emergence of inflorescence. Wide difference in flowering period was observed in cultivated *E. coracana* as compared to rest of the wild species. Wild species took more days (7 - 10) to attain full blooming than the domesticated *E. coracana* (3 - 4). The time of anther dehiscence was earlier among wild species (1.30 AM – 4.00 AM) with peak anther dehiscence around 2.30 AM, whereas among domesticated cultivars it was between 3.00 AM – 6.00 AM, with a peak anther dehiscence around 4.00 AM (Fig. 23).

Analysis of variance revealed significant differences among germplasm accessions and improved varieties for all the floral as well as other morphological characters. The accessions were highly variable as indicated by higher estimates of PCV and GCV (>20%)

and higher broad sense heritability, except for No. of spikelets/ Head and plant height. Based on floral characteristics and other morphological characters 40 accessions were clustered into six distinct groups.

implementing participatory seed production programme etc. and was mailed to all the co-operating centers in India for collecting secondary data pertinent to implementation of ICAR- seed Project.

Fig. 23: Anther dehiscence of *Eleusine* sp.

1.1.7 Newly initiated programmes

1.1.7.1 Impact assessment of institutional interventions on quality seed production system under ICAR Seed Project

Project entitled 'Impact assessment of institutional interventions on quality seed production system under ICAR Seed Project' was approved in IRC-2015 of IISS, Mau.

Following activities were undertaken during 2015-16

1. Review of literature was completed on:

- ICAR seed project implementation in various co-operating centers
- Annual reports of ISP for last 10 years
- Economic Methodology for impact evaluation of projects

Subsequently, a questionnaire was developed to get details on quality seed production aspects such as year wise production, participatory seed production, technology adoption in quality seed production, criteria for selection of participating farmers, constraints in

Data received from 35 cooperating centres of ISP 4 has been compiled and data entry for the same has been done. Methodological framework for data analysis for Seed Multiplication Ratio (SMR) has been developed and data analysis was started.

1.1.7.2 Devising agro-techniques for enhancing seed quality in *Tagetes spp.* and *Viloa tricolor,* flowering annuals

Marigold is one of the important annual flowers grown for commercial purposes all over the world. It stands first among the loose flowers in India. Fast decline in vigour and viability of marigold seeds is a main problem even under ambient storage conditions. Pansies *(Viola tricolor)* is another most important annual flowers having seed export potential from India. Pansies seeds show morphological dormancy which results in poor germination rate and abnormal seedlings. Seed priming is one of the strategies being used to accelerate the activation of plant growth, especially seed germination in many a crops. The present study was conducted with the objectives to

optimize the dormancy breaking protocols and to understand the influence of various seed enhancement approaches on germination and related physiological characteristics of marigold and pansy seeds.

Healthy seeds of Pusa Narangi Gainda (PNG), Pusa Basanti Gainda (PBG) and Open Pollinated variety of pansy seeds were obtained from ICAR-IARI Pusa Campus New Delhi. These flower seeds were subjected to following treatments:

Priming of Marigold

Untreated control (T1), Hydro-priming (T2), $MgNO_3$ 50mM (T3), KNO_3 50mM (T4) and PEG 50mM (T5)

Breaking Seed dormancy in Pansy

i. Scarification: Performed by mechanical mean, sulphuric acid @50% along with untreated as control.

ii. Leaching by standard procedure.

iii. Use of Chemical: GA_3 @100 ppm, KNO_3 @ 0.2% and Ethanol(absolute) along with uuntreated control.

For all seed priming treatments 5 g of seed sample was used. The ratio of seed and working solution (g ml^{-1}) was kept at 1:5 ratio. Seeds of marigold and pansy were soaked in solution of $MgNO_3$ (T_3), KNO_3 (T_4) and PEG (T_5) and distilled water for 24 h at 25 ± 2°C. After priming, seeds were quickly rinsed with distilled water and spread in a thin layer on dry filter paper and dried for 1 day at 30°C until the initial seed weight was obtained. These seeds were then packed in polythene bags having 12% moisture content and stored in refrigerator at 10°C for seven days. Four replicates of 20 treated or non-treated seeds were germinated in 9 cm diameter Petri dishes on Whatman No. 1 filter paper which was made wet with distilled water under continuous florescent light at 25°C in a growth chamber for 7 days. Results showed that all the parameter (*viz.* germination %, field emergence, shoot length, root length, seedling fresh weight and seedling dry weight) were significantly influenced by various priming treatments (Table 31 & 32). Amongst the treatments, T_5 (PEG 50mM) recorded the most significant effect on all seed quality parameters. The experiment was repeated three times in a completely randomized design; data was recorded and subjected to statistical analysis through SAS.

Table 31: t Tests (LSD) for various parameters of marigold affected by various priming treatments

Treat-ments	Mean of Various parameters (same letter in each column are not significantly different)																	
	Germination %			Field emergence			Shoot length (cm)			Root length (cm)			Seedling fresh weight(mg)			Seedling dry weight(mg)		
	V1	V2	V3	V1	V2	V3	V1	V2	V3	V1	V2	V3	V1	V2	V3	V1	V2	V3
T1	57.25^{c}	57.5^{e}	58.25^{d}	55.00^{d}	53.50^{d}	54.75^{c}	3.75^{a}	3.55^{d}	4.750^{d}	2.50^{c}	2.56^{c}	2.62^{d}	13.75^{d}	14.00^{c}	14.75^{c}	0.807^{b}	0.852^{b}	0.857^{b}
T2	63.75^{b}	63.0^{d}	64.75^{c}	60.50^{c}	59.75^{c}	61.50^{b}	3.00^{b}	3.40^{cd}	5.00^{cd}	3.12c^{b}	3.37^{cb}	3.87^{c}	14.50^{c}	15.00^{bc}	15.00^{cb}	0.832^{b}	0.840^{b}	0.857^{b}
T3	72.5^{a}	72.5^{b}	72.50^{b}	68.25^{b}	65.25^{b}	65.00^{b}	4.50^{a}	4.40^{bc}	6.00^{bc}	3.37^{b}	3.37^{cb}	5.00^{b}	14.87^{bc}	15.62^{ab}	15.62^{bc}	0.842^{b}	0.850^{ab}	0.860^{b}
T4	65.25^{b}	66.0^{c}	66.75^{c}	64.00^{b}	65.00^{b}	65.50^{b}	5.00^{a}	5.10^{b}	6.50^{b}	3.43^{b}	3.75^{b}	4.12^{cb}	15.50^{ab}	15.75^{ab}	16.00^{b}	0.857^{b}	0.857^{ab}	0.872^{b}
T5	74.5^{a}	77.0^{a}	78.25^{a}	70.50^{a}	73.50^{a}	76.00^{a}	5.00^{a}	5.20^{a}	8.50^{a}	4.75^{a}	5.0^{a}	6.00^{a}	16.12^{a}	16.37^{a}	17.62^{a}	0.877^{a}	0.892^{a}	0.897^{a}

V1= PNG, V2= PBG and V3 = Pusa Arpita Gainda
Untreated control (T1), Hydro-priming (T2), $MgNO_3$ 50mM (T3), KNO_3 50mM (T4) and PEG (T550mM)

Table 32: t tests (LSD) for various parameters of pansy affected by various priming treatments

Treatments	Mean of Various parameters (same letter in each column are not significantly different)					
	Germination %	Field emergence	Shoot length (cm)	Root length(cm)	Seedling fresh weight (mg)	Seedling dry weight (mg)
T1	49.5^{e}	48^{d}	5.25^{c}	2.875^{c}	15.25^{b}	0.85^{b}
T2	51.5^{d}	51^{c}	6b^{c}	3.875b^{c}	15.5^{b}	0.85^{b}
T3	69.25^{b}	65.75^{b}	6.5^{b}	5.5^{ab}	15.625^{b}	0.86^{b}
T4	54^{c}	52.5^{c}	7^{b}	5.375^{ab}	16^{b}	0.8725^{ab}
T5	80.25^{a}	79^{a}	8.5^{a}	6.75^{a}	18.5^{a}	0.9075^{a}

Untreated control (T1), Hydro-priming (T2), $MgNO_3$ 50mM (T3), KNO_3 50mM (T4) and PEG50mM (T5)

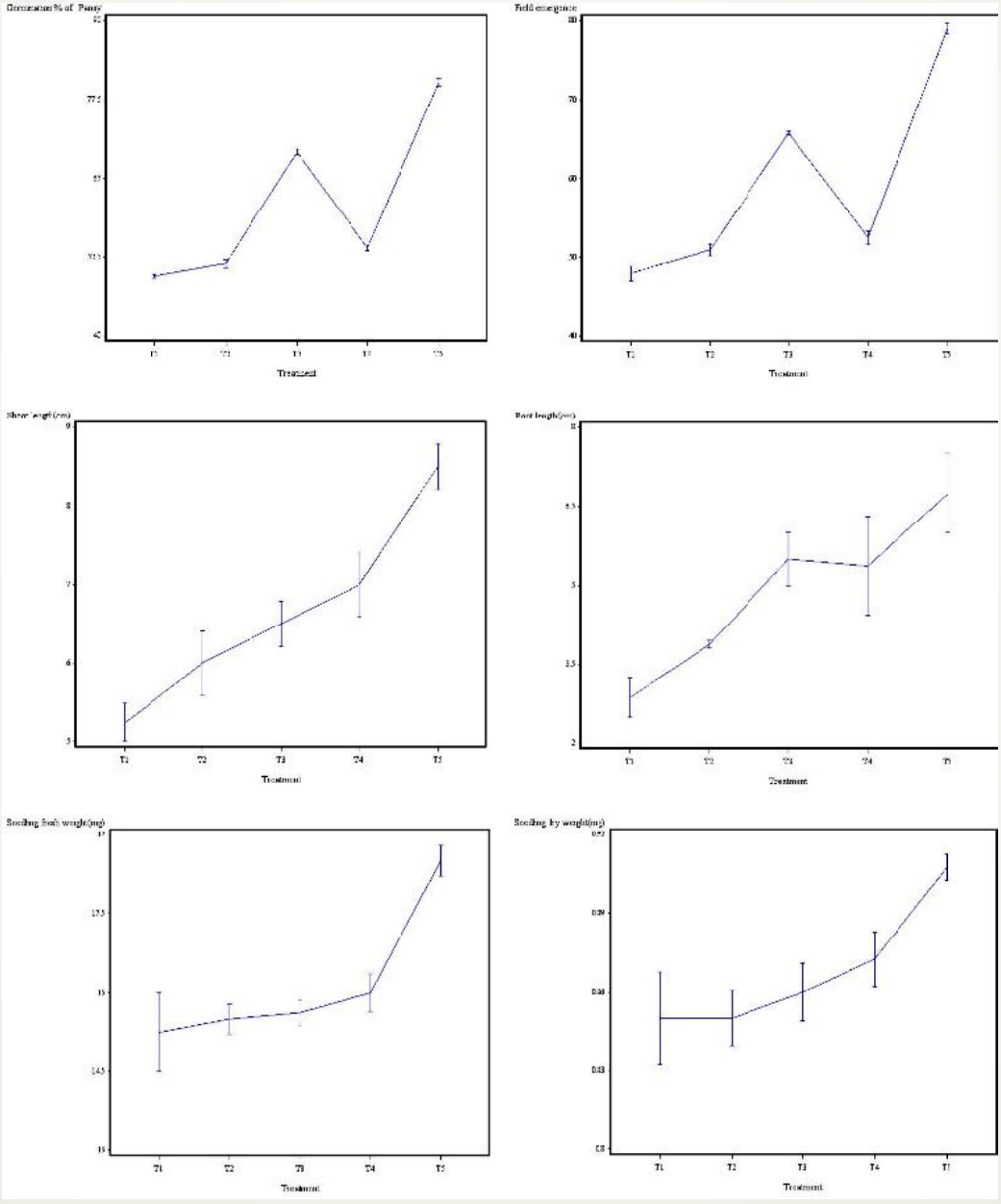


Fig. 24: Mean plots of various parameters of pansy affected by various treatments

1.1.7.3 Assessment of seed deteriorative changes in stored seeds of groundnut

Groundnut (*Arachis hypogaea*) is an important legume oilseed crop. The crop is grown in an area of 5.3 Mha with a production of 6.6 Mt and yield of 1257 Kg/ha (triennial period, 2010-13). The groundnut productivity is highly dependent on the selection and use of high quality seeds that are healthy, vigorous and viable. Groundnut being a self-pollinated crop (with < 2% natural out-crossing), most of the farmers are using own saved seeds for sowing, which results in poor seed replacement ratio (<2%) with promising varieties. Groundnut growers by tradition, store seeds either as pods or kernels, therefore it becomes more important to save healthy seeds for ensuring good crop.The major limitation in storing groundnut produce/seeds is deterioration of the seeds by Reactive Oxygen Species (ROS) which include superoxide, hydroxyl radical, hydrogen peroxide and singlet oxygen. To assess the seed deteriorative changes, various groundnut seed genotypes such as TMV-2, K-6, K-9, ICGV-9114, ICGV-00348, Dharani and TAG-24 were collected from various centres.

To evaluate the changes between natural and accelerated ageing, initially, proximate analyses were done by studying the seed quality parameters like germination (%), vigour index-I and II respectively (Fig 25 A, B). In addition, the Tetrazolium (Tz) and Nitro blue tetrazolium chloride (NBT) tests were conducted to know the viability and qualitative determination of ROS production in the stored groundnut (Fig 25 C).

Furthermore, it has been hypothesized, that the changes may take in lipid composition. The collected groundnuts were subjected to Gas Chromatography-Mass Spectrometer (GC-MS) and Fourier Transform-Infrared Spectroscopy (FT-IR) respectively, the same analysis would be conducted on aged seed lot. The compounds were validated with National Institute of Standards and Technology (NIST) library.

The lipid profile of the samples have been assessed with the help of GC-MS and FT-IR. The major fatty acids are palmitic acid, stearic acid, oleic acid and linoleic acid respectively (Fig. 26).The fatty acids of the genotype have been further corroborated with FT-IR and Mass spectra.

(A) (B) (C)

Fig. 25: (A & B) Germination tests of groundnut conducted in blotting paper (C) Tetrazolium test to determine the viability of groundnut seed

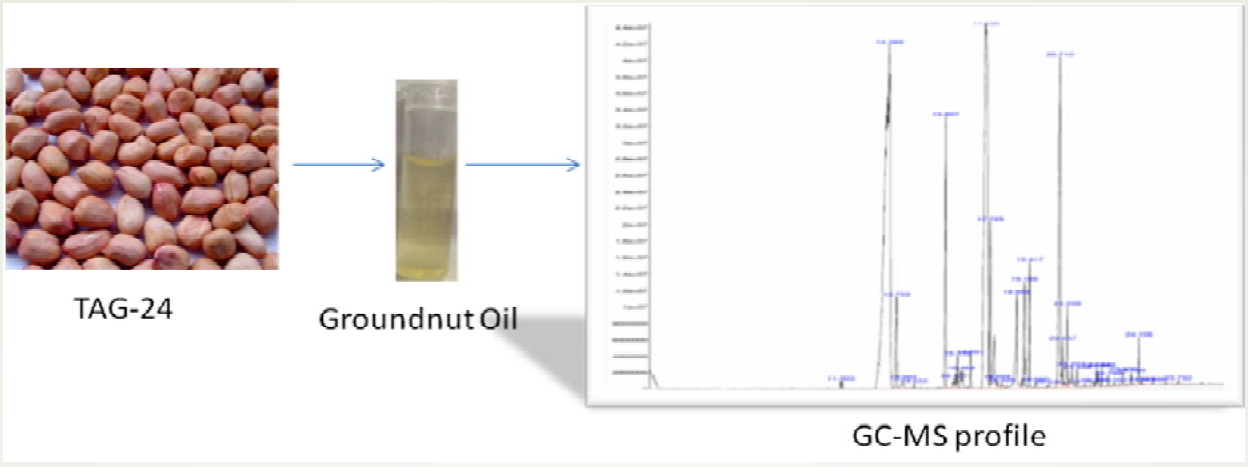


Fig. 26: Gas chromatogram depicting the lipid profile of groundnut TAG-24

The retention time and the major compounds eluted from the column have been tabulated below (Table 33).

Table 33: Major fatty acids and its relative peaks

Peak (R.T)	Compound
13.39	Palmitic acid
15.50	Stearic acid
17.53	Oleic acid
20.71	Linoleic acid

(R.T): Retention Time

FT-IR analysis

FT-IR analysis of the groundnut oil sample has been depicted in (Fig. 27). The peaks at various frequencies indicate the functional groups involved in the oil samples. To illustrate further the peaks and its respective functional groups have been given in the Table-34.

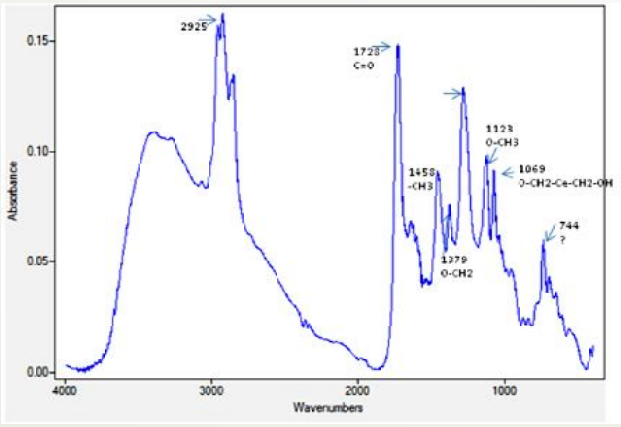


Fig. 27: Lipid analysis of TAG-24 using FT-IR

Table 34: Major fatty acids and its relative peaks of functional groups of the constituents

Peak (cm^{-1})	Functional Groups
2925	CH Bands
1800-1700	C=O esters
1458	$-CH_3$ group stretching
1379	$O-CH_2$ triglycerides
1123	$O-CH_3$

Mass Spectra of groundnut lipid profile

The major fatty acids are palmitic acid, stearic acid, oleic acid and linoleic acid respectively. The respective mass of each fatty acid and its structure identified through NIST library has been given below in the Fig-28.

Fatty acids such as palmitic acid, stearic acid, oleic acid and linoleic acid are predominantly present in the groundnut samples. In addition, the fatty acid profile

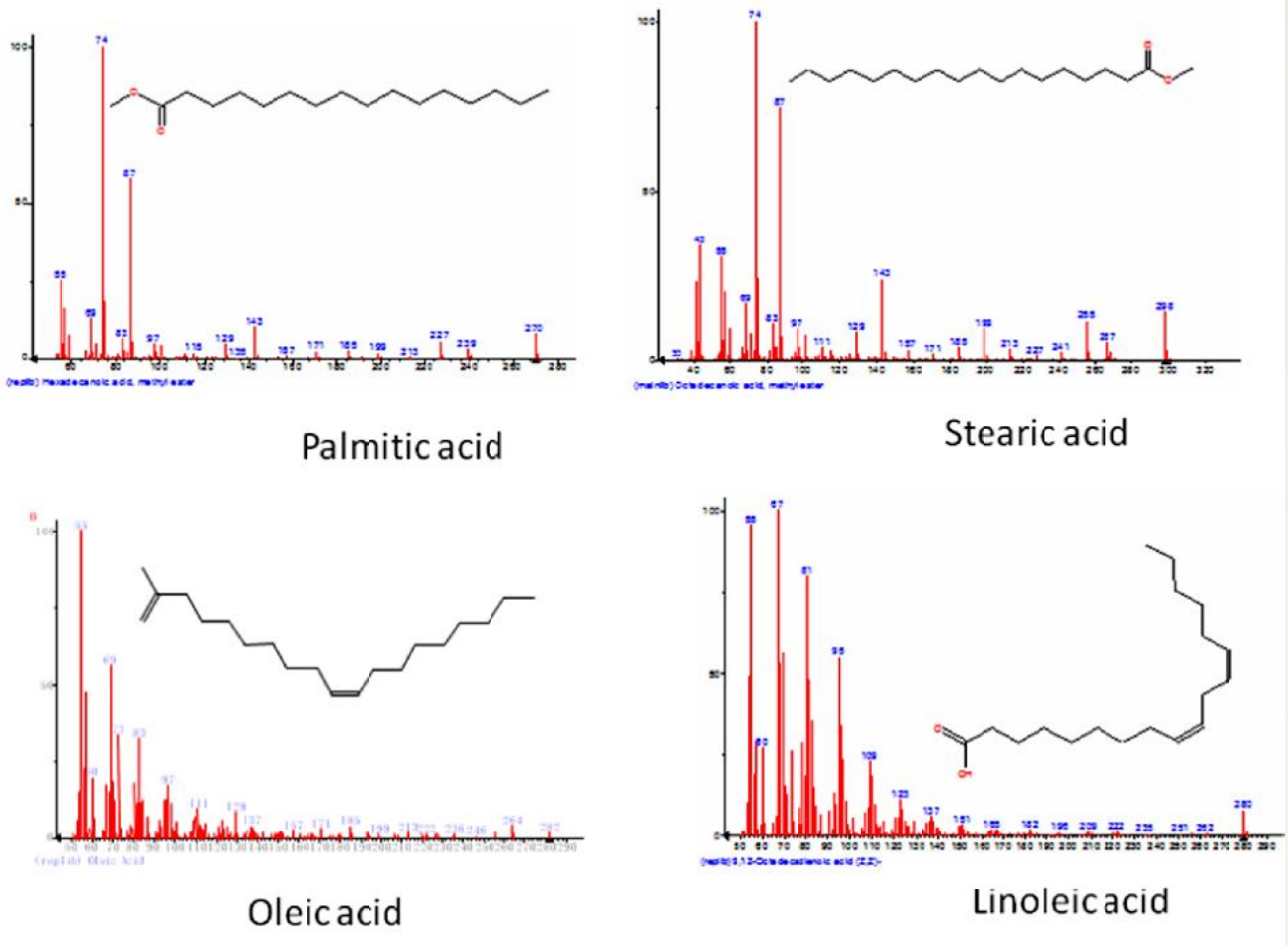


Fig. 28: Mass Spectra of groundnut lipid profile

has been further corroborated with FT-IR results. The presence of several functional groups of lipids substantiates that the FT-IR analysis may help in characterization of genotypes. The mass of each fatty acid has been validated with the NIST library of Mass Spectral studies.

1.1.7.4 Nano particulate seed invigoration for quality enhancement in paddy and soybean

The newly initiated project aims at enhancing the longevity of poor storing germplasm lines of paddy and commercial varieties of soybean through third generation seed enhancement technique (Nano particles). Necessary seed material has been procured and synthesis/ characterization of metal oxide nanoparticle will be initiated shortly and project will be conducted as per technical programme. Apart from this, development of carrier based nano-formulation for commercial use will also be targeted.

1.1.7.5 Digital Imaging System for seed health testing of wheat and marigold crops

Farmers require quick information to ascertain seed quality at local/field level. The concept used in the present study is to use of Digital Imaging System for seed health

testing of field and flower crops. It is based on two methods of digital image analysis *i.e.*

A. Changes in dimension

Seed dimension and shape changes during imbibition in comparison to time duration.

B. Changes in colour

Measurement of seed colour density *i.e.* red (long), green (medium) and blue (short) during physiological seed testing for viability *i.e* Tetrazolium

Seed vigour assessment

Initial standardization of techniques for seed vigour assessment was follows :

Four 6 cm diameter Petri dishes each containing 9 seeds of PNG were sealed with parafilm. The Petri dishes contained one piece of sterile transparent cellulose acetate film which was moisturised with 1ml of sterile water. The dishes were placed in the flat bed scanner placed in a growth chamber under a constant 25 °C from cool-white fluorescent lamp. The transparency adapter was placed on top of the Petri dish and scan initiated after 48 hours of incubation. Images were scanned every day and saved as 300 dpi TIFF image. The time to radicle (hypocotyl) protrusion and seedling growth were measured for 5 days. Germination rate was measured as the time required for 50 % of germinating seeds to complete radicle protrusion. Total seedling length was measured 6 days after imbibition for those seeds completing germination.

1.1.7.6 Seed enhancement through use of botanicals in field crops

Good quality seed acts as a catalyst for realizing the potential of all other inputs in agriculture. Production of quality seed and maintenance of high germination is of utmost importance in a seed programme, where seed quality is a multiple concept comprising several physical, chemical and biological components. Pre-sowing seed invigoration treatments claimed to have invigorative effect at field for enhancing the yield of crop to a tune of 10-15 percent. Some of the widely pronounced pre-sowing seed management techniques are seed fortification with growth regulators and nutrients including in organic salts. Uses of various types of chemicals and growth regulators are very costly and needs special skill to use them and may cause natural hazards whereas botanicals are relatively cheaper and are easily available to the farmers, safe to handle and can easily be prepared. Besides, they also contain various kinds of ingredients including amino acids growth regulating hormones, bio-pesticidal property and anti oxidants in their leaf/ plant extracts.

Green leaves of eighteen (18) plants of various species were collected, dried and grinded to make leaf powder of each plant separately and each leaf powders were used to prepare leaf extracts in water at 1:10 (w/ v) ratio involving 08 hours continuous shaking. Leaf extracts were applied uniformly in respective Petri dishes alternatively upto the final germination count.

