ICAR-IIOR

Annual Report 2019

भाकृअनुप-भारतीय तिलहन अनुसंधान संस्थान

ICAR-Indian Institute of Oilseeds Research

राजेंद्रनगर, हैदराबाद-500 030, तेलंगाना राज्य Rajendranagar, Hyderabad-500 030, Telangana State

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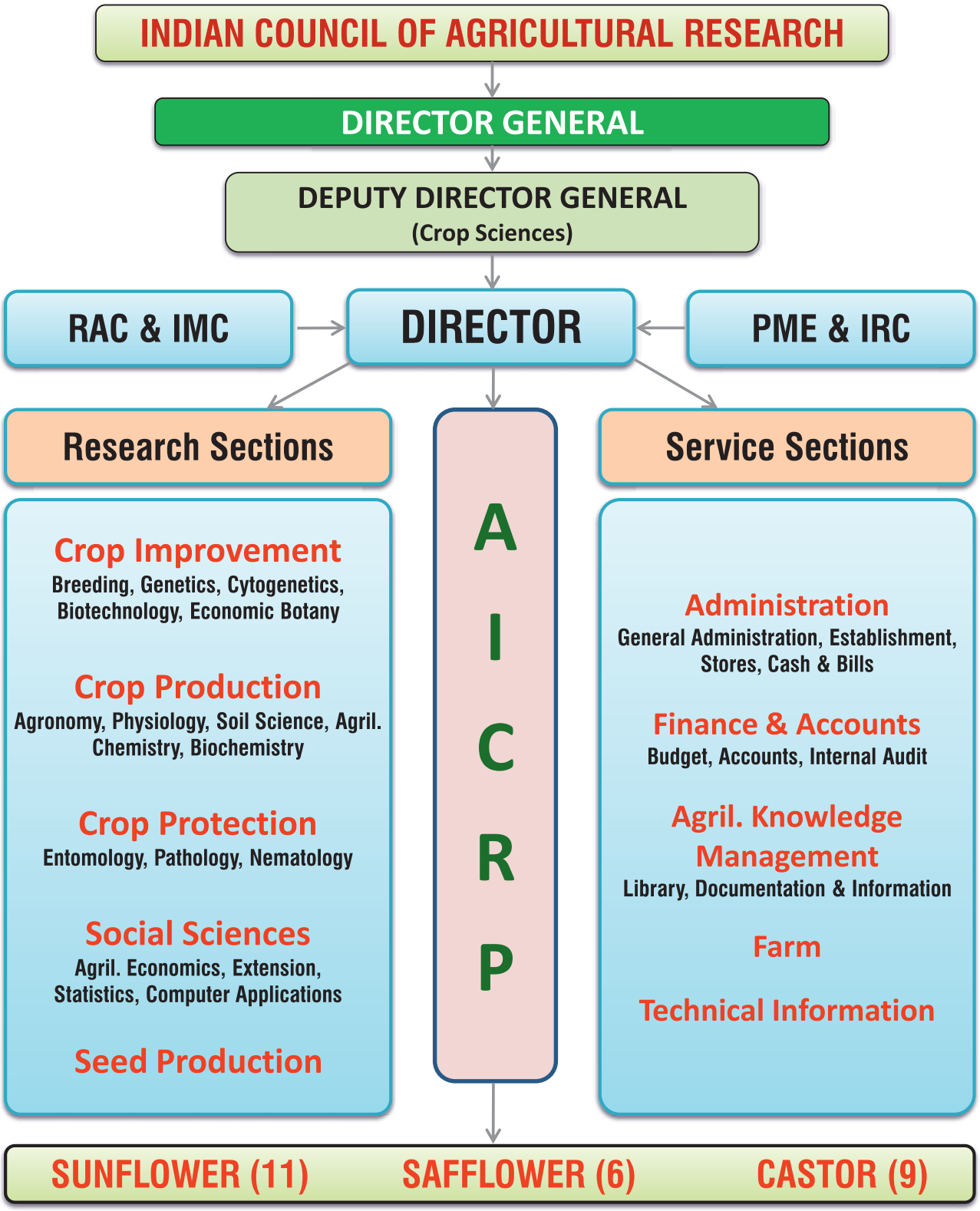
ICAR-IIOR

ORGANOGRAM



ICAR-IIOR
Annual Report

वार्षिक प्रतिवेदन
Annual Report
2019

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ICAR-Indian Institute of Oilseeds Research
राजेंद्रनगर, हैदराबाद / Rajendranagar, Hyderabad-500 030

ICAR-IIOR Annual Report

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Preface

It gives me great pleasure to present the ICAR-IIOR Annual Report 2019 with highlights on significant achievements made under research, extension and training programmes during 2019. Area and production of oilseed crops in the country was 25.07 m.ha and 33.50 m. tonnes, respectively. Over the last year, a slight decrease in the area was observed but the production and productivity (1336 kg/ha) increased to the tune of 2.67 m. tonnes and 126 kg/ha, respectively.

Notification of one castor hybrid, ICH-66 for cultivation under rainfed conditions of Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Odisha; notification of two safflower varieties, ISF-764 and ISF-1 (the first high oleic variety) for national release and receiving of two patents on 'A process for preparing storable insecticidal formulation using a combination of microbials' and 'Production process for improved yield of *Trichoderma* biomass' were the most remarkable achievements. New research on development of seed pelleting and seed coating technologies with biopolymers and T*richoderma* have been initiated, which are expected to play a role in improving the efficiency of agricultural input delivery systems through seed as well as alleviating biotic and abiotic stresses in the mandate oilseed crops. The other salient achievements include: development of cropping system oriented resource use efficient technologies; confirmation of sources of resistance to major pests and diseases (leafhopper, whitefly, wilt in castor; *Alternariaster helianthi* and leafhopper in sunflower; wilt and aphid in safflower); validation of castor gray mold prediction model and developing advisories for guiding farmers in taking up prophylactic fungicidal sprays. As a major step towards facilitating availability of improved varieties and hybrids to the farmers, a total of 1110.05 q of seeds were produced on-farm as well as through farmer participatory mode. The 'Oilseeds Seed Hub' on nine oilseed crops with the participation of 36 centres with a total budget outlay of Rs. 5091.18 lakhs is being coordinated by ICAR-IIOR, Hyderabad. The seed hub has been sponsored by Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India.

Considering the need for effective outreach of IIOR technologies to the farmers, IIOR conducted massive farmer-centric programmes including large scale field demonstrations, and capacity building of the farmers and other stakeholders. A total of 5518 Front Line Demonstrations (FLDs) were conducted across nine oilseed crops; 37 trainings and entrepreneurship development programmes were organized on oilseeds technologies, seed production, organic farming, non-chemical oil expelling, and mass production of microbial pesticides; promising hybrids of sunflower and varieties of sesame were evaluated in North Eastern Hill states in order to promote area expansion and crop diversification in non-traditional areas; showcasing of improved cultivars of the oilseed crops under best management practices through live-crop demonstrations at the institute farms, which attracted several farmer groups from Telangana and the neighbouring states; distribution of soil health cards to farmers were also carried out. Under Mera Gaon Mera Gaurav (MGMG), Tribal Sub-Plan (TSP), SC-Sub plan, Farmers First programmes, the farmers were periodically updated about various agricultural practices/technologies to enhance their income levels besides providing incentives such as seeds, other inputs and facilitating linkages with ICAR institutes, SAUs, Department of Agriculture and NGO's. Further, to draw a road map with actionable points, brainstorming sessions on "National mission on edible oilseeds" and "Value addition in castor oil" were organized at the institute by involving all the stakeholders.

I place on record my sincere gratitude and reverence to Dr. T. Mohapatra, Secretary, DARE and Director General, ICAR; Dr. A.K. Singh, DDG (CS); ICAR; Dr. S.K. Jha, Asst. Director General (O&P), Dr. D.K. Yadava, ADG (Seeds), ICAR for their visionary guidance and unstinted support in executing the mandate of the Institute. I express my gratefulness to the Chairman and Members of the newly constituted Research Advisory Committee for the critical assessment and improving the research programmes of the institute. My sincere thanks to all the Heads of Sections, Drs. M. Sujatha, G. Suresh, R.D. Prasad, S.V. Ramana Rao, S.N. Sudhakara Babu, Shri. Shitanshu Kumar, SAO and Shri. K. Srinivasa Rao, FAO, Dr. S. Senthilvel, Officer I/c PME Cell and Dr. Lakshmi Prayaga, I/c TIO for their inputs in compiling the information of their respective sections. I appreciate the efforts of Dr. N. Mukta and the team of editors of the IIOR Annual Report, Smt. R. Raji, PS for secretarial assistance, Shri. Pradeep Singh, Assistant Director (OL) for translation of the Annual Report in Hindi and other staff members of the Institute for their contribution in bringing out the publication.

Hyderabad
June 24, 2020

(A. Vishnuvardhan Reddy)
Director

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ICAR-IIOR

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Executive Summary

Executive Summary

Major Achievements (2019)

Hybrids/varieties released and notified

- Castor hybrid ICH-66 has been notified for cultivation in rainfed regions of Andhra Pradesh, Telangana, Tamil Nadu, Karnataka and Odisha.
- Safflower varieties ISF-764 (high yielding) and ISF-1 (high oleic) have been notified for cultivation across the country.

Patents granted

- Two patents entitled 'A process for preparing storable insecticidal formulation using a combination of microbials' and 'Production process for improved yield of *Trichoderma* biomass' were granted.

Technologies assessed/disseminated

- Seed treatment with biopolymer chitosan + *T. harzianum*, Th4d and Polymer 1+ *T. harzianum*, Th4d in soybean showed improved seed germination and seed yield in field trials.
- Sunflower knowledge management portal and Mobile App on 'Technologies for Quality Seed production in Sunflower' were developed for the benefit of seed producers, researchers, industry and farmers.
- Growth analysis in respect of area, production and yield of castor in major castor growing districts of Gujarat indicated the large scale adoption and penetration of GCH-7.

Major highlights of the results under various research projects and outreach activities are summarized theme-wise.

Crop Improvement

Germplasm-Maintenance, Evaluation and Enhancement

Castor

- Resistance against leafhopper was confirmed in three inbred lines (ICI-RG2661-7-9-1-1, ICI-RG2661-16-2-2 and ICI-RG2661-7-5-1-7).
- Two leafhopper resistant inbred lines, ICI-RG2661-7-9-1-3 and ICI-RG2661-7-9-1-1 exhibited resistance to Fusarium wilt as well.
- Using standard screening procedures, confirmed resistance against Macrophomina root rot and wilt in four inbred lines (ICI-RG2787-152-9, ICI-RG2787-181-12, ICI-RG2787-192-12 and ICI-RG2719-10); resistance to Fusarium wilt in three accessions (RG-1922, RG-2976 and RG-3795) and to gray mold in RG-1963 (18.2% disease incidence).
- The wilt resistant loci in castor genotypes RG-1149 and 48-1 were found to be allelic.
- Resistance to whitefly (0-1 grade on 1-5 scale) was confirmed in two accessions RG-3233 and RG-3428.
- Seeds of 1110 castor germplasm accessions were multiplied for distribution and conservation in gene bank.

Sunflower

- A total of 974 germplasm accessions were deposited in MTS at ICAR-IIOR, Hyderabad.
- Three pre-bred lines (PI-686496, PI-686764 and PI-686808) were identified with more than 39% oil content under heat stress conditions.

Safflower

- A set of 838 accessions for rejuvenation and 160 accessions for multiplication were sown during *rabi* 2019, and 217 accessions were supplied for utilization, screening and evaluation.
- Among the fresh collections from Maharashtra, five accessions (GMU-7871, GMU-7907, GMU-7901, GMU-7884 and GMU-7880) for high seed yield (40.5-45.6 g/plant *vis-à-vis* 29.0-29.9 g/plant in checks); 17 accessions for oil yield (8.0-13.2 g/plant *vis-à-vis* 7.1-7.8 g/plant in checks) and one accession GMU-7898 for early flowering (65 days vis-à-vis 87-91 days in checks) were identified based on two years of evaluation.
- Two germplasm accessions (IC-338171, IC-337833) were identified for high oil yield (10.6-12.5 g/plant) and EC-736501 for high oil content (42.8%). Three breeding lines, BC_1F_6-39-3-3, BC_3F_5-16-27 and BC_2F_6-38-1-7 were confirmed for high oleic acid content (81.1 to 82.9%).

Niger

- A set of 120 germplasm accessions were evaluated, multiplied and maintained. Seed yield varied from 4.2 to 9.1 g/plant and oil content from 29.1 to 40.7%.

Pre-breeding

Sunflower

- Under pre-breeding programme, nine interspecific cross combinations (six with wild *Helianthus annuus* and three with H. *argophyllus*) were advanced from BC_2F_3 to BC_2F_4 generation.

Safflower

- Two wilt resistant interspecific inbred lines (ISF-2342-17 and ISF-2305-17) derived from *Carthamus palaestinus* recorded 107% (2615 kg/ha) and 12% (1407 kg/ha) higher seed yield than the best check, ISF-764 (1259 kg/ha).
- Three interspecific inbred lines, ISF-1749-1-5-2016, ISF-1703-2-1-2016 and ISF-1749-1-2-2016 derived from *C. palaestinus* and *C. lanatus* showed tolerance to Alternaria (31-33% incidence) at Solapur.

Sesame

- Pollen sterility in crosses involving cultivated sesame with *Sesamum malabaricum* ranged from 80.1-87.5% in different backcross generations.

Parental Lines- Development, Characterization and Evaluation

Castor

- Ten inbred lines derived through single seed descent (SSD) and pedigree selection (PS) methods recorded 10-65% increase in mean seed yield over the best high yielding national check, DCS-107 (1288 kg/ha and 1327 kg/ha).
- Among the SSD and PS derived inbreds, three lines, ICS-271, ICS-280, ICS-283 were wilt resistant (<20% wilt incidence) in wilt sick plot at ICAR-IIOR, Hyderabad.

Varietal Development

Safflower

- One high yielding (ISF-764) and one high oleic (ISF-1) safflower varieties were notified for all India cultivation.
- Three safflower varieties (ISF-87-15, ISF-116 and ISF-849-sel-16) were promoted to AVT-I, and one variety (ISF-112-15) to AVT-II under AICRP.
- Eight promising genotypes developed using breeding lines supplied by IIOR (three from Tandur, two from Raipur and three from Parbhani) were nominated to IVT.
- Two non-spiny varieties, ISF-763 and ISF-1258, tested for three different consecutive years in AICRP (Safflower), have recorded 14.4% (1366 kg/ha) and 13.2% (1490 kg/ha) increase in seed yield, respectively over the non-spiny check, NARI-6 (1194 kg/ha; 1316 kg/ha) at national level.
- In the preliminary yield trial, four spiny varieties, ISF-123-sel-15, ISF-22-15, ISF-320 and ISF-319 recorded 62-87% higher seed yield (1764-2040 kg/ha) and one high oleic variety, ISF-153-26 recorded 14% (1244 kg/ha) higher seed yield over the best check, A-1 (1089 kg/ha).
- Four non-spiny varieties, SPP-70, ISF-134-15, ISF-2035 and ISF-53-15 recorded 27-164% higher

seed yield (853-1769 kg/ha) than non-spiny check variety, NARI-6 (670 kg/ha).

- One short duration safflower variety, ISF-867 flowered 14 days earlier and matured 15 days earlier than normal duration check, A-1, and recorded 15% higher seed yield (2760 kg/ha) than A-1 (2440 kg/ha) during the third consecutive year of testing.
- One high oil safflower variety, ISF-87-15 has recorded 40.8 and 43.9% oil content under rainfed and irrigated conditions, respectively.
- One high yielding variety, ISF-116 has exhibited resistance to wilt (9.8-16.1%) in wilt sick plots at Solapur, Tandur and ICAR-IIOR, Hyderabad.
- Twenty six best selections in S_0-S_3 generations derived from 1st- 4th cycle of random mating of RIPE population have recorded high seed yield (36.6-112.9 g/plant) and oil content (35-40.3%) compared to the best check, A-1 (25.57-28.3 g/plant and 22.9-23.9%, respectively).
- Multiplied 92 high oil inbred lines (35-41%) and 90 high oleic (76-84%) – high oil (35-42%) inbred lines.
- A subset of 39 MAGIC lines with oil content ranging from 35.3 to 43.1% was selected.
- Two breeding lines (DSF-4 and DSI-104) showed resistance to Fusarium wilt isolates from Solapur, Tandur and ICAR-IIOR.

Sesame

- Entries IIOS-7 and IIOS-8 have been nominated for AICRP coordinated trials for *kharif* 2019 and entry IIOS-1 for summer 2020.
- Three white sesame genotypes with bold seed (>3.6 g test weight) were developed.

Hybrid Development

Castor

- Castor hybrid ICH-66 was notified for cultivation in rainfed regions of Andhra Pradesh, Telangana, Tamil Nadu, Karnataka and Odisha.
- Preliminary evaluation of 222 experimental hybrids resulted in the identification of two (ICH-1072, ICH-1032) early flowering (36-40 DAS) hybrids and nine medium (>41-50 DAS) flowering hybrids with higher seed yield than the check.
- Seed production of six hybrids (ICH-278, ICH-515, ICH-239, ICH-277, ICH-440 and ICH-1060) was undertaken for nominating to different AICRP trials.
- Seeds of 30 pistillate lines and 70 male lines were produced for maintenance and further utilization.

Sunflower

- The hybrid IIOSH-15-20, which showed 5.7% and 21.4% seed yield and 15.9% and 18.0% oil yield superiority over the national check hybrids, KBSH-44 and DRSH-1, respectively and high level of resistance to downy mildew was promoted from AHT-I to AHT-II under AICRP.
- The hybrid IIOSH-15-10 was promoted from AHT-I to AHT-II with 2.7% and 18.4% seed yield and 1.8% and 3.9% oil yield superiority over the check hybrids, KBSH-44 and DRSH-1, respectively in AICRP trial. This hybrid has good central filling and downy mildew resistance.
- Four entries, IOSH-413, IOSH-566 (for *kharif* 2019) and IOSH-15-10, IOSH-15-20 (for *rabi*-2019-20) were nominated for initial hybrid trial (IHT) under AICRP.
- Five experimental hybrids *viz.*, IOSH-539, IOSH-525, IOSH-521, IOSH-623 and IOSH-563 developed at IIOR were promising for seed yield (2277-2499 kg/ha) compared to best check LSFH-171 (2166 kg/ha) in the preliminary yield trial at Nimpith Centre.

Safflower

- Three safflower hybrids (ISH-400, ISH-401 and ISH-402) were promoted to AHT-II and one hybrid (ISH-423) has been entered in IHT of AICRP.

Molecular Breeding and Biotechnology

Safflower

- The allelic information of safflower association mapping panel generated using 250 SSR markers led to identification of five significant marker-trait associations ($P < 0.05$) for oil content.

- Identified 59 genes involved in oil biosynthetic pathway and designed full length primers for allele mining.

Sesame

- An additional set of 300 SSR markers were added to augment a robust and working set of microsatellite markers for Indian sesame of which 32 were polymorphic among 40 Indian sesame genotypes with polymorphic information content (PIC) ranging from 0.25 to 0.63.
- Selected and genetically stabilized sesame genotypes that showed a spectrum of variability for morphological traits, seed weight/plant ranging from 1.2-32 g and oil content from 25-45%.

DUS Testing

- DUS testing of one new candidate variety of castor was undertaken along with two reference varieties under the Central Sector Scheme for Protection of Plant Varieties and Farmers Rights Authority.

Seed Production

- A total of 1110.05 q of quality seed parental lines, varieties and hybrids of castor, sunflower, sesame and safflower was produced by ICAR-IIOR, Hyderabad.
- Under seed hub programme, 14,059 q seed of nine oilseed crops were produced by 30 centres.

Crop Production

Conservation Agriculture

- Total N uptake was found to be the highest (50.1 kg/ha) in conventional tillage followed by reduced tillage (43.9 kg/ha) and zero tillage (42.2 kg/ha) across systems. Among systems, the highest N uptake was recorded in sole castor (59.6 kg/ha) followed by castor + groundnut (43.9 kg/ha); castor + greengram (43.4 kg/ha) and castor + redgram (34.8 kg/ha). Total P, K and S uptake followed similar pattern.

Cropping Systems Research

- Productivity of safflower crop sown after greengram/soybean in 2 rows/BBF fertilized with 50/100% RDF + *Azotobacter* + PSB was statistically on par with that of 3 rows/BBF fertilized with 50/100% RDF + *Azotobacter* + PSB.

Resource Use Efficiency

- In the second cropping cycle in maize (*kharif*) - castor (*rabi*) cropping system in Alfisols, highest seed yield of maize (4890 kg/ha) was recorded with 150% RDF to both the crops that was significantly higher over imbalanced nutrition with no manure, N alone, NP alone or 50% NPK to both crops.

Abiotic Stress Tolerance

- Five castor hybrids along with their parental lines were evaluated for shoot and root growth. Root dry weight and TDM was found superior in hybrids, DCH-177 and DCH-519 compared to their parents; hybrids ICH-66, ICH-278 were at par with their parents and ICH-440 was found inferior to its parents.
- Six sunflower parental lines, AKSF-6-3B, CMS-59B, CMS-135B, CMS-144B, CMS-127B, CMS-107B were found tolerant to high temperature with less (<15%) reduction in yield.
- Among 24 safflower genotypes subjected to salinity stress (0, 4, 6, 8, and 10 dS/m), a gradual decline in growth parameters with respect to shoot length, shoot weight, root length and root weight with increasing salinity level was observed. K content was high in 5 genotypes (IC-406143, EC-661173, IC-406052, A-1, PBNS-12) and highest K was observed in IC-406052 (1.6%) and lowest in SSF-733 (0.7%) at 10 dS/m.
- A set of 72 sesame accessions were evaluated for tolerance to drought during *kharif* and late *rabi* seasons. Five accessions (IC-96229, IC-132293, IC-132171, IC-204679 and JCSDT-26) were found tolerant to intermittent drought.

Value Addition

- Safflower kernel meal can efficiently substitute soybean meal up to 75% in the diet of *vanaraja* chicks without affecting performance and carcass yield.

Crop Protection

Patents granted

- Two patents entitled 'A process for preparing storable insecticidal formulation using a combination of microbials' and 'Production

process for improved yield of *Trichoderma* biomass' were granted.

Host Plant Resistance

Screening Methods

- Symptom progression caused by leafhoppers on sunflower was mapped to develop an injury rating scale.
- A susceptible check, NDCMS-2B was identified for scoring the reaction of sunflower accessions to leafhoppers.
- Sowing of sesame during second fortnight of July coupled with planting infester rows of Prachi was found to be reliable method for screening of genotypes for resistance to leaf webber and capsule borer under field conditions.

Sources of Resistance

- Castor inbred lines *viz.,* IPC-43, ICS-315, DPC-25, ICS-341, ICS-355, ICS-353, ICS-128 and ICS-144 were resistant to wilt (<10% incidence).
- Two castor monoecious lines, ICS-186 and ICS-217 were highly resistant (hopper burn grade 0) and two lines, ICS-190 and ICS-200 exhibited resistance (hopper burn grade 1 on 0-4 scale) to leafhopper.
- Three castor germplasm accessions, RG-2800, RG-3233 and RG-3428 were resistant to whitefly (0 to 1 on 0 to 5 scale) as compared to susceptible check, M-574 (scale 5).
- Tolerance reaction of 17 castor inbred lines (ICI-RG-2800-1 to ICI-RG-2800-8, ICI-RG-2774-1 to ICI-RG-2774-3 and ICI-RG-898-1 to ICI-RG-898-6) to capsule borer was confirmed.
- Two sunflower genotypes, GMU-755 and PM-82 exhibited tolerance reaction to Alternariaster leaf blight under artificial epiphytotic conditions in polyhouse.
- Two sunflower breeding lines, TSG-403 and TSG-391 were resistant to leafhoppers with MSI of 1.0.
- Safflower breeding lines, ISF-2342 and ISF-2413-17 and germplasm accessions, GMU-821 and GMU-864 were highly resistant to wilt disease.
- Safflower variety Girna was resistant to aphids with an aphid infestation index of 2.0 on a 1.0-5.0 scale while 7 varieties, A-1, Bhima, Manjira, PBNS-12, SSF-708, SSF-733 and SSF-748 were moderately resistant (A.I.I. >2.0 to 3.0).
- Three high oleic safflower selections, BC_2F_6-38-9-4-OL, BC_2F_6-38-14-15-OL, BC_2F_6-38-16-12-OL exhibited resistance to aphids with an A.I.I of 2.0.
- Seven accessions of safflower, GMU-1047, GMU-3256, GMU-5848, GMU-599, GMU-5133, GMU-671 and GMU-95 were confirmed to be moderately resistant to aphids after two years of screening.
- Sesame genotypes *viz.,* SEL-S-2019-1019, SEL-S-2019-1018, S-0448, SEL-S-2019-1013 and SEL-S-2019-1017 were moderately resistant to root rot (11- 20% incidence).
- Sesame genotype, GTG-30 recorded low phyllody incidence (<20%) consistently over two years under severe epiphytotic conditions.