Table 35: Response of plant leaf extracts on enhancement of germination in rice varieties

S.N.	Plant Species	Common Name	Germination % in rice	
			Naveen	CR Dhananjay
1	*Oscimum tenuiflorum*	Tulsi	88.00(15.79)	90.40(14.43)
2	*Azadirachta indica*	Neem	87.80(15.52)	92.00(16.45)
3	*Panica granatum* L	Annar	84.60(11.31)	88.60(12.15)
4	*Dalbergia sisso*	Shisham	85.80(12.89)	89.20(12.91)
5	*Carissa carandus*	Karouda	86.20(13.11)	88.90(12.53)
6	*Cassia fistula*	Amaltas	86.00(13.16)	88.40(11.89)
7	*Carica papaya*	Papita	86.40(13.68)	88.00(11.39)
8	*Bambuseae*	Bans	86.80(14.20)	89.20(12.91)
9	*Ficus syncomorus*	Pakad	85.60(12.63)	87.50(10.76)
10	*Syzygium cumini*	Jamun	86.50(13.81)	88.60(12.15)
11	*Annona squuamosa*	Sharipha	85.60(12.63)	86.30(09.24)
12	*Jatropha curcas*	Jatropha	82.00(07.89)	81.40(03.04)
13	*Tagetes spp*	Genda	84.40(11.05)	86.20(09.11)
14	*Moringa oleifera*	Shahjan	84.60(11.31)	87.90(11.25)
15	*Hibiscus rosa sinensis L.*	Gudhal	51.20(-32.63)	48.40(-38.73)
16	*Sesbania bispinosa*	Dhaincha	48.40(-36.31)	40.20(-49.11)
17	*Datura wrightii*	Dhatura	4.00(-94.73)	6.00(-9240)
18	*Cannabis sativa*	Bhang	12.00(-84.21)	15.00(-81.01)
19	Hydro-primed	Control	76.00	79.00
	CV/LSD		0.635/0.769	1.475/1.821

*Values given in parenthesis are representing the %improvement over control

Table 36: Response of plant leaf extracts on enhancement of germination in wheat and pigeon pea crops

S.N.	Plant Species	Common Name	Germination % in wheat and pigeon pea	
			Wheat(HD-3086)	Pigeon pea (Narendra-1)
1	*Oscimum tenuiflorum*	Tulsi	78.20(05.39)	74.80(15.07)
2	*Azadirachta indica*	Neem	79.00(6.47)	77.20(18.77)
3	*Panica granatum* L	Annar	74.20(0.00)	72.30(11.23)
4	*Dalbergia sisso*	Shisham	72.20(-02.70)	75.80(16.61)
5	*Carissa carandus*	Karouda	74.20(0.00)	74.20(14.15)
6	*Cassia fistula*	Amaltas	75.60(01.88)	75.10(15.54)
7	*Carica papaya*	Papita	77.40(04.31)	77.00(18.46)
8	*Bambuseae*	Bans	76.00(02.42)	76.50(17.70)
9	*Ficus syncomorus*	Pakad	72.10(- 02.83)	72.20(11.07)
10	*Syzygium cumini*	Jamun	75.20(01.35)	72.60(11.70)
11	*Annona squuamosa*	Sharipha	74.60(0.54)	68.50(05.38)
12	*Jatropha curcas*	Jatropha	70.20(- 05.40)	64.20(-01.23)
13	*Tagetes spp*	Genda	73.40(-01.10)	67.80(04.30)
14	*Moringa oleifera*	Shahjan	74.50(0.40)	68.40(05.23)
15	*Hibiscus rosa sinensis* L.	Gudhal	43.50(-41.39)	36.20(-44.31)
16	*Sesbania bispinosa*	Dhaincha	5.60(-92.45)	0.00(-100. 0)
17	*Datura wrightii*	Dhatura	0.00(- 100.0)	2.00(-96.92)
18	*Cannabis sativa*	Bhang	2.00(-97.34)	0.00(-100.0)
19	Hydro-primed	Control	74.20	65.00
	CV/LSD		0.745/0.759	1.163/1.134

*Values given in parenthesis are representing the % improvement over control

On the basis of data recorded following plant species were found beneficial for seed quality enhancement in rice wheat and pigeonpea crops.

Rice	Wheat	Pigeon pea
Oscimum tenuiflorum (Tulsi)	None of the leaf extract were found effective over control	*Azadirachta indica* (Neem)
Azadirachta indica (Neem)		*Dalbergia sisso* (Shisam)
Dalbergia sisso (Shisam)		*Bambuseae* (Bans)
Carissa carandas (Karonda)		*Carica papaya* (Papita)
Bambuseae (Bans)		*Oscimum tenuiflorum*
Ficus sycomorus (Pakad)		*Cassia fistula*
Syzygium cumini (Jamun)		*Carissa carandus*

Identification of QTLs associated with seed vigour though Marker – Trait Association analysis in Rice

1. Phenotyping

The 98 genotypes harvested during *kharif*, 2014 were phenotyped for various parameters which determines the seed vigour *viz.* root and shoot growth rate, speed of germination, dry matter production and seed longevity *viz.* germination, abnormal seedlings and dead seed percentages after 15, 20 and 25 days after accelerated ageing (Fig. 29).

A. Seed vigour

The seeds of all the 98 genotypes were sown between the glass plate and germination paper by following slanting method and placed in the germination room (Temp.: 25 °C; RH: 95 %). The root and shoot growth rate were recorded after 2, 4, 6, 8 and 10 days after sowing and found extensive variation among the genotypes. The highest root growth rate of 18.7 was recorded in JBT 36/41 which is on par with AC 39004, JBT 37/6, PS 404, JBT 36/114, JBT 36/169, AC 35298 and JBT 37/140 and the lowest root growth of 7.3 was recorded in PS 389 which is on par with IET 15924, AC 39014, S 9, Gangavati Sona and PS 401. Similarly, the genotypes PS 391 and PS 320 recorded highest (8.16) and lowest (6.21), respectively (Fig. 30), speed of germination (average time taken for radicle protrusion after imbibition) among the all genotypes.

Fig. 29: Variations in seed characteristics among 98 genotypes used in the study

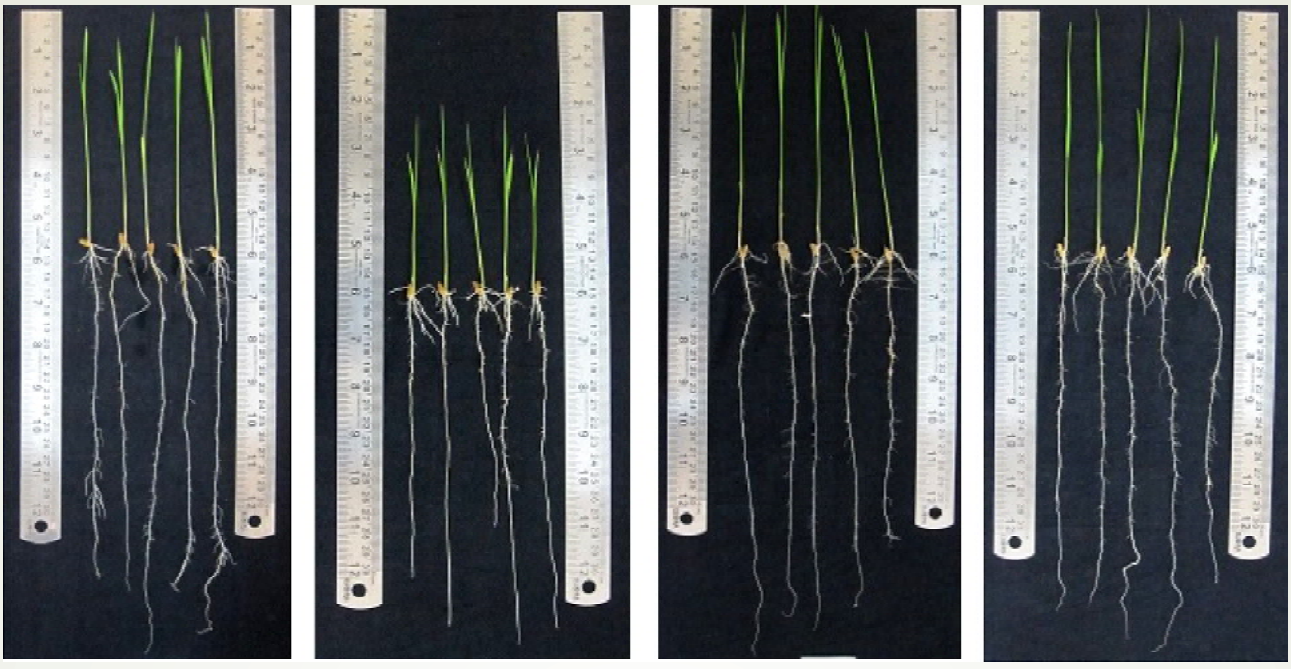


Fig. 30: Variations in seed characteristics among 98 genotypes used in the study

B. Seed longevity

Initially, random selected 10 genotypes among 98 genotypes were used to standardize the duration of accelerated ageing suitable to screen the genotypes for seed longevity based on the criteria that the duration should reduce the germination per cent to 50 % of the initial germination and found that 20 days of accelerated ageing reduced the germination per cent in seven genotypes below 50 % from the initial level. Accordingly, all the 98 genotypes were screened for seed longevity using the different duration of accelerated ageing *viz.* 15, 20 and 25 days and found wide variation among the genotypes for seed longevity. The genotypes *viz.* Thanu, Jaya, AC 35066 and PS 399 maintained high level of germination (>80 %) even after 25 days of accelerated ageing indicating high seed longevity and considered as good storer. The genotypes *viz.* Vavaprava, PS 404 and Samrat recorded very low germination (<20 %) after 25 days after accelerated ageing indicating its poor seed longevity (Fig. 31).

Fig. 31: Variations among the genotypes for seed longevity after 25 days of accelerated ageing

2. Genotyping of 22 genotypes using 291 SSR (Simple Sequence Repeats) markers

Out of 98 genotypes used for QTL mapping of seed vigour and longevity, 76 genotypes were already genotyped in University of Agricultural Sciences, Bengaluru. Hence, the left out 22 genotypes were genotyped with 291 Simple Sequence Repeat (SSR) markers to find out the genetic variations among the genotypes used in the study (Fig. 32).

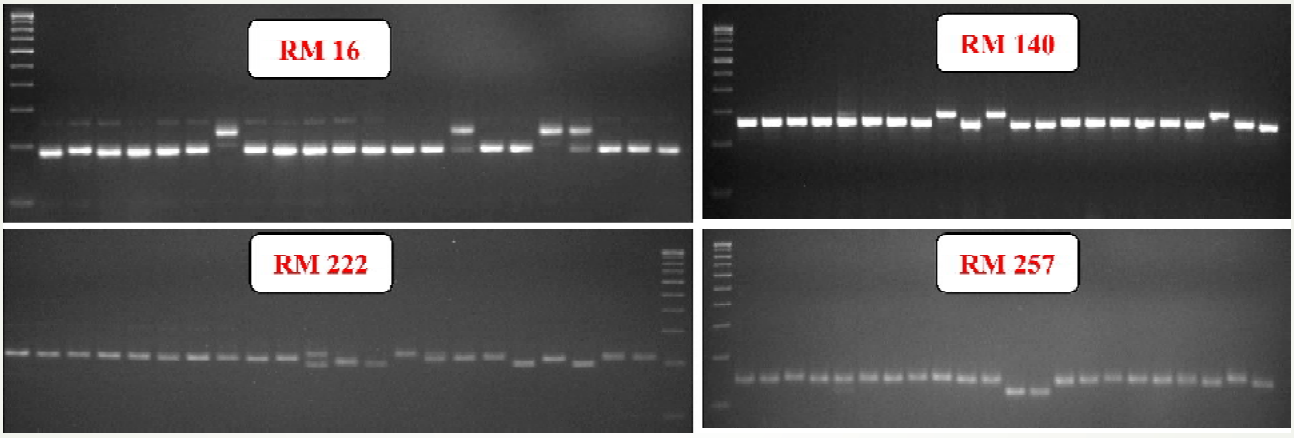


Fig. 32: Genetic variations among 22 genotypes used for genotyping

In the coming year, after completion of genotyping, the genotyping and phenotyping data will be analyzed using TASSEL (Trait Analysis by Association, Evolution and Linkage) software to identify the QTLs associated with seed vigour and longevity through marker – trait association analysis.

Studies on Seed Deterioration in Soybean (*Glycine max* L. Merrill) Genotypes

Research was undertaken to delineate physiological, biochemical and anatomical changes during seed ageing with genotypes having good and poor storage potential in soybean using accelerated ageing test as the screening test.

Studies on standardization of duration of accelerated ageing for screening genotypes based on predicted storability was initiated with seven genotypes (EC 18761, KBS 22-2009, CO1, CO2, DSB 24, MAUS 61 and NRC 93) and the results revealed that 50% reduction was obtained in most of the genotypes under 7 days of ageing at 40°C and 100 per cent RH. Based on the results, 30 genotypes of soybean were screened for their storage potential. The results exposed wider variability in seed and seedling quality characters with the genotypes of Kalitur, MACS 1416, DSB 21, EC 18761 and CO1 were identified as genotypes with good storability, while DS 228, JS 71-05, MAUS 61, NRC 93 and DSB24 with poor storability.

Over the 10 months of storage, the seed germination reduced from 93 per cent to 62 per cent, irrespective of genotypes. However, there was clear genotypic variability with storability of soybean genotypes. The genotypes predicted for good storability maintained higher seed germination at the end of 10 months storage (82.8%) compared to genotypes predicted for poor storability (40.4%). Among the genotypes, Kalitur maintained higher seed germination (87%) with only 7 % reduction

over the period, while MAUS 61 recorded lowest germination (5%) with 95 % reduction over the period of 10 months. The genotypes predicted for good storability deteriorated slowly as a result of lower lipoxygenase activity and lipid peroxidation, higher antioxidants and antioxidative enzymes activity and better cell membrane integrity and maintained higher physiological quality at the end of 10 months storage. Anatomical changes after the 10 months of storage revealed that the integrity of cell membrane and turgidity of cotyledon and embryonic axis cells was maintained among good storer genotype as that of fresh seed. Poor storer genotypes *viz*., MAUS 61, NRC 93, JS 71-05, DS 228 and DSB 24 screened from the accelerated ageing test had higher lipid peroxidation, lower antioxidants and antioxidative enzymes activity and poor cell membrane integrity during storage, as a result, they showed rapid decrease in seed physiological quality during storage and there was severe collapse of cells and the damage of cell membrane in cotyledons and embryonic axis were distinguishly visualised.

Genetics of powdery mildew resistance and productivity *per se* traits in black gram (*Vigna mungo* L. Hepper)

Screening for powdery mildew disease resistance and raising the crossing nursery

The 40 germplasm lines were screened for response to powdery mildew infection during *rabi* 2014-15 following infector-row technique under natural field conditions. All 40 germplasm lines were grown in 40 rows (each in a single row of 3m length) containing 20 plants each with a intra-row spacing of 15 cm and 30 cm between row. After 50-55 DAS, disease incidence scored using 0-5 scale (Gawande and Patil, 2003; Table 37). Based on the responses, two resistant and susceptible genotypes were selected and used as testers and were crossed to 10 genotypes differing for the responses to powdery mildew in Line x Tester mating design and 40 crosses were produced.

Table 37: Powdery mildew disease rating scale (0-5)

Grade	Leaf area infection	Classification
0	No infection	Highly resistant (HR)
1	0.1-10.0%	Resistant (R)
2	10.1-25.0%	Moderately Resistant (MR)
3	25.1-50%	Moderately Susceptible (MS)
4	50.1-75%	Susceptible (S)
5	75.7-100%	Highly Susceptible (HS)

Evaluation of F_1 s for productivity traits

All 40 crosses along with their parents were sown in early *kharif* 2015 for evaluation of seed yield and its attributing traits. Five

Fig. 33: Emasculated and pollinated flower and pod setting after 4 days of crossing (right)

LGB-752 × DBGV5 | LGB-752 × LBG-685 | VBN-4 × LBG-17

VBN-6 × LBG-17 | LBG-625 × LBG-17 | LGB-752 × LBG-17

Fig. 34: Plant view of six crosses showing resistant (R) & moderately resistant (MR) to PMD

competitive plants in each entry per replication were labelled and data on nine quantitative traits *viz.*, days to 50 % flowering, days to maturity, plant height (cm), branches/plant, number of pods per plant, pod length (cm), number of seeds per pod, 100 seed weight (g) and seed yield per plant (g) were recorded (Fig.33).

Selection of crosses and forwarding selected crosses

Six crosses were selected based on General Combining Ability (GCA) status and selfed to produce F_2 and F_3 generations. These F_2 and F_3 seeds will be grown along with their crosses (F_1s) and parents to asses breeding potential of selected crosses during *kharif*, 2016.

Evaluation of F_1 s for responses to powdery mildew disease

All 40 crosses along with their parents were sown in randomized complete block design (RCBD) in two replications during *Rabi* 2015 for evaluation of responses to powdery mildew disease using a 0-5 scale (Gawande and Patil, 2003, Table 37). Out of 40 crosses, six exhibited resistance which will be selfed to produce F_2 and F_3 generations and will be grown along with their crosses and parents to asses breeding potential of selected crosses during *rabi*, 2016 (Fig.34).

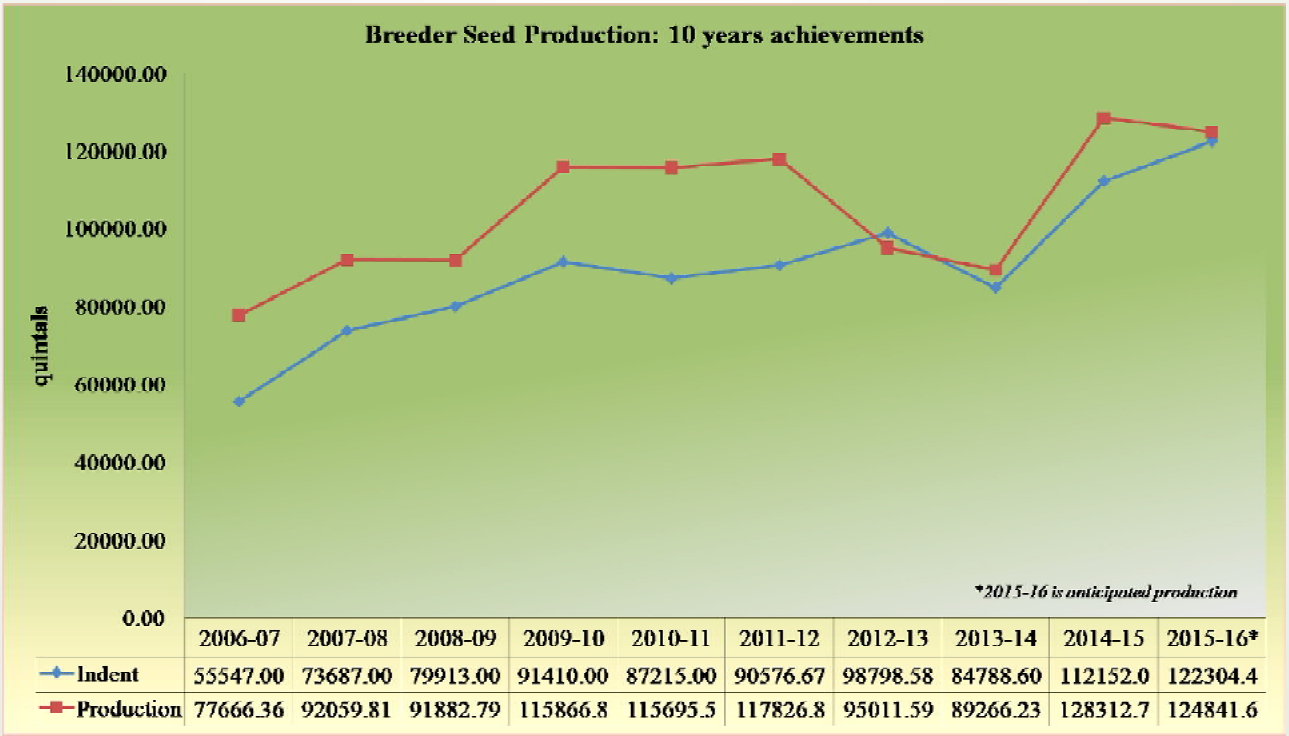
2 All India Coordinated Research Project – NSP (Crops)

2.1 Breeder seed production

The progress of breeder seed production of improved varieties with superior genetics and distribution is taking place at an incredibly faster pace, as witnessed in increased breeder seed production of 128312.76q as against the indent of 112152.07q in 2014-15 (*Kharif*, 2014 and *Rabi*/Summer 2014-15) (Figure 35). The breeder seed production during 2015-16 (*Kharif*, 2015 and *Rabi*/Summer 2015-16) is anticipated to reach 124841.67q against the indent of 122304.49q. The breeder seed production has amended the availability of quality seeds in subsequent generations in the seed multiplication chain and also resulted in increased Seed Replacement Rate (SRR) of various crops. The crop-wise breeder seed production of 2014-15 and 2015-16 have been given in Table- 38 & 39.

2.2 Seed Technology Research

Research highlights of experiments conducted in different disciplines / divisions *viz.*, Seed Production & Certification, Seed Physiology, Storage and Testing, Seed Pathology, Seed Entomology and Seed Processing under AICRP-NSP (Crops) STR component during 2015-16 at various cooperating centers are given below:



	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16*
Indent	55547.00	73687.00	79913.00	91410.00	87215.00	90576.67	98798.58	84788.60	112152.0	122304.4
Production	77666.36	92059.81	91882.79	115866.8	115695.5	117826.8	95011.59	89266.23	128312.7	124841.6

Fig. 35: Breeder Seed Production of field crops during 2006-07 to 2015-16

Table 38: Crop- wise breeder seed production for the year 2014-15

(Figures in quintals)

Crop	GOI		State		ICAR Seed Project		Total	
	Indent	Production	Indent	Production	Indent	Production	Indent	Production
CEREAL CROPS								
Rice	4387.12	5864.38	9235.40	10979.97	20353.20	27008.17	33975.72	43852.52
Wheat	13416.07	18203.14	9579.32	10951.77	15941.70	18543.64	38937.09	47698.55
Maize	26.02	41.11	52.05	83.12	506.99	614.35	585.06	738.58
Pearlmillet	6.60	11.44	0.82	3.91	66.96	39.60	74.38	54.95
Sorghum	39.72	127.88	65.05	378.35	790.60	1048.82	895.37	1555.05
Barley	929.00	763.43	16.79	28.73	308.30	516.98	1254.09	1309.14
Finger Millet	11.12	15.15	16.29	93.67	4.05	6.70	31.46	115.52
Foxtel Millet /Navane	0.00	0.00	1.25	16.90	0.00	0.00	1.25	16.90
Barnyard millet	0.00	0.00	0.50	0.50	0.00	0.75	0.50	1.25
Kodo	0.00	0.00	12.15	12.30	50.00	64.00	62.15	76.30
Littile Millet	0.00	0.00	4.34	4.30	20.50	24.60	24.84	28.90
Buckwheat	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10
Amaranth	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10
Total Cereal Crops	**18815.65**	**25026.53**	**18983.96**	**22553.52**	**38042.30**	**47867.81**	**75841.91**	**95447.86**
PULSE CROPS								
Chickpea	4995.12	4442.15	889.13	1072.10	396.45	509.37	6280.70	6023.62
Pigeonpea	235.16	228.62	212.23	305.03	379.94	211.45	827.33	745.10
Field Pea	274.17	406.01	82.10	89.07	27.30	33.30	383.57	528.38
Mung	601.33	539.05	195.82	292.74	253.35	241.85	1050.50	1073.64
Urd	264.55	268.58	252.48	354.61	109.78	84.41	626.81	707.60
Lentil	146.74	157.79	48.20	42.16	110.75	129.23	305.69	329.18
Rajmash	9.28	7.40	11.50	19.98	5.50	9.40	26.28	36.78
Horse Gram	0.00	0.00	6.56	12.28	2.60	5.80	9.16	18.08
Beans	0.00	0.00	1.00	15.50	2.00	2.60	3.00	18.10
Cowpea	24.70	2.83	7.10	28.32	18.30	32.54	50.10	63.69
Lathyrus	34.20	53.00	0.00	0.00	15.00	25.60	49.20	78.60
Moth Bean	71.65	35.20	0.00	0.00	0.00	0.00	71.65	35.20
Guar/ Cluster bean	150.06	28.50	4.20	7.40	0.00	0.00	154.26	35.90
Total Pulse Crops	**6806.96**	**6169.13**	**1710.32**	**2239.19**	**1320.97**	**1285.55**	**9838.25**	**9693.87**
OILSEED CROPS								
Soybean	9723.15	6571.79	1722.55	1904.17	2518.50	742.05	13964.20	9218.01
Sunflower	2.56	6.19	1.13	66.05	0.00	0.84	3.69	73.08
Groundnut	6499.45	7021.39	3454.21	3773.76	725.90	962.97	10679.56	11758.12
Linseed	29.91	41.11	71.62	78.83	11.55	12.25	113.08	132.19
Safflower	11.60	18.41	11.00	12.35	100.00	22.93	122.60	53.69
Sesamum	14.29	12.35	47.97	41.70	4.90	4.84	67.16	58.89
Niger	1.00	1.00	1.55	1.54	9.35	8.95	11.90	11.49
Castor	1.82	2.46	36.83	55.52	7.28	8.28	45.93	66.26

Rapseed Mustard								
Mustard	81.70	102.78	11.85	13.68	38.50	55.86	132.05	172.32
Toria	12.09	23.08	1.13	30.94	9.70	13.56	22.92	67.58
Ghobi Sarson	0.59	3.55	0.25	0.81	1.00	0.92	1.84	5.28
Yellow Sarson	0.45	23.00	0.01	0.33	15.00	25.00	15.46	48.33
Brown Sarson	0.00	0.00	1.25	1.25	0.50	0.30	1.75	1.55
Raya	0.31	1.23	0.05	0.05	0.20	0.16	0.56	1.44
Rai	0.55	7.69	0.00	0.00	10.00	12.24	10.55	19.93
Karan Rai	0.00	0.00	0.00	0.00	0.20	0.14	0.20	0.14
Til	0.59	0.59	1.10	0.65	16.30	16.30	17.99	17.54
Taramira	1.30	0.00	0.00	0.00	0.00	0.00	1.30	0.00
Total Oilseed Crops	**16381.36**	**13836.62**	**5362.50**	**5981.63**	**3468.88**	**1887.59**	**25212.74**	**21705.84**
FIBRE CROPS								
Cotton	39.98	46.70	6.12	10.91	104.56	106.89	150.66	164.50
Jute	10.87	11.90	0.00	0.00	0.00	0.00	10.87	11.90
Mesta	0.00	0.00	1.00	7.08	0.00	0.00	1.00	7.08
Total Fibre Crops	**50.85**	**58.60**	**7.12**	**17.99**	**104.56**	**106.89**	**162.53**	**183.48**
FORAGE CROPS								
Oats	155.90	191.60	52.43	70.05	65.00	70.68	273.33	332.33
Maize	116.78	129.00	0.00	29.00	20.00	35.14	136.78	193.14
Sorghum	28.27	45.96	0.00	0.00	1.50	2.00	29.77	47.96
Pearl Millet	0.05	0.20	0.00	0.05	0.00	0.00	0.05	0.25
Lucerne	4.40	1.65	0.75	0.75	6.80	6.80	11.95	9.20
Cowpea	5.05	2.20	0.00	0.00	0.00	0.32	5.05	2.52
Grain Cowpea	0.00	0.00	0.00	0.00	4.00	4.68	4.00	4.68
Berseem	39.13	36.08	0.00	0.10	0.00	0.10	39.13	36.28
Guar	118.40	149.30	0.00	0.00	475.00	501.10	593.40	650.40
Metha	0.00	0.00	0.20	1.50	0.00	0.00	0.20	1.50
Guinea Grass	0.00	0.00	0.08	0.50	0.20	0.30	0.28	0.80
Daincha	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00
Rey Grass	0.00	0.00	0.50	0.50	0.00	0.00	0.50	0.50
Setaria	0.00	0.00	0.00	0.00	0.20	0.15	0.20	0.15
Total Forage Crops	**467.98**	**555.99**	**53.96**	**102.45**	**574.70**	**623.27**	**1096.64**	**1281.71**
Grand Total	**42522.80**	**45646.87**	**26117.86**	**30894.78**	**43511.41**	**51771.11**	**112152.07**	**128312.76**

Table 39: Crop- wise expected/anticipated breeder seed production for the year 2015-16

(Figures in quintals)

Crop	GOI		State		ICAR Seed Project		Total	
	Indent	Production	Indent	Production	Target	Production	Indent	Production
CEREAL CROPS								
Rice	4832.87	5073.64	9237.77	10483.23	11241.20	12445.52	25311.84	28002.39
Wheat	12646.85	15210.65	16417.12	15942.30	15967.60	18755.50	45031.57	49908.45
Maize	10.41	18.76	127.44	134.42	269.21	236.51	407.06	389.69
Pearlmillet	0.50	1.61	0.40	0.58	1.00	2.00	1.90	4.19
Sorghum	45.41	151.41	9.92	258.38	707.00	628.84	762.33	1038.63
Barley	439.14	471.50	64.25	68.40	69.00	81.50	572.39	621.40
Finger Millet	19.18	27.30	6.96	45.86	2.50	4.00	28.64	77.16
Foxtel Millet /Navane	8.00	15.00	0.92	1.00	0.00	0.00	8.92	16.00
Barnyard millet	0.12	0.15	2.91	2.00	0.00	0.75	3.03	2.90
Kodo	1.00	1.00	22.95	22.97	0.40	0.50	24.35	24.47
Littile Millet	0.00	0.00	3.96	4.04	0.00	0.02	3.96	4.06
Buckwheat	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.12
Amaranth	0.04	0.15	0.00	0.00	0.00	0.00	0.04	0.15
Total Cereal Crops	**18003.52**	**20971.17**	**25894.60**	**26963.18**	**28257.91**	**32155.26**	**72156.03**	**80089.61**
PULSE CROPS								
Chickpea	4203.14	3863.44	3353.62	3473.11	2243.00	2912.00	9799.76	10248.55
Pigeonpea	182.64	192.80	276.39	315.80	578.76	389.20	1037.79	897.80
Field Pea	537.50	505.50	306.65	309.63	187.50	218.20	1031.65	1033.33
Mung	409.48	371.94	212.92	236.09	573.45	425.85	1195.85	1033.88
Urd	238.93	223.47	237.90	271.64	153.25	139.81	630.08	634.92
Lentil	226.82	291.25	179.97	178.30	231.85	300.50	638.64	770.05
Rajmash	7.60	10.57	19.10	15.12	3.50	7.50	30.20	33.19
Horse Gram	0.70	1.80	8.00	7.50	5.70	6.00	14.40	15.30
Beans	0.00	0.00	1.00	3.00	4.00	5.00	5.00	8.00
Cowpea	59.70	19.70	12.45	22.35	38.00	31.00	110.15	73.05
Lathyrus	4.20	8.00	2.00	3.00	10.00	15.00	16.20	26.00
Moth Bean	58.50	22.18	0.20	0.70	50.00	35.00	108.70	57.88
Guar/ Cluster bean	167.00	14.35	5.60	4.37	0.00	0.00	172.60	18.72
Total Pulse Crops	**6096.21**	**5525.00**	**4615.80**	**4840.61**	**4079.01**	**4485.06**	**14791.02**	**14850.67**
OILSEED CROPS								
Soybean	9793.03	6023.10	2538.06	2087.55	6187.00	3569.80	18518.09	11680.45
Sunflower	1.02	7.50	1.24	8.00	0.00	0.00	2.26	15.50
Groundnut	6558.60	8322.10	2586.36	2966.82	4443.10	3266.90	13588.06	14555.82
Linseed	38.20	53.05	212.20	213.30	79.90	110.25	330.30	376.60
Safflower	5.68	13.08	0.90	70.80	1057.00	1073.82	1063.58	1157.70
Sesamum	13.57	14.80	48.03	58.92	10.00	8.55	71.60	82.27
Niger	4.84	1.70	6.84	6.84	4.59	1.50	16.27	10.04
Castor	0.00	0.00	2.00	3.85	0.00	0.00	2.00	3.85
Rapseed Mustard								
Mustard	29.18	35.31	130.14	130.59	52.37	80.45	211.69	246.35

Toria	9.47	12.55	0.78	29.20	17.50	26.00	27.75	67.75
Ghobi Sarson	0.16	2.00	0.25	0.20	0.20	0.65	0.61	2.85
Yellow Sarson	0.15	0.00	0.00	0.00	0.00	0.00	0.15	0.00
Brown Sarson	0.00	0.00	1.05	1.55	0.05	0.05	1.10	1.60
Raya	0.13	1.60	0.10	0.10	0.10	0.10	0.33	1.80
Rai	1.65	9.50	0.01	0.50	41.00	47.00	42.66	57.00
Karan Rai	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.10
Til	6.29	1.54	0.15	0.15	2.00	2.10	8.44	3.79
Total Oilseed Crops	**16461.97**	**14497.83**	**5528.11**	**5578.47**	**11894.81**	**8187.17**	**33884.89**	**28263.47**
FIBRE CROPS								
Cotton	14.89	40.27	52.23	66.12	0.45	3.86	67.57	110.25
Jute	10.89	12.80	0.20	0.55	0.00	0.00	11.09	13.35
Mesta	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00
Total Fibre Crops	**25.78**	**53.07**	**53.43**	**67.67**	**0.45**	**3.86**	**79.66**	**124.60**
FORAGE CROPS								
Oats	305.00	329.00	127.33	170.10	0.50	0.60	432.83	499.70
Maize	49.99	58.00	0.00	0.00	10.15	5.65	60.14	63.65
Sorghum	7.87	18.77	0.00	0.00	2.00	2.50	9.87	21.27
Pearl Millet	0.20	1.55	0.08	4.05	0.00	0.10	0.28	5.70
Lucerne	4.50	5.10	0.55	0.70	8.00	8.00	13.05	13.80
Cowpea	6.65	4.70	0.00	0.00	0.00	0.05	6.65	4.75
Grain Cowpea	71.00	0.25	0.00	0.00	0.00	0.00	71.00	0.25
Berseem	43.72	49.80	7.50	7.50	0.50	0.50	51.72	57.80
Guar	76.30	119.50	0.10	0.50	670.00	723.00	746.40	843.00
Metha	0.00	0.00	0.15	2.00	0.00	0.00	0.15	2.00
Guinea Grass	0.00	0.00	0.10	0.30	0.00	0.00	0.10	0.30
Rey Grass	0.00	0.00	0.50	0.50	0.00	0.00	0.50	0.50
Stylo	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10
Setaria	0.00	0.00	0.00	0.00	0.10	0.20	0.10	0.20
Red Clover	0.00	0.00	0.00	0.00	0.10	0.30	0.10	0.30
Total Forage Crops	**565.23**	**586.67**	**136.31**	**185.65**	**691.35**	**741.00**	**1392.89**	**1513.32**
Grand Total	**41152.71**	**41633.74**	**36228.25**	**37635.58**	**44923.53**	**45572.35**	**122304.49**	**124841.67**

Crop-wise Breeder Seed Production in *kharif* and *rabi*/summer during 2014-15 and 2015-16

Crop	2014-15				2015-16 (Anticipated)			
	Kharif 2014		*Rabi*/summer 2014-15		*Kharif* 2014		*Rabi*/summer 2014-15	
	Indent	Production	Indent	Production	Indent	Production	Indent	Production
Cereal Crops	35650.73	46440.07	40222.64	49123.31	26552.07	29559.64	45603.96	50529.97
Pulse Crops	2664.83	2698.19	7199.70	7032.46	3132.17	2754.02	11658.85	12096.65
Oilseed Crops	24913.03	21257.08	311.61	460.25	33270.30	27509.42	632.86	767.94
Fibre Crops	162.53	183.48	0.00	0.00	79.66	124.60	0.00	0.00
Forage Crops	178.63	252.00	918.01	1029.71	148.64	96.62	1244.25	1416.70
Grand Total	**63569.75**	**70830.82**	**48651.96**	**57645.73**	**63182.84**	**60044.30**	**59139.92**	**64811.26**

2.2.1 Seed Production and Certification

- Investigations on standardization of isolation distance for hybrid seed production in wheat revealed the pollen flow from contaminator line (red glumed) resulting in seed set on tester line (white glumed) which was upto 8m and 4m in downward and upward wind direction respectively.
- The effect of various pre-sowing interventions for enhancing seed quality, health, yield and storability suggested that in chickpea, seed treatment with leaf extract (*Lantana camara* @ 10%) recorded higher germination (95%) while seed priming with vitavax powder @ 0.25% for 8 h recorded significantly lower wilt incidence (6.67%) and higher number of pods (120.87 per plant) and seed yield (1995.30 kg/ha). While in fieldpea, pre-sowing seed treatment (seed priming with sodium molybdate @ 500 ppm with *Trichoderma harzianum* @ 1.5% for 8h) recorded significantly higher seed yield (20.71 g/plant) over control (15.93 g/plant).
- Investigation to decipher the effect of seed film coating polymers for quality enhancement in various crops revealed that :
    1. Film coating in paddy with polymer *(DISCO AG SP RED L-200)+Thiram+Carboxin* documented significantly superior values for productive tiller per hill (16), seed setting (80%), seed yield per hill (25.38g) and seed yield per hectare (68.20q, which is 29.00% higher over control).
    2. In maize, film coating with *Polymer (DISCO AG SP RED L-200)+Thiram+Genius coat* recorded highest seed yield (81.81 q/ha) and B: C ratio (0.98).
    3. Seed film coating with *Polymer (DISCO AG SP RED L-200)+Thiram+Quick Roots/mycorrhiza* in sorghum revealed significant higher seed germination (91.66 %), field emergence (79.54 %), seed setting (94.07%) and seed yield (21.26 q/ha) over control.
    4. In Redgram, film coating with *Polymer (DISCO AG SP RED L-200)+Thiram+Genius coat* recorded higher seeds per plant (1476.86), 100 seed weight (11.37g) and seed yield/plant (163.89g) over other treatments and control.
    5. Seed film coating with *Polymer (DISCO AG SP RED L-200)+Thiram+Quick Roots/mycorrhiza* in soybean presented significantly higher pods per plant (99.50), 100 seed weight (6.58g) and yield per plant (7.70g).

Further, in storage all the above treatments in their respective crop domains shown superior seed quality attributes compared to other treatments and control.

- Experiments conducted for standardization of seed production technology in three major crops showed that:
    1. In Daincha (*Sesbania aculeata*) combination of foliar application of DAP (2%)+ micronutrient mixture (ZnSO4 0.5%+Boric acid 0.3%)+NAA @ 40 ppm at initiation

of flower and at the end of flowering period with pinching of terminal bud after 60 days after sowing produced significantly higher pods per plant (96.00), higher dry pods yield per plot (1.750 kg) and seed yield (5.22 q/ha).

2. Effect of pinching/ foliar sprays in Sunhemp (*Crotolaria juncea*) shown that number of pods/plant (91.57), seeds/pod (8.27), seed yield/plot (1.541 kg) and seed yield/ha (770.50 kg), were significantly higher with pinching of terminal bud at 65 days after sowing along with foliar application of DAP (2%)+Micro nutrient mixture ($ZnSO_4$ 0.5%+Boric acid 0.3%)+NAA @ 40 ppm.

3. In Pillipesara (*Phaseolus trilobus*), pinching of terminal buds and foliar application of DAP (2%) + micronutrient mixture (2%) + NAA @ 40 ppm showed significant effect on number of pods/plant (110.80), seeds/pod (6.73), 100 seed weight (1.09g) and seed yield/ha (386.67 kg) over other treatments.

- In a bid to standardize the techniques to mitigate the effects of elevated temperature, investigations in sorghum (*cv*. CSH 14) revealed that two foliar sprays (vegetative & seed filling stages) of salicylic acid (400 ppm) exhibited significantly superior seed setting (98.27 %), 100 seed weight (2.29 g), seed yield (26.66 q/ha) and germination (87.66%) under first sowing condition (standard sowing date). In second sowing condition (late sown, flowering & seed set coincides high temperature stress) also two foliar sprays (vegetative & seed filling stages) of salicylic acid (400 ppm) recorded significantly superior seed setting (93.33%), seed yield/plant (26.21g) seed yield (24.55 q/ha).

- Experiments instituted for standardization of seed production techniques in millets revealed certain significant observations as mentioned below:

1. In Finger millet (*cv*. ML 365), priming of seeds with 2% (KH_2PO_4) for 6h (1:1 w/v) followed by seed treatment with carbendazim @ 2.5g/kg, transplanting (21 days old seedling) and application of organic and inorganic fertilizers along with borax spray (125 kg neem + 1250 kg vermicompost + 50 kg urea + 50 kg SSP and 50 kg MOP per ha + top dressing urea at 3-4 weeks after transplanting + 2 % Borax during flowering) exhibited significantly higher seed yield (61.50g/plant; 3.31kg/plot and 55.20q/ha) over the control (direct sowing & normal package of practice) (24.80g/plant;1.20kg/plot and 20.04q/ha).

2. In Kodomillet, transplanting procedure found to be disadvantageous. However, seed priming with 20% liquid formulation of *Pseudomonas fluorescens* for 6 hours and application of 125 kg neem+ 1250 kg vermi compost/ ha + 50 kg Urea + 50 kg Super phosphate and 50 kg Murate of potash per ha + Top dressing urea at 4 weeks + 2% Borax spray at flowering stage recorded higher field emergence (72.33%), chlorophyll content (27.33%), 100 seed weight (0.46 g) and seed yield (5.87g per plant; 25.28 q/ha).

3. Similar observation was also recorded in Littlemillet, transplanting found to be non-economical whereas seed priming with 2% KH_2PO_4 for 6 hours followed by application of (125 kg neem + 1250 kg vermicompost/ha + 50 kg Urea + 50 kg Super phosphate and 50 kg MOP per ha + Top dressing with urea at 4 weeks after transplanting + 2% Borax spray at flowering stage documented significantly higher field emergence (70.33%), chlorophyll content (30.73%), and seed yield [2.71 g per plant (6.75 q/ha)].

- Various seed encrustation treatments (seed encrustation @ 1:1.2 build-up with Thiram; Thiram & mycorrhiza and Thiram & Genius coat) enabling direct seeding in small seed crops revealed that:

1. In onion, mustard and rapeseed, all seed encrustation treatments had detrimental effect which significantly reduced seed germination, field emergence and final plant stand over hydro priming and control.
2. Seed encrustation in carrot had no positive effect on germination, root growth, field emergence, seedling vigour and plant height.
3. However, seed encrustation in sesame seed @ 1:1.2 buildup with Thiram and genius coat performed significantly superior revealing higher germination (90.30%), seedling dry weight (26.70 mg), capsule/plant (36.90) and seed yield/plant (6.161g which is 23.89% over control).

2.2.2 Seed Physiology, Storage and Testing

- Seedling length, primary and secondary root length, root volume, root and shoot weight and root density were found to be better seed vigour traits in rice hybrid seed resulting in higher number of tillers and leaf area index and higher yield.
- In maize hybrid, SVI I and SVI II were found to be concurrent with few root parameters (root volume, root-shoot ratio). Further, 1000 seed weight is positively correlated with seed vigour and seed yield.
- SSR markers RM 234, RM 228, RM 279, RM 237 and RM 84 have been found to be unique for JRH 5 rice hybrid which can be employed for ascertaining genetic purity.
- RM 234 and RM 279 were identified as the specific SSR markers for paddy hybrid JRH 8 and JRH 9, respectively.
- RM81057, RM10103, RM9a2 were the unique SSR markers for rice hybrid KRH-4 and RM9310, RM9106 for rice hybrid KRH-2 which can also be multiplexed.
- SSR marker RM 552 identified as specific SSR marker for rice variety RNR 2458 which clearly distinguished rest other 10 varieties.
- RM 228 is found to be unique SSR marker for DRRH 3 rice hybrid which can identify any potential contaminant from PSD 1, PSD 3, PRH 10, NDRH 2 and thirty two popular rice varieties.
- Pulsed Electromagnetic Field (PEMF) treatment @ 50 Hz & 100 Hz improves germinability and vigour in tomato and green gram, respectively.

- The seeds of soybean stored in super grain bags along with desiccant beads (Zeolite beads @ 0.15kg/1.5kg of seed & silica gel @ 0.30kg/1.5kg of seed) recorded maximum seed quality attributes even after 4 months of storage with least infection of storage insects.
- Dry dressing of seed with elemental and metal oxide nanoparticles *viz*., silver and ferrous oxide @ 1250mg/kg of seed recorded better germination, vigour indices and other physiological attributes of seed quality in maize.
- Hydro-priming (with thiram @ 0.25%) and biopriming (*T. viride* @10g/kg seed) for six hours resulted in higher field emergence and speed of germination in popular desi chickpea cultivar Pusa 547.
- Priming with 2.5% solution of KNO_3 (1:2 w/v) improves seed yield by 3.3-14.5% in different crops (wheat, pearl millet, sorghum, mungbean, pigeonpea and chickpea).
- Seed treatment with HYT-D @ 3ml/kg seed significantly improves necessary seed quality parameters for higher field emergence, yield attributing traits and seed yield in maize, paddy, soybean and pearlmillet.
- A total of 25 demonstrations of seed priming technology were organized at farmers' field across the centers during 2015-16 and farmers were convinced upon low cost technological intervention for maximizing grain yield (7.5-10% advance in grain yield).

2.2.3 Seed Pathology

- Seed wash examination technique has been identified as relatively quick method for detection of surface adhered spores of *Alternaria burnsii*, the causal agent of cumin blight.
- Standard blotter method is best suited technique for the detection of *Macrophomina phaseolina, Fusarium oxysporum Colletotrichum dematium* (*Colletotrichum truncatum*) associated with soybean, mungbean, urdbean and sesame seeds.
- PCR based detection technique for detection of chilli anthracnose fungus *Colletotrichum truncatum* (Ccap F; Ccap R.); *Colletotrichum gloeosporioides* (Cboncoll F; Cboncoll R.); *Colletotrichum coccoides* (Cco 1NF1; Cco2NR1) associated with seed have been validated.
- As per IMSCS, rice bunt (*Tilletia barclayana*) is designated as objectionable seedborne pathogen in rice seed production and its prevalence for the first time has been reported in southern India in cultivated variety Co 50 by TNAU.
- False smut (*Ustilaginoidea virens*) is a potential threat in paddy seed production. Field experiment conducted at 03 centers revealed that, foliar application of propiconazole @ 0.1% at boot stage resulted in maximum disease control.
- Critical monitoring on new emerging seed-borne diseases indicated presence of septoria blotch of wheat (*Septoria nodorum*) at Anantnag and Baramulla districts of Jammu & Kashmir and rice bunt (*Tilletia barclayana*) at Thanjavur district of Tamil Nadu.
- Investigations on analysis of farmers' saved seed samples indicated alarming association of Karnal bunt of wheat

(*Tilletia indica*) in Punjab, Haryana, Himachal Pradesh, and Uttarakhand of *Macrophomina phaseolina*; *Fusarium oxysporum* with soybean in Madhya Pradesh, Maharashtra and Rajasthan and *Aspergillus flavus* with groundnut in Gujarat , Maharashtra, Odisha and Andhra Pradesh.

- Effective management of seed rot, seedling blight, die-back and fruit rot of chilli caused by *Colletotrichum capsici* can be achieved through seed dressing with *Trichoderma harzianum* @10 g or *Trichoderma viride* @ 05 g + *Pseudomonas fluorescens* @ 05 g /kg seed.
- Transmission of pathogens from plant to seed and management of pod blight complex disease of soybean has been achieved through two sprayings of Carbendazim + Mancozeb (0.30%) first at pod formation and second at pre-harvest stage resulting in 62.30% disease control.
- For ecofriendly management of early blight of tomato, seed dressing with bioagents *Trichoderma harzianum* @ 10g /Kg seed is promising under conditions of Uttarakhand and Himachal Pradesh with higher seed germination (81.5%) and least association of *Alternaria solani* (2%) was recorded.
- Effective management of cumin blight (*Alternaria burnsii*) has been achieved through three applications of Azoxystrobin (0.25%) at 10 days interval resulting in minimum disease intensity (8.87%) and minimum association (3.95%) of *Alternaria burnsii* in harvested cumin seeds.
- Bio-priming of safflower seeds with *Trichoderma harzianum* + *Pseudomonas fluorescens* @ 05 g each resulted in least association (10.00%) of *Fusarium carthamii* with enhanced seed germination (92.00%) and disease control (77.78%).

2.2.4 Seed Entomology

- Among various newer insecticides evaluated along with standard chemical (Deltamethrin) against major storage insect-pests damaging cereals and pulse seeds, Emamectin benzoate (Proclaim 5SG) @ 2 ppm (40.0 mg/kg seed), Spinosad (Tracer 45 SC) @ 2 ppm (4.4 mg/kg seed) were on par with Deltamethrin (Decis 2.8 EC) @ 1.0 ppm and provided maximum control against storage upto 6-9 months. Whereas Profenofos (Curacron 50 EC) @2ppm (0.004ml/kg seed), Chlorfenapyr (Intrepid 10 EC)@2ppm (0.02ml/kg seed), Rynaxypyr (Coragen 20 SC) @ 2ppm (0.01ml/kg seed) and Novaluron (Rimon 10 EC) @ 5ppm (0.05ml/kg seed) were effective to some extent but not as effective as Emamectin benzoate, Spinosad or Deltamethrin.
- Paddy seeds treated with Flubendiamide (Fame 480 SC) (4.2 mg/kg seed), Emamectin benzoate (Proclaim 5SG) @ 2 ppm (40.0 mg/kg seed), Spinosad (Tracer 45 SC) @ 2 ppm (4.4 mg/kg seed), Deltamethrin 2.8 EC (0.04ml /kg seed) and stored in moisture impervious bags like super grain bags maintained seed germination above IMSCS with minimum insect infestation upto 9 months period.
- Among 1667 samples of farmers saved seed evaluated for seed health status revealed that about 66.50% seed samples were having germination above IMSCS but large proportion (39.40%) of seed samples were infested with storage pests. About 26.10% samples were

having insect damage beyond seed certification standard. The intensity of damaged seed usually varied from 0.25-5.0%.

- Bee pollination plays major role in improving quantity of seed produced in berseem. Apart from seed yield, parameters like seed germination and vigour improved substantially due to bee pollination. In case of pigeon pea, other pollinators like leaf cutter bee, carpenter bee play major role in pollination.
- CO_2 concentration of 50% (v/v) provide effective protection against *Khapra* beetle in wheat, groundnut beetle in groundnut and pulse bruchid in green gram and pigeon pea without affecting seed quality upto 6-9 months storage.
- Effectiveness of CO_2 treatment in 200L capacity containers for storage of green gram seed has been successfully demonstrated at TNAU, Coimbatore. UAS, Bengaluru and ANGRAU, Hyderabad also demonstrated efficacy of modified atmosphere storage in management of storage insects of paddy.
- Various botanicals i.e., *Acorus calamus* TNAU formulation @ 10 ml/kg seed, neemazal 10000ppm @1.5ml/kg seed, pongamia oil @ 5ml/kg of seed and citronella oil @ 5 ml/kg of seed were tested along with emamectin benzoate and deltamethrin. Results revealed that *Acorus calamus* TNAU formulation treated seeds recorded maximum germination and least insect damage upto six months of storage in paddy, wheat, chickpea, pigeon pea, mung bean, field pea and black gram.
- Groundnut pod borer causes great problem in storage and for its management, pod treatment with insecticides *viz.*, Emamectin benzoate @ 2ppm, Spinosad @ 2 ppm, Thiodicarb @ 2ppm, Rynaxypyr @ 2ppm, Profenofos @ 2ppm, Novaluron @ 5 ppm and Deltamethrin @ 1ppm were evaluated and found that, emamectin benzoate, spinosad and deltamethrin were highly effective as they provided complete protection upto 6-9 months and maintained seed germination above IMSCS.
- Preliminary results suggest that spraying of insecticides *viz.*, emamectin benzoate @ 0.3ml/L and profenofos 50 EC @ 1ml/L at 50% pod and crop maturity reduced adult emergence significantly during storage of green gram and black gram, respectively.
- Three types of insecticide impregnated bags like (a) Treated bag, no lamination, no liner; (b) Treated bag, non-treated lamination, non-treated liner and (c) Treated bag, treated lamination, treated liner were tested along with untreated bag (same fabric *i.e.* PP Bag) and gunny bag as control. Insecticide impregnated bags were highly effective in management of storage insects of wheat, paddy, maize, chickpea and green gram and maintained seed germination above IMSCS upto 8-10 months of storage.