Mechanism of Resistance

- Waxy bloom on castor capsules is aiding in pathogen infection for causing gray mold. It was observed that with increase in waxy bloom intensity there was an increase in disease severity.

Chemical Management

- Fungicide propiconazole (0.1%) and pyraclostrobin + fluxapyroxad (0.1%) were found effective in management of gray mold of castor.
- Forty on-farm demonstrations on management of gray mold of castor using fungicide propiconazole (0.1%) were conducted in farmers' field in Mahabubnagar district of Telangana state to showcase the effectiveness of fungicidal management of the disease.

Biopesticides

- Bt-127 SC formulation as a component of IPM for management of lepidopteran pests of sunflower showed better performance (net returns: Rs. 10,658/acre; CBR: 2.30) over the farmer's practice (net returns: Rs. 7,034/acre; CBR: 1.94).
- Seed biopriming with *Trichoderma harzianum* @ 10 g/l was highly effective in management of safflower wilt.

Biopolymers and bioagents for plant health management

- Seed treatment with biopolymer chitosan + *T. harzianum*, Th4d and Polymer 1+ *T. harzianum*, Th4d in soybean significantly improved germination and seed yield in field trials.

Forecasting of Pests and Diseases

- Castor gray mold prediction model was improved and a protocol was developed by integrating decision rules and the model to predict the risk level/ initiation of disease three days in advance. SMS alerts for taking up of prophylactic fungicidal sprays were sent to 4000 farmers of Mahabubnagar district, Telangana.

Social Sciences

Impact Assessment of Oilseed Technologies

- The temporal performance of castor against competing crops in Gujarat state for the last five decades (1966-2016) analysed through Markov chain approach indicated that castor area was substituted by cotton to the extent of 24.7, 57.8 and 68.9% during the decades of 1986-95, 1996-2005 and 2006-16, respectively.
- The growth analysis in respect of area, production and yield of castor in major castor growing districts of Gujarat indicated the acceleration mode in the post-release period of GCH-7 hybrid over the pre-release period of GCH-7 thus indicating the large scale adoption and penetration of GCH-7.
- The decomposition approach to quantify the change in production of castor in pre and post-release of castor hybrid GCH-7 clearly indicated that the technology/yield effect (GCH-7) primarily contributed to the change in production followed by area expansion (area effect).

Knowledge Management

Demonstrations of Oilseed Technologies

- A total of 5518 Frontline demonstrations on nine annual oilseeds crops were conducted (2483 in *kharif* season and 3035 in *rabi* season) during 2019 by the Oilseed Institutions/ Directorates/ Project Coordinating Units in various agro-ecological regions of the country.
- Twenty nine training programmes on oilseeds technologies were organized for input dealers, extension officers and other extension workers dealing with oilseeds.
- Under the Farmers FIRST Programme
  - 112 soil test based soil health cards for major crops encompassing 12 major, micro and secondary nutrients were provided to households in adopted villages. The cost of fertilizer in *kharif* castor crop reduced by Rs.854/ha on account of soil test based fertilizer use.
  - Contour cultivation and associated soil and moisture conservation technologies in redgram crop under rainfed ecosystem enabled enhanced yields of 10.12 q/ha as against 7.89 q/ha with conventional practice.
  - Castor production technology (DCH-519/ ICH-66) under rainfed *kharif* situations resulted in productivity of 6.5 q/ha.
  - The non shattering paddy variety, KNM-118, in *kharif* season, resulted in 19% increase in productivity and Rs.18,618/ha of additional returns against the prevailing cultivar.
  - Sorghum production technology under *Zaid* situations of low water table resulted in productivity of 12.25 q/ha providing additional net returns of Rs.6,520/ha over operational costs.

ICAR-IIOR

Annual Report 2019

The Institute

- Mandate
- Staff Position
- Financial Statement

The Institute

The establishment of All India Coordinated Research Project on Oilseeds (AICORPO) in April, 1967 based on the recommendations of a sub-committee appointed by the Government of India was the most significant event in the history of oilseeds research in India. The project had its beginning with one Project Coordinator to coordinate and monitor the research programmes of groundnut, rapeseed-mustard, sesame, linseed and castor operating at 32 research centres. Later during 1972, safflower, sunflower and niger were brought under the umbrella of AICORPO and the number of research centres increased to 40. Realizing the need for one national institute for oilseeds, the AICORPO was elevated to the status of Directorate of Oilseeds Research on August 1, 1977 with a Project Director as its administrative head and seven Project Coordinators for these oilseed crops. Subsequently, groundnut and rapeseed-mustard were delinked from the Directorate with the establishment of National Research Centre for each of these crops during 1979 and 1993, respectively. In April, 2000, the AICRP on Sesame & Niger and Linseed have been separated from the administrative control of DOR. DOR has been entrusted with the responsibility to plan, coordinate and execute the research programmes to augment the production and productivity of sunflower, safflower and castor crops in the country through All India Coordinated Research Project on Oilseeds (AICRP) operating at 29 locations spanning over 14 states. The Directorate of Oilseeds Research is upgraded to Indian Institute of Oilseeds Research (IIOR) w.e.f. February 3, 2015 as per the approval of XII Plan EFC. The IIOR is a premier national institute under the aegis of the Crop Science Division of Indian Council of Agricultural Research, New Delhi.

Vision

Enhanced technological production of sunflower, safflower, castor and sesame through knowledge based interventions.

Mission

Contributing to the sustained growth of oilseeds production by harnessing frontier scientific tools and through generation, refinement, validation and dissemination of improved technologies in sunflower, safflower and castor.

Mandate

- Basic and strategic research to augment the productivity, oil content and quality of castor, sunflower, safflower, sesame, niger and linseed.
- Information management on oilseeds to develop policy framework for research and development strategy.
- Coordination of applied research on national and regional issues to develop location specific varieties and technologies.
- Dissemination of technology and capacity building.

Staff position as on December 31, 2019

Category	Sanctioned	Filled	Vacant
Scientific	43*	38	5
Technical	49	29	20
Administrative	29	21	8
Skilled supporting	18	17	1
Total	**139**	**105**	**34**

*including one RMP

Financial Statement

Allocation and Expenditure

Head of Account	Allocation (Rs. in lakhs) 2019-20			Expenditure (Rs. in lakhs)*		
	IIOR Unified Budget	AICRPO(OS + S&N + LIN)	TOTAL	IIOR Unified Budget	AICRPO (OS + S&N+ LIN)	TOTAL
A. GRANT IN AID – CAPITAL						
Works	66.00	18.00	84.00	33.00	0.00	33.00
Equipment	0.00	37.00	37.00	0.00	3.53	3.53
Information & Technology	5.41		5.41	1.22		1.22
Library	9.22		9.22	8.77		8.77
Vehicle & Vessels	18.16		18.16	17.16		17.16
Furniture	1.21		1.21	0.07		0.07
SC-SP	26.05		26.05	0.00		0.00
B. GRANT IN AID – SALARIES						
Establishment Charges	1692.05	1715.49	3407.54	1378.64	1051.30	2429.94
Wages	363.00		363.00	270.46		270.46
Overtime Allowance			0.00	0.00		0.00
Pension	455		455.00	403.75		403.75
C. GRANT IN AID – GENERAL						
TA	25.00	53.73	78.73	18.98	36.68	55.66
Res. & Operational Expenses	227.75	259.27	487.02	226.07	182.64	408.71
Administrative Expenses	232.25		232.25	207.98		207.98
Miscellaneous Expenses	15		15.00	0.87		0.87
Need Based Research	20.00	65.00	85.00	0.00	37.50	37.50
N.E.H.		61.07		0.00	61.07	61.07
TRIBAL SUB-PLAN	31.00	63.60	94.60	6.83	27.00	33.83
SC - SP	150.00		150.00	57.77	0.00	57.77
TOTAL	**3337.10**	**2273.16**	**5549.19**	**2631.57**	**1399.72**	**4031.29**

*upto December 31, 2019

AICRP on Sunflower, Safflower, Castor, Sesame & Niger and Linseed

Head of Account	AICRP (Sunflower, Safflower & Castor)		AICRP (Sesame & Niger)		AICRP (Linseed)	
	Allocation (in lakhs)	Expenditure (in lakhs)	Allocation (in lakhs)	Expenditure (in lakhs)	Allocation (in lakhs)	Expenditure (in lakhs)
Grants for Capital	30.00	0.00	20.00	0.00	5.00	3.53
Grants for Salaries	1000.00	664.16	354.11	214.67	361.38	172.47
Grants for General	147.00	103.78	82.00	59.22	84.00	56.32
TSP	20.00		20.00	15.00	23.60	12.00
NEH (Salaries)					61.07	61.07
NEH (General)	10.00		5.00		50.00	37.50
Total	**1207.00**	**767.94**	**481.11**	**288.89**	**585.05**	**342.89**

Resource Generation

Particulars	Amount (in lakhs)
Sale of Farm Produce	3.36
Sale of Old Vehicles & Machine Tools	0.11
Sale of IIOR Publications & Tender forms etc.	0.09
Rent (Hostel)	3.28
License Fee (Quarters)	0.35
Interest earned on Loans & Advances	1.43
Leave Salary & Pension Contribution	0.00
Analytical testing charges	3.57
Interest earned on STDR	22.88
Miscellaneous receipts	18.82
Total	**53.89**

Funds received for Externally Sponsored Projects

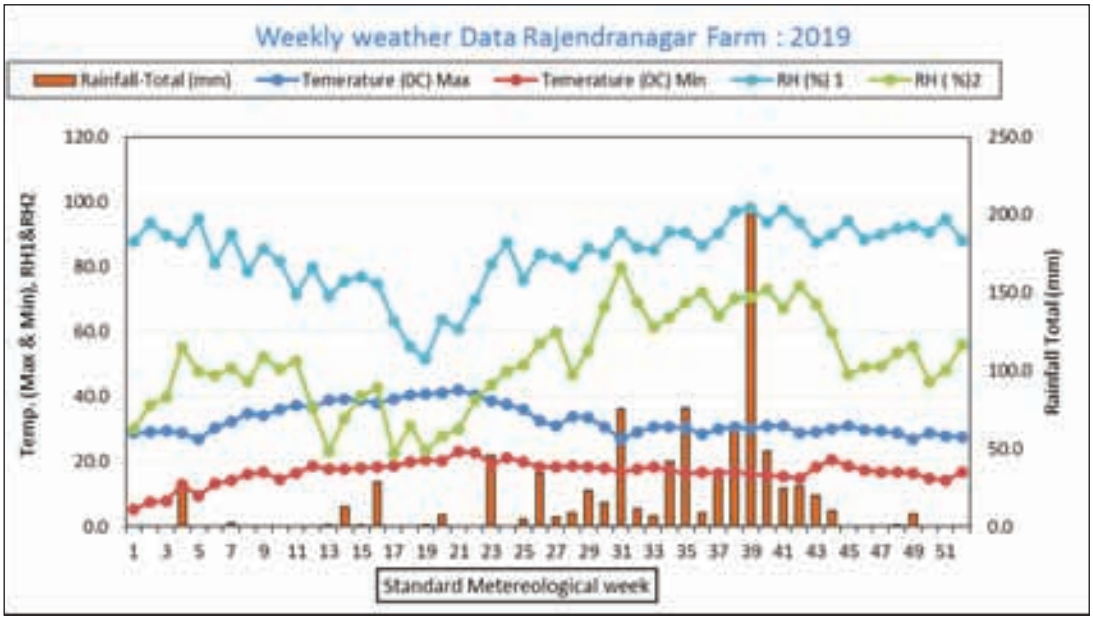
Particulars	Fund	
	Receipt/Opening balance	Expenditure
DBT Projects	15.57	9.84
DST Projects	16.93	8.32
International Collaboration	21.49	7.94
Deposit Schemes	789.59	462.14
Total	**843.58**	**488.24**

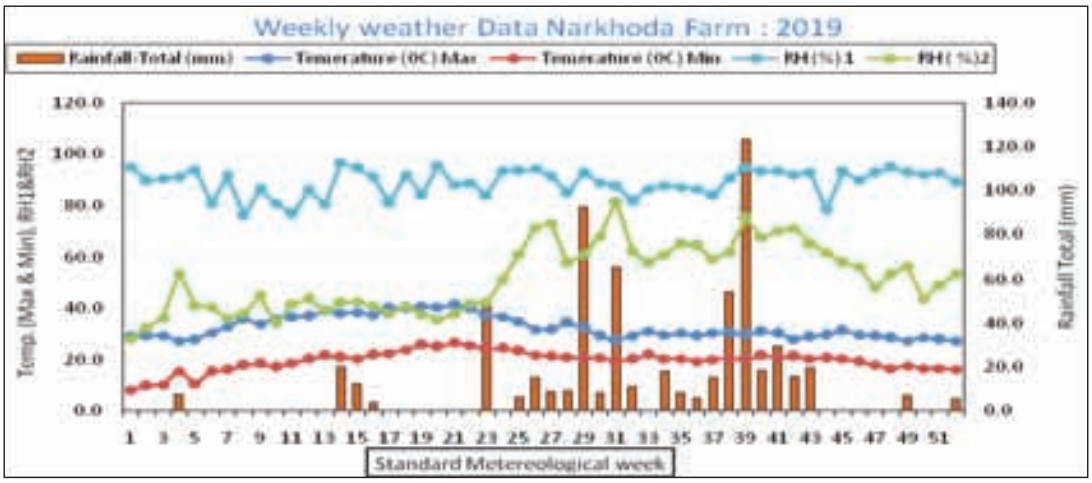
ICAR-IIOR

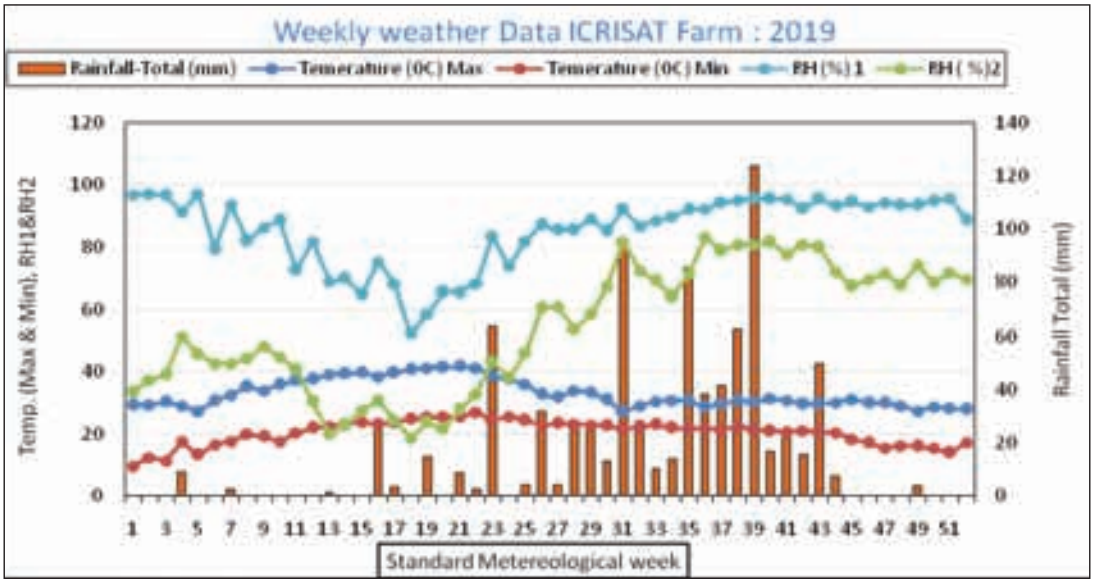
Annual Report 2019

Research Achievements

- Crop Improvement
- Crop Production
- Crop Protection
- Social Sciences
- AICRP on Oilseeds


Weekly weather Data Rajendranagar Farm : 2019
Rainfall-Total (mm)
Temerature (0C) Max
Temerature (0C) Min
RH (%) 1
RH (%)2
Temp. (Max & Min), RH1&RH2
Rainfall Total (mm)
Standard Metereological week


Weekly weather Data Narkhoda Farm : 2019
Rainfall-Total (mm)
Temerature (0C) Max
Temerature (0C) Min
RH (%) 1
RH (%)2
Temp. (Max & Min), RH1&RH2
Rainfall Total (mm)
Standard Metereological week


Weekly weather Data ICRISAT Farm : 2019
Rainfall-Total (mm)
Temerature (0C) Max
Temerature (0C) Min
RH (%) 1
RH (%)2
Temp. (Max & Min), RH1&RH2
Rainfall Total (mm)
Standard Metereological week

Crop Improvement

Germplasm - Maintenance, Evaluation and Enhancement

IIOR has the mandate of maintaining, characterizing, cataloguing, and distributing the germplasm accessions/ lines of the mandate crops namely castor, sunflower, safflower sesame and niger, for crop improvement research efforts. The primary gene pool is the main source of specific traits that are to be incorporated into elite lines through breeding activities. Under germplasm evaluation, main emphasis has been on the identification of trait specific germplasm lines conferring resistance to biotic and abiotic stresses, yield enhancing traits and oil content in the mandate crops.

Once the germplasm lines for specific traits of interest are identified and confirmed, they are multiplied, evaluated at different locations and seasons and then shared with the breeders of the institute as well as AICRP centres. The institute also owns the responsibility of rejuvenating the working germplasm periodically and depositing the material with NBPGR for long term storage. The activities carried out by germplasm units are summarized here.

Castor

In castor, the traits of importance for plant breeding have been earliness, resistance to diseases such as wilt, root rot and gray mold, tolerance to insect pests such as leafhopper, tobacco hairy caterpillar, capsule borer and leaf miner.

Multilocation evaluation of trait-specific inbred lines

Trait-specific inbred lines were confirmed for resistance to biotic stresses through multilocation evaluation.

Inbreds confirmed for resistance to biotic stresses

Trait	Inbreds
Leafhopper and wilt resistance	Leafhopper resistant lines ICI-RG2661-7-9-1-3 and ICI-RG2661-7-9-1-1 exhibited resistance reaction against Fusarium wilt (11.1 and 0%; 18.2 and 7.7% wilt incidence) in wilt sick plots at ICAR-IIOR, Hyderabad and S.K. Nagar.
Leafhopper resistance	ICI-RG2661-7-5-1-2, ICI-RG2661-17-6-1-9, ICI-RG2661-7-5-2, RG3432-4, ICI-RG3600-14, ICI-RG2661-7-9-1-1, ICI-RG2661-7-9-1-7, ICI-RG2661-7-9-1, RG155-3, RG155-4, RG155-10 and RG155-11 showed resistance to leafhopper (0-1 hopper burn on 1-4 scale) at Palem and Yethapur.
Confirmation of leafhopper resistance	ICI-RG2661-7-9-1-1, ICI-RG2661-16-2-2 and ICI-RG2661-7-5-1-7 at all centres at Palem, Yethapur, ICAR-IIOR, Hyderabad and SK Nagar.
Confirmation of root rot resistance	ICI-RG2787-152-9, ICI-RG2787-181-12, ICI-RG2787-192-12 and ICI-RG2719-10 using stem-tape inoculation technique for two consecutive years. Earlier three of these root rot resistant inbred lines *viz.*, ICI-RG2787-152-9, ICI-RG2787-181-12 and ICI-RG2787-192-12 were confirmed for their resistance against Fusarium wilt in glasshouse in pot-culture method.

Screening of germplasm accessions against biotic stresses

Germplasm accessions were screened against diseases at multilocations and promising accessions identified are presented.

Promising stress tolerant accessions of castor

Biotic stress	Accessions
Diseases	
Fusarium wilt	RG-2746, RG-2784, RG-2976, RG-3432, RG-3975, RG-3976 and RG-3997 showed resistance reaction (0-18% wilt incidence) against Fusarium wilt in wilt sick plots at ICAR-IIOR, Hyderabad and S.K. Nagar.
Botrytis gray mold	RG-96, RG-1826, RG-2096, RG-2781, RG-2842, RG-3012, RG-3100, RG-3603 and RG-3700 have shown 20-25% disease severity on castor spikes under glasshouse conditions using detached spike technique while the susceptible check, DCH-519 had 100% disease.
Resistance to Macrophomina root rot	RG-3807, RG-3838, RG-3854, RG-3855, RG-3857, RG-3875 and RG-3895 exhibited resistance against root rot (0% root rot incidence) in sick plot.
Confirmation of wilt resistance	RG-1922, RG-2976 and RG-3795 in pot-culture condition in glasshouse at ICAR-IIOR, Hyderabad, Palem and S.K. Nagar.
Confirmation of Botrytis gray mold resistance	RG-1963 (18.2% disease severity) under artificial epiphytotic conditions in the poly house while the susceptible check, DCH-519 had 90% disease.
Insect pests	
Resistance to leafhopper	RG-3089, RG-3105, RG-3181, RG-3298, RG-3330, RG-3390, RG-3129, RG-3142, RG-3146, RG-3201, RG-3216, RG-3329, RG-3346, RG-3347, RG-3363 and RG-3406 showed resistance to leafhopper (0-1 hopper burn) at Palem and Yethapur whereas the susceptible check, DCS-107 showed grade 3 hopper burn.
Confirmation of whitefly resistance	Resistance to whitefly (0-1 grade on 1-5 scale) was confirmed in two accessions *viz.,* RG-3233 and RG-3428 at ICAR-IIOR, Hyderabad, Yethapur and S.K. Nagar.

Allelic relationship of wilt resistance genes in RG-1149 and 48-1

Castor genotypes RG-1149 and 48-1 are stable resistant sources for Fusarium wilt disease. Earlier inheritance studies showed that wilt resistance in these lines is governed by digenic recessive complementary genes. To determine the allelic relationship of the resistant genes, F_1 and F_2 progenies of the cross RG-1149 × 48-1 were generated. The F_1 (20 plants) and F_2 populations (221 plants) were raised in the wilt sick plot maintained at ICAR-IIOR during *kharif*-2019. Trueness of F_1 was confirmed with the help of two morphological characters *viz.*, stem colour and capsule spininess. Stem colour is governed by single dominant gene with red stem being dominant over green stem. Similarly, capsule spininess exhibits single dominant gene control with incomplete dominance of spininess over non-spiny capsules. Among 221 F_2 plants scored for stem colour, 156 were red and 65 were green showing expected segregation for F_2 population (χ^2= 2.294, p=0.1299). The reaction of plants to wilt was observed till 150 days after sowing. All F_1 and F_2 plants were found to be resistant. No segregation for susceptibility in the F_2 population indicates that both the resistant sources share common loci for wilt resistance.

Multiplication of trait-specific inbred lines

Sixty two inbred lines including 10 extra-early (DM: 83-86) and three early maturing (DM: 86-100), six high ricinoleic acid (90-92%) inbred lines, four wilt resistant, two root rot resistant, four wilt and root rot resistant, 17 capsule borer resistant and 14 leafhopper resistant inbred lines, and two inbred lines harbouring low thrips population at multilocations were multiplied for seed distribution to breeders for utilization in breeding programmes.