2.2.5 Seed Processing

- Optimum sieve size for processing were worked out as per varieties among different crops :

Crop	Variety	Screen size(mm)
Pigeonpea	Bahar	4.75 mm (R)
	Amar	
	TS 3R	4.00 mm (R)
Chickpea	JAKI-9218, Vijay & Digvijay	5.00 mm (R)
	GBM 2, Virat, Vishal & Krupa	5.50 mm (R)
Mungbean	Basanti, Satya & MH-421	2.4 mm (R)
Wheat	K-9162, K-1006, K-402 & AB-39	2.5 mm(S)
	WH-1105, WH-711 & WH-1124	2.2 mm (S)
	HD-2967	2.10 mm (S)
Sunhemp	CO 1	BSS 8

Note: BSS 8: British Screen Size 8 (approximate seed diameter is about 2.00 mm)

- The use of combine harvester at 15 cm height of cutter bar from ground level at 12% moisture content along with 500 rpm drum speed is found most economical and effective for maintaining seed quality during harvesting and threshing of soybean.
- In case of soybean (JS 335), mechanical drying at 30^{0}C for moisture content to fall to a level of 6.00% was found highly economical recording germination (88.0%), 1000 seed weight (86.5g), vigour index-I (3036.0), mechanical damage (6.0%) and physical purity (98.0%).
- Sun, shade and mechanical drying (30 & 35^{0}C) maintained higher seed germination (93.50, 94.75, 94.50 and 93.00%, respectively) and seed vigour index-I (2866, 2854, 2809 and 2689 respectively) even after 6 months of storage.

2.3 Awards and Publications

In reference to recognitions, scientists / cooperating centres received 37 awards / merit certificates for excellence in seed research and development activities and also published 134 research papers related to seed science and technology in national / international peer reviewed journals. Imparting field level training and practical exposure to field staff and farmers engaged in seed production programme are being taken up by different centres. *In toto* 111 training programmes on various aspects of seed science and technology were organized for different stakeholders of seed industry and 62 exhibitions, *kisan melas, kisan goshtis,* field day, demonstrations have been conducted by several cooperating centres during 2015-16.

2.4 Extension activities

Imparting field level training and practical exposure to field staff and farmers engaged in seed production programme are being taken up by different centres. Several extension activities like exhibitions, *kisan melas*, *kisan goshtis*, field day, demonstrations have been conducted by several cooperating centres. In order to create the required scientific manpower and to enhance the expertise and skill of the existing scientific staff, the STR centres were entrusted with the task of conducting training programmes under human resource development (HRD). This would certainly boost the quality and quantity of the seed and would help to increase the seed replacement rate (SRR) in different crops.

3 ICAR Seed Project : Seed Production in Agricultural Crops

During the year 2014-15, total production of quality seed including all classes was 576252 quintals against the target of 399175 quintals. Production comprises 97982 quintals of breeder seed, 175622 quintals of foundation seed, 128465 quintals of certified seeds, 140006 quintals of truthfully labelled seed and 34176 quintals of planting material of field crops. In addition, 2018 lakhs of planting material and 8.48 lakh tissue culture plantlets were produced against the targets of 204.8 and 3.67 lakhs, respectively.

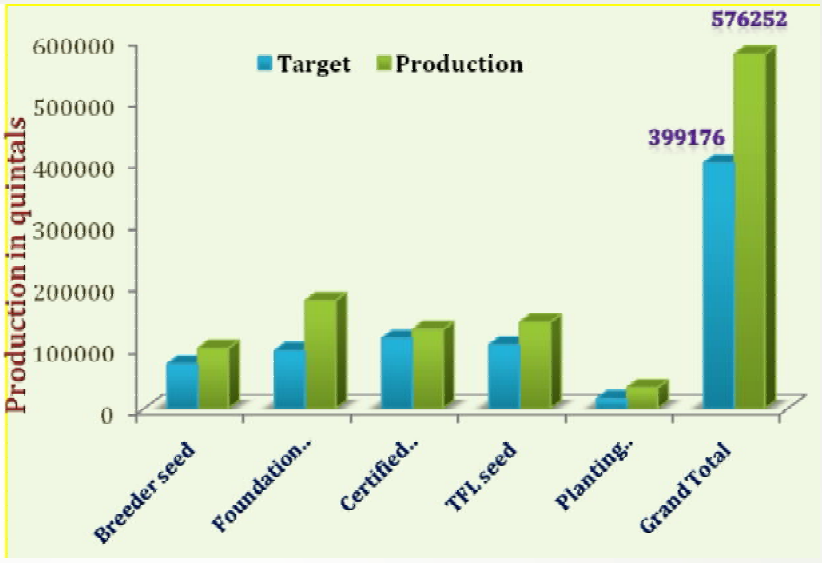


Fig. 36: Progress under ICAR Seed Project – Seed Production in Agricultural Crops during 2014-15

Table 40: Quality seed production under ICAR-Seed project

(in quintals)

S. No.	Particulars	In University/Institute		Participatory Seed Production		Total	
		Target	Production	Target	Production	Target	Production
1	Breeder seed	70812.41	96703.66	1217.75	1278.47	**72030.16**	**97982.13**
2	Foundation seed	60796.01	86571.32	33288.50	89051.07	**94084.51**	**175622.39**
3	Certified seed	27481.00	44432.01	86748.00	84033.27	**114229.00**	**128465.28**
4	TFL seed	54732.93	66251.60	48739.00	73754.66	**103471.93**	**140006.26**
5	Planting material	15360.00	34176.30	-	-	**15360.00**	**34176.30**
	Total	**229182.35**	**328134.88**	**169993.25**	**248117.47**	**399175.60**	**576252.35**

(in lakh)

S. No.	Particulars	Target	Production	Target	Production	Target	Production
1	Planting material	204.80	2018.01	-	-	204.80	2018.01
2	Tissue culture plants	3.67	8.48	-	-	3.67	8.48
	Total	**208.47**	**2026.49**	**-**	**-**	**208.47**	**2026.49**

HRD/Capacity Building

Having a mandate of Human Resource Development in seed domain, various modules of trainings have been carried out by varied cooperating centres to cater the need of seed producing personnel including farmers, trainers and employees (field staff) of State Seed Certification Agency/ State Seed Corporation/ Seed Producer Companies and NGOs. Trainings were mainly focused on seed production, processing, storage, packaging, quality enhancement, quality control and seed health management. According to crop season, need and type of beneficiary, trainings were imparted under ICAR Seed Project on regular basis under Human Resource Development (HRD) component. Special training programmes on quality seed production for farmers of tribal areas were also started under Tribal Sub Plan component in selected cooperating centres across the country.

In toto 362 trainings/field days were organized for various stakeholders during the year 2014-15. Similarly, 88 exhibitions/ *Kisan melas*/*Kisan goshtis* were organized on diverse themes related to seed by different cooperating centres across the country.

Fund release during 2015-16

S. No.	Recurring	Amount (Rs. in lakh)
1	Travelling Allowance (TA)	90.35
2	Human Resource Development (HRD)	110.75
3	Other Recurring Contingency (ORC)	344.50
4	Tribal Sub Plan (TSP)	20.00
	Total	**565.60**
Technology development		
1	Technical / Wage Labour	16.90
2	Operational Cost	17.50
	Total	**34.40**
	Grand total	**600.00**

Quality seed production under ICAR Seed Project during 2015-16 - at a glance

(in quintals)

S. No.	Particulars	In University/Institute		Participatory Seed Production		Total	
		Target	Production	Target	Production	Target	Production
1	Breeder seed	56523.07	56328.15	859.10	1444.58	57382.17	57772.73
2	Foundation seed	56005.65	68538.31	11380.50	15278.90	67386.15	83817.21
3	Certified seed	30644.85	28960.45	97197.00	87541.02	127841.85	116501.47
4	TFL seed	66040.13	69247.70	44620.50	51089.00	110660.63	120336.70
5	Planting material	17126.00	32145.17	-	-	17126.00	32145.17
	Total	**226339.70**	**255219.78**	**154057.10**	**155353.50**	**380396.80**	**410573.28**
							(in lakh)
S. No.	**Particulars**	**Target**	**Production**	**Target**	**Production**	**Target**	**Production**
1	Planting material	297.35	269.78	-	-	297.35	269.78
2	Tissue culture plants	14.77	12.93	-	-	14.77	12.93
	Total	**312.12**	**282.71**	**-**	**-**	**312.12**	**282.71**

Note: Cooperating centres viz., CCSHAU, Hisar; CSAUA&T, Kanpur; MPUAT, Udaipur; SDAU, SK Nagar; CRIJAF, Barrackpore; IIMR, Hyderabad; ICAR-RC, Goa and ICAR-IISR, Indore are yet to submit data for referred period.

Quality seed production in field crops

Paddy- Sahyadri 4

Mustard seed production plot at GBPUA&T, Pantnagar

Field view of DCH-177 castor hybrid seed production at IIOR, Hyderabad

Seed production plot at MPKV, Rahuri

Breeder seed production of Soybean at VPKAS, Almora

Wheat breeder seed production at VPKAS, Almora

Infrastructure development

Seed store at IGKVV, Raipur

Seed processing plant at UAS, Bengaluru

Capacity building

Seed Day at PAU, Ludhiana

Women Farmers' Training at PAU, Ludhiana

Sprayer distribution in JAU, Junagadh

TSP training at Sindega and Khunti districts of Jharkand

4 Tribal Sub Plan

4.1 IISS Main Scheme Achievements under Tribal Sub Plan

- A total amount of Rs. 127.00 lakhs has been released to six SAUs, one Central University and 2 ICAR Institutes for welfare of the tribal community through training / demonstration in quality seed production and storage activities, supply of quality seed, storage structure and micro-irrigation facility etc during the year 2015-16.
- More than 940 tribal farmers have been benefited through distribution of quality seed of paddy, wheat, pea, groundnut, chickpea, rapeseed mustard, linseed, lentil, potato and soybean etc. of 14 districts from 5 states.
- A total number of 30 training programmes for more than 1740 tribal farmers have been conducted for tribal farmers of five states on seed treatment, quality seed production, processing technology and safe seed storage of different field crops and vegetables.
- Farmers participatory seed production programme have been conducted for making tribal farmers self-reliant in quality seed production and improvement in their livelihood.
- Regarding physical assets created in Tribal Sub Plan, a total number of 230 seed storage structures, 234 Knapsak sprayers, 70 paddy weeders, 51 wheel hoe, 3 diesel pump sets, 67 unbreakable plastic containers, 20 cono-weeders and 7 small water pumps with pipes have been distributed to tribal famers.

Activities carried out in Tribal Sub Plan of IISS Main Scheme

Farmers participation in quality seed production in Dindori of Madhya Pradesh


Training Programme on Seed Production Techonology at Dindori, Madhya Pradesh


Training Programme on Seed Production Techonology at Udham Singh Nagar, Uttarakhand

Inputs distribution and fabrication of RC bin under TSP in Manipur


Training on quality seed production and demonstration on use of quality seed in Senapati district, Manipur

4.2 Achievements of AICRP-NSP (Crops) under Tribal Sub-Plan (TSP) Programme

With the objective of improving the livelihood of tribal farmers and as per the direction received from the Council for formulation, implementation and monitoring of TSP, the following cooperating centres of AICRP-NSP (Crops) were provided with funds under TSP as detailed below for the year 2015-16.

Total expenditure incurred for implementation of TSP by co-operating centres

(Rs. in lakhs)

Sl. No.	Centre	AICRP –NSP (Crops)
		Tribal Sub Plan
1	SKUAST, Srinagar	11.00
2	HPKVV, Palampur	9.00
3	MAF, Kota	6.00
4	AAU, Anand	7.00
5	MPKV, Rahuri	9.00
6	PDKV, Akola	9.00
7	UAS, Bangalore	8.00
8	TNAU, Coimbatore	9.00
9	CRIJAF, Barrackpore	8.00
10	CAZRI, Jodhpur	4.00
11	NRRI, Cuttack	6.00
12	IIRR, Hyderabad	3.00
13	IIMR, Hyderabad	3.00
14	CICR, Nagpur	3.00
	Total	**95.00**

Various activities of the implementation of TSP program by selected cooperating centres of AICRP-NSP (Crops) along with details of the inputs provided to tribal farmers for taking up quality seed production, seed health and storage were as follows.

SKUAST, Srinagar

Tribal Sub Plan has been implemented in Kashmir and Ladakh regions of the state for benefiting farmers belonging to Schedule Cast and Schedule Tribe. Total expenditure incurred for implementation of the scheme was Rs. 5,99,300/-.

Training Programmes

Under the scheme, 213 tribal farmers were identified from four districts of Kashmir valley and Ladakh division. Two training programmes on "Quality Seed Production in wheat and strategies for utilizing farmers own saved seed" were conducted in each district including both male and female tribal farmers.

Details of trainings conducted in Kashmir and Ladakh

S. No.	Location (villages)	District	Crop	Variety	No. of farmers benefited	Storage bins distributed
1.	RahimThang & Saleskote	Kargil	Wheat	HS-375	50	50
2.	Groong Echichoot, Thiksy & Rambir pora	Leh	Wheat	HS-375	50	50
3.	Chemkote & Dringle Twetwall	Kupwara	Wheat	HS-240	50	50
4.	Rakh Brah Mattan & Anantnag	Anantnag	Wheat	HS-240	50	50

Inputs distributed

An amount of quintals of Wheat variety HS-375 and 20 quintals of wheat variety-HS 240, 8.00 quintals of oats variety-Sabzaar and 3.00 quintals of mustard variety KS-101 and one quintal capacity of 200 seed bins were distributed to beneficiaries.

Distribution of quality seed at Kargil

Training programme conducted at Leh

CSK HPKV, Palampur

During 2015-16, four farmer trainings were conducted, two each at Lahaul & Spiti and Kinnour districts. Female farmer participation was very high. Since in both the districts agriculture is combined with horticulture, thus the training included both the components.

The seeds of rajmash and wheat were distributed to the farmers and on cluster basis the spray pumps were distributed to the farmers.

Details of trainings conducted in Kashmir and Ladakh

S. No.	Location	No. of Training	Crop	Variety	No. of farmers benefited	Storage bins distributed
1.	Lahaul & Spiti	2	Wheat & Rajmash	-	130	-
2.	Kinnour	2	Wheat & Rajmash	-	133	-

RAU, Bikaner

During 2015-16, one training programme on "Quality seed production of cereals, pulses, oilseeds and vegetable crops, processing, seed health and storage" was organized along with two *kisan sammelan* on "Contingent agriculture plan and storage bin distribution for safe grain storage. Detailes were given below:

Details of trainings conducted by RAU Bikaner

S. No.	Title	Partici-pants	Storage bins distri-buted
1.	Food Grain Storage	125	305
2.	*Kisan Sammelan* on Contingent agriculture plan and storage bin distribution for safe grain storage	95	
3.	*Kisan Sammelan* on Contingent agriculture plan and storage bin distribution for safe grain storage	80	

PDKV, Akola

During 2015-16, Seed Technology Research unit, Dr. PDKV, Akola (MS) has implemented various programmes for tribal farmers with the aim of increasing seed production in agricultural crops as mentioned below in two districts *viz.*, Amaravati and Chilkhaldhara:

1. Training/demonstration to the farmers of tribal community.
2. Supply of quality seed and farm equipments.

Ten *One Day* farmers training on "Seed production, processing and safe storage" was organized at following tribal areas:

Sl. No.	Village	No. of partici-pants	Seeds distributed	Agriculture equipment distributed
1.	Talai	92	Wheat (WASM 1472 & MACS 1967): 1600 kg	Cycle hoe with ridge attachment, weeding sickle and harvesting sickle
2.	Takarkheda	95		
3.	Bijudhavadi	101		
4.	Dabhiya	97		
5.	Dolar	103		
6.	Zilang-Pati	90		
7.	Mansudhavadi	95		
8.	Dhakana	103		
9.	Tembrusonda	98		
10.	Chandpur	103		
11.	Dharamdoh	105		
12.	Aaki	102		
13.	Morgarh	97		

Details of trainings conducted and inputs distributed by Dr. PDKV, Akola

The trainings included technical lectures on quality seed production of cereals, pulses, oilseeds and vegetable crops, processing, seed health and storage. Improved methods of cultivation for increasing production, seed treatment, drying, cleaning, grading, bagging and safe storage and improved agricultural implements were demonstrated successfully on farmer's field. University publication *"Krishi Sanvadini"* was distributed to the young learned tribal farmer's for their reference.

The tribal areas where the seed was distributed are monitored by Seed Technology Research unit during the different growth stages of crop for the feed-back of above programme. More such programmes for tribal community will be helpful for adopting the new technologies in future also.

PDKV team visit at village Dolar

PDKV team visit at village Talai

Wheat Seed distribution at village Dadhiya

Wheat Seed distribution at village Bijudhavadi

UAS, Bangalore

Under AICRP-NSP (Crops) for implementation of TSP, a survey was conducted and identified 750 tribal farmers comprising at H.D. Kote, Nanjanaguda and Hunsur taluk of Mysore district. The tribal farmers were interviewed and identified the crops grown by them during previous years. Ragi is the major crop grown by almost all the tribal farmers; hence, it was decided to distribute quality seeds of improved varieties of food crops. The training-cum seed distribution programme was organised on 05.05.2015 and inaugurated by Dr. M.A. Shankar, Director of Research, UAS, Bengaluru and officials from various line departments of Mysuru district and scientific staff of NSP, GKVK, UAS, Bengaluru were attended.

Details of inputs distributed by UAS, Bengaluru

Sl. No.	Location	No. of farmers benefited	Crop	Variety	Quantity
1.	H.D.Kote, Nanjanaguda and Hunsur taluk, Mysuru district	750 Families, 32 Colonies.	Ragi	ML-365	3600kg
			Maize	Hema (hybrid)	150kg
			Field Bean	-	375kg
			Redgram	BRG-1	750 kg

ICAR-CAZRI, Jodhpur

During 2015-16, ICAR-CAZRI, Jodhpur conducted one training programme at village Kali Amdi (GP- Mandela Pada), district- Banswara under AICRP-NSP (Crops)-TSP programme, benefiting nearly 120 tribal farmers. The programme was implemented with the help of gram panchayat. Looking to the needs of the farmers and after consultation with the Sarpanch and villagers, improved seeds of wheat and fertilizers were provided to the Scheduled Tribe farmers in the month of November, 2015.

Details of inputs distributed by ICAR-CAZRI, Jodhpur

Sl. No.	Village	Input	Quantity
1.	Kali Amdi	Wheat seed var. Raj 4037 (C/S)	4800 kg
2.		Urea	6000 kg
3.		DAP	6000 kg

Seed distribution to farmers of village Kali Amdi

MAF, AU, Kota

A two day training programme for 60 tribal farmers from Kota district was organized at NSP, MAF, Kota. The training imparted techniques involves various aspects of seed production technology to educate the farmers regarding cultivation of crops, selection and preservation of seeds, testing of seeds before sowing, use of Knapsack sprayer, safety measures to be taken during spraying of pesticides preparation of formulation for different pesticides and insecticides, crop-wise safe dosage levels etc. After the training programme, 60 seed storage bins of 4-5 quintal capacity and 60 Knap sack sprayers were distributed to tribal farmers.

ICAR-CICR, Nagpur

AICRP-NSP (Crops)-TSP was undertaken at tribal villages: Banera, Narhar, Surera, and Dhawalpur of Parseoni cluster in Maharashtra. The information on various aspects from these villages were collected. Based on the outcome of baseline survey, a farmers training program was conducted at ICAR-CICR on 28th Sept. 2015, wherein 50 tribal farmers were trained. Various activities of the institute were explained and taken them around to research farms and laboratory. Basic agricultural information like- cultivation practices, insects and disease problems on cotton, physiological disorders, fertilizer and pesticides application, harvesting and threshing of common cultivated crops have been explained in the training programs conducted at various villages in November and December, 2015. Printed literature/ pamphlets and folders were distributed containing all the information regarding package of practices of field crops. Soil samples were collected from the farmers' field to test the samples at KVK, Nagpur and to prepare soil health cards for the farmers.

Interaction with gram sevak & gram panchayat members at Kolitmara Panchyat Office

Interaction with woman Krishi Mitra & farmers at Narhar Village

Interaction with sarpanch & farmers at Dhawalpur Village

4.3 Achievements of ICAR-Seed Project under Tribal Sub Plan Programme (TSP)

Budget allocation (Rs. lakh)	Trainings (no)	FLDs (no)	Exhibitions (no)	Exposure visit (no)	Beneficiaries (no)	Supply of inputs (Type with units)	Asset created (Type & Number)
31.00	42	191	7	26	2917	Quality seed along with recommended fertilizers & pesticides; seedlings / samplings (banana and vegetable) were distributed.	Seed storage bins; Knapsack sprayers, Sickles; Manuals/technical bulletins and technology inventory pertinent to quality seed production were distributed.

5 Extension Activities

Seed Village Scheme

Implementation of seed village scheme by improving of socio-economic status of farmers through seed technological intervention (DoAC).

Objectives

- To improve the quality of farmers saved seed through use of different seed enhancement techniques.
- To ensure the disease & insect free quality seed production by suitable plant protection measures.
- To train the farmers about seed production technology, use of quality seed along with improved package of practices for different seed crops.

In order to promote quality seed for improving production and productivity, ICAR- Indian Institute of Seed Science, Mau has implemented seed village Scheme for development and strengthening of seed infrastructure facilities for production and distribution of quality seeds of IISS with financial support of Department of Agriculture & Cooperation (DAC), Government of India, Ministry of Agriculture, New Delhi.

Districts covered	:	Mau, Ballia, Ghazipur
No. of villages covered	:	134
Seeds distributed (q)	:	4991.81
No. of farmers benefited	:	15310

Crops and Varieties

S.No	Crop	Varieties
1.	Pigeon pea	Bahar, NDA-1 & NDA-2
2.	Paddy	BPT-5204, IR-36, IR-64, MTU-7029, Naveen, CR Dhananjay, HUR-105, Pusa Sugandh-5, Rajendra Sweta, Pusa Basmati-4, Pusa Basmati-1, Pusa Basmati-1509, Pusa Basmati- 6, Kala Namak-3, Kala Namak-101 & Sarju 52
3.	Mustard	Pusa Bold & Pusa Tarak
4.	Chickpea	Pusa 362, JG-16, PG-186, & BGD 72
5.	Lentil	DPL-62, IPL-406, NDL-1 & IPL-316
6.	Wheat	HI 1563, HD 2967, DBW-17, PBW-502, HD-3086, HD-3059, PBW-621, WH-1105, WH-1124, WR-544, Kundan, DBW-39, DBW-644, PBW-533, PBW-343, HD-2932, DBW-16, DBW-71, PBW-550 & DBW-107


Distribution of quality seeds under Seed Village Scheme in district Mau, U.P.

Crop cafeteria

- A crop cafeteria of various *kharif* 2015 with different recommended and locally suited sustainable varieties is at IISS farm. Considering 'seeing is believing', an overall face to face view along with IISS scientists for getting technical know-how for practicing farmer, rural youth and farm women with special reference to extension functionaries crop cafeteria is available for the purpose of horizontal spread of technologies like paddy-MTU-7029, MTU-1064, PR-122, Rajendra Sweta, BPT-5204, Sambha Sub-1, HUR 4-3, HUR 105, Kala Namak-102, IMP. PB-1, Pusa Basmati 1121, Pusa Sugandh 5, Pusa Basmati 1612, Pusa Basmati 1509, Rajendra Bhagawati, Naveen, Sarju-52, IR-36, IR-64, MTU-1001, MTU-1001, Narendra Lalmati and RK Raghunath.
- A crop cafeteria of various *Rabi* 2015-16 with different recommended and also locally suited sustainable varieties is at ICAR-IISS farm: **Chickpea**- Kripa K, BG-1086 K, Pusa-362, PG -186, JG-11, JG 16, BGD- 72, RSG-807, KGD-11, CSJK-21; **Lentil**- DPL 62, NDL 1, IPL 406, IPL-316, HUL-57; **Linseed**: Azad-1; **Field pea**: Rachna, Indra, (KPMR 400), Prakash, IPFD 10-12, Kashi Nandani and IPF 4-9 and **Wheat** PBW-343, PBW-502, PBW-550, PBW 644, PBW-373, PBW-509, PBW-621, PBW-154, HD-3118, HD-2643, HD-2733, HD-3086, HD-2967, HD-3059, HD-2932, HD-2894, DBW-107, DBW-39, DBW 621-50, DBW-17, DBW-71, WH-711, WH-1105, WH-1124, KRL-19, KRL-210, KRL-213, K-307, Unnat Halna, WR-544, HUW-234 and Kundan.

Kisan Mela-2016

ICAR-Indian Institute of Seed Science (ICAR-IISS), Kushmaur, Mau, organized *Kisan Mela* on 12th March, 2016 under the theme of "Quality seed and healthy soil: Better Harvest". *Kisan Mela* was inaugurated by Dr. J.S. Chauhan, Assistant Director General (Seed), ICAR, New Delhi, as special invitees Dr. A.K. Saxena, Director, NBAIM, Mau, Dr. V. K. Pandey, Deputy Director, Uttar Pradesh State Seed Certification Agency, Mau; Dr. Ashutosh Mishra, Deputy Director of Agriculture, Mau, U.P. and Sh. Prabhu Nath Mall, Progressive farmer were present and graced the occasion. Dr. S. Rajendra Prasad, Director, ICAR-IISS welcomed the Chief guest, special invitees,

farmers and highlighted about major achievements of the Institute. He further emphasized that, technologies developed by the institute are performing very well in the eastern Uttar Pradesh and explained about various technologies popularized by the institute for cultivation of various crops for seed production. Considering this year as the International pulse year -2016, emphasis was given to steps being taken to produce more breeder/quality seeds among pulses.