Multiplication and rejuvenation of germplasm accessions

Thirty promising germplasm accessions were multiplied for distribution to castor researchers, and 1080 accessions were rejuvenated at ICAR-IIOR, Hyderabad (202), and Ananthapuramu and Palem (878).

Sunflower

Present status of sunflower genetic resources in gene bank at IIOR

A total of 395 sunflower accessions were augmented from North Central Regional Plant Introduction Station, USA through NBPGR and added to IIOR collection during 2018-19. These 395 accessions include 337 pre-bred lines, 8 checks and other inbred lines. Major emphasis during the year was on multiplication and deposition of the sunflower accessions in IIOR MTS and 974 accessions were deposited. Seven hundred and sixty accessions were multiplied and 106 accessions including genetic stocks were supplied to researchers as per their demand.

Evaluation of pre-bred lines

Three hundred and forty eight pre-bred lines derived using 25 wild donor species of *Helianthus* received from USDA, USA, were raised along with five checks during summer 2019 in α lattice design with two replications. The wild species used had tolerance to abiotic stresses such as heat and drought besides high seed yield and oil content. Therefore, the derived lines from the interspecific crosses were evaluated for high temperature tolerance along with five checks. Phenotypic data on 16 yield, and yield related traits were collected for the identification of heat resistant lines with high oil content. Large variability was observed among the pre-bred lines for the traits under evaluation. The resistant and susceptible pre-bred lines showing symptoms of heat stress are represented in the figure. The pollen fertility is known to be affected under higher temperature stress. In the evaluated material, the pollen sterility percent ranged from 0 to 45% under severe heat stress.

Performance of pre-bred lines with more than 37% oil content under heat stress conditions

Accession	Days to 50% flowering	Plant height (cm)	Head dia-Meter (cm)	100-seed weight (g)	Seed yield/ plant (g)	Oil content (%)
PI-686496	68	77.3	4.0	3.3	2.0	40.1
PI-686529	57	70.1	5.5	1.6	6.0	38.9
PI-686580	56	75.2	9.0	3.3	8.0	37.3
PI-686590	59	84.7	5.6	2.2	2.0	38.2
PI-686616	61	72.8	8.6	3.0	5.0	37.1
PI-686629	61	61.8	7.1	2.9	3.0	37.5
PI-686762	57	70.7	7.0	3.4	6.0	37.8
PI-686764	60	64.9	7.3	3.7	9.0	39.4
PI-686767	63	76.3	8.3	2.7	6.0	37.9
PI-686779	61	75.9	8.6	3.6	9.0	38.0
PI-686800	64	61.0	3.6	1.8	4.0	37.0
PI-686808	61	77.8	9.0	3.1	4.0	39.4
AMES-31950 (check)	61	78.8	7.1	2.5	4.0	28.4
AMES-31956 (check)	63	65.9	5.0	2.8	2.0	31.4
AMES-31960 (check)	63	82.1	7.3	2.5	5.0	20.5
AMES-31962 (check)	59	54.0	7.7	3.6	4.0	23.6
AMES-31968 (check)	56	75.5	5.3	2.3	4.0	36.0

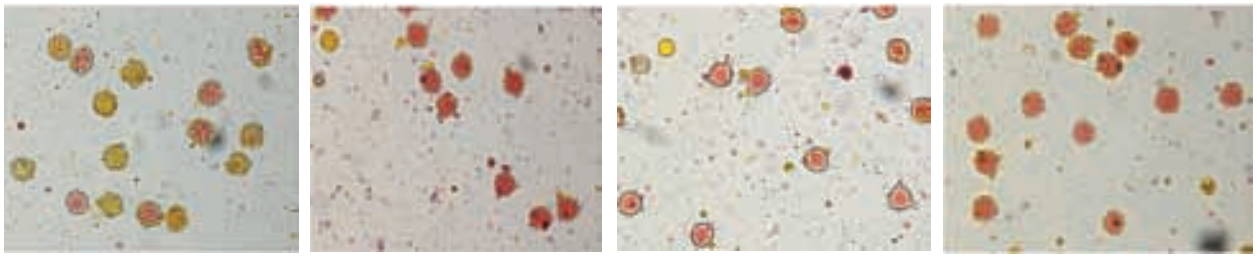
Susceptible (PI-686579) *Resistant (PI-686580)*

Resistant (PI-686794) *Susceptible (PI-686795)*

Resistant (PI-686556) *Susceptible (PI-686557)*

Susceptible (PI-686550) *Resistant (PI-686551)*

Identification of susceptible and resistant pre-bred lines under heat stress



PI-686801 *PI-686792* *PI-686575* *PI-686564*

Variation among the pre-bred lines for pollen sterility under heat stress

Safflower

Of the 6970 safflower germplasm accessions conserved in the medium term storage (MTS) module, viability testing was undertaken for 495 accessions after six years of conservation and 23% of the accessions recorded germination >85%. Sowing was taken up for 838 accessions for rejuvenation and 160 promising accessions for multiplication during *rabi*, 2019-20. Seeds of 258 accessions were multiplied and conserved under MTS. A total of 321 samples of 217 accessions were supplied to indenters for utilization in breeding, screening against wilt, aphid and for salinity tolerance at multilocations.

Evaluation of collections from Maharashtra

A set of 59 accessions collected from Maharashtra during 2017 were evaluated for the 2nd year along with two checks during *rabi* 2018-19. Based on the performance over two years (2017-18; 2018-19), 18 accessions were identified for early flowering and high seed or oil yield. Five accessions *viz.* GMU-7871,

GMU-7907, GMU-7901, GMU-7884 and GMU-7880 were identified for high seed yield ranging from 40.5-45.6 g/plant as against 29.0-29.9 g/plant observed in checks. Oil yield among 18 accessions ranged from 8.0-13.2 g/plant compared to 7.1-7.8 g/plant in checks. The accession GMU-7898 was the earliest to flower (65 days) but recorded low seed and oil yield. The accessions, GMU-7899, GMU-7879, GMU-7880, GMU-7901 and GMU-7923 recorded early flowering (68.5-78.5 days to 50% flowering) compared to the checks (87-91 days to 50% flowering).

Characteristics of promising germplasm accessions from Maharashtra

Accession no.	Collector's ID	District of collection	Days to 50% flowering	Seed yield/ plant (g)	100-seed weight (g)	Oil content (%)	Oil yield/ plant (g)
GMU-7862 (IC-0631926)	NMDC-2	Parbhani	83.5	35.5	7.0	26.1	9.3
GMU-7869 (IC-0631933)	NMDC-9	Latur	87.0	38.7	6.5	28.0	10.8
GMU-7871 (IC-0631935)	NMDC-11	Beed	85.5	40.5	6.5	27.2	11.0
GMU-7879 (IC-0631943)	NMDC-19	Osmanabad	75.0	27.7	5.4	30.0	8.3
GMU-7880 (IC-0631944)	NMDC-20	Osmanabad	78.0	45.6	6.2	28.8	13.2
GMU-7881 (IC-0631945)	NMDC-21	Osmanabad	86.5	34.9	6.8	28.7	10.0
GMU-7882 (IC-0631946)	NMDC-22	Solapur	86.0	33.2	6.7	27.5	9.1
GMU-7884 (IC-0631948)	NMDC-24	Solapur	86.5	43.6	5.1	29.1	12.7
GMU-7887 (IC-0631951)	NMDC-27	Satara	82.5	32.3	5.0	29.1	9.4
GMU-7898 (IC-0631962)	NMDC-38	Sangli	65.0	11.1	5.9	26.3	2.9
GMU-7899 (IC-0631963)	NMDC-39	Sangli	68.5	29.3	5.3	27.3	8.0
GMU-7901 (IC-0631965)	NMDC-41	Sangli	78.0	41.0	5.8	29.0	11.9
GMU-7905 (IC-0631969)	NMDC-45	Solapur	82.5	34.1	5.8	28.3	9.7
GMU-7907 (IC-0631971)	NMDC-47	Osmanabad	85.5	40.7	7.2	27.2	11.1
GMU-7917 (IC-0631981)	NMDC-57	Latur	81.5	34.9	6.8	27.7	9.7
GMU-7920 (IC-0631984)	NMDC-60	Latur	85.5	37.6	7.0	26.9	10.1
GMU-7922 (IC-0631986)	NMDC-62	Latur	82.0	37.1	7.2	28.2	10.5
GMU-7923 (IC-0631987)	NMDC-63	Latur	78.5	32.7	6.6	28.0	9.2
A-1	(Check)		91.0	29.9	6.6	23.9	7.1
Bhima	(Check)		87.5	29.0	6.8	26.9	7.8

Evaluation of promising germplasm and breeding lines

A trial comprising of seven accessions, 14 breeding lines and four checks (A-1, PBNS-12, NARI-57, Bhima) was conducted (plot size: 5 rows x 5 m) with two replications. The germplasm accessions IC-338171, IC-406143, IC-337833 and breeding lines F_5-125, BC_1F_6-39-3-3, BC_2F_6-38-1-7, BC_2F_6-38-9-4, BC_2F_6-38-14-15, BC_3F_5-16-12 and BC_3F_5-16-27 were identified for high oil yield ranging from 8.5-12.5 g/plant. The breeding lines, *viz.* F_5-8, F_5-55, F_5-125, F_5-157, SAF-20B, SAF-39A, THS-86-2-1, BC_1F_6-39-3-3 and germplasm accession EC-736501 (42.8%) recorded high oil content ranging from 35.2 to 42.8%. Breeding lines with high oleic acid content were also confirmed. Three lines *viz.* BC_1F_6-39-3-3, BC_3F_5-16-27 and BC_2F_6-38-1-7 recorded oleic acid content from 81.1 to 82.9%.The promising genotypes identified for higher oil yield than the check A-1 during 2018-19 are presented.

Promising lines identified for oil yield and oil quality

Accessions/selections	DF	DM	SYP	TW	OC	OYP	Palmitic	Stearic	Oleic	Linoleic
IC-338171	93	140	36.2	4.8	29.2	10.6	6.3	2.1	21	70.7
IC-406143	88	140	28.2	4.5	30.2	8.5	5.9	1.7	17.5	74.9
IC-337833	84	134	41.5	5.3	30.0	12.5	6.2	1.9	20.6	71.2
F_5-125	87	139	25.5	4.6	35.3	9.0	6.1	2.2	75.3	16.0
SAF-20B	84	135	23.2	3.7	39.3	9.1	6.2	2.6	70.6	20.1
BC_1F_6-39-3-3	84	132	33.3	3.9	35.4	11.8	4.9	1.4	81.1	12.5
BC_2F_6-38-1-7	88	138	38.1	5.2	32.2	12.3	4.7	1.4	82.9	10.9
BC_2F_6-38-9-4	85	138	34.8	5.3	30.9	10.8	5.5	2.0	74.9	17.6
BC_2F_6-38-14-15	83	139	34.2	5.5	32.3	11.1	4.8	1.4	78.9	14.8
BC_3F_5-16-12	84	137	35.2	5.2	32.6	11.5	6.0	2.3	72.4	19.3
BC_3F_5-16-27	81	137	33.1	5.0	31.2	10.3	4.7	1.4	81.8	12.0
A-1 (check)	88	140	32.9	5.9	26.2	8.6	6.6	2.3	23.7	67.2
Bhima (check)	88	140	35.8	5.5	29.7	10.7	5.9	1.9	19.0	73.1
PBNS-12 (check)	82	132	35.9	5.6	27.9	10.0	6.5	2.3	23.0	68.1
NARI-57 (check)	81	140	14.5	3.6	39.5	5.7	8.4	2.7	21.5	67.4
*Mean	84	137	26.8	4.6	33.0	8.5	6.0	1.9	50.1	41.9
Minimum	75	132	6.7	2.4	25.8	2.6	4.7	1.3	17.5	10.9
Maximum	93	140	41.5	6.0	42.8	12.5	8.4	2.7	82.9	74.9
SE	2.14	2.16	4.90	0.20	0.83					
CD (P=0.05)	6.22	6.28	14.29	0.59	2.41					
CV (%)	3.59	2.23	25.91	6.16	3.56					

DF: Days to 50% flowering; DM: Days to physiological maturity; SYP: Seed yield/plant (g); TW: 100-seed weight (g); OC: Oil content (%); OYP: Oil yield/plant (g) *Statistics presented based on entire set of 25 genotypes

Niger

Seed multiplication and maintenance of 120 germplasm accessions was done by sibbing. The accessions were characterised and evaluated under open pollination and variability for seed yield and related traits was recorded.

Variability for yield and related traits

Accession	Days to 50% flowering	No. of branches	Plant height (cm)	No. of capitula	Yield/ plant (g)	Oil content (%)
JN-6	49	9	104	118	8.0	39.4
JN-18	49	10	117	120	8.1	39.6
JN-20	47	9	122	115	7.7	40.2
NSS-5440	49	9	110	120	8.0	39.6
NSS-5470	51	11	118	113	8.3	39.8
NSS-5466	48	10	112	117	8.9	40.1
NSS-5502	48	10	113	101	6.9	37.4
NSS-5505	47	11	118	124	8.8	38.0
NSS-5561	47	12	113	144	9.1	40.0
NSS-5569	46	10	111	121	8.3	40.7
JNS-9(check)	49	12	116	122	7.2	37.3
IGPN-2004-(check)	47	10	118	107	6.3	38.2

Pre-breeding

Pre-breeding activities utilizing the wild species have been carried out in sunflower, safflower and sesame. In sunflower, the major emphasis is for widening the genetic base for yield related traits, drought tolerance and resistance for powdery mildew. In safflower, emphasis has been to utilize wild species to transfer Alternaria leaf spot as well as Fusarium wilt resistance. In sesame, the wild species are basically used for developing male sterility system for hybrid development. The results obtained under these activities are summarized here.

Sunflower

Generation advancement of pre-bred material from BC_2F_3 to BC_2F_4 generation and characterization

Interspecific hybrids involving *Helianthus argophyllus* (ARG-153, ARG-1317 and ARG-1575), *H. debilis* (DEB-369 and DEB-691), *H. petiolaris* (PET-1910) and *H. praecox* (PRA 1823) were advanced from BC_2F_3 to BC_2F_4 generation through selfing during *kharif* 2019. Uniform progenies of each of the combinations were characterized for days to 50% flowering, plant height (cm), number of leaves/plant, head diameter (cm), seed yield/plant (g) and 100-seed weight (g) under selfing. Wide variability was observed for most of the traits evaluated.

Leafhopper is a major insect pest of sunflower and stem hairiness plays an important role in non-preference of leafhoppers towards resistant lines. Stem pubescence was more in pre-bred material developed using *H. argophyllus* showing field level resistance to leafhopper. Uniform progenies developed using *Helianthus* species are being screened during *rabi* 2019-20 along with susceptible and resistant checks.

Uniformity of pre-bred lines

Variability for hairiness on apical part of stem in pre-bred lines derived from crosses with H. argophyllus

Variability for different traits in pre-bred material of different combinations

Trait	ARM-243B x ARG-153		ARM-243B x ARG-1317		ARM-243B x ARG-1575		ARM-243B x PET-1910		ARM-243B x DEB-366		ARM-243B x DEB-691	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Days to 50% flowering	59.9	56.0-71.0	71.3	63.5-85.6	69.7	66.2-82.3	62.3	59.7-74.3	52.6	50.8-67.8	56.8	54.9-78.4
Plant height (cm)	225.0	174-270	195.0	164-285	232.0	189-284	215.0	162-269	211.0	159-294	235.0	194-284
No. of leaves/ plant	32.1	16.0-48.0	34.4	14.0-50.0	35.1	19.0-52.0	30.2	14.0-49.7	34.0	13.0-47.0	30.8	16.0-46.2
Head diameter (cm)	16.6	10.7-19.9	17.2	8.7-20.3	15.7	10.5-21.9	18.7	11.8-213	15.9	11.3-19.8	14.6	12.2-20.9
Seed yield/ plant (g)	16.0	12.5-30.0	13.0	09.0-30.0	14.2	11.0-29.8	13.2	10.0-32.0	14.5	12.0-31.9	17.5	10.9-33.6
100-seed weight (g)	6.2	3.8-8.7	6.0	3.5-8.3	5.4	4.2-8.9	6.3	4.0-8.9	5.9	3.5-7.9	5.6	3.2-8.0

Safflower

Development of biotic stress resistant inbred lines

High yielding wilt resistant interspecific inbred lines: Thirteen wilt resistant interspecific inbred lines developed using four wild species *viz.* *C. palaestinus*, *C. lanatus*, *C. creticus* and *C. oxyacantha* were evaluated alongwith three checks, ISF-764, A-1 and PBNS-12 in 6.75 sq.m plot. Two inbred lines namely, ISF-2342-17 and ISF-2305-17 recorded 107% (2615 kg/ha) and 12% (1407 kg/ha) higher seed yield than the best check, ISF-764 (1259 kg/ha). Both ISF-2342-17 and ISF-2305-17 exhibited Fusarium wilt resistance in wilt sick plots at Solapur (7.7 and 18.5%), Tandur (13.3 and 0%) and ICAR-IIOR, Hyderabad (0%) while the susceptible check, Nira recorded 100% wilt incidence.

Pyramiding of wilt resistance from wild species into wilt susceptible variety, A-1: F_1's of five interspecific crosses developed using five wild species *viz.* *C. palaestinus*, *C. lanatus*, *C. creticus, C. turkestanicus* and *C. oxyacantha*, F_2's of six interspecific crosses developed using four wild species *viz.* *C. glaucus*, *C. lanatus*, *C. creticus* and *C. turkestanicus* and two BC_2 and one BC_1 generations of three interspecific crosses involving *C. tinctorius* (A-1) and *C. oxyacantha* were advanced to next generations.F_3 generation of six crosses between *C. tinctorius* (A-1) and *C. oxyacantha* were also advanced to next generation.

Alternaria leaf spot tolerant inbred lines: Three interspecific inbred lines ISF-1749-1-5-2016, ISF-1703-2-1-2016 and ISF-1749-1-2-2016 were identified for resistance against Alternaria at ICAR-IIOR, Hyderabad. These lines which were developed using two wild species *C. palaestinus* and *C. lanatus* showed tolerance reaction (31-33%) at Solapur where the susceptible check, Manjira had 96.7% Alternaria disease.

Sesame

In sesame, the emphasis has been to identify germplasm lines that are resistant to phyllody, root rot and Antigastra.

Development of stable cytoplasmic genetic male sterile lines

As a part of the programme on development of CGMS system in sesame, crosses were made with *Sesamum malabaricum* and male sterility was observed in the crosses and generations as mentioned below.

Range of pollen sterility in different generations

Backcross generations	Range of pollen sterility (%)	Mean sterility (%)
BC_5F_1-(ISMB-2 x GT-10) F_1x GT-10 -1-1-1-2-1-1	77.0 - 84.2	80.1
BC_5F_1- (ISMB-3 x GT-10) F_1x GT-10-1-1-1-2-1-1	76.2 - 86.1	80.9
BC_3F_1- (ISMB-7 x GT-10) F_1x GT-10-1-1-1-2	83.0 - 88.4	87.5
BC_1F_1-(G-3 x TKG-22) F_1x TKG-22-1-1-1	84.0 - 89.7	85.6

Parental Lines-Development, Characterization and Evaluation

IIOR being the coordinating and nodal agency of the AICRP on mandate crops, plays a pivotal role in developing parental lines using germplasm available and the phenotyping facilities developed at the institute, and then supplying the enhanced breeding lines to the co-operating centres. In castor and sunflower, where predominantly hybrids are cultivated, parental line development has been an important activity. Emphasis has been given to develop parental lines with additional ancillary traits like resistance to stresses and suitable for different agro-ecological situations. In castor, new pistillate as well as new male (monoecious) line development has been the primary activity. Different approaches have been adopted to develop these lines and the stable lines developed have been characterized for their combining ability as well as other agronomic traits such as wilt resistance, earliness, moisture stress tolerance, etc. In sunflower, the focus has been to identify and develop parental lines with good combining ability, resistance to powdery mildew, tolerance to moisture stress and salinity, and high oil content. Results obtained under different activities carried out during the year are presented.

Castor

Development of wilt with and gray mold resistant monoecious male lines

Selection and generation advancement has been completed by single plant selections from 222 F_3, 42 F_4, 135 F_5, 103 F_6 families of 31 bi-parental crosses and 215 S_1 progenies of genepool for gray mold resistance towards developing superior male lines. A total of 150 farmers' collections have been multiplied and 20 new crosses were generated using proven male parents, farmer's collections and wilt resistant monoecious lines.

New monoecious male line development

Pooled mean analysis of single seed descent (SSD) and pedigree selection (PS) derived lines for two years (2017-18 and 2018-19) indicated that ICS-257 (65%), ICS-272 (40%), ICS-252 (37%), ICS-268 (24%) of SSD and ICS-240 (51%), ICS-241 (24%), ICS-242 (17%), ICS-244 (16%), ICS-239 (13%) and ICS-243 (10%) of PS derived lines recorded significant yield increase over the best high yielding national check, DCS-107 (1288 kg/ha and 1327 kg/ha).

Among the SSD and PS derived inbreds, three lines *viz.*, ICS-271, ICS-280, ICS-283 were wilt resistant (<20% wilt incidence) and other three lines *viz.*, ICS-287 (23%), ICS-277 (21%), ICS-273 (25%) were moderately resistant (<25% wilt incidence) to wilt in wilt sick plot at IIOR, Hyderabad.

Pooled mean performance of top ten lines selected by SSD method

Entry	Plant height up to primary spike (cm)	Number of nodes to primary raceme	Days to 50 % flowering of primary spike (DAS*)	Total primary spike length (cm)	Effective primary spike length (cm)	100-seed weight (g)	Seed yield (kg/ha)	Oil content (%)
ICS-257	98.0	13.6	57.8	50.7	50.5	24.0	2123	45.7
ICS-272	153.1	18.1	59.0	47.3	47.3	23.8	1807	43.2
ICS-252	89.2	14.1	54.3	41.3	38.9	26.5	1765	45.5
ICS-268	63.5	10.8	48.8	41.0	39.6	27.7	1600	45.2
ICS-271	135.3	15.4	54.5	53.5	51.6	24.9	1530	44.2
ICS-261	86.4	14.2	48.0	38.2	35.3	26.1	1475	45.0
ICS-278	107.8	14.6	56.5	47.3	47.2	23.5	1380	44.6
ICS-270	83.7	14.4	52.8	43.3	43.1	21.6	1339	44.2
ICS-267	90.1	14.2	55.8	50.9	49.6	23.1	1275	45.6
ICS-265	89.7	13.8	47.5	47.7	47.0	25.8	1241	44.6
48-1 (check)	111.3	16.5	56.5	38.9	37.8	27.0	989	46.1
DCS-107 (check)	106.6	16.5	58.5	38.3	38.1	29.0	1288	45.4
CD (P=0.05)	18.5	NS	NS	6.0	6.7	15.5	266.7	13.6
CV (%)	7.9	4.7	9.1	5.3	6.6	4.8	11.3	2.4

*DAS-Days after sowing

Pooled mean performance of top ten lines selected by pedigree selection method

Entry	Plant height up to primary spike (cm)	Number of nodes to primary raceme	Days to 50 % flowering of primary spike (DAS*)	Total primary spike length (cm)	Effective primary spike length (cm)	100 seed weight (g)	Seed yield (kg/ha)	Oil content (%)
ICS-240	60.0	9.5	36.8	33.1	32.4	30.8	1999	49.0
ICS-241	78.4	12.3	41.0	34.6	32.8	32.2	1649	49.9
ICS-242	86.2	13.1	45.3	34.7	33.4	27.0	1554	47.1
ICS-244	162.6	17.7	56.0	52.4	52.3	22.3	1543	46.0
ICS-239	61.4	10.7	36.0	32.1	31.1	31.5	1501	49.6
ICS-243	110.8	15.5	56.3	45.3	44.7	21.7	1468	47.6
ICS-245	96.0	14.6	47.5	52.0	51.1	23.8	1449	44.8
ICS-249	41.6	8.7	39.3	30.0	30.2	23.9	1354	43.3
ICS-250	78.0	11.6	45.8	33.9	33.3	23.3	1178	45.9
ICS-232	136.6	16.4	55.3	48.2	47.6	28.0	1151	46.9
48-1 (check)	124.6	16.7	53.8	41.5	39.6	28.2	1058	47.8
DCS-107(check)	126.0	16.3	58.0	45.6	44.3	31.0	1327	44.5
LSD	29.7	6.1	8.9	7.9	7.7	NS	137.3	NS
CV (%)	15.0	10.1	8.7	9.0	9.0	21.0	5.8	3.9

*DAS-Days after sowing)

Development of wilt and leafhopper resistant pistillate lines with good combining ability

A large F_2 bulk population generated from Cycle-1 of random mating population involving Rb-1854 as female parent crossed with pollen mixed from 3 other female parents *viz.*, DPC-9, SKP-84 and JP-86 of diverse origin and morphological characters (dwarf and normal plant type) was raised during *rabi* 2019-20. In addition, single seed collected from each of the 99 individual plants of random mating population was also grown in *rabi* 2019-20 in two sets. Preliminary observations up to primary/ secondary spikes in both genepool and SSD methods indicated higher frequency of pistillate plants (65%) while up to 40% recombinants for different morphological characters like stem colour, bloom, plant type, spike characters, etc. were selected and selfed for second cycle of random mating.