Chief guest Dr. J.S. Chauhan, Assistant Director General (Seed), ICAR, New Delhi in his address emphasized on second green revolution through use of quality seeds. Dr. A.K. Saxena, Director, NBAIM, highlighted key role of microorganisms in agriculture and emphasized on use of liquid bio-fertilizer. A number of dignitaries including specialist from ICAR Institutes, KVKs, State Govt. Departments, private firms (input and farm machinery) and different banks and NGOs exhibited respective products/ services in the *Mela* and actively participated in the deliberations. More than 32 organizations have displayed their product / materials in the stalls. On this occasion of *Kisan Mela*, a field visit was organized where farmers interacted with scientists and discussed diverse problems related to their farming. Film show related to seed production was made along with a technical session. Around 3000 farmers of various districts of Uttar Pradesh participated in this *Mela*.

***Kisan Mela* organized at ICAR-IISS, Mau 2016**

Farmers attended in *Kisan Mela* held at ICAR-IISS, Mau 2016

On the occasion of *Kisan Mela* a souvenir was released by the Chief Guest and invited Guests. Farmers producing quality seed of paddy and wheat were also honoured on this occasion. The programme was co-ordinated by Dr. A.N. Singh, Senior Scientist.

Jai Kisan Jai Vigyan Programme - 2015

ICAR-IISS, Mau celebrated '*Jai Kisan Jai Vigyan*' week from 23rd - 29th December 2015 on the birth anniversary of two former Prime Ministers, Shri. Atal Bihari Vajpayee and Late Shri. Chaudhary Charan Singh. As the part of celebrations, different programmes were organized at the institute. The scientist-farmer interaction, essay writing, debate and quiz competition for school children were organised. During scientist-farmer interaction, the importance of having closer linkage between farmers and scientists for effective transfer of technologies were highlighted. The concluding function of '*Jai Kisan Jai Vigyan* Week' was organized at ICAR-IISS, Mau on 29th December, 2015. The programme was attended by more than 60 students and farmers of different villages from the Mau district of Uttar Pradesh.

Scientists-Students and Farmers interaction meet at ICAR-IISS, Mau during *Jai Kisan Jai Vigyan* Programme

Model Village Scheme

Five villages viz., Onhaich, Paniara, Bagali, Khiria, Kushmaur have been exclusively identified under the scheme for intensified extension activities. Large number of farmers from these villages were trained for quality seed production. Quality seeds of wheat, mustard, gram and paddy were distributed on subsidized rates among about 2000 farmers of selected villages for seed production. Various techniques, line sowing of wheat, vermicomposting were demonstrated on farmer's field in selected villages. Many progressive farmers are also associated with institute through participatory seed production. Front line demonstration on use of quality seed of berseem is conducted on 20 farmers' field. The programme was co-ordinated by Dr. A.N. Singh, Senior Scientist.

Mera Gaon Mera Gaurav

This programme has been initiated from the year 2015-16. Twenty five villages namely Pirua, Pallia, Chalha, Ranipur, Nasopur, Umapur, Bhawnathpur, Sadikpur, Adeydeeh, Sarwaan, Rakewaredih, Piparidih, Bramanpur, Bhar, Panditpur, Ahilad, Itaura, Basti, Mirzapur, Vinodpur, Tajopur, Kahinaur, Bandhu, Bakwal and Hardaspur have been identified. Quality seeds were distributed in these villages under seed village scheme and farmers were advised on improved cultivation practices and crop varieties of paddy, wheat, pigeon pea and mustard. Periodical visits of Scientists team are being made to various villages under *Mera Gaon Mera Gaurav* programme. The programme is being co-ordinated by Dr. A.N. Singh, Senior Scientist.

Participation in Exhibition, *Kisan Goshthis* and farmers' training programmes

- ICAR-IISS, Mau has put up stall in *Kisan Mela* organised by NEFFORD on 22.05.2015. Hon'ble M.P. from Bhadohi Shri Virendra Singh was the chief guest of *Mela*. ICAR-IISS, Mau participated in *Mela* by putting the stall and seed selling counter. Seed selling counter of the institute was the major attraction during *mela*.
- *Kharif Krishak Goshthi* was organised by State Agriculture Department, Mau, U.P. on 23-05-2015. District Magistrate, Mau was the chief guest of *Goshthi*. It was organized by Agriculture

Department of Mau. ICAR-IISS stall was installed in *Goshthi* which was appreciated by visiting farmers. About 150 farmers visited the stall.

- ICAR-IISS, Mau put up a stall in the exhibiton at Barhi, Hazaribagh, Jharkhand on 27th and 28th June 2015. Ministry of Agriculture and Farmers Welfare, Govt. of India, Shri Radha Mohan Singh Ji inaugurated the exhibition on the occasion of unveiling the foundation stone of Indian Agriculture Research Institute-Jharkhand by Hon'ble Prime Minister. Institute stall was visited by about 200 farmers.
- ICAR-IISS, Mau participated in *Mela* organised by Institute of Agricultural Sciences, BHU, Varanasi on 3rd and 4th November, 2015 by putting the stall. About 250 farmers visited institute's stall.
- A *Kisan-Vaigyanik Mahasangam* was organised at Motihari, Bihar on 25.12.2015. Ministry of Agriculture and Farmers Welfare, Govt. of India Shri Radha Mohan Singh Ji inaugurated the programme under the *Jai Kisan Jai Vigyan*. Institute stall was visited by about 200 farmers.
- ICAR-IISS, Mau has put up stall in *Rashtriya Kisan Mela evam Sabji Pradarshni* organised by Indian Institute of Vegetable Research, Varanasi on 30.01. 2016. About 220 farmers visited the IISS stall and took the information about use and source of quality seed.
- ICAR-IISS, Mau has put up stall in *Swadeshi Mela* on 06.02.2016. ICAR-IISS, Mau stall was visited by about 100 farmers.
- *Virat kisan mela evam Pradarshani* was organised on 26th-28th March, 2016 by State Agril. Dept., Mau. District Magistrate, Mau inaugurated the *Mela*. Institute stall was visited by about 225 farmers.
- An exihibition on commencement of International Year of Pulses at IIPR, Kanpur on 13.03.2016. Honourable Ministry of Agriculture and Farmers Welfare, Govt. of India Shri Radha Mohan Singh Ji inaugurated the exhibition on the commencement of International Year of Pulses. ICAR-IISS, Mau has put up the stall which was visited by Hon'ble Agriculture Minister. The status of breeder, foundation and certified pulse seed production in country was displayed in the stall. About 150 farmers visited the stall.
- *Krishi Unnati Mela*, was organised by Ministry of Agriculture and Farmers Welfare, New Dehi on 19th-21st March, 2016. Hon'ble Prime Minister Shri Narendra Modi Ji inaugurated the *Mela*. ICAR-IISS, Mau has put up the stall which was visited by Hon'ble Agriculture Minister. Various seed related technologies were put up for display and useful literature were distributed to farmers. About 500 farmers visited the stall.

Programmes Conducted for Farmers under different programmes of ICAR-IISS, Mau

S. No	Venue	Programme	Date
1	Onhaich, Mau	Farmer meeting	19.06.2015
2	Dumraon, Mau	Training	04.08.2015
3	Chakra, Mau	Training	05.08.2015
4	Indian Institute of Seed Science, Mau	Soil health card distribution	05.12.2015
5	Indian Institute of Seed Science	*Jai Jawan Jai Kisan*	23.12.2015 to 29.12.2015
6	Indian Institute of Seed Science	Farmers-Scientist interaction programme	16.02.2015
7	Indian Institute of Seed Science, Mau	*Kisan Mela*	12.03.2015

6 Quality Seed Production

Revolving Fund Scheme

- About **370.0 quintals** of quality seed of paddy varieties such as MTU-7029, BPT-5204, Rajendra Sweta, HUR-105, PB-1509 & Sarju-52 during *Kharif* season 2015 were produced under Revolving Fund Scheme of ICAR-IISS, Mau.
- About **790.0 quintals** of quality seed of wheat varieties such as HD-2967, PBW-533 and WH 1105 during *Rabi* season 2015-16 were produced under Revolving Fund Scheme of ICAR-IISS, Mau.

Dr. J.S. Chauhan, ADG (Seeds), ICAR New Delhi visiting participatory seed production plot at farmer's field along with Dr. S. Rajendra Prasad, Director, ICAR-IISS, Mau and other staff members

Quality Seed Production in ICAR-IISS, Mau, Farm

- About **38 quintals** of breeder seed of **paddy** varieties such as IR-36, IR-64, MTU-7029 and BPT-5204 during *Kharif season* 2015 were produced at IISS farm.
- About **122 quintals** of foundation, certified & TFL seed of **paddy** varieties such as MTU-7029, IR-36, IR-64, BPT-5204, PB-1612, PB-1121, Improved Pusa Basmati-1, PB 1509, BPT 5204, MTU-1064, MTU-1075, MTU-1001, MTU-7029, Pusa Sugandh-5, Rajendra Bhagwati, Rajendra Sweeta, Kala Namak-101, Narendra Lalmati and PR-122 varieties during *Kharif* season 2015 were produced at IISS Farm.

Quality Seed production at ICAR-IISS Farm

- About **20 quintals** of breeder seed of wheat varieties such as HD-2733, HD- 3059 and HI 1563 during *Rabi* season 2015-16 were produced at IISS farm.
- About **80, 5** and **5 quintals** of foundation, certified & TFL seed of ***wheat, lentil*** and **mustard** during *Rabi* season 2015-16 were produced at IISS farm and supplied to the farmers.

Total seed production for the period of 2015-16 at Regional Station, ICAR-IISS, GKVK campus, Bengaluru

Sl. No.	Crop	Variety	Class	Total Quantity of seeds after processing (Kg)	Amount (Rs.)
1	**Cowpea**	KBC-2	BS	**250.00**	25,325.00
		C-152	BS	**280.00**	28,364.00
2	**Red gram**	BRG-2	BS	**200.00**	20,000.00
3	**Soybean**	JS-335	BS	**140.00**	14,175.00
4	**Ragi**	ML-365	BS	**995.00**	48,357.00
		ML-365	TL	**210.00**	6,510.00
5	**Horse gram**	PHG-9	TL	**600.00**	36,000.00
				Total Income Generated	**1,78,731.00**

7 Capacity Building – Training Programmes Conducted

International certificate course on "Requisites of Seed Production, Processing and Quality Assurance"

International certificate course for eight Nigerian nationals was concluded at ICAR-Indian Institute of Seed Science, Mau. The said six month training programme was commenced on 20th July 2015 at ICAR-IISS, Regional Station, Bengaluru.

The international certificate course was executed in three phases: first phase began in ICAR-IISS, Mau, Regional station, GKVK Campus, Bengaluru; second phase focussed on exposure visits to various institutions and private seed enterprises at Hyderabad and Delhi; and third phase was instituted at ICAR-IISS, Mau. The training programme focussed on expert talks and practical sessions on various aspects of seed science and technology *viz.*, seed production technology in field and horticultural crops; seed processing; seed testing and certification; seed storage and handling; seed quality enhancement; seed health management and seed economics, marketing and management. Trainees were also exposed to methodology of seed production through hands-on training in seed production technology, wherein trainees were engaged in seed production of OPV/ Hybrid of various crops. As a part of project appraisal, four project proposals were brought up by trainees targeting seed entrepreneurship for the holistic upliftment of seed scenario in major crops of Nigeria. *In toto* 462 expert talks, 128 practical sessions, 68 field visits and 52 exposure visits covering five states were instigated during six months period.

The valedictory ceremony was graced by chief guest Dr. J.S. Chauhan, Assistant Director General (Seed), ICAR, New Delhi and guest of honour's Dr. S.K. Rao, Director of Research Services, JNKVV, Jabalpur; Dr. M.A. Shankar, Ex-Director of Research, UAS Bengaluru; Dr. Ashok Gaur, Ex-Principal Scientist, DSST, IARI, New Delhi; Dr. S.N. Sharma, Emeritus Scientist (ICAR), RARI, Durgapura; and Dr. S.R. Maloo, Dean,

Faculty of Agriculture, MPUAT, Udaipur. Dr. S. Rajendra Prasad, Programme Coordinator & Director, ICAR-IISS, Mau welcomed the gathering and detailed about the progress of training programme.

International training on "Quality Rice Seed Production"

International training on "Quality Rice Seed Production" was organized during 03-06th October, 2015 by Institute of Agricultural Sciences (IAS), Banaras Hindu University (BHU), Varanasi, (UP), India in collaboration with International Rice Research Institute (IRRI), Manila, Philippines, ICAR-Indian Institute of Seed Science (ICAR-IISS), Kushmaur, Mau, UP, India, and National Seed Research and Technology Centre (NSRTC), Varanasi, UP, India. The aim of the training was to improve the technical skills of researchers and trainees in quality seed production and discussions with special emphasis on seed production problems encountered by farmers, researchers and other stake holders. The training included a series of lectures, delivered by eminent scientists and experts on various topics on seed production, quality control, new innovations in seed research, post-harvest technologies, and storage related aspects pertaining to quality control mechanisms in quality rice seed production system.

A total of 39 participants from three countries *i.e.* Cambodia (13 participants) Nepal (19 participants) and India (07 participants) attended the training. The team visited the ICAR-Indian Institute of Seed Science, Mau on 06th October 2015 and all the trainees were given practical exposure through field demonstration of various classes of seed production plots of rice *i.e.* Nucleus seed, Breeder seed, Foundation seed, Certified seed and hybrid seed production at ICAR-IISS, Mau. Further, trainees also visited various laboratories of ICAR- IISS Mau for different aspects of seed technology *viz.*, genetic purity testing using molecular tools, seed quality enhancement and seed health management etc. Dr. S. Rajendra Prasad, Director, ICAR-IISS, Mau highlighted achievements of institute.

Training on Seed Quality, its control and management with reference to *Kharif* crops

ICAR-Indian Institute of Seed Science (ICAR-IISS), Mau in collaboration with Indian Farm Forestry Development Cooperative Limited, Gurgaon, organized two day training programme entitled "Seed Quality, its Control and Management with reference

to *Kharif* crops (Rice and Soybean)" during 11-12 June, 2015.

Training programme encompassed various lectures on different aspects *viz.*, general principles of seed production technology, quality seed production technology in rice and soybean, principles and procedures of seed certification, genetic purity testing in seed lots, improved agronomic practices for seed production, management of seed borne diseases, storage insect, seed quality enhancement technology for rice and soybean, seed sampling, physical seed purity testing, economics of seed quality production and aspects of seed processing, packing and legislation including Seed Act, 2004 with practical hands on training was delivered by respective resource persons.

बीजों की सुरक्षा व भण्डारण पर पाँच दिवसीय राष्ट्रीय प्रशिक्षण

संस्थान में दिनांक 21.12.2015 से एक पाँच दिवसीय राष्ट्रीय प्रशिक्षण का आयोजन किया गया जिसमें राष्ट्रीय बीज निगम के 20 प्रशिक्षणार्थीयों ने भाग लिया तथा उपरोक्त प्रशिक्षण में न केवल निदेशालय के वैज्ञानिकों द्वारा बल्कि भारतीय कदन्न अनुसंधान संस्थान, हैदराबाद, काशी हिन्दू विश्वविद्यालय, भारतीय सब्जी अनुसंधान संस्थान, वाराणसी एवं राष्ट्रीय बीज निगम के विषय विशेषज्ञों द्वारा विभिन्न विषयों पर व्याखान दिये गये। इस प्रशिक्षण कार्यक्रम में प्रशिणार्थियों नें भारतीय सब्जी अनुसंधान संस्थान, वाराणसी में प्रक्षेत्र भ्रमण के दौरान सब्जी बीज उत्पादन के तकनीकों को सीखा एवं गुणवत्तायुक्त बीज उत्पादन, कीटों एवं रोगों से बचाव, आनुवंशिक शुद्धता, खरपतवार प्रबन्धन आदि की नवीनतम तकनीकियों की जानकारी ली। दिनांक 25.12.2015 को उपरोक्त प्रशिक्षण कार्यक्रम का समापन समारोह सम्पन्न हुआ।

Advanced training on "Fodder Seed Production"

The shortage of feed and fodder is the most important reason along with other reasons such as breeding and reproduction, diseases and management of dairy animals average low milk yield in our country as compared to world's average. Lack of availability of quality seeds & planting material of fodder and forages is one of the weak links in this precarious situation of demand & supply of green fodder. Considering the importance of this area in the overall health of dairy industry, National Dairy Development Board (NDDB) is doing its bit along with World Bank to equip the officials of various state milk unions with technical know-how of standard seed production practices among fodder and forage crops. In light of these facts, ICAR-IISS, Mau in collaboration with GBPUA&T, Pantnagar and National Dairy Development Board organized an advanced training programme on Fodder Seed Production from 15th-19th March, 2016 at Pantnagar. This was the third training that had been organized on Fodder Seed production in collaboration with NDDB. A total of 20 officials representing milk unions of various states such as Bihar, Gujarat, Karnataka, Maharashtra and Rajasthan attended the programme.

Hon'ble Vice Chancellor, GBPUA&T, Pantnagar Dr. Mangala Rai presided the inaugural session of this training on 15.3.2016 in the presence of Shri A.K. Garg, DGM (AN), NDDB, Dr. S. Rajendra Prasad, Director ICAR-IISS, Mau along with the distinguished faculty of the university. Trainees were given a wide exposure to various aspects and technologies involved in quality seed production among fodder crops through well designed classroom lectures & practicals as well as field visits. The five days training programme came to conclusion with valedictory session presided over by Dr. J. S. Chauhan, ADG (Seed), ICAR on 19.3.2016.

8 Intellectual Property Rights

Patents

Three international PCT applications have been filed at Indian patent office, New Delhi after availing permission and sanction from competent authority, ICAR and IP&TM Unit, New Delhi.

1. PCT/IN2015/000176 titled "Three way matrix sampling device for seeds and a method thereof"
2. PCT/IN2015/000177 titled "Three way matrix sampling device for leaves and a method thereof"
3. PCT/IN2015/000178 titled "Three way sampling method for assessing genetic purity of seed lots and crop plants"

Capacity Building in IP management

Training/Workshop/Seminar etc. organized

Sensitization Programme on IPR

A sensitization programme of Intellectual Property Rights (IPR) was organized on 24 February 2016 at ICAR-Indian Institute of Seed Science, Mau. Dr. S. Rajendra Prasad, Director, ICAR-IISS, Mau emphasized the awareness creation among students on various issues related with IPR. Dr. Arvind Nath Singh, Senior Scientist highlighted the importance of IPR and role of patents for growth of any nation. Dr. Jitendra Kumar described different types of IPR like patent, copyrights, trademarks, trade secrets etc. with suitable examples. A film was also displayed on Protection of Plant Varieties and Farmers Rights (PPV&FR) for understanding of importance of Plant varieties and rights of farmers. On this occasion, about one hundred students and teachers of Kasturba Gandhi Girls School, Kopaganj, Mau participated in the programme.

9 Other Important Activities

स्वच्छ भारत अभियान

संस्थान में स्वच्छ भारत अभियान के अंतर्गत वर्ष 2015–16 में विभिन्न कार्यक्रम आयोजित किये गये जिसका उद्देश्य महात्मा गाँधी की अवधारणा की स्वच्छता आजादी से अधिक महत्वपूर्ण है, को कार्यान्वित करना था। इस क्रम में संस्थान में आयोजित किये गये कार्यक्रमों का संक्षिप्त विवरण निम्नलिखित है :–

- संस्थान द्वारा ओन्हाईच गांव को गोद लिया गया है। इस क्रम में वहां बार–बार स्वच्छता अभियान के अंतर्गत जागरूकता अभियान के साथ–साथ विभिन्न कार्यक्रम आयोजित किये गये।
- संस्थान के परिसर एवं आस–पास के खेतों में साफ–सफाई एवं जागरूकता प्रसार हेतु प्रति सप्ताह 2 घण्टे निर्धारित है, जिसमें संस्थान के सभी कर्मचारी, अधिकारी, श्रमिक आदि नियमित रूप से भागीदारी करते रहे हैं।
- संस्थान के द्वारा आयोजित किये जाने वाले विभिन्न प्रशिक्षण कार्यक्रमों में स्वच्छता के प्रति जागरूकता अभियान को एक अनिवार्य अंग के रूप में संचालित किया जा रहा है।
- संस्थान परिसर में स्वच्छता अभियान के अंतर्गत संस्थान को पार्थेनियम मुक्त बनाने का प्रयास किया गया है।

Vigilance Awareness Week

Vigilance Awareness Week was observed with main focus on "Preventive Vigilance as a tool of good Governance" during 26th Oct. to 31st Oct. 2015 at the ICAR-Indian Institute of Seed Science, Mau.

On Oct.26th, 2015 at 10 a.m. the oath taking ceremony was held at ICAR- Indian Institute of Seed Science, Mau and all scientists, technical officers, administrative and other staff took oath for eradication of corruption in all spheres of life. The Vigilance Pledge was administered simultaneously both at ICAR-IISS main centre and at Regional Station, Bengaluru for all the scientists and technical staff.

On Oct. 30, 2015, essay competition was conducted at the Institute for all staff in Hindi as well as in English on "Preventive Vigilance: Way forward for prosperity". On 31st Oct. 2015, the concluding programme for vigilance awareness week was held at ICAR-IISS, Mau. During the concluding programme, Dr. Pawan Kumar Sharma, Principal Scientist and Vigilance Officer of NBAIM, Mau delivered a lecture on Preventive Vigilance. Sh. Ajay Kumar Soni, Administrative Officer delivered an illustrative lecture on "Preventive vigilance

Oath taking ceremony at IISS committee room on 26th Oct. 2015

Shri Ajay Kumar Soni, Adm. Officer delivering lecture on 31.11.2015

and official procedures". Dr. D. K. Agarwal, Principal Scientist, IISS shared his thoughts on preventive vigilance. Dr. S. Natarajan, PS and Vigilance Officer briefed about the week-long vigilance awareness week activities followed by Director concluding remarks. The programme ended with vote of thanks by Sh. Dipak Kumar, DDO, ICAR-IISS, Mau.

World Soil Day

ICAR- IISS, Mau (U.P.) organised a "Soil Health Card" distribution programme on the occasion of "World Soil Day" on 5th December, 2015 at its campus. Soil Health Cards of 300 were made in collaboration with U.P. State Agriculture Department among selected villages of *Mera Gaon Mera Gaurav* programme and were distributed among farmers present in the ceremony. The programme was presided over by Dr. S. Rajendra Prasad, Director, ICAR-IISS, Mau and Dr. Ashutosh Mishra, Deputy Director of Agriculture, Mau District, U.P. was present as the chief guest of the function. Dr. Arvind Nath Singh, Senior Scientist and co-ordinator of the programme elaborated the importance of Soil Health Card Scheme among the farmers. A number of lectures on various aspects of maintaining soil health were delivered by the senior faculty of the

institute. Dr. Dinesh K. Agarwal, Principal Scientist, highlighted the importance of healthy soil for healthy agriculture. Dr. A.K. Sinha, Senior Scientist educated the farmers about crop rotations in maintaining the soil fertility. Dr. Rajiv K. Singh and Dr. T.N. Tiwari, Senior Scientist gave detailed information on importance of green manuring and integrated nutrient management, respectively. An interactive session to solve farmers' problem along with a poster exhibition on the theme of soil health was also organised. International guest trainees from Federal Republic of Nigeria also attended the World Soil Day celebrations at the institute.

Institute Foundation day

ICAR-Indian Institute of Seed Science, Mau celebrated its Foundation Day on 16th February, 2016 by organizing Scientists-Farmers interaction meet. Chief guest of the function, Dr. B. N. Singh, Ex-Director, ICAR-CRRI, Cuttack and Director Research, BAU, Ranchi, highlighted the importance of improved varieties for drought and flood conditions and also emphasized on zero tillage in wheat crops for the eastern Uttar Pradesh. Dr. A. K. Saxena, Director, ICAR-NBAIM, Mau emphasized the utility of microorganisms in quality seed production and the need for further enhancing the production of quality seed among various crops. Dr. S. Rajendra Prasad, Director, ICAR-Indian Institute of Seed Science, Mau in his presidential address highlighted the importance of quality seed and progress country has made in safeguarding the food security through ensured supply of quality seeds among field and horticultural crops. He also emphasized upon the progress made by the institute over the years for assuring availability of quality seed and the technologies developed for farmers of eastern Uttar Pradesh. Considering this year as the International Year of Pulses -2016, he further mentioned the steps being taken to produce more breeder and quality seeds among pulses. During this occasion about 80 farmers from neighbouring villages, scientists, officers and employees of ICAR-IISS, Mau were present. During this programme farmers also visited experimental filed of the institute.

10 राजभाषा का वार्षिक प्रगति प्रतिवेदन

एक दिवसीय हिन्दी कार्याशाला : ''हिन्दी का अन्य भारतीय भाषाओं के साथ अंतर्सम्बन्ध'' (दिनांक 27.06.2015)

राजभाषा कार्यान्वयन समिति द्वारा आयोजित किये जाने वाले कार्यक्रमों की श्रृंखला में दिनांक 27.06.2015 को एक दिवसीय कार्यशाला का आयोजन किया गया जिसका विषय था – ''हिन्दी का अन्य भारतीय भाषाओं के साथ अंतर्सम्बन्ध''।

कार्यक्रम का उद्घाटन दीप प्रज्जवलन के साथ प्रभारी परियोजना निदेशक डा. दिनेश कुमार अग्रवाल ने किया। मुख्य अतिथि डा0 प्रभाकर सिंह, सहायक प्राध्यापक, बी.एच.यू. ने कुएं के जल बजाय बहते जल से भाषा की तुलना करते हुए कहा कि भाषाई शुद्धता व क्लिष्टता को नजर अंदाज करके ही हिन्दी को जन भाषा बनाया जा सकता है। विशिष्ट अतिथि डा. पवन कुमार शर्मा, प्रधान वैज्ञानिक एन.बी.ए.आई.एम. ने हिन्दी

की संवैधानिक स्थिति को स्पष्ट किया तथा हिन्दी –गैर हिन्दी विवाद पर प्रकाश डाला।

कार्यक्रम के अन्त में राजभाषा कार्यान्वयन समिति के सदस्यों को आयोजन के लिए शुभकामना दी गयी। कार्यशाला को सफल बनाने में राजभाषा कार्यान्वयन समिति के सदस्यों में डा. टी. एन. तिवारी, डा. गोविन्द पाल, डा. मदन कुमार, श्री अरूण कुमार चतुर्वेदी, श्री सुधाकर श्रीवास्तव तथा श्री अजय कुमार सोनी का प्रमुख योगदान रहा।

हिन्दी सप्ताह/पखवाड़ा/मास के अंतर्गत आयोजित विविध कार्यक्रमों का प्रतिवेदन

हिन्दी चेतना मास के अंतर्गत निम्न प्रतियोगिताए आयोजित की गईः–

क्रम सं.	प्रतियोगिता का नाम	आयोजन तिथि
1.	हिन्दी कार्यशाला	14.09.2015
2.	प्रश्न मंच	16.09.2015
3.	हिन्दी टिप्पण/प्रारूपण लेखन	19.09.2015
4.	यूनिकोंड में हिन्दी टंकण	22.09.2015
5.	हिन्दी निबन्ध लेखन (हिन्दी भाषी)	24.09.2015
6.	हिन्दी निबन्ध लेखन (गैर– हिन्दी भाषी)	29.09.2015
7.	तात्कालिक भाषण प्रतियोगिता	01.10.2015
8.	वाद–विवाद प्रतियोगिता	05.10.2015
9.	हिन्दी अनुवाद प्रतियोगिता	07.10.2015
10.	संविदा कर्मियों के मध्य निबन्ध लेखन प्रतियोगिता	08.10.2015
11.	संविदा कर्मियों के मध्य टंकण प्रतियोगिता	09.10.2015
12.	काव्य पाठ	13.10.2015
13.	समापन व पुरस्कार वितरण समारोह	13.10.2015

एक दिवसीय हिन्दी कार्याशाला : ''कार्यालय भाषा के रूप में हिन्दी'' (दिनांक 14.09.2015)

कार्यशाला का उद्घाटन दीप प्रज्जवलन के साथ परियोजना निदेशक डा. एस. राजेन्द्र प्रसाद द्वारा किया गया। कार्यशाला में निदेशालय के वैज्ञानिक डा. टी. एन. तिवारी द्वारा स्वागत भाषण दिया गया। वरिष्ठ वैज्ञानिक डा. अशोक कुमार सिन्हा ने इस बात पर चिन्ता व्यक्त की कि अधिकांश कार्यालयों में कामकाज अभी भी अंग्रेजी में हो रहा है। प्रधान वैज्ञानिक डा. दिनेश कुमार अग्रवाल ने हिन्दी को लोकभाषा बनाने के लिए व्यावहारिक सुझाव दिये। श्री अरूण कुमार चतुर्वेदी ने काव्यपाठ के माध्यम से हिन्दी के स्वरूप को समझाया। शोध अध्येता डा. जितेन्द्र कुमार ने हिन्दी के बदलते स्वरूप पर प्रकाश डाला। अध्यक्षीय उद्बोधन करते हुए डा. एस. राजेन्द्र प्रसाद ने भाषाई विविधता पर जोर देते हुए भाषाई शुद्धतावाद के आग्रह का खंडन किया।

हिन्दी कार्यशाला को सफल बनाने में राजभाषा कार्यान्वयन समिति के सदस्यों में डा. टी. एन. तिवारी, डा. गोविन्द पाल, डा. मदन कुमार, श्री अरूण कुमार चतुर्वेदी, श्री सुधाकर श्रीवास्तव तथा श्री अजय कुमार सोनी का प्रमुख योगदान रहा।

एक दिवसीय हिन्दी कार्याशालाः ''शोध प्रकाशन में हिन्दी का अनुप्रयोग''(दिनांक 22.12.2015)

राजभाषा कार्यान्वयन समिति के सौजन्य से दिनांक 22.12.2015 को एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया, जिसका विषय था–''शोध प्रकाशन में हिन्दी का अनुप्रयोग'' कार्यक्रम का उद्घाटन दीप

प्रज्जवलन के साथ परियोजना निदेशक डा. एस. राजेन्द्र प्रसाद द्वारा किया गया। विशिष्ट अतिथि के रूप में पधारे डी.सी.एस. के पी.जी. कालेज के प्राध्यापक डा. सर्वेश पाण्डेय ने शोध प्रकाशन के रूप में हिन्दी को प्रचलित करने पर बल दिया। मुख्य वक्ता के रूप में डी. सी.एस. के. पी.जी. कालेज मऊ से हिन्दी विभाग की विभागाध्यक्ष डा. कंचन राय ने हिन्दी में शोध प्रकाशन पर बल दिया तथा इसमें लोक भाषा तथा स्थानीय भाषा के समावेशन को आवश्यक बताया। अध्यक्षीय उद्बोधन करते हुए डा. एस. राजेन्द्र प्रसाद ने कहा कि हिन्दी में शोध कार्य पिछले एक दशक से काफी बढ़ा है। सदस्य सचिव श्री अजय कुमार सोनी द्वारा विविध आयोजनो की रूप रेखा प्रस्तुत करते हुए धन्यवाद ज्ञापित किया गया।

हिन्दी कार्यशाला को सफल बनाने में राजभाषा कार्यान्वयन समिति के सदस्यों में डा. टी. एन. तिवारी, डा. गोविन्द पाल, डा. मदन कुमार, श्री अरूण कुमार चतुर्वेदी, श्री सुधाकर श्रीवास्तव तथा श्री अजय कुमार सोनी का प्रमुख योगदान रहा।

एक दिवसीय हिन्दी कार्याशाला : ''कृषि तकनीकी के प्रसार में हिन्दी का योगदान'' (दिनांक 02.05.2016)

राजभाषा कार्यान्वयन समिति के सौजन्य से दिनांक 02.05.2016 को एक दिवसीय हिन्दी कार्यशाला का आयोजन किया गया, जिसका विषय था–''कृषि तकनीकी के प्रसार में हिन्दी का योगदान'' कार्यक्रम का उद्घाटन दीप प्रज्जवलन के साथ निदेशक डा. एस. राजेन्द्र प्रसाद द्वारा किया गया। विशिष्ट अतिथि के रूप में पधारे भा.

कृ.अनु.परि.–भारतीय सब्जी अनुसन्धान संस्थान, वाराणसी के कृषि प्रसार विभाग के प्रधान वैज्ञानिक डा. नीरज सिंह को अध्यक्ष डा. एस. राजेन्द्र प्रसाद द्वारा पुष्पगुच्छ भेंट करने के साथ स्वागत भाषण राजभाषा कार्यान्वयन समिति के सदस्य डा. गोविन्द पाल द्वारा दिया गया। वक्ता के रूप में कार्यशाला को संबोधित करते हुए डा. अशोक कुमार सिन्हा ने स्पष्ट किया कि कृषि तकनीकी का प्रसार में हिन्दी की आवश्यकता क्यों है। डा. अरविन्द नाथ सिंह ने भाषा की सरलता व सहजता पर बल देते हुए हिन्दी के साथ अन्य भारतीय क्षेत्रीय भाषाओं में कृषकों तक तकनीक पहुंचाने पर बल दिया। श्री अरूण कुमार चतुर्वेदी ने हिन्दी भाषा को सर्वस्वीकार्य तथा सहज मानते हुए सम्प्रेषण के लिए उपर्युक्त बताया।

मुख्य वक्ता के रूप में कार्यशाला में पधारे डा. नीरज सिंह ने कहा कि कृषि तकनीकों को प्रयोगशाला से खेत तक पहुचाने में हिन्दी को उपर्युक्त माध्यम बनाने पर बल दिया उन्होंने बताया कि तकनीकों की प्रासंगिकता सिर्फ कृषकों को तकनीक का हस्तान्तरण नहीं होना चाहिए बल्कि उसकी उपयोगिता पर भी ध्यान देना आवश्यक है साथ ही परिणामों पर भी ध्यान देना होगा उन्होंने कहा कि न केवल शोध कार्य की प्रक्रिया के दौरान बल्कि उसके प्रसार में हिन्दी भाषा निश्चित रूप से भारत के विकास के लिए लाभदायक सिद्ध हो सकती है।

अध्यक्षीय उद्बोधन देते हुए डा. एस. राजेन्द्र प्रसाद ने कहा कि हम भाषा की शुद्धता के प्रति आग्रह का मोह त्यागकर भाषा को यथावत जैसी कि वह जनसामान्य के बीच प्रचलित के रूप में स्वीकार करें। तकनीक के विस्तार के क्रम में हमें अपने मूल उद्देश्य की अनदेखी किये बिना यह ध्यान रखना है कि भाषा अपने आप में साध्य नहीं है वरन वह एक साधन है, अतः वह देशकाल, वातावरण आदि के अनुसार परिवर्तनशील है। हिन्दी को उसके प्रचलित स्वरूप के साथ प्रयोग करने पर वह कृषि तकनीक के विस्तार में उपयुक्त साबित हो सकती है।

कार्यशाला के अन्त में निदेशालय की राजभाषा क्रियान्वयन समिति के सदस्य सचिव श्री अजय कुमार सोनी ने मुख्य वक्ता सहित सभी प्रतिभागियों एवं राजभाषा क्रियान्वयन समिति के सदस्यों को धन्यवाद ज्ञापित किया। कार्यशाला के दौरान सभा का संचालन एवं कार्यक्रम का समन्वयन निदेशालय के वरिष्ठ वैज्ञानिक डा. त्रिभुवन नारायण तिवारी ने किया।

हिन्दी कार्यशाला को सफल बनाने में राजभाषा कार्यान्वयन समिति के सदस्यों में डा. त्रिभुवन नारायण तिवारी, डा. गोविन्द पाल, डा. मदन कुमार, श्री अरूण कुमार चतुर्वेदी, श्री सुधाकर श्रीवास्तव तथा श्री अजय कुमार सोनी का प्रमुख योगदान रहा।

11 Awards

1. Dr. S. Rajendra Prasad, Director, ICAR-Indian Institute of Seed Science, Mau was bestowed with Honorary Fellowship Award 2016 for his outstanding contributions in the field of Seed Science & Technology by Bioved Research Institute of Agriculture, Technology and Sciences, Allahabad on the occasion of 18th Indian Agricultural Scientists' and Farmers' Congress, 20th-21st February, 2016.

2. Dr. A.N. Singh became Fellow of Plant Protection Association of India, ICAR-National Bureau of Plant Genetic Resources- Regional Station.

3. Dr. Govind Pal, received 'Best Paper Award' in the National seminar on 'Harmonizing biodiversity and climate change: Challenges and opportunity' during April 17-19, 2015 at ICAR- CIARI, Port Blair.
4. Dr. Govind Pal, received 'Best Researcher Award' by EET CRS, Noida, Uttar Pradesh under Science and Technology Award – 2015.
5. Dr. Govind Pal, received 'Young Scientist Award' in the ISEE Golden Jubilee National seminar by Indian Society of Extension Education, New Delhi.
6. Dr. Govind Pal, received 'Best Paper presentation Award' in the ISEE Golden Jubilee National seminar by Indian Society of Extension Education, New Delhi.
7. Renu, Upasana Sahu, Manish S. Bhoyar, Udai B. Singh, Dipak T. Nagrale, Rajiv Kumar Singh and Arun Kumar Sharma received '3rd Poster Presentation Award' in the 3rd UP Agricultural Science Congress on Strategic Governance and Technological Advancement for Sustainable Agriculture during June 14-16, 2015 at Sam Higginbottom Institute of Agriculture, Technology & Science, Allahabad by UPCAR and UPPAS, Lucknow.
8. Dr. Rajiv Kumar Singh, Senior Scientist (Agronomy), ICAR-DSR, Mau has received Best KVK Scientist Award-2015

in the ISEE Golden Jubilee National Seminar 2015 on "Strategy to Drive Skill Based Agriculture Development Forwarded for Sustainability and Rural Employability" during 5-7 November, 2015 at IAS, BHU, Varanasi by Indian Society of Extension Education, New Delhi

9. Dr. Rajiv Kumar Singh, Senior Scientist (Agronomy), ICAR-IISS, Mau has received Certificate of Appreciation in the ISEE Golden Jubilee National Seminar 2015 on "Strategy to Drive Skill Based Agriculture Development Forwarded for Sustainability and Rural Employability" during 5-7 November, 2015 at IAS, BHU, Varanasi by Indian Society of Extension Education, New Delhi

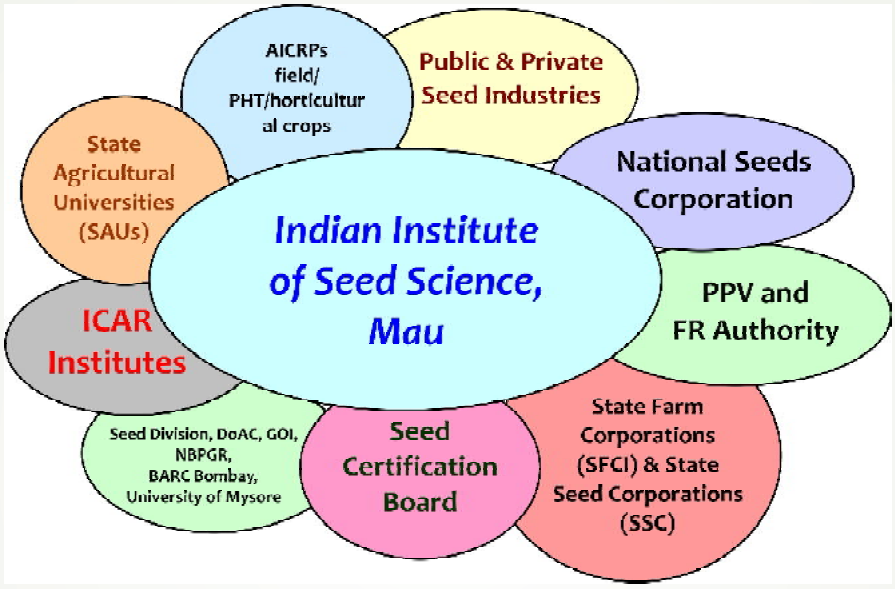
10. Poster Presentation Award (Second) for Udai B. Singh, Deepti Malviya, Wasiullah, Shailendra Singh, Gopal Tiwari, Renu, J.P. Rai, B.K. Sarma, R.K. Singh, P.K. Sharma, Saman Deep Kaur, M.C. Manna, Sushil K. Sharma and Arun K. Sharma (2015 in IPS National Symposium cum Mid eastern Zonal meeting on impact of climate change on plant microbe interaction and its implications held at Department of Botany, Institute of Science, BHU, Varanasi on Dec. 18-19, 2015.

11. Dr. Rajiv Kumar Singh, Senior Scientist (Agronomy), ICAR-IARI, Pusa, New Delhi has received Young Scientist Associate Award-2016 in the 18th Indian Agricultural Scientist and Farmers' Congress on "Prospects of Skill Development in Agriculture and Rural Development-A step towards make in India" during 20-21 February, 2016 at Allahabad by Bioved Research Institute of Agriculture, Technology & Sciences, Allahabad.

12 Linkages

National Linkages

The Indian Institute of Seed Science, Mau has active linkages with national agencies involved in the seed production and seed science research and development.



Linkages proposed at National level

1. There is need to strengthen better linkage and interaction with All India Crop Improvement Projects.
2. Linkages are also required with research institutes like IISR, Indore for Soybean, IIMR, Hyderabad for Sorghum, and IIRR, Hyderabad for rice etc. for better planning and implementation of the programme. Linkage should be strong with the Institutes like IIPR, Kanpur for augmenting pulses seed production and IGFRI, Jhansi for strengthening the fodder seed situation in India.
3. The linkage is also required with other institutes related to similar type of research work like NBPGR, BARC Bombay, and University of Mysore etc.

13 Library

ICAR-IISS, Mau library is being strengthened with books from National and International publishers. Presently, it holds Annual Reports of different projects of IISS, and other ICAR institutes, Newsletters, Technical bulletins, National and International Journals and many books and manuals, which are as follows:

- Numbers of books 2504 related to diverse field of agriculture and allied subjects (Agronomy, Pathology, Entomology, Seeds Science and Technology, Plant Breeding and Genetics, Horticulture, General Agriculture, Bioinformatics, Nanotechnology, Animal Science, Biotechnology, Agricultural Extension Agricultural Economics, Agricultural Statistics, Molecular Biology, Crop Physiology, Biochemistry).
- Diagnostics characteristics of Pearl millet, Soybean, Cotton, Groundnut, Rajmash, Rice.
- Working Sheets on seed-borne diseases-Karnal bunt of Wheat, Ear cockle of Wheat, loose Smut of Wheat, Grain mould of Sorghum, Ergot of Pearl millet, Bunt of Rice, Anthracnose, Chacoal Rot and Purple Stain of Soybean.
- Disease free seed production of Pearl millet, Castor, Cotton, Rice, Wheat, Sorghum and Soybean.
- Morphological, Chemical and Electrophoretic Descriptors of Soybean, Groundnut, Sunflower, Castor, Mung, Urd, Pigeon pea, Chickpea, Sorghum, Pearl millet.
- Guidelines for Nucleus and Breeder Seed Production of Field Crops.
- National Guidelines for conduct of test for Distinctness, Uniformity and Stability.
- Laboratory protocol and training manuals.
- Research Highlights of AICRP – National Seed Project (Crops): 1979-2005 and AICRP –National Seed Project (Crops) XI Five Year Plan Accomplishment (2007-2012).
- Annual Reports of IISS, AICRP – NSP (Crops), ICAR Seed Production: Seed production in Agricultural crops and fisheries and other ICAR institutes.
- Annual Reports of preparation of Plant Variety Protection and DUS testing through ICAR –SAU System.
- Proceedings of different meetings in relation to various projects being co-ordinated and monitored by IISS, Mau.
- DSR Vision -2030, 2050.
- DSR Information Bank.
- Seed Regulations.
- Directory of Seed Research Workers.
- DSR 3 Decades of AICRP –NSP (Crops).
- Decade of ICAR Seed Project: Retrospect and Prospects.

Digital e-resources of IISS library

- Online free access of peer reviewed National and International journals through Consortium of e-Resources in Agriculture (CeRA).
- Recently, IISS Library has been digitalized, through LAN connection, now all the Scientist/staff of IISS can view the list of books & their availability, details of books etc. through the web (link http://dsrlibrary/webopac/).
- CD version of various ICAR publications related to Agri-Horti-Animal-Fishery technologies.
- CD-ROM version of scientific literature (CAB Abstracts) starting from 1979 to 2010.
- CD version of Indian Seed Industry Database 2011.

Library Automation

The ICAR-IISS library is operating in a fully automated environment. The various activities of library have been computerized using integrated library software *Total library software system*. The record of books and journals were entered in the database. Bar-coding of books for automated circulation is under active process. Online public access catalogue is made available for the library users.

14 Photo Gallery

Hon'ble Union Minister of Agriculture & Farmers Welfare Shri Radha Mohan Singh Ji, visiting the ICAR-IISS Stall in ICAR-IIPR, Kanpur on 13.03.2016

Hon'ble Union Minister of Agriculture & Farmers Welfare Shri Radha Mohan Singh Ji, visiting the ICAR-IISS stall in Barhi, Jharkhand on 27 & 28 June, 2015

Hon'ble Secretary, DARE & Director General, ICAR Dr. Trilochan Mohapatra (the then Director, NRRI, Cuttack) visiting ICAR-IISS Stall at Barhi, Jharkhand on 27 & 28 June, 2015 along with Dr. J.S. Chauhan, ADG (Seed), ICAR

Dr. J.S. Chauhan, ADG (Seed), ICAR along with Dr. S. Rajendra Prasad, Director, IISS and other Scientists visiting the Seed Production Plot at Farmer's field

Hon'ble Deputy Director General (CS), ICAR Dr. J.S. Sandhu and Dr. P.K. Chakraborty, ADG (PP), ICAR visiting the Vermicomposting unit of ICAR-IISS, Mau

Dr. G. Kalloo, Ex DDG (CS & Hort.), ICAR and Dr. B. Singh, Director, ICAR-IIVR, Varanasi visiting the ICAR-IISS, Mau stall on 30.01.2016 at IIVR *Kisan Mela*

Farmers' training by ICAR-IISS, Mau Scientists at *Sansad Adarsh Gram* on 05.08.2015

Dr. S. Rajendra Prasad, Director, ICAR-IISS, Mau addressing farmers in a village meeting on 19.06.2015

Farmers' visit to ICAR-IISS, Mau on Field Day on 29.10.2015

Jai Kisan Jai Vigyan Week at ICAR-IISS, Mau during 23-29 December, 2015

Institute Management Committee Meeting at ICAR-IISS, Mau

Hindi *Chetna Maas* at ICAR-IISS, Mau during 14.09.2015 to 13.10.2015

World soil day Celebrations at ICAR-IISS, Mau on 05.12.2015

Distribution of Soil Health Card on World Soil Day in ICAR-IISS, Mau on 05.12.2015

Dr. S. Rajendra Prasad, Director, ICAR-IISS, Mau addressing the gathering at Institute Foundation Day on 16.02.2016

Quality Seed distribution under Seed Village Scheme among identified villages under *Mera Gaon Mera Gaurav* Programme of ICAR

Sensitization programme on IPR at ICAR-IISS, Mau on 24.02.2016

Visit of school children to ICAR-IISS, Mau

11th RAC Meeting of ICAR-IISS, Mau on 19.01.2016

Nigerian Trainees in discussion with Dr. S. Rajendra Prasad, Director, ICAR-IISS, Mau in an interactive session

Swachh Bharat Abhiyan activities at a school in Onhaich village

15 Participation in Meetings/ Trainings/ Seminars/ Workshops

Programmes organized by IISS, Mau

Sl. No.	Name of programme organized	Date	Place	Coordinator/ Participants
1.	XXX AGM of AICRP on NSP (crops)	03.04.2015 - 05.04.2015	ICAR-IISS, Mau	All Scientists of ICAR-IISS, Mau
2.	Farmers meeting to discuss the Strategies to mitigate the water stress condition in agricultural Production	19.06.2015	Onhaich, Mau	Dr. S. Rajendra Prasad Dr. A.N. Singh Dr. Hardev Ram
3.	Institute Research Committee (IRC) Meeitings	30.06.2015 & 01.07.2015	ICAR-IISS, Mau	All Scientists of ICAR-IISS, Mau
4.	Farmers training on "Seed production technology & scientific cultivation of	04.08.2015	*Sansad Gram Dumraon*, Mau	Dr. A.N. Singh Dr. Hardev Ram
5.	Farmers training on "Seed production technology & scientific cultivation of paddy	05.08.2015	*Sansad Gram Chakra*, Mau	Dr. A.N. Singh Dr. Hardev Ram
6.	QRT meeting for cooperating centres in North East zone	15.09.2015 – 16.09.2015	ICAR Research Complex for NEH Region, Meghalaya	Dr. S. Rajendra Prasad Dr. S. Natarajan
7.	Meeting with Nodal Officer of ICAR Seed Project of North Eastern States	16.09.2015	ICAR Research Complex for NEH Region, Meghalaya	Dr. S. Rajendra Prasad Dr. S. Natarajan
8.	10th Annual Review meeting of ICAR Seed Project	24.09.2015 - 25.09.2015	CCARI, Goa	Dr. S. Rajendra Prasad Dr. Rajiv K. Singh Dr. Uday Bhaskar K.
9.	Organized a one day farmers training programme under SVS	28.09.2015	ICAR-IISS, Mau	Dr. Rajiv K. Singh Dr. Hardev Ram
10.	Field day programme under ICAR Seed	04.10.2015	Kushmaur, Onhaich and BagaliPinjara, Block: Pardaha, Mau	Dr.J.S. Chauhan, ADG (Seed) Dr. S. Rajendra Prasad and Other Scientists
11.	Farmers training programme-cum-field day under ICAR-Seed Project	29.10.2015	ICAR-IISS, Mau	Dr. Rajiv K. Singh
12.	Soil health card distribution	05.12.2015	Indian Institute of seed science, Mau	Dr. A.N. Singh
13.	*Jai Jawan Jai Kisan*	23.12.2015 to 29.12.2015	Indian Institute of Seed Science	Dr. A.N. Singh

14.	Farmers-Scientist interaction	25.12.15	ICAR-IISS, Mau	Dr. A.N. Singh & Scientists of ICAR-IISS, Mau and Farmers from nearby villages
15.	Research Advisory Committee (RAC) meeting	19.01.2016	Indian Institute of Seed Science, Mau	ICAR-IISS RAC Members Dr. J.S. Chauhan (ADG) Dr. S. Rajendra Prasad All Institute Scientists
16.	Farmers-Scientists Interaction	16.02.2016	ICAR-IISS, Mau	All Scientists of ICAR-IISS, Mau and Farmers from nearby villages
17.	*Kisan Mela*	12.03.2016	Indian Institute of Seed Science, Mau	Dr. A.N. Singh
18.	Training programme on quality seed production techniques of chickpea, lentil, mustard and wheat	11.03.2016	ICAR- IISS, Mau	Dr. Govind Pal Dr. Hardev Ram
Visits				
19.	Seed Production Centre of IISS at GKVK Campus, Bangalore for monitoring of seed production and research activities.	24.04.2015-25.04.2015 & 27.04.2015	GKVK Campus, Bangalore	Dr. S. Rajendra Prasad
20.	BCKV, Nadia, Kolkata and monitored ICAR-Seed Project and BSP activities on 25th May, 2015.	25.05.2015	BCKV, Nadia, Kolkata	Dr. S. Rajendra Prasad
21.	Seed Production Centre of IISS at GKVK Campus, Bangalore for planned the seed production and research activities for *kharif*- 2015. Arranged for commissioning of bore well and fencing along the boundary.	26.05.2015 - 27.05.2015	GKVK Campus, Bangalore	Dr. S. Rajendra Prasad
22.	Visited & monitored the Breeder Seed and ICAR Seed Project activity at BHU, Varanasi	30.05.2015	BHU, Varanasi	Dr. S. Rajendra Prasad
23.	ICAR-Directorate of Medicinal & Aromatic Plants Research, Boriavi, Anand, Gujarat and interacted with scientists about the research programme/activities of the Institute	27.06.2015	Anand, Gujarat	Dr. S. Rajendra Prasad
24.	Visited Seed Science & Technology lab of Incotec India Pvt. Ltd., Ahmedabad, Gujarat and discussed about seed coating, pelleting , seed enhancement and analytical services for genetic analysis and quality inspection and also the progress of the joint research projects on "Validation of UTLIEF based Genetic Purity as an acceptable tool to ascertain genetic purity in Certified Seeds" and "Recognition of seed film coating polymers for efficient and health friendly seed treatment operations for Certified Seeds of Cereals and legumes"	27.06.2015	Incotec India Pvt. Ltd., Ahmedabad	Dr. S. Rajendra Prasad