Selection and generation advancement of agronomically superior single plant selections / progenies is under progress for pistillate trait from the following crosses/progenies.

- Four quadruple crosses derived from two double crosses (DPC 25 x Rb 13-1854) x (CNES-1 x NES-6) and (DPC 21 x DCS-106) x (JP-77-1 x DPC-21).
- 11F_2 progenies from two double crosses, 3 F_2 progenies from 2 single crosses.
- 21 + 3 BC_1F_2 progenies from six crosses *viz.*, [(CNES-1 x FC-8) x CNES-1], [(CNES-1 x PMC-36) x CNES-1], [(M-619 x FC-8) x M-619], Kh-13-154 x M-574, Kh-13-154 x DPC-19, Kh-13-154 x DPC-9.
- 71 F_3 selections derived from six bi-parental crosses (Rb 13-1854, x DPC 25, CNES-1 x NES-6, JP-77-1 x DPC-21, DPC-21 x DCS-106, DPC-25 x Rb 13-1854 and M-619 x 48-1) for pistillate line diversification.
- Four F_1s raised during *rabi* 2019-20 were used to generate two double crosses {(DPC-16 xM-571) x (SL x DPC-25)} and {(DPC-23 x DPC-21 and DPC-9 x DPC-14)} for further multi-parent crosses and generation of diverse pistillate sources.

Maintenance breeding of parental lines

Multiplication of 30 pistillate and 70 male lines is in progress.

Evaluation of parental lines for drought tolerance in field

Selection and generation advancement of BC_1F_2 of DPC-9 x RG-72 for drought tolerance (by imposing drought stress from 30-90 DAS) and selfing single plants after relieving stress is under progress.

Varietal Development

In safflower and sesame, predominantly the focus has been on the development of varieties. In safflower, emphasis has been given to derive inbred lines from populations, originated from either bi-parental crosses, multiple crosses, and interspecific crosses, with traits such as high oil content, resistance to diseases like wilt and leaf spot, short duration, and high oleic acid. Two varieties, ISF-764 with high seed yield and ISF-1 with high oleic acid (~76%) have been notified this year. In sesame, concerted efforts have been made to develop elite breeding lines from the variability available and also to create additional variability by effecting multi-parent crosses. Progress made under different activities are presented briefly.

Safflower

Variety release and notification

The high yielding variety, ISF-764 and the first high oleic variety, ISF-1 were notified for all India cultivation during the, 83rd meeting of the Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops.

ISF-764

ISF-1 (High oleic type)

Variety promotion

Three varieties namely, ISF-87-15, ISF-116 and ISF-849-sel-16 were promoted to AVT-I, and the variety, ISF-112-15 has been promoted to AVT-II.

Varieties ready for release

The non-spiny variety, ISF-763 tested for three years (2015-2017) in AICRP (Safflower), recorded 14.4% increase in seed yield (1366 kg/ha) and 11.6% increase in oil yield (423 kg/ha) over the non-spiny check, NARI-6 at national level. Another non-spiny variety, ISF-1258-15, which was initially designated as ISF-1258, recorded 13.2% higher seed yield (1490 kg/ha) than NARI-6 (1316 kg/ha) at national level in three years (2016-19) of testing.

Field view of ISF-763 and ISF-1258-15

Performance of ISF-763 at national level

Variety	Seed yield (kg/ha) *	Oil content (%)*	Oil yield (kg/ha) *
ISF-763	1366 (14.4)	30.2	423 (11.6)
NARI-6 (check)	1194	31.2	379

*Three years weighted mean; figures in parenthesis indicate per cent increase over NARI-6

Performance of ISF-1258-15 at national level

Variety	Seed yield (kg/ha) *	Oil content (%)*	Oil yield (kg/ha) *
ISF-1258-15	1490 (13.2)	28	417
NARI-6 (check)	1316	33	439

*Three years weighted mean; figures in parenthesis indicate per cent increase over NARI-6

High yielding spiny and non-spiny varieties

Eight spiny and eight non-spiny varieties have been tested along with two spiny checks, A-1 and PBNS-12 and a non-spiny check, NARI-6 in ABD. Plant stand and growth of the entries were affected due to very heavy rainfall (51.6 mm) on a single day (14/12/2018). Three spiny and two non-spiny varieties were evaluated for two years and one non-spiny was evaluated for four consecutive years. Four spiny varieties, *viz.,* ISF-123-sel-15, ISF-22-15, ISF-320 and ISF-319 recorded 62-87% higher seed yield (1764-2040 kg/ha), one high oleic variety, ISF-153-26 gave 14% (1244 kg/ha) and one spiny variety, ISF-317 recorded 13% higher seed yield (1227 kg/ha) over the best check, A-1 (1089 kg/ha). Four non-spiny varieties *viz.,* SPP-70, ISF-134-15, ISF-2035 and ISF-53-15 recorded 27-164% higher seed yield (853-1769 kg/ha) over non-spiny check, NARI-6 (670 kg/ha).

Performance of promising high yielding varieties

Variety	Yield (kg/plot)	Yield (kg/ha)‡	FPS	100-seed weight (g)	Oil content (%)
Spiny					
ISF-309	2.3	2040 (87)	126	3.3	30.3
ISF-320*	2.3	2022 (86)	102	5.6	27.7
ISF-22-15	2.3	2000 (84)	95	4.8	31.2
ISF-123-sel-15*	2.0	1764 (62)	110	5.4	31.7
ISF-153-26 (oleic)	1.4	1244 (14)	103	5.5	29.0
ISF-317*	1.4	1227 (13)	83	6.0	25.6
PBNS-12 (check)	1.0	911	98	7.80	23.9
A-1 (check)	1.2	1089	101	7.05	23.2
Non-spiny					
SPP-70¶	2.0	1769 (164)	90	3.5	28.2
ISF-134-15*	1.6	1409 (110)	84	4.5	29.3
ISF-2035*	1.1	1018 (52)	126	3.9	32.1
ISF-53-15	1.0	853 (27)	108	3.5	32.2
NARI-6 (check)	0.7	670	94	4.55	29.6

*tested for two years; ¶ tested for more than four years; ‡ percent increase over the best check, A-1 and non-spiny check, NARI-6; plot size: 11.25 sq.m; FPS: Final plant stand

Short duration varieties

Two short duration varieties along with a short duration check, JSI-99 and a normal duration check, A-1 were evaluated in the third consecutive year in plot size of 7.5 sq.m with the spacing of 30 x 20 cm. ISF-867 which flowered 14 days earlier and matured 15 days earlier than normal duration check, A-1 recorded 15% higher seed yield (2760 kg/ha) than A-1 (2440 kg/ha).

Performance of short duration varieties

Variety	Final plant stand	Plant height (cm)	Days to flower-ing	Days to maturity	100-seed weight (g)	Number of seeds/ capitu-lum	Number of capit-ula/ plant	Seed yield (kg/ ha)	Oil con-tent (%)
ISF-867	74	58	81	122	4.9	22	48	2760	27
ISF-833	93	37	55	110	5.2	5	7	220	27
JSI-99 (SD-C)	72	34	53	108	6.9	7	10	153	25
A-1(ND-C)	101	60	95	137	6.5	7	30	2440	26
SEm±	7.1	6.8	10.2	6.6	0.4	3.9	9.5	699	0.4

SD-C: short duration check; ND-C: normal duration check

Varieties developed at AICRP centres using ICAR-IIOR material

Of the 10 varieties developed at Tandur (3), Raipur (2), Parbhani (3) and Indore (2) using the female parent supplied by ICAR-IIOR under national crossing programme, eight varieties namely, TSF-85, TSF-86, TSF-87, RSS-2018-1, RSS-2018-2, PBNS-190, PBNS-192 and PBNS-193 have been nominated to IVT and two varieties *viz.*, RVS-18-1 and RVS-18-2 were promoted to AVT-I.

Generation advancement

Of the 40 selections advanced to F_5, four recorded 10-39% higher seed yield (1519-1933 kg/ha) than the best check, PBNS-12 (1385 kg/ha) even when heavy rainfall on a single day severely affected plant growth. Reduced plant growth reduced the oil content in all test genotypes. Oil content was 35.7-36.2% till F_4 in 2017-18 and was reduced to 28.6-29.4% in 2018-19.

Performance of best F_5 families

Entry	Yield (kg/plot)	Yield (kg/ha)*	Final plant stand	100-seed weight (g)	Oil content (%)	
					2017-18	2018-19
ISF-998-17 (O)	1.0	1533 (11)	50	4.3	36.2	28.6
ISF-999-17 (O)	1.0	1519 (10)	49	4.3	36.1	28.9
ISF-1000-17 (O)	1.1	1689 (22)	41	4.0	35.7	29.0
ISF-1005-17 (O)	1.3	1933 (39)	46	4.9	36.0	29.4
A-1 (check)	0.7	963	39	7.7	26.0	23.2
PBNS-12 (check)	0.9	1385	43	7.4	29.2	25.2

*percent increase over A-1; plot: 6.75 sq. m

Development of inbred lines from recurrent introgressive population enrichment (RIPE) population

Two hundred and ninety two individual progenies were selected based on *per se* seed yield performance and oil content out of 1086 progenies in S_0-S_3 generations tested in progeny-rows.

Best selections in S_0 generation

Despite heavy damage to plant growth due to heavy rain during crop growth period, 16 selections out of a total 116 open-pollinated selections derived from 4th RIPE population, exhibited high *per se* seed yield (50.3-112.9 g/plant) and oil content (35-39.1%) compared with the checks A-1 and PBNS-12.

Performance of the best selections in S_0 generation derived from 4th cycle of RIPE

Generation	Best selection	Seed yield (g/plant)	Oil content (%)	Parent performance in previous generation	
				Seed yield (g/plant)	Oil content (%)
S_0 (4C)	RIPE-18-684	111.8	37.1	91.6	30.1
	RIPE-18-749	50.7	37.7	83.6	35.7
	RIPE-18-810	57.8	36.6	47.6	37.0
	RIPE-18-814	62.2	35.5	47.6	37.0
	RIPE-18-815	46.5	38.8	47.6	37.0
	RIPE-18-852	57.8	37.5	21.0	35.7
	RIPE-18-860	112.9	36.2	21.0	35.7
	RIPE-18-884	86.6	35.4	85.8	32.3
	RIPE-18-895	50.6	35.0	69.2	36.3
	RIPE-18-896	71.0	38.7	69.2	36.3
	RIPE-18-915	57.6	36.4	69.2	36.3
	RIPE-18-916	58.0	38.4	69.2	36.3
	RIPE-18-963	63.8	38.3	53.2	35.5
	RIPE-18-1025	50.3	39.1	56.4	37.3
	RIPE-18-1044	55.3	35.5	47.8	34.9
	RIPE-18-1084	84.3	37.0	37.6	38.0
	A-1 (check)	25.6	22.9		
	PBNS-12 (check)	23.5	24.8		

C: cycle of random mating

Best selections in S_1, S_2 and S_3 generation

Seven best selections in S_1, one in S_2 and two in S_3 generation derived from 3rd (3C), 2nd (2C) and 1st cycle (1C) of RIPE, respectively recorded 36.6-90.9 g/plant seed yield and 34.1-40.3% oil content as compared to high yielding check varieties, A-1 and PBNS-12.

Performance of the best selections in S_1, S_2 and S_3 generations derived from various cycles of RIPE

Generation	Best selection	Seed yield (g/plant)	Oil content (%)	Parent performance in previous generation	
				Seed yield (g/plant)	Oil content (%)
S_1 (3C)	RIPE-18-269	50.0	35.0	50.0	35.4
	RIPE-18-309	90.9	35.1	72.2	37.4
	RIPE-18-316	51.9	34.5	45.3	39.2
	RIPE-18-322	59.3	38.0	45.3	39.3
	RIPE-18-323	52.0	36.2	45.3	39.3
	RIPE-18-401	38.4	40.1	28.3	37.3
	RIPE-18-410	36.6	40.3	28.3	37.3
	A-1 (check)	27.1	23.0		
	PBNS-12 (check)	26.6	24.8		
S_2 (2C)	RIPE-18-499	69.6	36.9	45.3	35.8
	A-1 (check)	21.3	23.9		
	PBNS-12 (check)	18.2	25.2		
S_3 (1C)	RIPE-18-551	54.5	36.7	51.1	35.9
	RIPE-18-554	50.2	35.2	51.1	35.9
	A-1 (check)	28.3	23.2		
	PBNS-12 (check)	24.1	25.0		

C: cycle of random mating

Initial evaluation of safflower MAGIC lines for oil content and fatty acid composition

A set of 100 lines from previously selected MAGIC population for high oil content were further tested. A subset of 39 lines with oil content ranging from 35.23 to 43.1% were selected for further trials. Six selections showed high oleic (75-82%) acid content in seed oil and among them four selections were high oil (35-42%) and high oleic acid (81-82%) contents.

High oil/oleic selections from MAGIC population

Selection	Oil content (%)	Fatty acid composition (%)			
		Palmitic acid	Stearic acid	Oleic acid	Linoleic acid
M-313-1	42.2	6.0	0.6	81.5	12.4
M-366-2	36.2	4.5	0.8	81.7	13.0
M-422-1	35.7	5.5	1.0	81.6	12.0
M-422-2	35.9	5.3	1.1	82.1	11.5
M-467-1	32.0	5.8	1.7	77.7	14.8

Development of high oil and high oleic-high oil inbred lines

Ninety two high oil inbred lines (35-41%) and 90 inbred lines with high oleic (76-84%) and high oil (35-42%) were multiplied. One variety, ISF-87-15 consistently exhibited high oil content at multilocations under both rainfed and irrigated conditions.

Oil content in high oil variety, ISF-87-15 at multilocations

Rainfed	Oil content (%)	Irrigated	Oil content (%)
Annigeri	40.0	Nandyal	39.4
Buldana	44.1	Indore	45.6
ICAR-IIOR, Hyderabad	42.6	Raipur	45.9
Parbhani	41.9	Overall average	42.2
Tandur	35.6		
Chainki	44.7		

Development of wilt resistant intra-specific inbred lines and varieties

Two breeding lines namely, DSF-4 and DSI-104 showed resistance to Fusarium wilt isolates from Solapur, Tandur and ICAR-IIOR when screened under artificial inoculation conditions in pot-culture at Solapur, Tandur and ICAR-IIOR. Earlier DSI-104 had also exhibited tolerance to Alternaria (32%) at Solapur.

In IVT, the high yielding variety, ISF-116 exhibited resistance to wilt (9.8-16.1%) in wilt sick plots at all the three locations; two IVT varieties namely, ISF-849-sel-16 and ISF-319 showed wilt resistance at Tandur (12.0 and 7.9%) and ICAR-IIOR, Hyderabad (15.6 and10.0%) and moderate resistance to wilt at Solapur (32.3 and 30.6%) in sick plots.

Sesame

Development of bold and white seeded inbreds

Twelve white seeded entries with high test weight (3.5g/1000 seeds) were selected for preliminary yield trials along with four check varieties *viz.*, GT-2, JLT-8, Swetha Til and TKG-22 that are popular among the farmers and traders. Yield and phenological data are presented in the table. The yield trials resulted in identification of Sel-s-2017-8 and IIOS-1 for their stability across the seasons. Of these the entry IIOS-1 has been nominated for AICRP coordinated trials for summer 2020.

Performance of white and bold seeded selections in three seasons

Entry	Days for flower initiation			Days for maturity			Seed yield/plot (4.05sqm)			Test weight (g)			Oil content (%)		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Sel-s-2017-1	35^{bcde}	42^{a}	38^{d}	96^{cd}	102^{ab}	92^{abcd}	109.7^{f}	99.9d^{ef}	193.4	3.2	3.2^{ab}	4.0	35.0	36.9	46.4^{a}
Sel-s-2017-2	36de	34^{d}	38^{d}	100^{cd}	97^{cd}	87^{e}	226.1^{ab}	144.4^{bcde}	203.0	3.5	2.6^{c}	3.8	32.5	35.6	43.9^{ab}
Sel-s-2017-3	35de	34^{d}	41^{bcd}	100^{cd}	98^{cd}	87^{e}	146.5^{def}	125.4^{cdef}	218.4	3.5	3.3^{ab}	3.4	30.3	37.5	47.2^{a}
Sel-s-2017-4	35de	36^{bcd}	44^{b}	92^{d}	104^{ab}	89^{bcde}	229.5^{ab}	146.9^{bcde}	205.1	3.4	3.4^{a}	3.8	34.9	38.1	46.3^{a}
Sel-s-2017-5	50^{b}	37^{bcd}	41^{bcd}	113^{ab}	97^{cd}	88^{cde}	125.6^{ef}	127.2^{cdef}	242.8	3.4	3.3^{ab}	3.3	30.9	37.1	41.8^{bc}
Sel-s-2017-6	34de	36^{cd}	38^{d}	92^{d}	98^{cd}	91^{abcd}	152.5^{cdef}	100.4^{def}	171.3	3.5	3.3^{ab}	3.7	33.0	33.9	44.6^{a}
Sel-s-2017-7	37^{cde}	35^{cd}	39^{cd}	104^{ab}	97^{cd}	94^{a}	293.2^{a}	140.5^{bcde}	195.2	3.6	2.1^{d}	3.7	34.6	36.4	45.0^{ab}
Sel-s-2017-8	35de	39^{abc}	40^{bcd}	92^{d}	98^{cd}	94^{a}	161.1^{cdef}	139.4^{bcde}	142.1	3.5	3.1^{ab}	3.9	36.2	41.0	47.4^{a}
Sel-s-2017-9	35de	37^{bcd}	40^{bcd}	96^{cd}	96^{d}	93^{ab}	176.0^{cdef}	112.7^{def}	220.3	3.7	3.2^{ab}	4.0	41.5	38.9	45.6^{ab}
IIOS-1	47^{ab}	37^{bcd}	39^{cd}	113^{ab}	107^{a}	93^{ab}	231.9^{ab}	237.8^{a}	191.1	3.8	3.3^{ab}	3.7	39.1	37.5	48.8^{a}
Sel-s-2017-10	43^{ab}	36^{bcd}	41^{bcd}	103^{ab}	107^{a}	93^{ab}	80.1^{f}	174.5^{abcd}	166.2	2.9	3.2^{ab}	3.5	35.9	37.1	47.8^{a}
Sel-s-2017-11	54^{a}	42^{a}	49^{a}	110^{a}	107^{a}	92^{abcd}	208.3^{abc}	188.0^{abc}	221.8	3.5	3.2^{ab}	3.3	31.5	36.8	47.2^{a}
JTS-8 (check)	34^{e}	36^{bcd}	41^{bcd}	92^{d}	96^{d}	88^{cde}	118.0^{ef}	95.2^{ef}	197.7	3.6	3.3^{ab}	3.8	33.2	37.7	39.4^{c}
GT-2 (check)	34^{e}	34^{d}	39^{cd}	93^{d}	97^{cd}	90^{abcd}	138.5^{cdef}	61.1^{f}	139.9	3.6	3.3^{ab}	3.6	37.0	37.5	46.4^{a}
Swetha Til (check)	55^{a}	41^{ab}	43^{bc}	113^{a}	107^{a}	93^{ab}	126.3^{ef}	206.4^{ab}	155.5	3.6	3.3^{ab}	3.6	34.0	37.4	47.2^{a}
TKG-22 (check)	36d^{e}	36^{bcd}	37^{d}	100^{ab}	98^{cd}	90^{adcd}	200.8^{abc}	80.2^{ef}	144.3	3.5	2.9b^{c}	3.6	32.3	35.4	38.1^{c}
General Mean	40	37	41	100	100	91	170.3	136.2	188.0	3.5	3.1	3.7	34.5	37.2	45.1
p-Value	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.6	0.8	<0.05	0.1	0.4	0.4	<0.05
CV (%)	2	5	5	4	2	2	18.4	24.5	30.9	12.2	5.7	8.2	14.0	6.9	5.7
SE(d)	1	2	2	4	2	2	25.6	27.3	47.4	0.3	0.2	0.2	3.9	2.1	2.1
LSD at 5%	4	4	4	7	4	3	52.3	55.7	ns	ns	0.3	ns	ns	ns	4.3

Yield and yield related traits during preliminary yield trials during *kharif, rabi* -2018 and summer-2019.
Figures in each column followed by different letters are significantly different according to LSD

Varietal entries in IVT

Two entries IIOS-7 and IIOS-8 have been nominated for AICRP (Sesame) coordinated trials during *kharif* 2019.

Raising of Multi parent F_1

The F_1's of eight parent F_1's were raised during *kharif* 2019 to generate F_2 generation through artificial selfing using glue dip method to ensure self pollination. The crosses which will be forwarded to advance the generation are given.

Similarly, F_1 of four way cross (EC-343403 x IC-204444/EC-118591 x IC-14136) was raised to generate F_2 seeds through selfing.

1	(HT-1 x RT-351)/(GT-2 x TKG-22)// (HIMA x TSS-6)/(RAJESHWARI x E-8)
2	(RAJESHWARI xE-8)/(TSS-6 x VRI-3)//(GT-2 xRT-351)/(HT-1 x TKG-22)
3	(GT-2 x HT-1)/(RAJESHWARI x TSS-6)//(RT-351 x TKG-22)/(HIMA x E-8)
4	(SWETHA TIL x VRI-3)/(GT-2 x RT-351)// (PHULE TIL x E-8)/HT-1 x TKG-22)
5	(PHULE TIL x RT-351)/(GT-2 x E-8)//(HT-1 x VRI-3)/(TKG-22 x SWETHA TIL)
6	(GT-2 x TKG-22)/(PHULE TIL x VRI-3)/(HT-1 x SWETHA TIL)/(RT-351 x E-8)

Evaluation of F_2 segregating population

To understand the genetics of flower lip colour and multicapsule/node in sesame, F_2 segregating population of (IC-205776 x EC118591) was raised during *kharif* 2019. The parent IC-205776 has a distinct pink floral lip and EC-118591 has multicapsules at every node. The population showed variation for flower lip colour, number of capsules per node and capsule pubescence. The seed yield varied from 6-24 g/plant. Single capsule from each plant was harvested without operating selection.

F_2 of the cross IC-205776 x EC-118591 showing segregation for flower colour and capsules/node

Generation advancement of double cross white sesame

F_2 populations derived from four way crosses listed below were raised. Plants within each cross were selected for distinct morphological characters with >80 capsules and >15 g of seed yield/plant.