25.	Visited IIHR, Bangalore fields, labs and interacted with scientists along with Nigerian Trainees	14.08.2015	IIHR, Bangalore	Dr. S. Rajendra Prasad
26.	NSP centre (BSP, STR & ICAR Seed Project) and paddy, cowpea, breeder seed production plots of RAU, Dholi	08.10.2015	RAU, Dholi	Dr. S. Rajendra Prasad
27.	Visited and monitored the ICAR Seed Project, STR and BSP activities at Junagadh Agricultural University, Junagadh.	20.10.2015	JAU, Junagadh	Dr. S. Rajendra Prasad
28.	Under *Mera Gaon Mera Gaurav* for distribution of different varieties of wheat quality seeds.	18.11.2015 - 22.11.2015	Nasopur, Adhedy, Bhavnathpur, Saravaom and Umapur, Mau	Dr. Sripathy K.V.
29.	Under *Mera Gaon Mera Gaurav* for collection of soil samples for testing	28.11.2015 – 05.12.2015	Nasopur, Adhedy, Bhavnathpur, Saravaom and Umapur, Mau	Dr. Sripathy K.V.
30.	Seed production plot under RFS for *Rabi* season 2015-16		Semari Jamalpur, Bahrampur, Attraul Pandeya, Padumpur Jakhaniyan and Belaunjha, Mau	Dr. Sripathy K.V.
31.	Seed production plots under revolving fund scheme (RFS) for *Rabi* 2015-		Dokati, Baliam, Uttar Pradesh	Dr. Sripathy K.V.
32.	Visited and monitored the STR experiments, BSP Unit and ICAR Seed Project at ANGRAU, Rajendra Nagar, Hyderabad	21.11.2015	ANGRAU, Hyderabad	Dr. S. Rajendra Prasad
33.	Visited council for discussion on Civil work concerning of Regional Station of ICAR-IISS, GKVK campus, Bangalore	11.12.2015	ICAR- IISS, GKVK campus, Bangalore	Dr. S. Rajendra Prasad
34.	Regional Station of IISS at GKVK Campus, Bangalore and monitored the seed production and research activities	14.12.2015	GKVK Campus, Bangalore	Dr. S. Rajendra Prasad
35.	Visited and arranged for inauguration of Regional Station, ICAR-IISS at GKVK Campus, Bangalore by Dr. S. Ayyappan, Hon'ble Secretary, DARE & DG, ICAR, New Delhi, on 27th December, 2015 and monitoring of the seed production and research activities	24.12.2015-31.12.2015	GKVK Campus, Bangalore	Dr. S. Rajendra Prasad
36.	Visited council for discussion about IISS research activities and other pending issues	25.01.2016	New Delhi	Dr. S. Rajendra Prasad

37.	Met DDG (CS) and ADG (Seed), ICAR, New Delhi regarding Annual Group meeting of AICRP-NSP (Crops) and finalized the proceedings of Annual Breeder Seed Review meeting	27.01.2016	ICAR, New Delhi	Dr. S. Rajendra Prasad
38.	Met Senior Director (CS) and Legal Advisor, ICAR, New Delhi regarding pending court cases and met Deputy Commissioner (Seeds), DAC, New Delhi and discussed about the implementation of Seed Village Programme and release of budget and non lifting of Breeder Seed	08.02.2016-10.02.2016	ICAR, New Delhi	Dr. S. Rajendra Prasad
39.	Visited and monitored the BSP, STR centre and ICAR Seed Project at CCS, Haryana Agricultural University, Hissar	09.02.2016	CCS, Haryana Agricultural University, Hissar	Dr. S. Rajendra Prasad
40.	Visited Regional Station of ICAR-IISS at GKVK Campus, Bangalore for monitoring of seed production and research activities	11.02.2016 - 12.02.2016	GKVK Campus, Bangalore	Dr. S. Rajendra Prasad
41.	Visited ICAR-Indian Institute of Millets Research, Hyderabad and reviewed the breeder seed and quality seed production activity of BSP and ICAR Seed unit	28.02.2016	ICAR-Indian Institute of Millets Research, Hyderabad	Dr. S. Rajendra Prasad
42.	Visited to Chandra Shekar Azad University of Agriculture & Technology, Kanpur for monitoring of BSP, STR and ICAR Seed Project.		University of Agriculture & Technology, Kanpur	Dr. S. Rajendra Prasad
43.	Visited Regional Station of ICAR-IISS at GKVK Campus, Bangalore for monitoring of seed production and research activities	16.03.2016 - 22.03.2016	GKVK Campus, Bangalore	Dr. S. Rajendra Prasad
Seminars Delivered				
44.	RNA-interference as a Tool for Plant Functional Genomics and Crop Improvement	18th June 2015	ICAR-IISS, Mau	Mr. S. Prashant Jeevan Kumar, Scientist (Agri. Biotechnology), ICAR-IISS, Mau
45.	Effect of bio-control agents on growth promotion and physico-chemical changes in rice (*Oryza sativa* L)	26th June, 2015	ICAR-IISS, Mau	Mr Krishan Kumar Mishra (student) under the guidance of Dr Madan Kumar, Scientist (Plant Physiology), ICAR-IISS, Mau
46.	Seed biopriming: Shield against soil and seed borne phytopathogen	02nd July 2015	ICAR-IISS, Mau	Dr. H.B.Singh, FNAAS, Dept. of Mycology and Phyto-pathology, IAS, BHU, Varanasi

47.	Effect of various seed priming agents on seed quality parameters and biochemical changes in germination process of pulses	19th August 2015	ICAR-IISS, Mau	Dr. Lalit Krishana meena, Scientist (Plant Physiology), (Pat-FOCARS-101) ICAR-IIFSR, Modipuram, UP. under the guidance of Dr. T.N. Tiwari, Sr. Scientist (Plant Physiology), ICAR-IISS, Mau
48.	Research data management in ICAR	24th November 2015	ICAR-IISS, Mau	Dr. Govind Pal, Sr. Scientist (Agricultural Economics), IISS, Mau
49.	Response of clover seed to priming treatments under drought and salinity stress condition	17th feb., 2016	ICAR-IISS, Mau	Dr. Sanjay Kumar, Scientist (SST), (Pat-FOCARS-102) ICAR-IGFRI, Jhansi, UP. under the guidance of Dr Uday Bhaskar K, Scientist (ISST), ICAR-IISS, Mau
Other programmes				
50.	Workshop on "Shodh *prakashan me Hindi ka anuprayog*"	27.06.2015	ICAR-IISS, Mau	All the staff members of ICAR-IISS, Mau
51.	Workshop on "*Karyalay bhasha ke roop me Hindi*"	14.09.2015	ICAR-IISS, Mau	All the staff members of ICAR-IISS, Mau
52.	Exposure visit of 50 students to ICAR-IISS, Mau	16.09.2015	ICAR-IISS, Mau	Dr. A.N. Singh
53.	Vigilance awareness week on the theme " Preventive Vigilance: Way forward for prosperity"	26.10.2015 - 31.10.2015	ICAR-IISS, Mau	All the staff members of ICAR-IISS, Mau
54.	"Soil Health Card" distribution programme on the occasion of "World Soil Day" on 5th December, 2015 at its campus. 300 Soil Health Cards were made in collaboration with U.P. State Agriculture Department among selected villages of *Mera Gaon Mera Gaurav* programme.	05.12.2015	ICAR-IISS, Mau	Dr. S. Rajendra Prasad Dr. Ashutosh Mishra Dr. Dinesh K. Agarwal Dr. A.N. Singh Dr. A.K. Sinha Dr. T.N. Tiwari Dr. Rajiv K. Singh
55.	'*Jai Kisan Jai Vigyan*' Week w.e.f 23rd December to 29th December 2015 on the birth anniversary of two former Prime Ministers Shri Atal Bihari Vajpayee and Late Shri Chaudhary Charan Singh.	23.12.2015 - 29.12.2015		All the staff members of ICAR-IISS, Mau and Farmers
56.	Agriculture Quiz & Essay writing competition	24.12.15	ICAR-IISS, Mau	Dr. A.N. Singh
57.	Sensitization Programme on intellectual property rights (IPR) for 100 students and teachers of Kasturba Gandhi Girls School, Kopaganj, Mau were participated.	24.02.2016	ICAR-IISS, Mau	Dr. Rajendra Prasad Dr. A.N. Singh

Programmes/ Meeting/Training attended by IISS Scientists and Staff

Sl. No.	Name of programme/ Meeting/ Training	Date/ duration	Venue	Participants
International				
1.	Conference "International Conference on Innovation and Business Management'' organized by Society of Technical and Management Professionals(STMP).	20.06.2015-21.06.2015	STMP, Haridwar	Dr. Uday Bhaskar K. Mrs. Radhika C.
2.	International Conference on "Integrating Climate, Crop, Ecology -The Emerging Areas Of Agriculture, Horticulture, Livestock, Fishery, Forestry, Biodiversity And Policy Issues"	19.07.2015	School of Social Science Auditorium, Jawaharlal Nehru University, New Delhi	Dr. Hardev Ram
3.	International training programme on "Conservation Agriculture Developing Resilient System" organized by CIMMYT & CSSRI during	02.09.2015-11.09.2015	CSSRI, Karnal	Dr. Hardev Ram
4.	Attended & delivered a presentation in the International training entitled "Quality Rice Seed Production"	03.10.2015	BHU, Varanasi	Dr. S. Rajendra Prasad
5.	International training entitled "Quality Rice Seed Production" organized at Institute of Agricultural Sciences, Banaras Hindu University (BHU), Varanasi, UP in collaboration with IRRI, Manila, Philippines ICAR-DSR, Mau and NSRTC Varanasi	03.10.2015-06.10.2015	ICAR-IISS, Mau	Dr. Chandu Singh Dr. Madan Kumar
6.	Attended and supervised the Short term training Certificate Course on Seed Technology for Trainees nominated by WAAPP	12.11.2015 - 13.11.2015	Regional Station, ICAR-IISS, Bangalore and IISS, Mau	Dr. S. Rajendra Prasad
7.	Attended International Rice Symposium 2015 and delivered the lead talk on "Seed Systems & supply chain on the issue of Hybrid Rice Seed Production Problems & Prospects in the Country"	20.11.2015	Hyderabad	Dr. S. Rajendra Prasad
8.	Attended XXII International Grassland Congress 2015 meeting at The Leela Ambience Gurgaon, Hall: Pearl Ballroom 2 on 23rd November, 2015.	23.11.2015	The Leela Ambience Gurgaon	Dr. S. Rajendra Prasad
9.	International Extension Education Conference on Education, Research and Services	27.01.2016 -30.01.2016	IAS, BHU, Varanasi	Dr. Govind Pal
10.	Attended "International Year of Pulses" and Scientists Farmers' interaction meeting	13.03.2016	IIPR, Kanpur	Dr. S. Rajendra Prasad Dr. A.N. Singh

National				
11.	Training on Intellectual Property Rights in IPR	12.08.2015 – 01.09.2015	IARI, New Delhi	Dr. Jitendra Kumar
12.	Attended and delivered lecture on "Importance of seed testing and researchable issues in seed testing and quality enhancement" during training programme on "Advances in seed testing and quality enhancement"	21.09.2015	UAS, Bangalore	Dr. S. Rajendra Prasad
13.	Attended five days training programme "Advances in Applications of Nanotechnology"	05-09.10.2015	ICAR-CIRCOT, Mumbai	Dr. Uday Bhaskar K.
14.	Attended Training on "Patenting System in India (patent filing, processing & drafting)".	05.10.2015-09.10.2015	RGNIIPM, Nagpur, Maharashtra	Dr. A.N. Singh Dr. Dhandapani R.
15.	Attended Training Programme on Science Governance & Management during	29.02.2016 – 04.03.2016	Administrative Staff College of India, Hyderabad.	Dr. S. Rajendra Prasad
16.	Successfully completed eight week online AGMOOCs on GIS in Ag.-Essentials and applications	March 2016	IIT Kanpur under NPTEL online certification	Dr. A.K. Tiwari
17.	Successfully completed thirteen week online AGMOOCs on Technical communication for Scientists and Engineers	March 2016	IIT Mumbai under NPTEL online certification	Dr. A.K. Tiwari
18.	Attended a training program on " RNA-Interface As A Tool For Plant Functional Genomics and Crop Improvement" at ICAR- National Research Centre on Plant Biotechnology, New Delhi from 06-26, 2015 (21 days).	06-26, 2015	ICAR- National Research Centre on Plant Biotechnology, New Delhi	Dr. S.P. Jeevan Kumar
Meeting/workshop				
19.	Meeting of the Varietal Identification Committee of Groundnut under the Chairmanship of ADG (P & O)	12.04.2015	ARS, Kadiri, Andhra Pradesh	Dr. S. Rajendra Prasad
20.	Attended "Brain Storming Session on Rice strategy for India"	14.04.2015	Hyderabad	Dr. S. Rajendra Prasad
21.	National Seminar on 'Harmonizing biodiversity and climate change: Challenges and opportunity'	17.04.2015-19.04.2015	ICAR- CIARI, Port Blair	Dr. Govind Pal
22.	Meeting on the issues relating to the research activities and other matters under the chairmanship of DDG (CS)	14.05.2015	NASC Complex, New Delhi	Dr. S. Rajendra Prasad
23.	Annual Conference of Vice Chancellors of Agricultural Universities and ICAR Directors	15.05.2015-16.05.2015	NASC Complex, Pusa, New Delhi	Dr. S. Rajendra Prasad
24.	Apomixis in plants: Genetic gold of plant breeding	16.05.2015		Dr. Boraih K.M.

25.	Attended the 22nd meeting of the ICAR Regional Committee Zone III for discussion on issues relating to the research activities and other matters	22.05.2015-23.05.2015	Pragna Bhawan, Agartala, Tripura	Dr. S. Rajendra Prasad
26.	Attended the meeting on preparedness for the implementation of Seed Bill 2004 under the chairmanship of DDG (CS)	29.05.2014	NBPGR, Pusa, New Delhi	Dr. S. Rajendra Prasad
27.	Attended the meeting of CAS of the Scientists of Seed Technology as a Member of DPC and visited labs and interacted with scientists.	22.06.2015	CPRI, Shimla	Dr. S. Rajendra Prasad
28.	Meeting on "India Rice Conclave" to be a "Panelist" at the Technical Session I: Panel discussion on increasing Rice Productivity through quality seed: production, processing, storage, marketing, distribution	24.06.2015-25.06.2015	Kolkata	Dr. S. Rajendra Prasad
29.	QRT meeting of DSR, Mau for Western zone under the Chairmanship of Prof. M. Mahadevappa	26.06.2015-27.06.2015	Anand Agricultural University, Anand	Dr. S. Rajendra Prasad
30.	Meeting on Implementation of Projects under Indo-Africa Forum Summit-II (IAFS-II)-under the Chairmanship of Dr. S. Ayyappan, Secretary (DARE) and DG, ICAR,	06.07.2015	Committee Room, DG's office, Krishi Bhawan, New Delhi	Dr. S. Rajendra Prasad
31.	National Seminar on "Take it to Farmers - The Farmers Rights through Awareness"	07.07.2015	Lecture Hall, 2nd Floor, NASC Complex, Pusa Campus, New Delhi	Dr. S. Rajendra Prasad
32.	Met DDG (CS) and ADG (Seed), ICAR, New Delhi regarding Annual Review meeting of ICAR Seed Project 2015-16	08.07.2015	ICAR Head Quarters, New Delhi	Dr. S. Rajendra Prasad
33.	Participated in the interactive session for the Nigerian nationals regarding starting of Certificate Course on Seed Technology by DSR at Agrinnovate India Ltd.	17.07.2015	Agrinnovate India Ltd., NASC Complex, New Delhi	Dr. S. Rajendra Prasad
34.	Attended ICAR Foundation Day and National Conference of Krishi Vigyan Kendras (KVKs)	25.07.2016-26.07.2015	Patna	Dr. S. Rajendra Prasad
35.	Participated in the first workshop of Nodal Officers of ICAR research repository for knowledge management initiative (KRISHI: Knowledge based Resources Information Systems Hub for Innovations in Agriculture)	04.08.2015-05.08.2015	NASC, New Delhi	Dr. Govind Pal
36.	Met DDG (CS) and ADG (Seed), ICAR, New Delhi regarding Annual Review meeting of ICAR Seed Project 2015-16 and discussed the issues related to facilities access to laboratory and other logistics for ICAR-IISS at NSRTC, Varanasi	07.08.2015-08.08.2015	NSRTC, Varanasi	Dr. S. Rajendra Prasad

37.	Supervised and gave lecture in the Short term training Certificate Course on Seed Technology for Nigerian Trainees nominated by West Africa Agricultural Productivity Programme (WAAPP), at Regional Station, ICAR-DSR, Bangalore and monitored seed research and production activities	11.08.2015-15.08.2015	Regional Station, ICAR-DSR, Bangalore	Dr. S. Rajendra Prasad
38.	Attended 54th All India Wheat and Barley Research Workers Meet	21.08.2015-24.08.2015	SDAU, Sardarkrushinagar, Dantiwada, Gujrat	Dr. A.K. Sinha
39.	Attended National Group Meeting (Rabi, 2015-16) of All India Coordinated Research Project on Forage Crops on 4th September, 2015.	04.09.2015		Dr. S. Rajendra Prasad
40.	Attended Brain Storming session (BSS) on Augmenting Forage Resources in Rural India: Policy Issues and Strategies	08.09.2015	NASC Complex, New Delhi	Dr. S. Rajendra Prasad
41.	Attended meeting with Joint Secretary (Seed), DAC regarding MoU for sharing facilities at NSRTC, Varanasi	10.09.2015	NSRTC, Varanasi	Dr. S. Rajendra Prasad Dr. Dinesh K. Agarwal
42.	Attended the Workshop for identifying the production and technological gaps in Middle Gangetic Plains Region	07.10.2015	ICAR Research Complex for Eastern Region, Patna	Dr. S. Rajendra Prasad
43.	25th Asia-Pacific Weed Science Society Conference. Presented lead paper "Weed Seed Atlas: Ready Reckoner for Seed Regulation"	13.10.2015-15.10.2015	PJTSAU, Hyderabad	Dr. Sripathy K.V.
44.	Attended & presented on "Seed Situation in India" in Brain Storming session on quality seed production	19.10.2015	ICAR-Directorate of Groundnut Research, Junagadh	Dr. S. Rajendra Prasad
45.	Met ADG (Seed), ICAR, New Delhi regarding purchase of vehicle under XII Plan EFC of DSR and ICAR Seed Project – DSR unit and discussed the issues related to facilitating laboratory access and other logistics facilities at NSRTC, Varanasi	21.10.2015	NSRTC, Varanasi	Dr. S. Rajendra Prasad
46.	Attended ISST EC meeting at ISST office	21.10.2015	ISST office in NASC Complex, DPS Marg, New Delhi	Dr. S. Rajendra Prasad
47.	Met CEO, Agrinnovate India Ltd., New Delhi discussed about progress of the WAAPP training programme	21.10.2015	New Delhi	Dr. S. Rajendra Prasad
48.	Participated and presented a paper in the National Seminar 2015 on 'Strategy to drive skill based agriculture development forward for sustainability and rural employability'	05.11.2015-07.11.2015	BHU, Varanasi	Dr. Govind Pal Dr. Rajiv K. Singh

49.	Meeting of Committee for preparing the seed quality standards for Bt. Cotton seeds under Refugia in bag concept	20.11.2015	Committee Room of Directorate of Oilseeds Research, Hyderabad	Dr. S. Rajendra Prasad
50.	Participated in the interaction meeting of FAOs of ICAR Institutes with AS & FA, DARE/ ICAR	20.11.2015	IIWM, Bhubaneswar	Dr. Govind Pal
51.	Attended Indo-German Workshop on DUS Testing: Technical Session V: Regulatory Aspects: Seed Industry & Govt Policies	24.11.2015	Lal Bahadur Shastri Auditorium, National Research Centre for Plant Biotechnology, IARI Campus, New Delhi	Dr. S. Rajendra Prasad
52.	Attended meeting for discussing the breeder seed production and availability of certified seed	26.11.2015	Committee Room No. 228, NITI Aayog, New Delhi	Dr. S. Rajendra Prasad
53.	Attended Golden Jubilee of Green Revolution in India meeting	27.11.2015	A.P.Shinde Symposium Hall, NASC Complex, DPS Marg, New Delhi	Dr. S. Rajendra Prasad
54.	Attended assessment committee meeting for CAS of Sr. Scientist to Principal Scientist	10.12.2015	ASRB, Pusa, New Delhi	Dr. S. Rajendra Prasad
55.	The role of plant traits in the regulation of plant diversity	19.12.2015		Dr. Boraih K.M.
56.	Made oral presentation in the 2nd International Journal of Tropical Agriculture International Conference	27.12.2015	Shimla (Himachal Pradesh).	Dr. A.K. Sinha
57.	Attended Regional expert consultation meeting on "Assessment of Common Crop Varieties and their demand and supply for the SAARC Seed Bank	28.12.2015-30.12.2015	Trivandrum, Kerala	Dr. S. Rajendra Prasad
58.	Participated in "Seed Industry Programme" organized by Sathguru Management Consultants, Hyderabad and Cornell University	19.01.2016-22.01.2016	Bengaluru	Dr. Dinesh K. Agarwal Dr. Vijay Kumar HP
59.	Interactive meeting of Vice Chancellor and Directors Conference	23.01.2016-24.01.2016	NASC Complex, New Delhi	Dr. S. Rajendra Prasad
60.	Attended 19th Annual Breeder Seed Review Meeting and presented the Breeder Seed Production status for the year 2014-15 and 2015-16	27.01.2016	Dr. B.P. Auditorium, ICAR-NBPGR, New Delhi	Dr. S. Rajendra Prasad Dr. Dinesh K. Agarwal Dr. Sripathy K.V.
61.	Participated and presented the paper in Conference on National Priorities in Plant Health Management	04.02.2016-05.02.2016	S V Agriculture College, Tirupati, A.P, India.	Dr. A.N. Singh
62.	Participated in Training Workshop on Competency Development for Human Resource Development during	10.02.2016-12.02.2016	NAARM, Hyderabad	Dr. Govind Pal

63.	Attended National Symposium on Vegetable Legumes for Soil and Human Health: Co-chaired the Session on Seed enhancement, marketing and PPP and delivered a lecture on "Advances in seed quality enhancement and seed quality assurance for improved seed delivery "as a Lead Speaker	14.02.2016	ICAR-IIVR, Varanasi	Dr. S. Rajendra Prasad
64.	National workshop on "Current Trends in Agricultural Bioinformatics"	15.02.2016-17.02.2016	NAARM, Hyderabad	Dr. S.P. Jeevan Kumar
65.	18th Indian Agricultural Scientists and Farmers' Congress on "Prospects of Skill Development in Agriculture and Rural Development	20.02.2016	Bioved Krishi Prodyogiki Gram, Moharab, Sringverpur, Allahabad	Dr. S. Rajendra Prasad, Dr. Rajiv K. Singh
66.	Meeting of Scientific Advisory Committee of Krishi Vigyan Kendra, Mau as the member on 25. 02. 2016 at KVK, Mau.	25. 02. 2016	KVK, Mau	Dr. A.N. Singh
67.	2nd International conference on New Challenges in Biotechnology and Molecular Biology in the Context of 21st Century (NCBMBCC)	27.02.2016-29.02.2016	Indian Society of Genetics and Biotechnology, Research Development and St. Johns College, Agra, U.P.	Dr. Jitendra Kumar
68.	Attended & delivered a talk on "Institution of Seed Enterprise in Demanding Domains: NEH Context" in National Seminar on "Integrating Agri-Horticultural and Allied Research for food and nutritional security in the Era of Global Climate Disruption"	06.03.2016	Imphal, Manipur	Dr. S. Rajendra Prasad
69.	"Expert Elicitation Programme for Wheat in Uttar Pradesh" organised by ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi in collaboration with CIMMYT, Mexico	16.03.2015	ICAR-National Bureau of Fish Genetic Resources, Lucknow	Dr. A.K. Sinha
Monitoring				
70.	Monitored the STR experiments, BSP Unit and ICAR Seed Project	04.09.2015-07.09.2015	MPKV Rahuri, PDKV Akola and VNMKV Parbhani	Dr. S. Rajendra Prasad
71.	Monitoring of AICRP -NSP Centres	12.10.2015-17.10.2015	OUAT, Bhubaneswar; NRRI, Cuttack; IGKVV, Raipur; CICR, Nagpur and JNKVV, Jabalpur	Dr. Dinesh K. Agarwal