(IC-96227 x IC-96160)/(Rajeshwari x VRI-3)
(IC-132201x IC-96160)/(Phule Til x VRI-3)
(Phule Til x E-8) /(IC-204613 x IC-96160)
(Phule Til x RT-351)/(IC-500472 x IC-96227)

Generation advancement of breeding population by single capsule descent method from F_3 to F_5

Single capsule from every plant without operating selection was harvested and planted for generation advancement in *kharif*-2019 for the crosses listed below.

Generation	Cross	Number of lines forwarded
F_4	IS-49-1A x RT-346	106
	CT-55 x CT-57	568
	EC-30344-1B x TKG-22	437

Generation advancement of breeding population

Generation advancement of F_3 to F_4; F_4 to F_5 of following crosses were made by single plant selections. Plants with seed yield >10 g/plant and disease free plants were selected within the progeny rows.

Generation	Crosses	Selections
F_4	CT-36 x TMV-7	17 F_3 families selected
	DSTA-1-A x VRI-2	14 F_3 families selected
F_4	GRT-8609 x HT-2	24 progeny rows
F_5	RT-346 x S-0449	11 progeny rows
	SI-349 x DS-5	15 progeny rows
	N-32 x RT-127	11 progeny rows

Selection from local landraces from North Eastern Hill regions

Five landraces *viz.*, Longkong-1, Longkong-2, Longidong, Lawkuti and Khensa were collected from Nagaland of NEH region of India. All these landraces are shattering types and exhibited variation for maturity within a plant. Single plant selections based on uniform maturity and seed yield per plant were made during summer 2019 to improve the local landraces.

Performance of the local landraces from NEH region

Genotype	Seed color	Plant height (cm)	Days to flower initiation	Days to maturity	Seed yield/ plant (g)
Longkong-1	White	124-156	43	102-110	8.5-12.7
Longkong-2	Black	117-151	32	106-110	7.3-11.7
Longidong	Black	103-127	35	98-110	9.5-14-8
Lawkuti	Black	106-110	32	95-112	6.7-10.8
Khensa	Black	106-128	32	95-110	6.2-9.7
Longla	Black	115-120	36	115-120	7.1-9.2

Hybrid Development

During this year, in castor breeding programme the focus has been to identify and develop hybrids suitable to different planting seasons as well as different ecosystems. The emphasis has been given to develop wilt and leaf hopper resistant high yielding hybrids with different durations. Many of the promising hybrids, identified in the previous years have been evaluated for their superiority over national checks and the superior ones have been advanced to next level of testing. Also, ICH-66 hybrid has been identified for release for its cultivation in peninsular India under rainfed conditions. In sunflower, superior experimental hybrids developed in the institute have been identified at different levels of testing under the AICRP system and advanced to next level of evaluation. Additionally, in both castor and sunflower, many experimental hybrids have been developed for further evaluation. A summary of the results obtained under different activities in the pipeline of hybrid development is presented here.

Castor

Hybrid notification

The hybrid ICH-66 has been notified for cultivation in rainfed regions of Andhra Pradesh, Telangana, Tamil Nadu, Karnataka and Odisha.

Preliminary evaluation of experimental hybrids

A total of 222 hybrids were evaluated in seven sets along with 50 parents and two checks, ICH-66 and GCH-8 during *kharif* season. Each entry was raised in a single row in a randomized block design of three replications at a spacing of 90 x 60 cm under rainfed conditions. Promising early hybrids (flowering between 36-40 DAS) were ICH-1072, ICH-1032 and medium duration hybrids were ICH-1024, ICH-1036, ICH-1040, ICH-1047, ICH-1050, ICH-1068, ICH-1046 ICH-1060 and ICH-1216. Final seed yield and other post-harvest operations are under progress.

ICH-1160

ICH-1146

Confirmatory yield trial of selected hybrids

A total of 13 hybrids, which were found promising in the preliminary yield trials in previous years were evaluated with two checks, ICH-66 and GCH-8 during *kharif* season. Each entry was raised in three rows at 90 x 60 cm spacing in a randomized block design with three replications. Among the entries, ICH-368, ICH-898, ICH-901, ICH-904 and ICH-941 were found promising based on preliminary data.

Sunflower

Hybrid promoted from AHT-I to AHT-II

IIOSH-15-20, a new hybrid recorded 5.7% and 21.4% higher seed yield and 15.9% and 18.0% higher oil

yield over the national check hybrids, KBSH-44 and DRSH-1, respectively in multiloction testing under AICRP. It recorded 0% downy mildew incidence and was promoted from AHT-I to AHT-II.

Sunflower hybrid promoted from AHT-I to AHT-II

Hybrid	Overall seed yield (kg/ha)	Seed yield superiority (%)	Overall oil yield (kg/ha)	Oil yield superiority (%)	Downy mildew (%)
IIOSH-15-20	1987	105.7	720	115.9	0
KBSH-44 (National check)	1880	100.0	621	100.0	60
DRSH-1 (National check)	1586	84.3	608	97.9	85
LSFH-171 (National check)	1869	99.4	561	90.3	0
CD (P=0.05)	84.7				
CV (%)	10.9				

Sunflower hybrid IIOSH-15-20 with good central filling

Performance of IIOSH-15-10 in AHT-II trial

Entry IIOSH-15-10 was promoted from AHT-I to AHT-II with 2.7% and 18.4% seed yield and 1.8% and3.9% oil yield superiority over the check hybrids, KBSH-44 and DRSH-1, respectively in AICRP trial. This hybrid has good central filling and with 0% downy mildew.

Performance of sunflower hybrid IIOSH-15-10 in AHT-II

Hybrid	Overall seed yield (kg/ha)	Seed yield superiority (%)	Overall oil yield (kg/ha)	Oil yield superiority (%)	Downy mildew (%)
IIOSH-15-10	1934	102.7	632	101.8	0
KBSH-44 (National check)	1880	100.0	621	100.0	60
DRSH-1 (National check)	1586	84.3	608	97.9	85
LSFH-171 (National check)	1869	99.4	561	90.3	0
CD (P=0.05)	84.7				
CV (%)	10.9				

Evaluation of hybrids for seed yield and yield contributing traits

Newly synthesized hybrids of IIOR were evaluated at Nimpith centre for identification of best hybrids for West Bengal conditions during *spring*-2019 in a randomized block design in two replications using KBSH-44, DRSH-1, KBSH-53 and LSFH-171 as checks. Out of 40 hybrids evaluated, 7 hybrids were promising with significantly higher seed yield than the best check. Highest seed yield was reported in hybrids

IOSH-521, IOSH-525, IOSH-539 and IOSH-623 (2499 kg/ha each) followed by IOSH-566 (2277 kg/ha) compared to the best check LSFH-171 (2166 kg/ha).

Synthesis of new experimental hybrids

A total of 100 new experimental hybrids were generated during *kharif*-2019 in a Line x Tester fashion using 10 CMS lines (CMS-234A, CMS-335A, ARM-243A, CMS-1010A, HA-430A). In the first set five CMS lines were crossed with 10 newly developed powdery mildew tolerant restorer lines. In the second set, five CMS lines (ARM-248A, CMS-38A, COSF-6A, COSF-7A and FMS-852A) were crossed with 10 newly developed drought tolerant restorer lines.

Safflower

Hybrid promotion

Three hybrids namely, ISH-400, ISH-401 and ISH-402 were promoted to AHT-II, and one hybrid, ISH-423 has been entered in IHT.

Seed production of hybrid and parental lines

Produced seed of eight new CGMS-based safflower hybrids, their male and female parents (A-lines), and seeds of maintainer lines of A-lines under nylon nets.

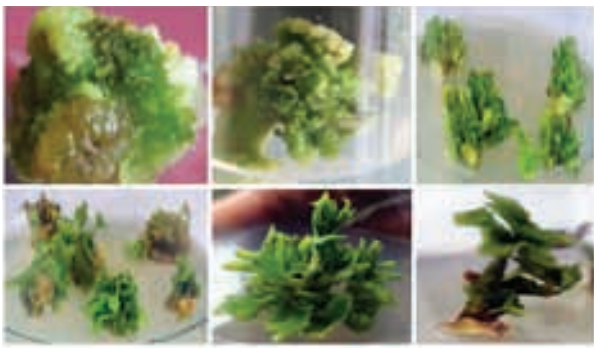
Molecular Breeding and Biotechnology

Molecular breeding has been adopted to address the traits that are difficult to phenotype or where pyramiding the genes that impart same phenotype is important. Developing genomic resources has been the focus in molecular breeding programmes in castor, safflower and sesame. Establishing marker–trait associations has been the primary activity in castor. The traits being addressed through MAS have been wilt resistance, nematode resistance and gray mold tolerance. Both bi-parental populations and association mapping panels have been employed to identify and map markers associated with wilt and also efforts have been made establish the allelic relationship of wilt resistance genes from germplasm sources. In safflower, during this year, focus has been on developing additional genomic resources including the *de novo* genome sequencing and annotation, and identification of additional SSR markers with high PIC, association mapping of QTLs for agro-morphological and quality traits, phenotyping of mapping population for aphid resistance and field evaluation of high oleic lines developed by marker-assisted backcrossing. In sesame, concentration has been on developing SSR based marker system. Continued efforts are being made to develop a reliable in vitro regeneration protocol in castor and further screening of progenies derived from *in planta* transformed lines have been carried out. A brief summary of the progress made under different programmes pursued during 2019 are presented here.

Castor

In vitro regeneration

Out of 60 different hormonal combinations tried for regeneration using embryo axes derived hypocotyls, three combinations *viz.*, BAP at 3 mg/l+ 0.5 g/l2-N-morpholinoethane sulphonic acid (MES), BAP 4.5 mg/L + 0.5 g/L MES and BAP 6mg/l + IAA 1mg/l, showed better shoot induction with about 4-5 shoots per explant. Responding explants were sub-cultured onto the same media after every 15-20 days. Shoot induction from the explants is shown in the figure. BAP at 4.5 mg/l + 0.5 g/l MES produced the best response with about 85% explants showing shoot induction. This medium also produced shoots with better elongated shoots and differentiated leaves compared to other combina-tions. Medium with BAP alone @ 0.5 mg/l or along with GA_3 @ 1 mg/l showed better elongation of the shoots (3 cm). Elongated shoots were transferred for root induction on MS medium supplemented with different auxins. The rooting was better on medium supplemented with IBA @ 1 mg/l.

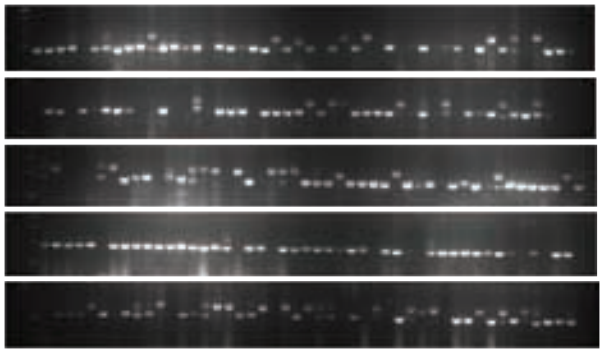


Multiple shoot induction on the media 4.5 mg/l BAP + 0.5 g/l MES

Safflower

Screening of germplasm mapping panel for association mapping of agronomic traits, oil content and quality

To identify marker-trait associations in safflower, a germplasm mapping panel comprising of 240 accessions was genotyped with 250 polymorphic SSR markers. The markers were selected from previous studies which were polymorphic and have high PIC value. The SSR markers generated a total of 728 alleles and number of alleles ranged from 2-16. The PIC value ranged from 0.15 – 0.74.For preliminary understanding, association mapping was performed for oil content generated from 4 locations through General Linear Model. The study identified five significant marker-trait associations ($P < 0.05$) for oil content i.e., ctdes258, ctdes91, ct102, ct201 and mCtIIOR15.



SSR profile of germplasm mapping panel with mCtIIOR10

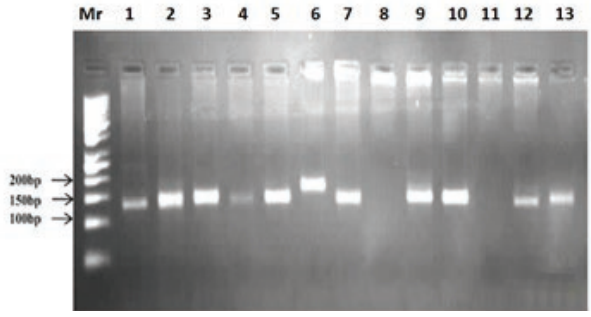
Allele mining for oil content

Full length genes associated with glycerol lipid metabolism, fatty acid biosynthesis, fatty acid elongation and transcription factors etc were identified from genome sequencing data and primers were designed for amplification. Initially, genes accD (Acetyl CoA carboxylase D), FAD2-1, FAD2-2, FAD2-10 (Oleate desaturases), GAPDH (Glyceraldehyde 3-Phosphate Dehydrogenase), Oleosin 2, 3, 5, 7, 8 genes, DGAT (Diacyl glycerol acyl transferase), FATA and FATB (Fatty acid thioesterases), GPAT (glycerol-3-phosphate acyltransferase) have been studied for sequence variation in 40 germplasm lines which had been phenotyped at four locations for oil content. Allele mining with the genes GAPDH, Oleosin genes 2, 7, 8, FAD2-2, FAD2-10, accD failed to show any sequence variation. Oleosin 4 showed nucleotide deletion in high oil lines and the association of these deletion with oil content needs to be established in a mapping population.

Sesame

Genomic resources in Indian sesame

Advanced breeding techniques are required to break yield barriers which requires the exploitation of marker assisted breeding requiring adequate genetic and genomic resources. Towards this direction, an additional set of 300 SSR markers were optimized for their PCR-amplification in Indian sesame and were tested for their amplifiability in a panel of 40 Indian genotypes. Out of 300 SSRs, 32 were polymorphic and the polymorphic information content (PIC) varied from 0.25 to 0.63. About 100 SSR markers were assigned to linkage groups based on *in silico* analysis using publicly available sesame genome sequence information. This information helps in selection of a set of SSR markers with genome-wide coverage.



Electrophoregram showing polymorphism of sesame markers Mr: marker; SSR markers: 1. SIM030, 2. SIM034, 3. SIM051, 4. SIM055, 5. SIM059, 6. SIM065, 7. SIM072, 8. SIM077, 9. SIM101, 10. SIM105, 11. SIM107, 12. SIM109 and 13. SIM112 showing amplification in sesame genotype NIC-16426-IS

Identification and stabilization of genotypes for mapping of various agronomic traits

In order to develop mapping population, the most important and critical requirements is a pair of contrasting and genetically stable genotypes. In this direction, 106 selected and selfed Indian sesame genotypes were raised under field condition and were evaluated for the stability of the traits that they were selected. The following spectrum of variability was recorded : number of branches ranged from 0-18,

number of capsules per axil exhibited the range of 1-6, number of locules per capsule varied from 4-8, intermodal length ranged from 3-16 cm, plant height was in the range of 41-117 cm, the basal bearing was recorded in the range of 4-74 cm with 25-65 days taken to 50% flowering and 93-128 days to physiological maturity, seed weight (g/plant) ranged from 1.2-32 and seed oil percentage (NMR based) was in the range of 25-45.

Range of yield contributing traits and genotypes recording minimum and maximum values

Trait	Range	Min. recorder	Max. recorder
Plant height (cm)	41-117	TKG-22-p5-p3-p9	NIC-3181-p9-p10-p1
No. of branches	0-18	DS-5-p1-p7-p6	G-TIL-2-p1-p4-p7
No. of capsules/node	1-6	G-3-p1-p8-p5	RT-351-p4-p6-p3
No. of capsules/plant	18-415	RT-351-p10-p3-p2	G-TIL-10-1-p4-p8-p1
No. of locules/capsule	4-8	Many	SI-2192-1-p8-p2-p6
Internodal length (cm)	3 – 16	NIC-161848-p1-p8-p9,	G-43-1-p4-p6-p1
Days to 50% flowering	25-65	12 genotypes	52 genotypes
Days to physiological maturity	93-128	8 genotypes	23 genotypes
Height of basal capsule (cm)	4-74	IS-113-A-1-p8-p5-p2	ES-303311-1-p10-p2-p5
Seed weight per plant(g)	1.2-32	TKG-22-p10-p1-p4	G-TIL-10-1-p4-p8-p1
Seed oil content (%)	25-45	Swetha-p9-p1-p5	VRI-SV-2-p7-p10-p3

DUS testing

Under the Central Sector Scheme for Protection of Plant Varieties and Farmers Rights Authority, DUS testing of one new candidate variety of castor was undertaken along with two reference varieties and data were recorded for 30 DUS traits. Multiplication of one farmer's variety of castor was undertaken during *kharif* 2019. The monitoring team visited the castor DUS trial on 7 November 2019 and were satisfied with the activities conducted by the centre as well as the conduct of the DUS trial.

Seed Production

A total of 1110.05 q of quality seeds of parental lines, varieties and hybrids of castor, sunflower, sesame and safflower were produced during the year.

Seed production of different oilseed crops

Crop	Variety/ Parent/ Hybrid	Seed Production (q)*
Castor	DCS-107 (V) (BS)	1.50
	ICS-164 (Male Parental line)	1.20
	SKP-84 (Female Parental line)	2.00
	ICH-66 (Hybrid) (CS)	400.00**
	DCH-519 (Hybrid) (in Stock)	259.70
	Total	**664.40**
Sunflower	DRSF -113 (V) (BS)	0.20
	DRSF-108 (V) (BS)	0.10
	243 A (Female Parent)	0.40
	243 B (Female maintainer line)	0.20
	6 D-1 (Male Parent)	0.35
	DRSH-1 (Hybrid) (TL)	40.00*
	Total	**41.25**

Crop	Variety/ Parent/ Hybrid	Seed Production (q)*
Sesame	YLM -66 (V) (TL)	2.50
	Shweta til (V) (TL)	30.00
	CUMS-17 (V) (TL)	3.00
	GT-10 (V) (TL)	1.00
	Total	**36.50**
Safflower	NARI-96 (V) (BS)	2.00
	ISF-764 (V) (BS)	12.00
	ISF-764 (V) (CS & TL)	350.00**
	NARI-57 (V) (BS)	0.35
	DSH-185 (H) (TL)	2.00
	CMSA-133 (Parental line) (BS)	0.75
	B-133 (Parental line) (BS)	0.30
	1705-p22 (R line) (BS)	0.50
	Total	**367.90**
Grand total	**2019-20**	**1110.05**

*= Expected Production, **=Participatory certified seed production under Oilseeds Seed hub

Oilseeds Seed Hub project

A Seed Hub project entitled 'Creation of Seed-Hubs for Enhancing Quality Seeds Availability of Oilseed Crops' sponsored by Oilseeds Division, NFSM, Department of Agriculture, Cooperation & Farmers Welfare, MoA, Govt. of India was sanctioned for the period 2018-19 to 2019-20 with a total budget outlay of Rs.5091.18 lakhs and included nine annual oilseeds in 36 seed hubs in 16 states with a production target of 60825 q. For each seed hub, Rs.100.0 lakhs as revolving fund and Rs.50.0 lakhs for infrastructure development has been provisioned. ICAR-IIOR is the nodal coordinating centre with ICAR-DGR for Groundnut, ICAR-IISR for Soybean, ICAR-DRMR for Rapeseed & Mustard and ICAR-IIOR for Castor, Sunflower, Safflower, Linseed, Sesame and Niger crops as Co-nodal centres. ICAR-IIOR is also one of the seed hubs for castor and sunflower crops during 2018-19. The main objectives of the oilseeds seed hub is to increase VRR and SRR to supply quality seed availability by undertaking certified seed production of latest (<10 years old) varieties.

Summary of production target and budget for 2018-19 & 2019-20

Crop	Number of seed hubs	Physical target of quality seed production (q)			Total budget (Rs. in lakhs)
		2018-19	2019-20	Total	
Groundnut	9	7,450	11,100	18,550	1350
Soybean	7	7,350	11,500	18,850	1050
Rapeseed & Mustard	8	3,800	6,000	9,800	1200
Castor	1	2,100	2,000	4,100	750
Sunflower	2	1,200	1,650	2,850	
Sesame	1	800	1,000	1,800	
Safflower	2	800	1,000	1,800	
Linseed	3	1,400	1,400	2,800	500
Niger	3	65	210	275	200
Total	**36**	**24,965**	**35,860**	**60,825**	**5050.00**
Coordination unit (IIOR)					41.18
Grand Total	**36**	**24,965**	**35,860**	**60,825**	**5091.18**

During 2018-19, as against 36 seed hubs, only 30 seed hubs participated with a production target of 20565 q. The production achieved was 14059 q. The shortfall was mostly in groundnut and soybean due to shortage of source seed of latest varieties and inclement weather and extreme weather conditions during the main (*kharif*) season of production for these crops. Other crops could achieve 85 to 100% of targets. Accordingly, the production target for 2019-20 was revised to cover the shortage of 2018-20 to achieve total targeted production. There were issues of lifting in crops like rapeseed-mustard, linseed and castor. Out of total budget allocation of Rs. 5,091.18 lakhs, Rs.3,300 lakhs have been received during 2018-19. Total budget towards infrastructure has been released to all centers and revolving fund was released as per the production targets and the funds availability. Review meetings were organized periodically for monitoring the physical and financial progress under the project.

Crop Production

Conservation Agriculture

Conservation agriculture aims at achieving sustainable agriculture and improved livelihoods of farmers through the application of the three basic principles: minimal soil disturbance, permanent organic cover (crop residues or cover crops) and crop rotations in sequences and/or associations. In the long-term, conservation agriculture has been found to render several benefits including soil conservation with improved soil health, high rain water use efficiency, climate change mitigation and adaptation, improved biodiversity, resilience to climate shocks and higher economic returns. Keeping this in view, a field experiment was initiated to assess the potential of conservation agricultural practices in castor based cropping systems and the results are presented.

Development of conservation agricultural practices for castor based cropping systems

The field experimentation on conservation agriculture in shallow Alfisols was continued in fixed plots under rainfed conditions. During the second year, three tillage treatments *viz.,* (i) conventional tillage - one disc plough+two cultivators + rota tiller; (ii) reduced tillage - one cultivator+one rota tiller (no disc plough); (iii) zero tillage - no tillage and herbicidal weed management in main plots and four intercropping systems *viz.,* sole castor (cv. DCH-519); castor+redgram (cv. Hanuma) (for grain and cut *in situ* spread) (1:1); castor+greengram (cv.WGG-42) (for grain and uprooted and *in situ* spread) (1:3) and castor+groundnut (cv.K-6) (1:3) were imposed.

During the crop growth period, 625 mm of rainfall was received in 55 rainy days as against the normal rainfall of 730 mm in 51 days (14% deficit rainfall). Low rainfall during early stages followed by high amount (306 mm during 34-43 standard weeks) influenced the performance of castor and associated crops.

The physiological observations on performance of castor was influenced due to different tillage practices. The stomatal conductance was highest in conventional tillage (0.278 m mol $H_2O/m^2/s$) followed by reduced tillage (0.238 m mol $H_2O/m^2/s$) and zero tillage (0.224 m mol $H_2O/m^2/s$). The mean intercellular CO_2 was highest (0.307 ppm) in conventional tillage followed by zero tillage (0.293 ppm) and reduced tillage (0.283 ppm). The transpiration rate was highest in zero tillage (1.98 μ mol $H_2O/m^2/s$) followed by conventional (1.94 μ mol $H_2O/m^2/s$) and reduced tillage (1.84 μ mol $H_2O/m^2/s$). The net photosynthesis was found to be highest in reduced tillage (11.35 μ mol $CO_2/m^2/s$) followed by conventional and zero tillage methods (8.4 μ mol $CO_2/m^2/s$). The leaf temperature across tillage methods and intercropping systems did not differ and it ranged from 26-28 ^{0}C.

During the first year, the total nutrient uptake of castor (N, P, K and S) by stalks and seed was significantly influenced by different tillage methods and castor based intercropping systems. The total N uptake was found to be the highest (50.1 kg/ha) in conventional tillage followed by reduced tillage (43.9 kg/ha) and zero tillage (42.2 kg/ha). Among intercropping systems, the highest N uptake was recorded in sole castor (59.6 kg/ha) followed by castor + groundnut (43.9 kg/ha); castor + greengram (43.4 kg/ha) and castor + redgram (34.8 kg/ha). The total uptake of P, K and S by castor followed a similar trend.

Comparative performance of castor in zero tillage and conventional tillage

Performance of castor+redgram (1:1) intercropping under reduced tillage

Cropping Systems Research

System approach to agriculture involving sequential cropping helps in bringing stability to the production through better use of resources, improving soil health, reduced production costs and enhanced yields of the component crops in the system. Short duration legume or cereal or *kharif* fallow preceding safflower is a common practice in safflower growing regions of the country in Vertisols. Greengram-safflower or fallow-safflower are popular in rainfed regions whereas soybean-safflower is popular in irrigated regions. Broad bed and furrow (BBF) method of land configuration ensures moisture conservation and timely sowing of safflower under zero tillage conditions. In this direction, sustainability of safflower based cropping system productivity under BBF was carried out and the results are presented.

Assessing safflower based cropping systems productivity under BBF with different crop geometry and IPNM practices

A field experiment was conducted in Vertisols under rainfed conditions with three safflower based cropping systems *viz.*, greengram (WGG-42)-safflower, soybean (JS-93-05)-safflower and soybean (JS-335)-safflower. Four rows of *kharif* crop were sown on each broad bed and furrow with a row to row spacing of 30 cm. Safflower (PBNS-12) was sown in zero tilled field. In each cropping system, six treatment combinations *viz.*, (2 rows/BBF; 3 rows/BBF) and three fertilizer levels (control, 50% RDF + *Azotobacter* + PSB, 100% RDF + *Azotobacter* + PSB) were tested in a split plot factorial design with two replications.

Safflower was sown on September 20, 2019 after harvest of greengram and on October 15, 2019 after harvest of both the varieties of soybean. *Kharif* crops did not influence the productivity of safflower. Productivity of safflower when sown in 2 rows/BBF fertilized with either 50% RDF + *Azotobacter* + PSB (839 kg/ha) or 100% RDF + *Azotobacter* + PSB (820 kg/ha) was statistically on par with that of the crop sown in 3 rows/BBF fertilized with either 50% RDF + *Azotobacter* + PSB (884 kg/ha) or 100% RDF + *Azotobacter* + PSB (866 kg/ha). Crop raised without fertilizer recorded the lowest productivity. Greengram and soybean were sown in the first week of July with the onset of monsoon. The seed yield of greengram (WGG-42), soybean (JS-93-05) and soybean (JS-335) were 700, 1500 and 1800 kg/ha, respectively.

Preceding crops of safflower

Soybean (JS-335)

Greengram (WGG-42)

Soybean (JS-93-05)

Sowing of crops on broad bed and furrow with animal drawn tropicultor

Sowing of kharif crops on Broad bed and furrow

Sowing of safflower under zero tillage

Resource Use Efficiency

Resource use efficiency is a measure of factor productivity in terms of output (seed yield) per unit of input (resource) or totality of inputs as combination. Use efficiency of resources of plant nutrients and moisture, mainly depend on the capacity of soils and nature of crops grown under a specific season with defined management practices. Resource use pattern is being assessed through long term field experiment (LTFE) in emerging cropping systems in oilseeds. Furthermore, Fe and Zn based nano system is being evaluated to improve nutrient use efficiency.

Long-term fertilizer studies in maize-castor cropping system in Alfisols

The cropping system in the fixed plot field experiment initiated during *kharif* 1999 with the response of major, secondary and micronutrients on a long-term basis was assessed in the second cropping cycle in maize (*kharif*)-castor (*rabi*) cropping system in Alfisols. Highest seed yield of maize (4890 kg/ha) was recorded with 150% RDF to both the crops that was significantly higher over imbalanced nutrition with no manure control, N alone, NP alone or 50% NPK to both crops. Integrated and balanced nutrient management with organic manure or crop residue or secondary and micronutrients use along with recommended NPK were at par. Soil fertility parameters after harvest of maize in 2018 indicated that the INM treatment with FYM along with RDF recorded an organic carbon content of 0.57%. The soil Zn content was significantly higher only wherever Zn had been applied along with RDF. The performance of *rabi* castor in terms of growth was similar to that of maize for different nutrient management practices.

Abiotic Stress Tolerance

Abiotic stresses like drought and salinity are the limiting factors for oilseeds production under rainfed conditions. Occurrence of drought at sensitive stages severely limits crop yields. Therefore, identification of drought tolerant lines and traits contributing to tolerance is a prerequisite of such breeding programmes. Towards this direction, castor, sunflower, safflower and sesame genotypes were screened and sources of resistance to drought and salinity were identified which are elaborated.

Castor

Evaluation of hybrids along with parents for root growth (poly bags)

Five hybrids (DCH-177, DCH-519, ICH-440, ICH-66, ICH-278) along with parents, DCS-107 variety and ICS-210 male line were grown in poly bags to study the root and shoot growth during *kharif*, 2019 in CRBD with four replications and three plants per replication till 90 days after sowing (DAS). Data on plant growth, root traits (length, volume, weight) and total drymatter (TDM) were recorded. Strong positive correlation (>0.60) between plant height with stem girth, root volume, root dry weight, TDM; stem girth with root length, volume, dry weight and TDM; root volume with root dry weight, TDM and root dry weight with TDM were recorded. TDM showed positive correlation with all shoot and root traits.

Correlation coefficients among different root and shoot traits

Parameter	Stem girth	Root length	Root volume	Root dry weight	TDM
Plant height	0.718	0.299	0.784	0.865	0.650
Stem girth		0.601	0.709	0.822	0.747
Root length			0.532	0.519	0.316
Root volume				0.924	0.592
Root dry weight					0.702

Plant height was greater in ICS-210 (116.4 cm) followed by ICS-164 and DCS-107 (101.5 cm). Stem girth of genotypes ICS-210, DCS-107, ICS-164, ICH-278 and SKP-84 were on par with each other. Secondary branch production was seen in all genotypes at 90 DAS. DCS-107 recorded long tap root which was on par with DPC-25, ICS-210, ICH-278, DPC-15, SKP-84 and DCH-177. Higher root volume was recorded in ICS-210 followed by DPC-25, DCS-107. ICS-210 also recorded more root dry weight followed by DCS-107. Root dry weight was on par in ICS-164, SKP-84, DPC-25 and in hybrids DCH-177, DCH-519, ICH-66. Total spike weight was more in DCH-177 (148.8 g/plant) which was on par with ICH-278 (130.7 g/plant). Highest TDM was recorded with DCH-177 and was on par with DCS-107, ICH-278, ICS-210, ICS-345 and DCH-519.

Among the hybrids and their parents, root growth (volume and dry weight) and TDM at 90 DAS was significantly more in the hybrid DCH-177 followed by its female parent. Growth of male parent (DCS-9) was less than that of female parent (DPC-9). Crop growth, root characters and total spike weight of hybrid DCH-519 was on par with that of parents, but TDM of male parent (DCS-78) and hybrid was at par and significantly higher than female parent (M-574). In ICH-440 hybrid, performance in terms of root and shoot growth was significantly higher in male parent (ICS-345), female parent (DPC-15) and hybrid performance was on par and poorer than that of male parent. More root growth was recorded in male (ICS-164) parent of ICH-66 but statistically on par with female parent (SKP-84) and hybrid. Spike weight was more and on par in male and hybrid but TDM was more in male parent than female parent and hybrid ICH-66 which were on par with each other. Root dry weight of ICS-164, male parent of ICH-278 was more and on par with female parent (DPC-25). However, TDM was significantly higher in hybrid ICH-278 which was on par with male parent. Growth of the hybrids in terms of root dry weight and TDM, DCH-177, DCH-519 were superior, on par with ICH-66, ICH-278 and ICH-440 was inferior to the parents in ICH-440.

Growth parameters and root traits of castor genotypes in poly bags at 90 DAS

Geno-types	Plant height (cm)	Stem girth (mm)	Root characters (per plant)			Spike weight (g/plant)	TDM (g/plant)
			Root length (cm)	Root volume (ml)	Root dry weight (g/plant)		
DPC-9	55.7	22.1	95.4	180.8	33.0	98.9	203.5
DCS-9	50.6	17.7	99.7	81.1	14.3	41.0	100.8
DCH-177	56.2	22.7	109.0	221.8	40.0	148.8	283.2
M-574	54.7	18.1	93.1	142.5	31.4	81.9	181.6
DCS-78	76.3	22.7	94.0	169.9	36.7	109.9	238.3
DCH-519	92.7	22.4	91.4	213.5	43.3	99.0	242.8
DPC-15	28.3	21.0	109.8	104.3	19.7	72.5	150.4
ICS-345	65.5	21.5	103.1	176.7	38.0	118.0	244.4
ICH-440	37.5	16.1	86.3	147.5	21.3	76.9	169.7
SKP-84	63.8	23.5	131.0	227.5	48.8	62.3	191.3
ICS-164	101.5	24.3	99.5	254.0	51.9	85.3	244.9
ICH-66	87.4	20.3	97.3	194.6	40.2	94.8	196.0
DPC-25	80.8	21.9	120.8	350.0	44.5	71.3	200.2
ICS-164	101.5	24.3	99.5	254.0	51.9	85.3	244.9
ICH-278	80.9	23.1	120.1	190.8	35.9	130.7	279.7
ICS-210	116.4	25.7	115.1	458.3	77.1	69.7	267.5
DCS-107	101.4	24.7	132.0	331.0	64.3	79.3	275.0
Minimum	28.3	16.1	86.3	81.1	14.3	41.0	100.8
Maximum	116.4	25.7	120.8	458.3	77.1	148.8	283.2
CD (0.05)	12.6	2.2	19.4	48.1	11.3	18.8	43.7
CV (%)	12.3	7.07	12.8	15.6	19.8	14.6	14.1

Sunflower

Identification of sunflower inbreds tolerant to temperature stress

Forty seven lines including B and R lines with five hybrids (DRSH-1, KBSH-44, CO-2, RSFH-130 and CSFH-12205) were evaluated for temperature tolerance under field conditions by taking up sowing at two dates one normal (February 1, 2019) and another delayed sowing (March 1, 2019) to expose the crop to high temperature. Crop was irrigated whenever necessary and not subjected to water stress at any stage. Days to flowering and days to harvest were reduced in delayed sowing when compared to the normal sowing. Mean maximum and minimum temperatures recorded from sowing to flowering in normal sowing were 34.5°C and 17.4°C; and in delayed sowing were 37.5°C and 20°C, respectively. The mean maximum and minimum temperatures from sowing to harvest was recorded as 36.4°C, 19.1 °C and 42°C, 25.6 °C in normal and delayed sowing, respectively. Temperature stress advanced days to flowering by 4 days and days to harvest by 9 days. Significant yield reduction was observed due to high temperature. Among the hybrids, KBSH-44 and CO-2 showed less yield reduction. Three lines showed more than 80% yield reduction. Ten best performing entries *viz.*, AKSF-6-3B, CMS-42B, CMS-58B, CMS-59B, CMS-107B, CMS-108B, CMS-127B, CMS-135B, CMS-144B, and CMS 275 B showed tolerance to high temperature with no significant difference between two sowing dates.

Sunflower inbreds tolerant to high temperature stress

S. No	Genotype	Seed weight (g/plant)		% reduction
		Normal sowing (ideal temperature)	Delayed sowing (high temperature)	
1	AKSF 6-3B	7.2	7.1	2
2	CMS-42B	3.5	4.1	-17
3	CMS-58B	1.9	1.6	15
4	CMS-59B	3.6	3.3	8
5	CMS-107B	4.9	4.3	11
6	CMS 108B	4.2	3.5	16
7	CMS-127B	8.1	7.3	9
8	CMS-135B	3.6	3.1	13
9	CMS-144B	4.1	4.7	-15
10	CMS-275B	2.9	1.9	34
11	DRSH-1	20.1	9.5	53
12	KBSH-44	21.0	16.5	22
13	CO-2	7.8	6.5	16
14	CSFH-12205	24.3	10.8	56
15	RSFH-130	32.2	9.8	69
16	CMS 103B	6.4	1.0	85
17	CMS 607B	1.5	0.2	86
18	HA 248B	5.1	0.1	98
	Mean	7.5	3.9	45
		Genotypes at different sowing dates	Genotypes at same sowing date	
	C.D (0.05)	1.06	1.09	

Safflower

Evaluation of genotypes to salinity stress in laboratory using paper towel method

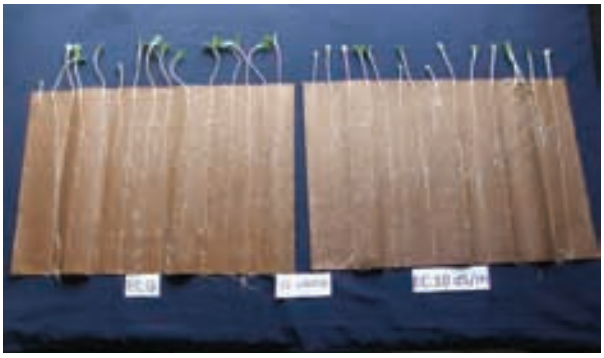
Paper towel based laboratory study was conducted to further evaluate the previously screened 24 safflower genotypes (based on % germination at a salinity of 23.0 dS/m in petri plate method) at five levels of salinity (EC=0, 4, 6, 8 and 10 dS/m) to record the growth parameters of the seedlings in response to salinity. Based on the growth response, paper towel method was standardized for rapid screening of safflower genotypes at a growth limiting EC value of 10 dS/m.

At EC=10 dS/m, the genotype IC-406052 showed only 23% reduction in shoot length against control (0 salinity) while, a maximum reduction of 65% was recorded in genotype SSF-733. The shoot dry weight of genotypes varied due to salinity levels. Highest reduction of shoot weight (54%) was noticed in SSF-733 and minimum was recorded in IC-406052 (26%) compared to zero salinity.

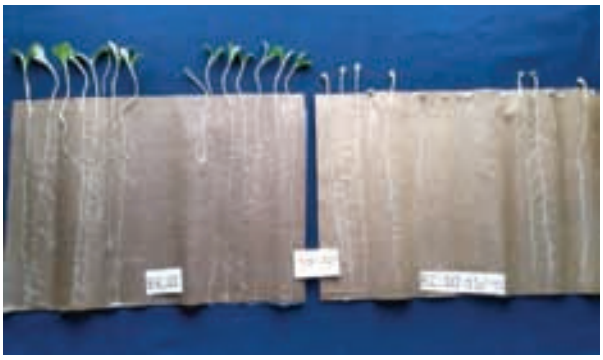
The growth of the seedlings in paper towel at different salinity levels varied significantly and this was directly affected by the concentration of sodium (Na) and potassium (K) contents in the shoot and roots of the genotypes. It was observed that as the salinity increased from EC=0 to 10 dS/m, the Na content also increased, it was highest in susceptible genotype (8.0%) compared to the tolerant types. It was observed that the concentration of K in shoot remained almost

the same at both low and high salinity levels in all the tolerant genotypes. However, it was the least in susceptible genotype (0.7%). Growth of shoot and root was prominent in genotype IC-406052 compared to susceptible check SSF-733 at salinity of EC=0 and 10 dS/m.

Growth of roots in tolerant and susceptible genotypes



Genotype IC-406052 (tolerant type)



Genotype SSF-733 (Susceptible type)

Though the root growth in terms of its length decreased due to increased salinity levels for all the genotypes, the highest root length was observed in genotype IC-406052 (30.1 cm) and the shortest roots were observed in SSF-773 (27.4 cm) at highest salinity (EC=10 dS/m). Similarly, the highest root weight at high salinity (EC=10 dS/m) was seen in genotype IC-406052 (0.06 g) and the minimum weight was recorded in genotype SSF-773 (0.03 g). Genotype IC-406052 had significantly low concentration of sodium ions (6.1%) in the roots as compared to all the other genotypes, while highest sodium ions in roots was noticed in SSF-733 (10.2%) at high salinity (EC=10 dS/m). In contrary, the potassium was highest in IC-406052 (1.3 %) and lowest in SSF-733 (0.75%). Hence the salinity tolerance in genotype IC-406052 may be due to the maintenance of high potassium and low sodium concentration in the roots.

Salinity stress in safflower

G	Shoot length (cm)						Shoot weight (g)						Shoot Na content (%)						Shoot K content (%)					
	Salinity, EC (dS/m)						Salinity, EC (dS/m)						Salinity, EC (dS/m)						Salinity, EC (dS/m)					
	0	4	6	8	10	M	0	4	6	8	10	M	0	4	6	8	10	M	0	4	6	8	10	M
G1	7.8	6.5	6.3	5.3	5.4	6.3	0.29	0.26	0.24	0.21	0.20	0.24	2.0	4.4	6.4	7.1	7.0	5.4	1.4	2.0	1.6	1.3	1.5	1.6
G2	8.2	7.4	7.3	7.1	5.3	7.1	0.29	0.23	0.23	0.23	0.21	0.24	2.7	4.4	6.6	5.7	6.0	5.1	1.6	1.7	1.3	1.7	1.3	1.5
G3	8.9	7.4	7.3	7.0	6.8	7.5	0.38	0.35	0.32	0.30	0.28	0.33	2.1	3.4	5.2	4.5	5.2	4.1	1.3	2.2	1.8	1.6	1.6	1.7
G4	7.6	7.2	7.2	6.8	5.6	6.9	0.26	0.22	0.20	0.18	0.18	0.21	2.7	2.8	3.6	4.8	5.4	3.8	1.1	1.3	0.9	1.2	1.0	1.1
G5	7.6	5.8	5.8	5.6	5.6	5.9	0.22	0.24	0.20	0.21	0.20	0.21	2.4	3.5	4.8	4.6	5.4	4.1	1.1	1.1	1.0	1.0	0.9	1.0
G6	8.2	5.3	4.8	4.2	2.8	5.0	0.31	0.20	0.19	0.15	0.14	0.19	2.0	5.4	7.6	7.9	8.0	6.2	1.2	0.9	0.7	0.7	0.7	0.8
M	7.6	6.6	6.5	6.0	5.2	-	0.26	0.24	0.22	0.22	0.21	-	2.3	4.0	5.7	5.8	5.8	-	1.3	1.5	1.2	1.3	1.1	-
	CD (0.05)		SEm±		CV (%)		CD (0.05)		SEm±		CV (%)		CD (0.05)		SEm±		CV (%)		CD (0.05)		SEm±		CV (%)	
G	0.09		0.030.001		1.7		0.01		0.004		5.23		0.06		0.002		1.84		0.464		0.166		5.41	
S	0.004		0.007				0.05		0.02				0.03		0.01				0.207		0.074			
GXS	0.01						0.008		0.008				0.14		0.05				NS		0.37			

G= Genotypes; S= Salinity levels (EC= dS/m); G x S= Interaction; G1=IC-406143, G2=EC-661173, G3=IC-406052, G4= A-1, G5=PBNS-12, G6=SSF-773 (susceptible check); M= mean

Sesame

Identification of genotypes tolerant to drought

Evaluation for drought tolerant genotypes in sesame was carried out under well watered (WW) and water stress (WS) conditions. The core set of sesame germplasm (72) consisting of indigenous landraces from different agro-ecological zones of India were screened under intermittent drought. Stress level was monitored by using sensors and drought stress was maintained (-4.5 mpa) from post-anthesis stage to physiological maturity. Morphological, physiological traits, yield and yield attributes were recorded. Twenty accessions were selected based on cluster analysis, seed yield under intermittent drought and the traits associated with drought tolerance across seasons in 2018. Oil content varied from 38 to 52% under stress conditions. Structural root traits were studied at different soil depths and estimated their relationship with the seed yield and shoot biomass. The association of morpho-physiological traits with seed yield under WW and WS and across seasons was divergent. Expression of most of the traits was reduced under intermittent drought condition, though maximum number of traits were either positively or negatively associated with seed yield across seasons under intermittent stress condition. The total dry weight, dry matter efficiency, number of capsules, harvest index were positively correlated with seed yield, whereas traits such as leaf area, leaf area ratio, leaf dry weight and canopy temperatures were negatively associated with seed yield indicating that smaller and cooler canopy genotypes are better performers under intermittent stress conditions. The identified genotypes (IC-96229, IC-132293, IC-132171, IC-204679 and JCSDT-26) with potential root traits and better yields could be used in varietal development programme aimed at incorporating drouht tolerance.

IC-132171 *IC-204679* *JCSDT-26*

Sesame germplasm lines and local selections with drought tolerance under field conditions across seasons (rabi and kharif)

Groundnut

In vivo evaluation of biopolymer based *Trichoderma* formulations

Groundnut seeds were treated with biopolymer based *Trichoderma harzianum* (Th4d) liquid formulations (chitosan+Th4d; polymer 1+Th4d) and Th4d W.P. 1.5% along with untreated control. The plants were grown in growth chamber in pots (temperature 25 °C, RH 70%). The plants were watered up to 40 days after sowing and thereafter water was withheld to impose drought stress. Seedlings were observed for appearance of stress symptoms (rolling and wilting of leaves). Plants were harvested 7 days after withholding water. Observations on germination %, shoot length, root length, fresh and dry biomass of shoot, relative water content (RWC), chlorophyll content, proline and total sugars of leaves were recorded. For all the characters measured, except chlorophyll content, the treatments varied significantly. Treatments chitosan + Th4d and polymer 1 + Th4d were superior compared to Trichoderma (Th4d) along as well as the control treatments. Seed coating with chitosan+Th4d, polymer 1+Th4d and Th4d W.P. 1.5% resulted in significantly higher germination (drought not imposed), shoot length, root length, dry biomass of shoot, proline, total sugars and RWC under stress condition over control.

Effect of biopolymer based *T. harzianum* (Th4d) on groundnut under drought stress condition

Parameters	Chitosan+ *T. harzianum* (Th4d)	Polymer 1+*T. harzianum* (Th4d)	*T. harzianum* (Th4d) W.P. 1.5%	Control	LSD
Germination (%)	93.0^{a}	93.0^{a}	86.0^{b}	80.0^{c}	0.9
Shoot length (cm)	38.5^{a}	38.6^{a}	36.4^{a}	34.3^{b}	4.3
Root length (cm)	47.2^{a}	45.2^{b}	45.0^{c}	39.0^{d}	0.13
Shoot dry weight (g)	1.4^{a}	1.3^{a}	1.0^{b}	0.8^{b}	0.2
Relative water content (%)	81.6^{a}	77.3^{a}	71.9^{b}	64.7^{c}	4.3
Proline (µmol /g)	0.35^{a}	0.34^{a}	0.25^{b}	0.23^{b}	0.06
Total sugars (mg/g)	17.5^{a}	15.8^{b}	11.4^{c}	11.7^{c}	1.5
Chlorophyll content (SPAD)	32.9^{a}	33.7^{a}	32.0^{a}	30.6^{a}	4

(Figures followed by different alphabets differ significantly)

Seed coating of biopolymer based T. harzianum on groundnut under drought stress condition

Quality and Value Addition

Safflower is a good source of high quality protein and efficacy studies for replacement of soybean meal with safflower kernel meal and protein hydrolysates in diet of vanaraja chicks is discussed.

Value addition of safflower kernel

Efficacy of safflower kernel meal (SKM) and safflower protein hydrolysates (SPH) were tested in *vanaraja* variety of chicks during summer conditions. Results showed non-significant ($p > 0.05$) difference between body weight gain and feed conversion ratio (FCR) at different levels of SKM. However, feed intake reduced significantly with diet containing 75% (15.9 kg) of SKM. Results also showed that chicks fed on diet containing 50% and 75% of SKM recorded significantly ($p > 0.05$) higher levels of albumin content. Chicks fed on diet containing 50% of SKM recorded significantly ($p > 0.05$) higher levels of glutathione reductase activity. Activities of glutathione peroxidase, lipid peroxidase (LP), super oxide dismutase (SOD) and blood urea nitrogen (BUN) did not vary significantly across the treatments. Non significant ($p > 0.05$) changes were recorded in body parameters of the chicks with the gradient levels of SPH. However, in comparison with the control, significant increase (two folds) in glutathione reductase activity was recorded with SPH supplement. Overall, the study results suggested that SKM could efficiently substitute soybean meal up to 75% in the diet of *vanaraja* chicks without affecting the performance and carcass yield and thus it could be economical for poultry farmers.