72.	Monitoring of AICRP -NSP Centres		PAU, Ludhiana; Palamapur, SKAUST, Jammu; & SKAUST, Srinagar	Dr. A.N. Singh
73.	Monitoring of breeder seed of wheat varieties	30.03.2016	RAU, Pusa Bihar	Dr. A.K. Sinha
Other programmes attended by IISS staff				
74.	Delivered one lecture on 'Importance of quality seed production in summer mungbean & paddy at Chakrapanpur, Azamgarh	09.4.2015	Chakrapanpur, Azamgarh	Dr. Rajiv K. Singh
75.	*Kisan Mela* organized by NEFORD, Mau	22.05.2015	NEFORD, Mau	Dr. Dinesh K. Agarwal Dr. Rajiv K. Singh
76.	*Kisan Mela* organized by Deputy Director Agriculture, Mau	23.05.2015	Mau	Dr. Rajiv K. Singh
77.	*Kharif Krishak Goshthi* organised by Agriculture Department, Mau, U. P	30.05.2015	Agriculture Department, Mau, UP	Dr. A.N. Singh
78.	Delivered one lecture on 'Scientific cultivation of paddy seed	23.6.2015	Deputy Director (Agriculture), Mau	Dr. Rajiv K. Singh
79.	Exhibition	27.06.2015-28.06.2015	Barhi, Hazaribagh, Jharkhand	Dr. A.N. Singh Dr. Hardev Ram
80.	Delivered lecture on Principles of seed production in Pulses for farmers and attended plenary session on 9th July, 2015.	09.07.2015		Dr. S. Rajendra Prasad
81.	Delivered one lecture on 'Package and practices of paddy	05.08.2015	Chakra, Mau	Dr. Rajiv K. Singh
82.	Delivered one lecture on "Technological Advances for Enhancing Pulses Production in India" under farmers training programme	30.10.2015	ICAR-IISS, Mau	Dr. Rajiv K. Singh
83.	*Kisan Mela* organized by IAS, BHU,	03.11.2015-04.11.2015	IAS, BHU, Varanasi	Dr. Rajiv K. Singh
84.	*Kisan-vaigyanik Mahasangam*	25.12.2015	Motihari, Bihar	Dr. Hardev Ram Dr. K. Elayaraja
85.	*Rashtriya Kisan Mela evam Sabji Pradarshni* organised by Indian Institute of Vegetable Research, Varanasi	30.01. 2016	Indian Institute of Vegetable Research, Varanasi	Dr. A.N. Singh
86.	*Swadeshi Mela, Kashi*	06.02.2016	Varanasi	Dr. A.N. Singh
87.	*Kisan Mahotsav* organized by UP-State Agriculture Department	25.02.2016-27.02.2016	Community centre, Mau	Dr. Hardev Ram
88.	*Krishi Unnati Mela*	21.03.2016-23.03.2016	ICAR- Indian Agricultural Research Institute, New Delhi	Dr. A.N. Singh
89.	*Virat kisan mela evam Pradarshani-*	26.03.2016-28.03.2016	Mau	Dr. A.N. Singh

16 Publications

Publications in Peer-reviewed Journals

- A.K. Sinha, D.K, Agarwal, S.P. Jeevan Kumar. Preclusion of hybrid necrosis in wheat by proline. Indian Journal of Experimental Biology (Under review).
- S. P. Jeevan Kumar, S. Rajendra Prasad, Madan Kumar, Chandu Singh, A.K. Sinha, Avinash Pathak (2016) Seed Quality Markers: A review. International and National reviews in Journal of Botanical Sciences. (In Press).
- S. P. Jeevan Kumar, S. Rajendra Prasad, Ramesh K. V, Kalyani S. Kulkarni (2016) Green solvents and methods for oil extraction from oilseeds: a review. Sustainable Chemical process, (Under review). Springer open publishers.
- S. P. Jeevan Kumar, S. Rajendra Prasad, R. Banerjee, C. Thammineni (2015) Seed birth to death: dual functions of reactive oxygen species in seed physiology, Annals of Botany, 116: 663-668.
- A.K.Sinha, T.N.Tiwari, Dinesh Kumar Agarwal and Dinesh Singh (2015) Effect of spacing and foliar application of potassium nitrate and calcium nitrate on seed yield in rice. International Journal of Tropical Agriculture. 34 (4),2911-2915.
- Govind Pal, Radhika C., R. K. Singh, Udaya Bhaskar K., H. Ram and S. Rajendra Prasad (2015) Comparative economics of seed production *vis-à-vis* grain production of pigeon pea in Karnataka, India. Legume Research- An International Journal. DOI:10.18805/lr.v0iOF.7484.
- Govind Pal (2015) Analysis of export scenario and potential of Indian lac. The Indian Forester 141 (5): 533-537.
- Govind Pal. 2015. Study on methodology for estimation of lac production in India. International Research Journal of Agricultural Economics and Statistics, 6 (1), 205-209.
- Hardev Ram, R.K. Singh, Govind Pal and S. Rajendra Prasad (2015) Seed yield and economic profitability affected by tillage and genotypes in wheat (*Triticum aestivum* L.) of eastern Indo-Gangetic plains of India. Journal of Agro ecology and Natural resource management, 2 (4), 296-298.
- K. S. Vinutha, S. Rajendra Prasad, S.P. Jeevan Kumar, J. Shanthala, Rame Gowda, and P. Ravi Shankar (2015) Optimization of seed production techniques in a single cross maize hybrid. Seed Research, 42, 210-216.
- K. Thimmappa, Yashpal Singh, R. Raju, Sandeep Kumar, R.S. Tripathi, Govind Pal and A. Amarender Reddy (2015) Reducing farm income losses through land reclamation: A case study from Indo-Gangetic plains. Journal of Soil Salinity and Water Quality, 7 (1), 68-76.
- K.S. Vinutha, S. Rajendra Prasad, Rame Gowda, P. Ravishakar, Parashiva-

murthy and S.P. Jeevan Kumar (2015) Influence of staggered sowing, planting ratio and subtending cob leaf clipping on seed quality parameters of maize. 42 (1), 91-97.

- Madan Kumar, V.P. Singh, Ajay Arora, Dhandapani Raju and Akshay Sakhare (2015) Physiological alteration in *Gladiolus* flower during senescence as affected by abscisic acid. Indian Journal of Horticulture, 72(3), 397-401.
- Rajiv K. Singh, D. K. Agarwal, T. N. Tiwari, Hardev Ram, S. Rajendra Prasad and Renu (2016) Effect of seed treatments using plant growth regulators on wheat (*Triticum aestivum* L.) seedling establishment, growth, seed yield and quality. Annuals of Agriculture Research, 37 (1), 43-48.
- Ramesh, K. V. and Madan Pal (2015) Expression Kinetics of genes from α-Linolenic acid metabolism and HSPs under heat stress in rice seedlings. Indian Journal of Plant Physiology (In Press).
- Rohit Dwivedi, Govind Pal and G.K. Acharya (2015) Socio-Personal characteristics of lac growers in Bastar district of Chhattisgarh. Journal of Non-Timber Forest Products, 22 (3), 159-161.
- Sripathy K.V., Monika Atul Joshi, S.S. Parihar and Manjunath Prasad C.T (2015) Comparative seed morphology among four taxa of genus *Commelina* in relation to seed regulation. Bioinfolet, 3, 124-130.
- T. N. Tiwari, Dipti Kamal, A. K. Sinha and Rajiv K. Singh (2015) Relative performance of seed priming with tap water and inorganic salts on germination, invigoration, growth and yield of wheat (*Triticum aestivum* L.). International journal of Agricultural Sciences. (Accepted).
- T.N.Tiwari, Dipti Kamal, R.K.Singh and S. Rajendra Prasad (2015) Plant growth regulators priming enhances seed quality and enzyme activity in mung bean (*Vigna radiata* L.). Annals of Agriculture Research, 36(4), 350-357.
- T.N.Tiwari, T.K. Srivastava, A.B. Mandal and Dipti Kamal (2015) Seed coating with Hoagland solution enhances seed quality, growth and yield of rice under salt affected soil. Indian Journal of Agricultural Sciences, 85 (09), 1153-57.
- Tiwari A. K., Tiwari. T. N. and S. Rajendra Prasad (2016) Seed dormancy in ornamental plants: A review. *Indian Journal of Agricultural Sciences(Accepted).*
- Tiwari A.K., Kumar R., Kumar G., Kadam G. B., Saha T.N. and Girish K.S (2015) Comparing digital image analysis and visual rating of gamma ray induced Kentucky bluegrass *(Poapratensis)* mutants. Indian Journal of Agricultural Sciences, 85 (8),1046–1049.
- Tiwari A.K., Kumar R., Kumar G., Kadam G. B., Saha T.N (2015) Comparing digital image analysis and visual rating of gamma ray induced Bentgrass (*Agrostis stolonifera*) mutants, Indian Journal of Agricultural Sciences, 85 (1), 93–106.
- Upama Mishra, Sunit Kumar Tyagi, R.N. Gadag, Elayaraja K., and H. Pathak (2016) Analysis of water soluble and insoluble polysaccharides in kernels of different corns (*Zea mays* L.). (Under review Current Science).
- Vijayakumar H. P and A. Vijayakumar (2015) Standardization of accelerated

ageing duration to evaluate seed storability of soybean cultivars. International Journal of Agricultural Science and Research, 5(4), 93-98.

- Vijayakumar, H. P and A. Vijayakumar (2016) Screening of soybean varieties for seed storability using accelerated ageing test. International Journal of Agricultural Science and Research, 6(1), 93-98.

Papers presented in Seminar/ Symposia/ Conferences

- A.K.Sinha, T.N.Tiwari, D.K.Agarwal and Dinesh Singh (2015) Effect of spacing and foliar application of potassium nitrate and calcium nitrate on seed yield in rice. IJTA 2nd International Conference on Agriculture, Horticulture and Plant Sciences. Hotel Land Mark, The Mall, Shimla (H.P.) India, Pp. 2911-2915.
- Dipti Kamal, Yashodhara Verma and T.N.Tiwari (2015) Priming induced biochemical and physiological changes associated with free radicals in okra (*Abelmoschus esculentus* L.). International Conference on Biotechnological Advancement in Free Radical Biology and Medicine. Department of Biosciences & Bio Engineering, Integral University, Lucknow, Pp-22.
- Govind Pal, Radhika C, R. K. Singh, Udaya Bhaskar K, H. Ram and S. Rajendra Prasad (2015) A study on quality seed production in Pigeon pea for sustainability and rural employability: A case study in Karnataka. *In* Souvenir-cum-Abstract book of ISEE Golden Jubilee National Seminar, November 5-7, 2015 at BHU, Varanasi, P. 130-131.
- Govind Pal, Radhika C, R. K. Singh, Udaya Bhaskar K, H. Ram and S. Rajendra Prasad (2015) An analysis of economic profitability and determinants of adoption in pigeon pea seed production technology: A case study in Karnataka. *In* National seminar on harmonizing biodiversity and climate change: Challenges and opportunity, 17-19 April at ICAR- CIARI, Port Blair, P.99.
- Hardev Ram, Govind Pal and S. Rajendra Prasad (2016) Evaluation of conservation tillage practices and genotypes for higher seed yield and economic return of wheat in the Eastern-IGP of India. *In* Souvenir of 4th Uttar Pradesh Agricultural Science Congress-2016 at CSAU&T, Kanpur during March 2-4, P 125.
- Hardev Ram, Rajiv K. Singh, Govind Pal and S. Rajendra Prasad (2015) Seed yield and economic profitability affected by tillage and genotypes in wheat (*Triticum aestivum* L.) of eastern Indo-Gangetic plains of India. Presented in International Conference on "Integrating Climate, Crop, Ecology -The Emerging Areas Of Agriculture, Horticulture, Livestock, Fishery, Forestry, Biodiversity And Policy Issues" on 19th July, at School of Social Science Auditorium, Jawaharlal Nehru University, New Delhi.
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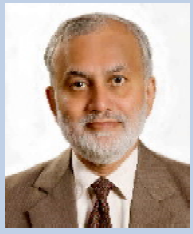
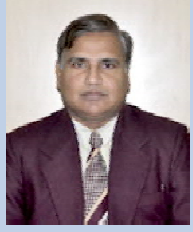
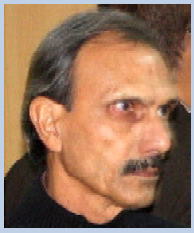
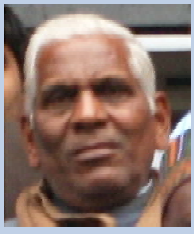
17 Distinguished Visitors

Visit Date	Visitor Name	
2-3, April 2015	Dr. S. Ayyappan Hon'ble Ex-Secretary, DARE & Director General, ICAR New Delhi	
2-3, April 2015	Dr. R.R. Hanchinal Chairman, PPV&FRA New Delhi	
2-3, April 2015 19, January 2016	Dr. S.K. Rao Director Research Services J.N.K.V.V., Jabalpur & Chairman RAC	
2-3, April 2015	Dr. Bijendra Singh Director ICAR-IIVR, Varanasi	
2-3, April 2015	Dr. N.P. Singh Director ICAR-IIPR, Kanpur	

Visit Date	Visitor Name	
21, May 2015	Dr. B. N. Tripathi, Director NRCE/UTCE, Hisar, Haryana	
11, June 2015	Dr. R. K. Chowdhury, Ex OSD, IISS, Mau	
1, July 2015	Dr. J.P. Tandon, Ex ADG (F&FC), ICAR, New Delhi	-
27, August 2015	Dr. J.S. Sandhu Hon'ble DDG (Crop Science) ICAR, New Delhi	
27, August 2015 4, October 2015 19, January 2016	Dr. J.S. Chauhan, ADG (Seed) ICAR, New Delhi	

Visit Date	Visitor Name	
27, August 2015	Dr. P.K. Chakraborthy ADG (PP) ICAR, New Delhi	
28, September 2015	Dr. H. B. Singh, Professor, BHU	
6, October 2015	IRRI Participants	
7, November 2015	Dr. J.K. Jena, Hon'ble DDG (Fisheries) ICAR, New Delhi	
5, December 2015	Dr. Ashutosh Mishra, Deputy Director (Agriculture), Mau, UP	
25, December 2015	Dr. Vilas Tonapi, Director, Indian Institute of Millets Research (IIMR), Hyderabad	

Visit Date	Visitor Name	
16, February 2016	Dr. B.N. Singh Chairman, Center for Research and Development, Gorakhpur, Uttar Pradesh	
19, January, 2016	Dr. M.A. Shankar Ex-Director of Research, UAS, Bengaluru & Member RAC	
19, January, 2016	Dr. S.N. Sharma Emeritus Scientist, RARI, Durgapura & Member RAC	
19, January, 2016	Dr. Ashok Gaur Principal Scientist (Retd.) I.A.R.I, New Delhi & Member RAC	
19, January, 2016	Dr. S.R. Maloo Dean & Chairman, Faculty of Agriculture, MPUA&T, Udaipur & Member RAC	
19, January, 2016	Shri Prabhunath Mall Progressive Farmer & Member RAC	

18 Committee of RAC, QRT, IMC & List of Personnel

18.1. Research Advisory Committee

Dr. S.K. Rao	:	Chairman
Dr. J. S. Chauhan	:	Member
Dr. S. Rajendra Prasad	:	Member
Dr. M. Bhaskaran	:	Member
Dr. M.A. Shankar	:	Member
Dr. S.N. Sharma	:	Member
Dr. Ashok Gaur	:	Member
Dr. S.R. Maloo	:	Member
Shri Shantanu Pratap Singh	:	Member (Farmer representative)
Shri Prabhunath Mall	:	Member (Farmer representative)
Dr. Dinesh K. Agarwal	:	Member Secretary

18.2. Quinquennial Review Team (2009-2014)

Prof. M. Mahadevappa	:	Chairman
Dr. Prafulla K. Das	:	Member
Dr. S.S. Pandey	:	Member
Dr. T.N. Venkota Reddy	:	Member
Dr. S. Rajendra Prasad	:	Member
Dr. S. Natarajan	:	Member Secretary (Till 23.12.2015)

18.3. Institute Management Committee (IMC)

Dr. S. Rajendra Prasad	:	Chairman
Dr. J.S. Chauhan	:	Member
Dr. D.K. Srivastava	:	Member
Dr. Dheerendra Khare	:	Member
Dr. H.B. Singh		Member
Shri Shantanu Pratap Singh	:	Member
Shri Prabhunath Mall	:	Member
Dr. Shushil Pandey	:	Member
Dr. T.K. Srivastava	:	Member
Dr. P.M. Singh	:	Member
Dr. D.K. Yadav	:	Member
Shri Raja Ram	:	Member
Shri Ajay Kumar Soni	:	Member Secretary

18.4. List of Personnel

Research Management Position (RMP)

Dr. S. Rajendra Prasad	-	Director

Scientific Staff

Dr. S. Natarajan	-	Principal Scientist (Seed Technology) (Uptil 23.12.2015)
Dr. Dinesh Kumar Agarwal	-	Principal Scientist (Genetics & Plant Breeding)
Dr. T.N. Tiwari	-	Senior Scientist (Plant Physiology)
Dr. A.K. Sinha	-	Senior Scientist (Plant Breeding)
Dr. Rajiv K. Singh	-	Senior Scientist (Agronomy) (uptil 28.01.2016)
Dr. A. N. Singh	-	Senior Scientist (Entomology)
Dr. Govind Pal	-	Senior Scientist (Economics)
Dr. Dhandapani R.	-	Scientist (Plant Physiology) (uptil on 20.12.2015)
Dr. Asit K. Mandal	-	Scientist (Plant Pathology) (on lien)
Dr. Udaya Bhaskar K.	-	Scientist (Seed Technology)
Dr. Chandu Singh	-	Scientist (Plant Breeding)
Dr. Madan Kumar	-	Scientist (Plant Physiology)
Shri Umesh Ravindra Kamble	-	Scientist (Seed Technology) (on study leave)
Dr. Hardev Ram	-	Scientist (Agronomy) (uptil 15.03.2016)
Shri Deveramane Raghavendra	-	Scientist (Entomology) (on study leave)
Mrs. Radhika C.	-	Scientist (Economics)
Dr. Elayaraja K.	-	Scientist (Plant Breeding)
Sh. Ramesh K.V.	-	Scientist (Plant Physiology)
Dr. Bhojraja Naik	-	Scientist (Plant Breeding)
Dr. S. P. Jeevan Kumar	-	Scientist (Agri. Biotechnology)
Shri Vijay Kumar HP	-	Scientist (Seed Technology)
Shri Somusundaram G.	-	Scientist (Seed Technology)
Shri Boraiah K.M.	-	Scientist (Plant Breeding) (on study leave)

Technical Staff

Shri S.A.M. Rizvi	-	Technical Officer (T-5)
Shri Nanhak Singh	-	Technical Officer (T-5)
Shri J. K. Tripathi	-	Technical Assistant (T-3)
Shri Arun Kumar Chaturvedi	-	Technical Assistant (T-3)
Shri Abhishek Kumar Rai	-	Senior Technician (T-2)
Shri Ambrish Dubey	-	Senior Technician (T-2)
Shri Sudheer Kumar Singh	-	Senior Technician (T-2)
Shri Sunil K. Kannujiya	-	Technician (T-1)
Shri Rajesh Chauhan	-	Technician (T-1)
Shri Vikas Singh	-	Technician (T-1) (Joined on 20.08.2015)

Administrative Staff

Shri Ajay Kumar Soni	-	Administrative Officer
Dr. Govind Pal	-	I/C Finance & Acounts Officer
Shri Dipak Kumar Singh	-	AAO
Shri Sudhakar Srivastava	-	Assistant
Shri Anupam Kumar Chaubey	-	Assistant
Shri Lal Singh Bisth	-	UDC
Smt. Ranjana Kumari	-	LDC
Shri A.K. Tripathi	-	LDC (Joined on 01.12.2015)

19 Staff position

Staff position at IISS, Mau

Category	No. of Sanctioned post	Position as on 31.03.2016
Director	01	01
Scientist	37	20
Technical	22	10
Administrative	15	07
Supporting	08	00
Total	**83**	**38**

20 Financial Statement

Budget

The budget outlay of the IISS, Mau for the XI & XII Plan

(Rs in lakh)

Head	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Total
A. Recurring										
Pay & Allowances	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TA PC/ Directorate Monitoring	6.00	8.00	13.50	15.94	16.00	16.00	21.67	23.31	15.47	97.11
HRD	1.00	2.00	4.50	0.00	1.00	1.81	4.21	4.57	4.49	14.52
Contingencies	120.00	100.00	138.60	206.98	163.47	204.19	249.12	268.12	349.04	1182.36
Total (A)	**127.00**	**110.00**	**156.60**	**222.92**	**180.47**	**222.00**	**275.00**	**296.00**	**369.00**	**1293.99**
B. Non – Recurring										
Equipments	120.00	46.00	185.90	232.39	45.16	52.05	70.96	80.23	48.25	752.46
Works	10.00	0.00	1.38	24.99	58.79	117.69	0.00	9.72	50.04	212.85
Library	20.00	10.00	8.26	11.99	15.58	24.10	6.55	8.64	00.03	96.48
Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	00.00	0.00
Fixture & furniture	23.00	0.00	7.07	11.46	0.00	19.63	4.59	1.41	01.97	65.75
Total (B)	**173.00**	**56.00**	**202.61**	**280.83**	**119.53**	**213.47**	**82.10**	**100.00**	**100.29**	**1127.54**
Grand Total (A+B)	**300.00**	**166.00**	**359.21**	**503.75**	**300.00**	**435.47**	**357.10**	**396.00**	**469.29**	**2421.53**

Budget details of IISS, Mau

IISS Plan

Year	Budget	Expenditure
2007- 08	300.00	136.11
2008- 09	166.00	108.26
2009-10	360.00	359.16
2010-11	504.00	503.75
2011-12	300.00	300.00
2012-13	449.00	435.47
2013-14	357.50	357.10
2014-15	396.00	396.00
2015-16	469.29	469.29

IISS Non- Plan

Year	Budget	Expenditure
2007- 08	153.00	152.99
2008- 09	195.00	196.10
2009-10	227.00	224.07
2010-11	188.50	188.44
2011-12	216.00	216.00
2012-13	275.64	275.64
2013-14	342.80	329.28
2014-15	376.80	374.80
2015-16	431.50	430.80

21 List of *in-house* Research Projects (2015-16)

Seed Molecular Biology

1. Assessment of genetic purity in major crops including hybrids through molecular tools and techniques

   (Dhandapani R & S.P. Jeevan Kumar)

2. Molecular regulation of dormancy and seed longevity in rice and soybean.

   (Dhandapani R. & Ramesh K.V.)

3. QTL mapping for seed vigour in rice (*Oryza sativa)*

   (Chandu Singh and Madan Kumar)

4. Molecular mapping of quantitative trait loci (QTL) for bruchids resistance in chickpea (*Cicer arietinum* L.)

   (Dinesh K. Agarwal, S. Rajendra Prasad, Hari D. Upadhyay and Raghavendra D.)

Seed Physiology Storage & Testing

5. Enhancing Seed Quality Parameters in Rice and Soybean with Smoke Water

   (Ramesh K.V., Madan Kumar, Chandu Singh, Sripathy K.V. and Asit K. Mandal)

6. Studies on the impact of priming agents on the improvement of physiological parameters and their relationship with seed yield in chickpea (*Cicer arietinum* L.)

   (A.K. Sinha, T.N. Tiwari, Rajiv K. Singh and Hardev Ram)

Seed Production & Certification

7. Devising agro-techniques for reducing the seed rate of wheat.

   (Rajeev Kumar Singh, T. N. Tiwari, Hardev Ram & Chandu Singh)

8. Effect of various bioactive chemicals on traits favoring out crossing and their molecular characterization in hybrid Rice (*Oryza sativa* L.)

   (Madan Kumar, Chandu Singh, Dhandapani R. And S. Rajendra Prasad)

9. Improving hybridization efficiency in castor through exogenous application of Plant Growth Regulators.

   (Uady Bhaskar and Chandu Singh)

10. Impact of genotypes and conservation tillage on seed quality and productivity of wheat in the eastern-UP.

    (Hardev Ram, Rajiv Kumar Singh, Umesh Kamble & Chandu Singh)

11. Hydropolymers : As regulatory switch for germination and smart delivery system in hybrid seed production of maize.

    (Udaya Bhaskar K., Umesh R. Kamble, S. Rajendra Prasad and Rachika C.)

Seed Protection

12. Bio-priming for seed born disease management and seed quality enhancement of rice and chickpea

    (Madan Kumar and A.N. Singh)

13. Biochemical characterization of insecticide resistance in major stored insect pest and their management

    (Deveramane Raghvendra, Arvind N. Singh, Dhandapani R. and Boraiah, K.M.)

14. Estimation of economic threshold level of key insect pests in paddy and mustard seed crops

    (Arvind N. Singh)

Seed economics & policy research

15. Impact assessment of quality seed production: Addressing scope and efficiency of certified seed production among seed growers.

    (Govind Pal, Radhika C., Rajiv Kumar Singh and Udaya Bhaskar K.)

Crop improvement

16. Studies on field weathering among soybean genotypes

    (D.K. Agarwal and T.N. Tiwari)

17. Improving hybrid seed production efficiency through synchronization of flowering in maize (*Zea mays* L.)

    (Elayaraja K., Boraih K.M., Rajiv K. Singh & Umesh Kamble)

18. Improving hybridization efficiency, seed set and development of male sterile lines for hybrid seed production in Finger millet [Eleusine coracana (l.) Gaertn]

    (Bhojraja Naik K, S. Rajendra Prasad, Ravishankar P. and Chandu Singh)

Newly initiated

19. Impact assessment of institutional interventions on quality seed production system under ICAR Seed Project

    (Radhika C., Govind Pal, Udaya Bhaskar K. And S. Rajendra Prasad)

20. Devising agro-techniques for enhancing seed quality in *Tagetes spp.* And *Viloa tricolor,* flowering annuals

    (A.K. Tiwari, T.N. Tiwari and Sripathy K.V.)

21. Assessment of seed deteriorative changes in stored seeds of groundnut

    (S.P. Jeevan Kumar)

22. Nano particulate seed invigoration for quality enhancement in paddy and soybean

    (Sripathy K.V.)

23. Digital imaging vision system for seed health testing of wheat and marigold crops

    (A.K. Tiwari and Sripathy K.V.)

24. Seed enhancement through use of botanicals in field crops

    (T.N. Tiwari)

Notes

Notes

भाकृअनुप
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