Host Plant Resistance

Host plant resistance to insect pests and diseases is an effective, economical, and eco-friendly method of pest management. Standardization of reliable mass screening method, identification of sources of resistance and deciphering the associated mechanism(s) were carried out against major and emerging pests viz., Fusarium wilt, gray mold, capsule borer and sucking pests (leafhopper, thrips and whitefly) in castor; Alternariaster leaf blight and leafhopper in sunflower; wilt and aphid in safflower; root rot, phyllody, leafhopper, leaf webber and capsule borer in sesame, for their utilization in resistance breeding programme

Screening methods

Symptom mapping on sunflower due to leafhoppers

The leafhopper screening method in sunflower is based on the natural infestation during *rabi* season. The symptoms caused by leafhopper are yellowing and browning (hopper burn) on leaves. They often mix up with the senescence of the crop. Therefore, it is essential to map the symptoms exclusively caused by leafhoppers. A trial was conducted during *rabi/summer* and symptoms and progress of the symptoms during vegetative and flowering stages were recorded and documented.

Healthy plant

Yellowing of borders

Spreading of yellowing on lower leaves

Browning of leaves and spreading of hopper burn

Complete yellowing and browning

Symptom mapping on sunflower due to leafhoppers

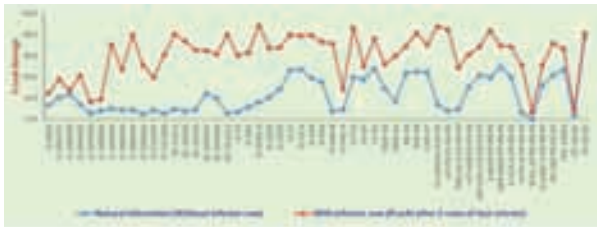
Identification of susceptible check for leafhopper in sunflower

A susceptible check in any of the screening trial is very essential to measure the reactions of test entries. The variety Morden is being used as a susceptible check for screening sunflower entries to leafhoppers. However, it is found that Morden is not uniform and inconsistent in its reaction to leafhoppers. A suitable susceptible check needs to be identified to replace Morden. Six susceptible lines (DRSF-113, CMS-125A, CMS-2023A, CMS-2023B, NDCMS-2A and NDCMS-2B) were evaluated for leafhopper build up and symptoms during *rabi*/summer season. Build up of leafhoppers was more in both NDCMS-2A/2B and CMS-2023A/B. Susceptible reaction was also the highest in these lines (MSI of 5.0 on 0 to 5 grade). Based on growth and reaction, NDCMS-2A/2B were identified as suitable replacement for Morden.

Susceptible reaction of NDCMS-2A and 2B to leafhopper

Development of improved methodology for mass screening of sesame genotypes for resistance to leaf webber and capsule borer (*Antigastra catalaunalis*)

The screening methods for leaf webber and capsule borer in sesame by adjusting sowing time during July II fortnight + planting of one infester row of Prachi after 2 rows of every test entry was evaluated in comparison to natural infestation (without infester row) using 50 sesame genotypes along with susceptible (TC-25) and resistant (GT-10) checks. Screening method with infester row of Prachi after every 2 rows of entries recorded higher leaf damage due to *Antigastra catalaunalis* (upto 44.3% leaf damage) as compared to natural infestation without any infester rows (leaf damage upto 24.8%). Among the genotypes, G-TIL-10-P9-P6-P1, IC-205183, IC-205638 and GT-10 recorded lowest infestation of Antigastra (less than 10% leaf damage) in both the methods, while resistant (GT-10) and susceptible (TC-25) checks recorded 1.7 to 4.4% and 38.2 to 40.5%, respectively. Hence, screening method *viz*., adjusting sowing time during July second fortnight and planting of one infester row of Prachi after 2 rows of test entries can be used for mass screening of sesame genotypes for resistance to *Antigastra*.



Improved methodology for mass screening of sesame genotypes for resistance to Antigastra under field conditions

Sources of resistance

Castor

Wilt

Parental lines *viz*., IPC-43, ICS-315, ICS-304, DPC-22, DPC-25, ICS-341, ICS-355, ICS-353,ICS-128, ICS-144, ICS-130, ICS-147, DCS-119, DCS-89, 2021-1, 2029-1, 2049-1, 2105-1, 2202-1, 2211-3, 2291-1, 2061-1, 2180-1, 2301-1, 2037-1, 2228-1 and experimental hybrids *viz*., ICH-1084, 1079, 883, 1111, 1112, 1148, 1113, 1120, 945, 1115, 963, 969, 990, 980, 1130, 954, 394, 1154, 982, 1159, 976, 973, 1134,1117, 1129, 1127, 1122, 1162, 1186, 1185, 1208, 1124, 1216, 1220, 1217, 1194, 1163, 1165,1187,1218,1182, 1202 and 1211 were resistant to wilt (<10% wilt incidence). Wilt incidence in resistant check (48-1) and susceptible check (JI-35) was 9.4 and 98.3%, respectively.



ICH-1148 *ICS-315* *JI-35 (Susceptible check)*

Resistant reaction of castor genotypes to wilt

Leafhopper

Two monoecious lines *viz.*, ICS-186 and ICS-217 were highly resistant to leafhopper with hopper burn grade 0 (on 0-4 scale). Two lines *viz.*, ICS-190 and ICS-200 were resistant to leafhopper with hopper burn grade 1 (< 10% foliage drying; hopper burn grade of 1 on 0-4 scale) as compared to grade 4 (>50% foliage drying) in susceptible check, DPC-9.



ICS-186 *ICS-190* *ICS-200* *DPC-9 (Susceptible check)*

Reaction of castor genotypes to leafhopper

Thrips

The monoecious lines *viz.*, ICS-217 and ICS-210 were promising with low infestation of thrips (10.6 and 13.3 thrips/spike, respectively) as compared to 29.0 to 42.9 thrips/spike in susceptible checks (DPC-9 and DCS-9). Five lines *viz.*, ICS-190, ICS-186, ICS-217, ICS-210 and ICS-200 recorded low population of thrips on leaf (< 10 thrips/top leaf) as compared to 27.0 thrips/top leaf in susceptible check, DCS-9.

Whitefly

Out of five germplasm accessions screened against whitefly for confirmation of resistance, three accessions *viz.*, RG-2800, RG-3233 and RG-3428 exhibited resistant reaction (whitefly scale of 0 to 1 on 0 to 5 scale) as compared to scale 5 in susceptible check, M-574. The population of adult whiteflies were the lowest (0.8 to 37.5 whiteflies/top leaf/plant) in RG-2800, RG-3233 and RG-3428 as compared to 101.2 whiteflies/top leaf/plant in susceptible check, M-574.

Resistant reaction of castor germplasm accessions (RG-3428 and RG-2800) to whitefly

Capsule borer

Seventeen inbred lines *viz.*, ICI-RG-2800-1 to ICI-RG-2800-8, ICI-RG-2774-1 to ICI-RG-2774-3 and ICI-RG-898-1 to ICI-RG-898-6 along with susceptible (DCS-9) and resistant (48-1) checks were screened against capsule borer under epiphytotic conditions using infester row technique. The inbreds *viz.*, ICI-RG-2800-1 to 8 and ICI-RG-2771-1 to 3 recorded less than 10% capsule damage and confirmed for their resistance to capsule borer in the fourth consecutive year as compared to 88.7% capsule damage in susceptible check (DCS-9). The damage in resistant inbred lines *viz.*, ICI-RG-898-1 to ICI-RG-898-6 ranged from 9.4 to 17.0%. Capsule borer showed low preference to the plant types having loose spikes with non-spiny and zero waxy bloom capsules as compared to compact spikes with spiny and waxy bloom capsules.

Reaction of castor inbred lines to capsule borer

Inbred lines	Capsule damage (%)
ICI-RG-2800-1 to ICI-RG-2800-8	4.7 to 9.1
ICI-RG-2774-1 to ICI-RG-2774-3	6.5 to 8.3
ICI-RG-898-1 to ICI-RG-898-6	9.4 to 17.0
48-1 (R-check)	8.1
DCS-9 (S-check)	88.7

ICI-RG-2800-3 *ICI-RG-2774-2* *DCS-9 (Sus.Check)*

Resistant reaction of castor inbred lines to capsule borer

DCS-9 (Sus. check) ICI-RG-2800-4 DCS-9 (Sus. check) ICI-RG-2774-3

Resistant reaction of inbred lines derived from germplasm and susceptible reaction of check, DCS-9 to capsule borer

Sunflower

Alternariaster leaf blight

A total of 40 sunflower genotypes comprising of germplasm accessions, CMS lines and parental lines were screened for leaf blight resistance under controlled polyhouse conditions. Artificial pathogen inoculations were performed at pre-flowering stage with the freshly prepared pathogen conidial suspension of 1 x 10^6 cfu/ml under controlled conditions (28 °C temperature, 12-14 h leaf wetness and 90% RH for a period of 10 days) for disease development. The symptoms were observed 4-5 days post inoculation and uniform and severe infection on all parts of the plant including flower heads and drying of entire plant were observed within 10 days post-inoculation. All the sunflower genotypes tested were susceptible with >80% disease severity. However, two genotypes namely GMU-755 and PM-82 were able to tolerate the severe infection and set seeds. These sunflower genotypes will be further evaluated in large plots for confirmation of disease reaction.

Uniform development of Alternariaster leaf blight under controlled conditions in polyhouse

PM-82

GMU-755

Genotypes that set seeds under severe infection

Reaction of sunflower genotypes to Alternariaster leaf blight

Leafhopper

Two breeding lines, TSG-403 and TSG-391 were resistant to leafhopper with an injury grade of 1.0 (on 0 to 5 grade). Eleven lines (HA-124B, CMS-104A, ARM-243A, CMS-11A, ARM-243B, CMS-30A, HA-292A, HA-133B, CMS-30B, HA-89B and HA- 133A) were moderately resistant; 9 lines (HA-259A, CMS-302B, HA-124A, HA-89A, CMS-148A,

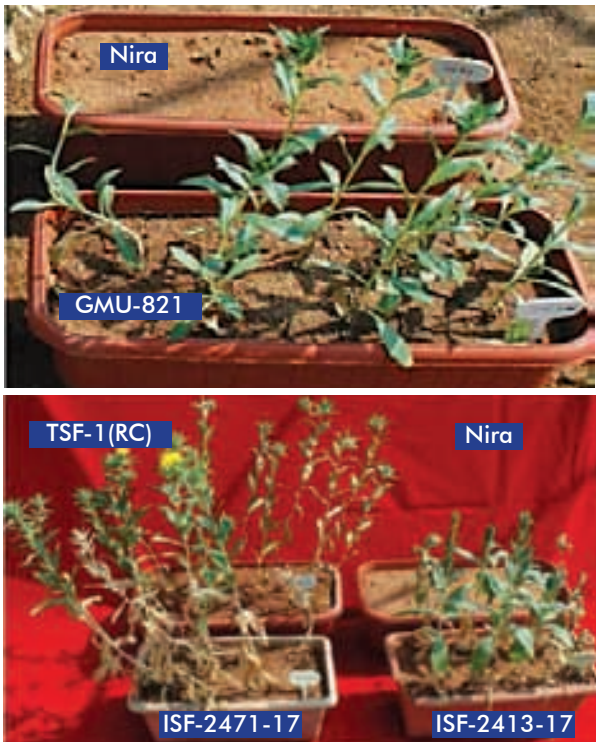
HA-292B, HA-259B, CMS-302A and HA-112A) were susceptible and one line, CMS-148B was found to be highly susceptible (MSI 5).

Resistant reaction of sunflower breeding line, TSG-403 to leafhopper

Safflower

Wilt

Safflower breeding lines *viz.*, ISF-2342 and ISF-2413-17 and germplasm accessions *viz.*, GMU-821 and GMU-864 have been identified as resistant sources against wilt (free from wilt incidence). Two breeding lines *viz.*, SAF-20B and SAF-39A were highly resistant and the lines, ISF-623, ISF-2258, ISF-2471-17, F_5-8, F_5-55 and BC_1F_6-39-3-3-OL were moderately resistant to Fusarium wilt (<20% wilt incidence).



Wilt resistant safflower breeding lines and germplasm accessions

Aphids

Five safflower sub-core germplasm lines, GMU-5848, GMU-5133, GMU-671, GMU-3256 and GMU-599 were moderately resistant to aphids with Aphid Infestation Index (A.I.I.) of >2 to 3 (on 1 to 5 A.I.I.). Susceptible check, CO-1 recorded A.A.I of 5.0 (highly susceptible). Seven safflower varieties *viz.*, Manjira, PBNS-12, A-1, SSF-733, SSF-708, SSF-748 and Bhima were moderately resistant to aphids whereas var. Girna showed a resistant reaction with an A.I.I. of 2.0. Three high oleic selections, BC_2F_6-38-9-4-OL, BC_2F_6-38-14-15-OL and BC_2F_6-38-16-12-OL were resistant to aphids with an A.I.I of 2.0. Susceptible check, CO-1 was highly susceptible with an A.I.I. of 5.

Resistant reaction of high oleic selections of safflower to aphids

Phenotyping of aphid reaction of safflower RILs (CO-1 x EC523368-2)

A set of 280 F_8-RILs were screened against aphids. Symptoms of aphid damage on plants was monitored daily and the day on which at least 80% of plants in each RIL wilted was recorded as 'days-to-wilt' after aphid infestation. The days-to-wilt of RILs after aphid infestation ranged from 14 to 40 with an average of 26.1. The susceptible parent of RILs, CO-1 had days-to-wilt of 17 and EC-523368-2 (resistant parent) did not die at 40 days after infestation. The RIL population displayed a good level of variability for the reaction to aphid. The variability was quantitative with some level of skewness towards susceptibility.

Differential reaction of F_8- RILs of CO-1 x EC-523368-2

Sesame

Macrophomina root rot

Sesame genotypes *viz.*, SEL-S-2019-1019, SEL-S-2019-1018, S-0448, SEL-S-2019-1013, SEL-S-2019-1017, SEL-S-2018-1003 and S-2019-F6-6 were promising with 11-20% root rot incidence. Twenty eight cultivars recorded moderately susceptible reaction (21-30%). Susceptible check VRI-1 and national check GT-10 recorded 85.0 and 20% disease incidence, respectively.

Screening of sesame genotypes against root rot disease by sick pot method

Phyllody

Sesame genotypes that include 115 germplasm accessions and varieties were evaluated against phyllody disease under field conditions by sowing during 3rd week of July 2019. Phyllody incidence was calculated as the percentage of symptomatic plants to the total number of plants observed. Phyllody incidence varied from 4.5 to 69.6% in sesame genotypes. Two sesame lines *viz.*, G-TIL-10-P1-P5-P3, G-TIL-10-P1-P5-P6 showed resistant reaction with low phyllody incidence of 0.1-10% and the genotypes IC-205699, IS-238, SEL-S-2019-1016, GTG-30, SI-982, S-05-27, IC-500426, SEL-S-2019-1019 were moderately resistant with 10.1-20% phyllody incidence. Out of 115 genotypes tested, 16 genotypes were tolerant (20.1-30%), 35 genotypes showed moderately susceptible reaction (>30%), 37 genotypes were susceptible (>40%) and 18 genotypes recorded highly susceptible reaction with >50 % disease incidence. GT-10 (check) and RJR-170 (susceptible check) recorded 9.8 and 68% phyllody incidence, respectively.

Sesame genotypes showing high phyllody

Sesame genotypes showing low phyllody incidence under high disease pressure

Leafhopper

The leafhopper (*Orosius albicinctus*) population among the 115 genotypes screened ranged from 0.2 (GTG-30, SEL-S-2019-1016, G-TIL-10-P1-P5-P6 and S-05-27) to 3.6 leafhoppers/3 leaves/plant (SEL-S-2018-1002). Entries KMR-58, SEL-S-2019-1011 and the susceptible check, RJR-170, also recorded higher leafhopper population (more than 3.0 leafhoppers/3 leaves/plant). Significant positive correlation (r=0.394) was observed between leafhopper population and phyllody incidence.

Leafhopper damage (bottom leaves) and population in susceptible check, RJR-170

Reaction of resistant check, GT-10

Mechanism(s) of Resistance

Influence of waxy bloom intensity on gray mold disease severity in castor

In vivo (field and polyhouse screening) and *in vitro* (detached spike technique) screening of 26 genotypes of no bloom, single bloom, double bloom, triple bloom having different waxy bloom intensities against gray mold indicated that no bloom genotypes (DPC-9, RG-1963, ICS-325, ICS-324) recorded very low gray mold disease severity (1 to 2%). Single bloom genotypes *viz.*, RG-1274, RG-3126, RG-61 and RG-2465 with low intensity (wax intensity score-1 to 2) showed low gray mold severity ranging from 1 to 20%. But some of the single and less than single bloom genotypes (RG-2717, RG-1645) having high waxy bloom intensities (wax intensity score-5) recorded high disease severity (50%). Double and triple bloom lines (TMV-5, RG-1289, DCS-118) with high wax showed high gray mold severity ranging from 50 to 80%. Double and triple bloom genotypes with low intensity of waxy bloom (DCS-107, ICH-538) recorded low disease severity of 20 to 30%. Among non-spiny genotypes, genotypes with high bloom (JL-315, 48-1) recorded high disease severity (25%) compared to no

bloom genotypes (ICS-324, ICS-325) which showed low infection (1-2%). The study indicated that waxy bloom on castor capsules must be aiding pathogen infection. It was also evident that with increase in waxy bloom intensity there was an increase in disease severity.

Reaction of different waxy bloom lines of castor to gray mold

Bloom Type	Genotype	Wax intensity (Score)**	Disease severity (%)*	Bloom type	Genotype	Wax intensity (Score)*	Disease severity (%)
No Bloom	DPC-9	0	8.3	Double Bloom	DCS-9	4	40.8
	RG-1963	0	4.8		DCS-107	3	30.0
	ICS-324	0	1.7		48-1	4	25.0
	ICS-325	0	1.7		JC-12	5	65.6
Single Bloom	RG-2944	3	31.2	Triple Bloom	ICH-538	3	33.3
	RG-1274	1	12.2		JI-315	4	25.0
	RG-3126	2	15.6		SKI-337	4	42.2
	RG1645	5	52.8		JI-96	5	45.0
	DCS-5	3	31.1		JI-226	5	51.0
	RG-61	1	5.0		DCS-118	5	82.2
	RG-2717	5	55.0		TMV-5	5	50.6
					RG-1289	5	75.0
	RG-2465	2	18.9		DCH-519	5	90.0

*Average disease severity percentages under field and polyhouse conditions

** 0 - No bloom; 1- very less; 2- less; 3- medium; 4- high; 5- very high

Chemical Management

Identification of new chemical molecules with better pesticide properties, lower dosage with selective action is a continuous process for integration in integrated pest and disease management. In this direction, new fungicides against gray mold in castor and comparative efficacy of botanicals, bio-agents and fungicides against *Macrophomina phaseolina* were evaluated.

Evaluation of fungicides for management of gray mold disease in castor

Among three fungicides *viz.*, propiconazole, carbendazim and pyraclostrobin + fluxapyroxad screened against gray mold in castor (cv. DCH-519) during *kharif* 2019, 0.1% propiconazole (Tilt) spray resulted in significantly low gray mold severity of 8% and a seed yield of 905 kg/ha followed by pyraclostrobin+ fluxapyroxad treatment as against 279 kg/ha of seed yield recorded in control.

Evaluation of fungicides for the management of gray mold disease of castor (*kharif*, 2019)

Fungicide	Disease severity (%)	Seed yield (kg/ha)
Propiconazole (0.1%)	8.0^{a}	905^{a}
Carbendazim (0.1%)	29.3^{b}	710^{b}
Pyraclostrobin + fluxapyroxad (0.1%)	14.1^{a}	816^{a}
Control	77.5^{c}	279^{c}
CD (p=0.05)	6.6	103.1
SEm (±)	2.6	41.3
CV (%)	9.3	7.4

(Figures having different alphabets as superscripts differ significantly)

Propiconazole *Carbendazim* *Pyraclostrobin+Fluxapyroxad* *Control*

Effective fungicides identified for management of castor gray mold

On-farm demonstration of management of gray mold disease of castor

On-farm demonstrations on management of gray mold of castor using chemical fungicide propiconazole (0.1%) were conducted in farmers' fields in Mahabubnagar district of Telangana state during *kharif* 2019. Prophylactic spray of the fungicide propiconazole (0.1%) was given based on the alerts generated by decision support system (DSS) as per data obtained from Wireless Sensors deployed in farmer's fields. Disease severity (%) at regular intervals and seed yield were recorded. Gray mold disease severity ranged from 22 to 29% and seed yield between 550 and 730 kg/ha were recorded in the fields where one spray of fungicides was given. In fields where fungicide was sprayed twice, disease severity ranging from 7 to 15 % and seed yield between 820 and 1010 kg/ha were recorded. Disease severity ranging from 60 to 85% and seed yield between 150 and 330 kg/ha was recorded in unsprayed fields. Field demonstration has clearly established that timely spray of propiconazole can effectively control gray mold and farmers can realize high seed yield.

On-farm demonstration of management of gray mold disease of castor (*kharif*, 2019)

Location	Farmer's field	No. of sprays	Disease severity (%)		Seed yield (kg/ha)	
			Sprayed	Unsprayed	Sprayed	Unsprayed
Jaklair	1	1	25.0	70.0	650	250
	2	1	23.0	67.0	680	270
	3	2	8.0	85.0	990	150
	4	2	10.0	65.0	875	280
	5	2	13.0	72.0	850	215
Undyala	1	1	28.0	78.0	630	175
	2	1	22.0	80.0	720	180
	3	2	9.0	82.0	950	160
	4	2	10.0	73.0	890	160
	5	2	12.0	77.0	860	190
Kanimetta	1	1	24.0	60.0	660	330
	2	1	29.0	61.0	550	315
	3	2	15.0	82.0	820	165
	4	2	10.0	71.0	870	200
	5	2	9.0	74.0	960	190
Gudigandla	1	1	22.0	68.0	730	215
	2	1	25.0	82.0	610	175
	3	2	12.0	72.0	875	205
	4	2	7.0	61.0	1005	320
	5	2	8.0	78.0	985	185

In vitro efficacy of botanicals, bio-agents and fungicides against *Macrophomina phaseolina*

Among ten botanical leaf extracts tested, leaf extracts of *Datura stramonium*, *Acorus calamus* and *Lantana camara* recorded highest inhibition of mycelial growth of *M. phaseolina* over untreated control. Different isolates of *Trichoderma* spp. and *Aspergillus awamori* were screened individually using dual culture technique. Among them, *Trichoderma*-THA isolate, TA-5 isolate, TH-7 isolate, RFB-2 isolate, *A. awamori* - parthenium rhizosphere isolate, *A. awamori* - red gram rhizosphere isolate showed highest suppression of mycelial growth of *M. phaseolina*. Among 24 fungicides evaluated against *M. phaseolina* by poisoned food technique, fungicides *viz.*, tebuconazole 25EC, trifloxystrobin 25% + tebuconazole 50%, carbendazim 12%+ mancozeb 63%WP and carbendazim 50% WP were found promising with complete inhibition of pathogen mycelial growth at all concentrations followed by carboxin 37.5% + thiram 37.5% at 150 ppm (91.65%), 200 ppm (91.75%), azoxystrobin 18.2 + difenoconazole 1.4% at 200 ppm (85.59%), thiophanate methyl 70% WP at 200 ppm (81.27%). All tested fungicides significantly reduced the growth of *M. phaseolina* as compared to control but the fungicides and their concentrations significantly differed within themselves.

Biopesticides

Sustainable pest management demands implementation of tactics that rely upon bio-control agents and their formulations. Various *Bacillus thuringiensis* and *Trichoderma harzianum* based biopesticide formulations have been developed and evaluated to mitigate the pest and disease problems in the mandated oilseed crops.

Large scale field evaluation of Bt-127 SC formulation as a component of IPM against major lepidopteran pests of sunflower

Suspension Concentrate (SC) formulation of a local strain of *B. thuringiensis* var. *kurstaki* DOR Bt-127 (MTCC-5976/NAIMCC-B-01463) was evaluated as a component of integrated pest management (IPM) in sunflower in farmers' fields (Harali Village, Lohara Taluka, Osmanabad District, Maharashtra State) during *kharif* 2019. Seed treatment with imidacloprid (5g/kg seed) for management of sucking pests, monitoring *Spodoptera litura* and *Helicoverpa armigera* using pheromone traps (4/acre) and hand collection of gregarious larval stages with damaged leaves, application of DOR Bt-127 SC formulation @ 3 ml/l for *H. armigera*, *S. litura* and *Thysanoplusia orichalcea* and use of reflecting ribbons for avoiding damage by birds were undertaken in an IPM module. Neem oil sprays were taken up in farmer's practice for management of the pests. Incidence of *T. orichalcea*, *S. litura* and *H. armigera* was reduced by 96.7%, 85.7% and 96.3%, respectively due to Bt-127 SC formulation in IPM trial. The IPM trial resulted in net returns of Rs.10,658/acre with a cost-benefit ratio (CBR) of 2.30 over net returns of Rs.7,034/acre with a CBR of 1.94 in farmer's practice.

Demonstration of Bt-127 SC formulation as a component of IPM in sunflower (Harali village, Osmanabad District, Maharashtra)

Management of safflower wilt by bioprimimg with *Trichoderma harzianum*

Priming of safflower seeds with *T. harzianum* @ 10 g/litre water for 12 h resulted in low wilt incidence (22.7%) and recorded significantly high seed yield (1062 kg/ha), net returns (Rs.22,742/-) and B:C ratio (2.29) compared to check (wilt incidence of 56%, seed yield of 494/kg/ha, net returns of Rs. 1188/- and B:C ratio of 1.07).

Seed biopriming with Trichoderma *Untreated control*

Effect of seed biopriming with T. harzianum on Fusarium wilt incidence in safflower

Biopolymers and Bioagents

The tailor-made polymers possess network properties which provide favourable environment to the beneficial microbes which improves viability under different soil environments and also serve as controlled release systems for regulated release of the agrochemicals impregnated in biopolymer. In this context, combined polymer and *Trichoderma* was synthesized and evaluated under *in vitro* and *in vivo* conditions for its efficacy against pathogens in different oilseed crops.

Biopolymer chitosan based *Trichoderma* liquid formulation and its effect on plant growth and disease management in soybean

Seed treatment with biopolymer Chitosan + *T. harzianum*, Th4d and Polymer 1+ *T. harzianum*, Th4d has significantly improved seed germination, seedling shoot length, root length, seedling vigor index, plant fresh weight, dry weight, chlorophyll content in comparison to control. Chitosan + *T. harzianum*, Th4d and Polymer 1+ Th4d treatments recorded low root rot incidence of 2% and 3%, respectively whereas a root rot incidence of 8% was recorded in control. Soybean seed coating with biopolymer chitosan based *T. harzianum* Th4d liquid formulation resulted in significantly higher seed yield (830 kg/ha) compared to control (620 kg/ha).

Effect of chitosan+Th4d, polymer 1+Th4d and Th4d on plant growth promotion and yield in soybean under field condition

Treatments	Germination (%)*	Root rot incidence (%)*	Shoot length (cm)	Root length (cm)	Seedling vigor index	Plant fresh wt. (g)	Plant dry wt. (g)	Chlorophyll content (SPAD units)	Seed yield (kg/ha)
Polymer 1 + *T. harzianum* Th4d @ 10 ml/kg seed	73.5 (59.0)	3.0 (9.9)	74.0	27.7	7475	68.8	8.6	41.6	818
Chitosan polymer + *T. harzianum* Th4d @ 10 ml/kg seed	74.3 (59.5)	2.0 (8.1)	76.2	28.1	7747	75.3	11.6	42.1	830
Carboxin+thiram @ 2 g/kg	64.0 (53.1)	6.0 (14.1)	61.4	23.7	5446	53.1	8.4	37.0	791
T. harzianum Th4d @ 10 g/kg	66.6 (54.7)	4.0 (11.5)	65.3	25.3	6038	54.8	8.9	39.7	812
Control	63.2 (52.6)	8.0 (16.4)	60.7	25.0	5416	49.4	6.0	36.4	620
CV (%)	7.7	4.3	2.6	10.3		4.1	9.9	6.1	16.6
CD (p=0.05)	6.0	2.6	2.4	5.7		4.5	1.7	3.1	164.3

*Values in parentheses are arc sine transformed values

Control *Chitosan+Th4d blend*

Effect of seed coating with Chitosan + T. harzianum on growth of soybean

On-farm validation of biopolymer based *T. harzianum*, Th4d liquid formulations as seed coating technologies in soybean

On-farm validation trials on soybean (cv. JSS 335) during *kharif* 2019 conducted at Kouta village (Adilabad district, Telangana), showed that seed coating with biopolymer chitosan + *T. harzianum*, Th4d and Polymer 1 + *T. harzianum*, Th4d resulted in high germination, shoot length, root length and seedling vigor. The same treatments recorded very low seed rot

incidence (0 to 4%). Seed treatment with chitosan + *T. harzianum*, Th4d resulted in significantly higher seed yield followed by polymer 1+ *T. harzianum*, Th4d in comparison with control.

Effect of seed coating with biopolymer based *T. harzianum*, Th4d liquid formulations on soybean growth and disease incidence

Field trial	Treatment	Germination (%)*	Root rot incidence (%)*	Shoot length (cm)	Root length (cm)	Seedling vigor index	Yield (kg/ha)
1	Polymer 1+ *T. harzianum* Th4d @ 10 ml/kg seed	80.0 (63.4)	4.0 (11.5)	59.4	28.1	7166	1750
2	Polymer 1+ *T. harzianum* Th4d @ 10 ml/kg seed	81.9 (64.8)	3.0 (9.9)	59.6	28.3	7199	2189
1	Chitosan polymer + *T. harzianum* Th4d @ 10 ml/kg seed	84.8 (67.0)	2.0 (8.1)	59.8	28.6	7496	2389
2	Chitosan polymer + *T. harzianum* Th4d @ 10 ml/kg seed	85.2 (67.3)	0.0 (0.0)	59.9	28.4	7487	2500
Control		71.2 (57.5)	5.0 (12.9)	48.0	23.4	5083	1500
CD (p=0.05)		5.5	2.6	0.5	2.5	-	230

*Values in parentheses are arc sine transformed values

Control *Chitosan+Th4d*

Effect of seed coating with chitosan + T. harzianumTh4d on soybean

Forecasting of Pests and Diseases

Forecasting of pests and diseases helps farmers in taking timely decision on their management. Castor gray mold prediction model has been developed and integrated with DSS enabling sending SMS alerts to farmers and the details are presented.

Validation of gray mold decision support system and forecasting of disease

Gray mold disease is highly weather dependent and has very short life cycle. Apart from prediction of disease occurrence over time, it is more important to predict the time of initiation of the disease. Efforts were made to develop a statistical model by considering the most favourable weather parameters *viz*., temperature, relative humidity and leaf wetness period. The model was improved by considering parameters like sowing date, rainfall and stage of the crop. Optimum temperature, RH and leaf wetness were computed based on the nonlinear hyperbolic function. By utilising the optimum parameters, sowing date, stage of the crop, rainfall occurrence for the last three days decision rules were developed. A protocol was developed by integrating decision rules and the model to predict the risk level/ initiation of disease. As per prediction of disease initiation SMS alerts were sent to about 4000 farmers three days in advance.

Wireless sensor networks deployment sites (*kharif,* 2019)

Deployment sites	Jaklair	Undyala	Kanimetta
WSN	16.5636, 77.7342	16.4571, 77.7534	16.4246, 77.9250

Castor Gray Mold Advisory system web page

Sending SMS alerts through DSS

Social Sciences

Impact Assessment of Oilseed Technologies

The temporal performance of castor vs. competing crops in Gujarat state for the last five decades (1966-2016) was attempted through Markov chain approach. The transition probabilities were computed to study the performance of castor area for the respective decade. The transition probabilities converted to per cent values are presented. The results indicated that the retention of castor area over the previous year was 36.8, 62.2, 57.8, 29.7 and 31.1% during decade I, II, III, IV and V, respectively. The castor area was chiefly substituted by pigeonpea (59.6%) during Decade I; paddy (37.8%) during Decade II; cotton (24.7%) and paddy (17.5%) during Decade III; cotton (57.8%) and paddy (18.1%) during Decade IV and; cotton (68.9%) during Decade V. The results suggest that cotton was the major crop that has substituted castor during the last three decades. This warrants identification of appropriate interventions to rejuvenate the castor area on agro-eco-sub regional approach.

Transition probabilities for castor area *vs.* competing crops

Period	Decade I (1966-75)	Decade II (1976-85)	Decade III (1986-95)	Decade IV (1996-2005)	Decade V (2006-16)
Castor acreage retention of previous year (%)	36.8	62.2	57.8	29.7	31.1
Major crop(s) substituted (%)	Pigeonpea (59.6)	Rice (37.8)	Cotton (24.7) Rice (17.5)	Rice (18.1) Cotton (57.8)	Cotton (68.9)

An attempt was made to examine the analysis of growth rate of area, production and yield in the major castor growing districts (>0.5 lakh ha). The period from 2000-01 to 2008-09 indicated the pre-release period of castor hybrid GCH-7 while the period 2009-10 to 2017-18 corresponds to the post-release/adoption of GCH-7. The results revealed that the compound annual growth rates in respect of area, production and yield have been on an acceleration mode in the post-release period of GCH-7 in all the districts over the pre-release period of GCH-7 thus indicating the large scale adoption and penetration of GCH-7.

Compound annual growth rate of castor in major districts of Gujarat (2000-01 to 2017-18)

District	Post-release period of GCH-7 (2009-10 to 2017-18)			Pre-release period of GCH-7 (2000-01 to 2008-09)		
	Area (%)	Production (%)	Yield (%)	Area (%)	Production (%)	Yield (%)
Banaskantha	1.99	3.54	1.51	-2.17	-1.11	1.08
Kutch	2.60	8.30	5.55	1.93	5.11	3.12
Patan	4.96	8.50	3.38	4.15	3.87	-0.27
Mehsana	3.25	5.50	2.17	-5.53	1.17	7.10
Ahmedabad	10.54	10.20	-0.31	-3.35	4.27	7.89

The change in production of castor for the above districts was analyzed through decomposition approach by quantifying the effect of area, yield and interaction of area and yield to the total change in production of castor pre and post-release of GCH-7. Triennium periods of 2015-17 (post-release) and 2002-03 (pre-release) were considered for the study. It is evidenced that inter-alia in the major castor growing districts (Gujarat), the yield effect (technology) was the highest (85%) in Mehsana district. Although the change in area in Mehsana was meagre 0.04 lakh ha, the change in production was 0.86 lakh tonnes primarily due to the technology *i.e.*, the yield effect that had contributed to 85%. The yield effect in Patan, Banaskantha and Kutch contributed to 72, 52 and 38% change in the castor production. The area effect contributed to 51% change in production in Ahmedabad district followed by 33 and 36% in Banaskantha and Kutch districts respectively. The results suggest that the castor hybrid GCH-7 contributed to the change in production through yield effect and also due to large scale area expansion.

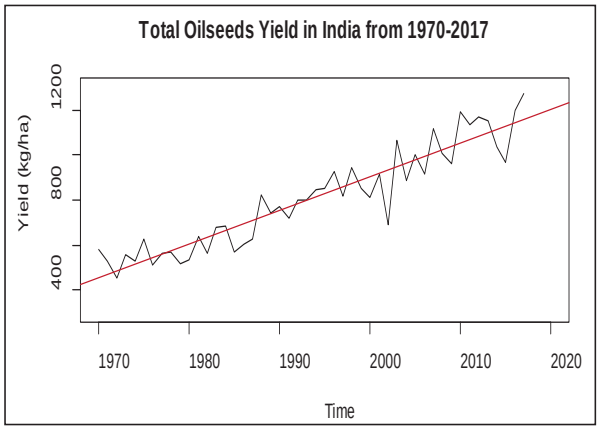
Decomposition of change in production of castor in major districts of Gujarat

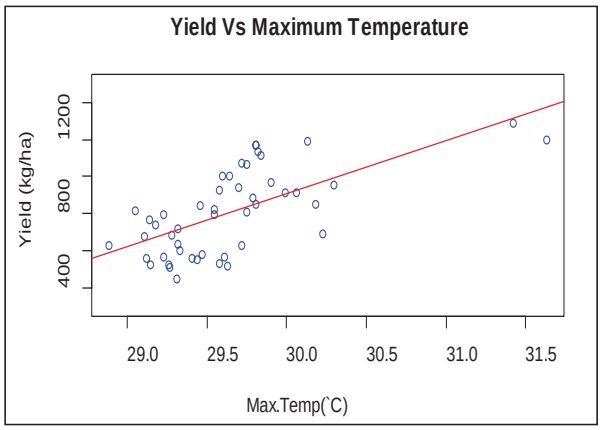
Districts	Change in			Contribution to change in production due to		
	Area (lakh ha)	Production (lakh tonnes)	Yield (q/ha)	Area effect (%)	Yield effect (Tech-nology) (%)	Interaction of area and yield (%)
Banaskantha	0.37	1.28	5.57	33	52	15
Kutch	0.35	1.36	10.41	36	38	26
Patan	0.54	1.18	3.99	10	72	18
Mehsana	0.04	0.86	10.63	9	85	7
Ahmedabad	0.32	0.64	6.36	51	19	30

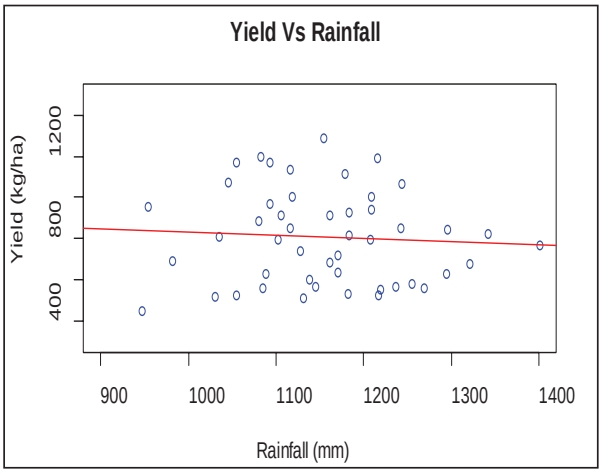
Development of Prediction Models

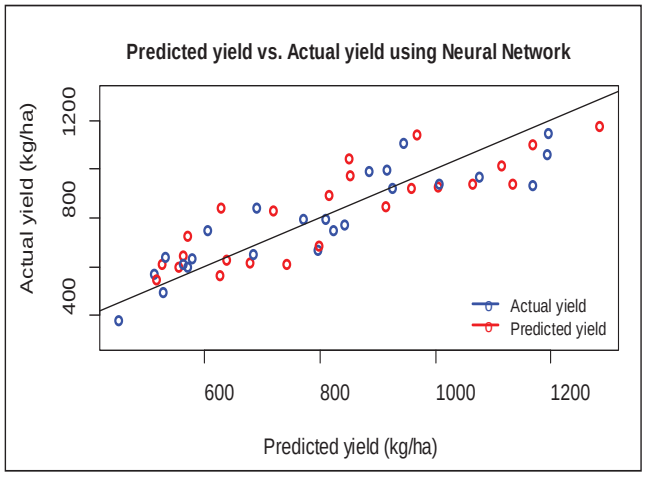
Development of models to predict yield responses to climate change in oilseed crops

Development of prediction models by including data on yield of annual oilseeds, annual data of weather parameters *viz.*, temperature (minimum and maximum), rainfall and relative humidity (RH-I and RH-II) for the period 1970-71 to 2017-18 was attempted. The models *viz.*, Artificial Neural Networks (ANN), Least Absolute Shrinkage and Selection Operator (LASSO), Weather indices and Composite weather variable models were fitted. The results indicated that the ANN model had a higher R^2 value and a lower percentage prediction error when compared to the LASSO, model based on weather indices and model using composite weather variables. This showed that the ANN model was able to predict the oilseeds yield better than the other models for the given data set.









Knowledge Management

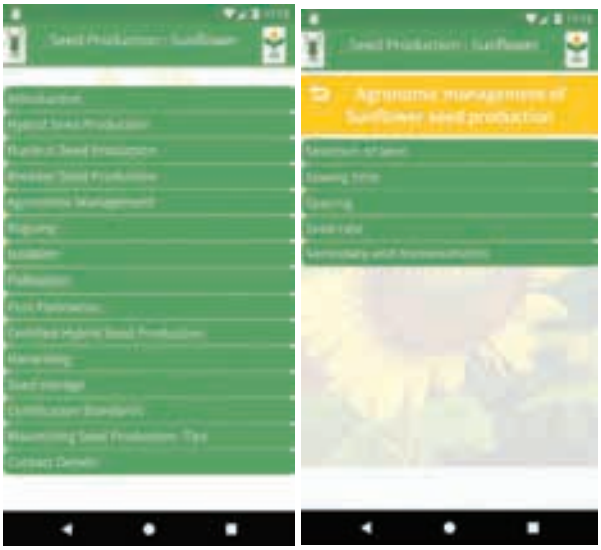
Sunflower knowledge management portal

Sunflower knowledge management portal is a user friendly portal exclusively developed and designed as a one stop ready reckoner to access information on germplasm resources, seed production, breeding research, production technologies, pests and diseases, success stories, FAQs, market prices of major APMCs, varieties and hybrids suited for different states, government schemes available for farmers, farm innovations, area, production and productivity statistics.

The entire information was compiled and was categorized into five major domains *viz.*, General domain, Research domain, Extension domain, Farmers domain and Service domain with sub chapters for each domain. The portal is useful for researchers, academicians, farmers, students, extension workers and NGOs.

Mobile app on sunflower seed production

User friendly mobile app on "Technologies for quality seed production in sunflower" was developed for the benefit of seed producer organizations, researchers, industry and farmers. The purpose of developing the app is to acquaint the user in the steps to be followed for seed production of the sunflower crop. The app provides information on breeder seed production, planting methods, roguing, isolation, pollination, certification, agronomic practices, certification standards and tips for maximizing hybrid seed production. The app available under Google play store can be installed on Android supported mobiles.



Demonstrations of Oilseed Technologies

Frontline demonstrations (FLD's) in oilseeds

FLDs on oilseeds were conducted in 2207 ha during 2019-20 by the Oilseed Institutions/ Directorates/

Project Coordinating Units as against the allotment of 2396 ha in various agro-ecological regions of the country. The demonstrations were conducted in 993 and 1214 ha during *kharif* and *rabi* seasons, respectively. In order to enhance the knowledge of input dealers, extension officers and other extension workers dealing with oilseeds, 29 training programmes on oilseeds technologies were organized. The conduct of FLDs on oilseeds and training programmes organized by the oilseeds based institutes are presented.

Frontline demonstrations on oilseeds and training programmes conducted by oilseed institutes (2019-20)

IIOR/AICRP	Progress						
	Frontline demonstrations (FLDs)					Trainings	
	Approved		Conducted		Total	Appro-ved	Con-ducted
	Kharif	*Rabi*	*Kharif*	*Rabi*			
ICAR-Indian Institute of Soybean Research, Indore	900	-	900	-	900	4	4
ICAR-Directorate of Rapeseed-Mustard, Bharatpur	-	1215	-	1215	1215	7	6
ICAR-Directorate of Groundnut Research, Junagadh	540	225	235	250	485	7	6
Project Coordinator (S&N), Jabalpur	600	240	533	170	703	4	4
Sesame	450	240	333	170	503	4	4
Niger	150	-	200	-	200	-	-
PC (Linseed), Kanpur	-	260	-	260	260	3	3
ICAR-Indian Institute of Oilseeds Research	870	1140	815	1140	1955	7	6
Castor	705	90	705	90	795	4	3
Sunflower	60	600	60	600	660	3	3
Safflower	-	270	-	270	270	-	-
Sesame	-	180	-	180	180	-	-
Niger	105	-	50	-	50	-	-
Total	**2910**	**3080**	**2483**	**3035**	**5518**	**32**	**29**

FLD's on castor

In order to show case the productivity potential and profitability of improved technologies of castor, the demonstrations were conducted in 50 ha in Mahabubnagar and Wanaparthy districts of Telangana State. The technologies demonstrated were castor hybrid DCH-519, seed treatment with *Trichoderma*, optimum spacing, management of gray mold. The details of village-wise productivity potential are presented.

Productivity potential of improved technologies of castor (*kharif,* 2019)

District	Village	Area (ha)	Seed yield (kg/ha)		% increase in seed yield
			IT	FP	
Mahabubnagar	Gudigandla	10	850	775	9.7
	Jaklair	10	950	800	18.8
	Madampally	6	1000	850	17.6
	Undhyal	6	700	650	7.7
Wanaparthy	Kanimetta	18	800	650	14.3
	Total/mean	50	852	747	14.1

*35 FLDs were vitiated due to severe incidence of gray mold disease; IT = Improved technology (DCH-519, seed treatment with *Trichoderma*; spacing = 90 cm x 60 cm and management of gray mold by prophylactic spray); FP = Farmers' practice (GCH-4/GCH-7; spacing = 90 cm x 45 cm).

The seed yield improvement ranged from 7.7% in Undhyal to 18.8% in Jaklair village with improved technology as compared to farmers' practice.

Demonstration of DCH-519 at Madampally (Mahabubnagar)

Demonstration of DCH-519 in Mahabubnagar

FLD's on sunflower

Frontline demonstrations on sunflower were conducted in 10 ha in Hegdoli village, Nizamabad district, Telangana State under rice-fallow, soybean-fallow and rice-sunflower cropping systems. The improved technology of using sunflower hybrid DRSH-1, seed treatment with imidachloprid and optimum spacing was demonstrated during *rabi* 2019-20. The crop is yet to be harvested.

Demonstration of DRSH-1 at Hegdoli (Nizamabad)

FLDs on sesame

Frontline demonstrations on sesame were conducted in rice-fallow; turmeric-fallow and groundnut-sesame cropping systems in different districts of Andhra Pradesh (Prakasam and Anantapur) and Telangana (Adilabad, Nizamabad, Vikarabad and Mahabubnagar). The crop is yet to be harvested.

Demonstrations conducted in different cropping systems of sesame

Centre	District	Situation	Technology	FLDs
REEDS, Prakasam	Prakasam	Rice-fallow	Swetha til, line sowing	50
VRSS, Mahabubnagar	Adilabad	Rice-fallow	Swetha til, line sowing	50
DAATTC, Nizamabad	Nizamabad	Turmeric-fallow	Swetha til/CUMS-17,line sowing	25
RDT, Anantapur	Anantapur	Groundnut-sesame	Swetha til/YLM-66, line sowing	25
ICAR-IIOR	Mahabubnagar and Vikarabad	Rice-fallow	Swetha til, line sowing	30
Total				180

Competitive oilseeds production technologies for improving profitability and socio-economic conditions of small holders in rainfed oilseeds production system of Telangana

As part of farmers' first programme, activities were undertaken in different modules to make the production of oilseeds and other crops of the region more competitive. The achievements made under various modules to improve livelihoods of the farmers' of four villages of Vikarabad are presented.

NRM module

- Prepared 112 soil test based soil health cards for major crops (for 12 major, micro and secondary nutrients) covering 214 ha. This intervention resulted in reduced cost of fertilizers by Rs. 854/ ha. in castor crop. In redgram, contour cultivation and associated soil and moisture conservation technologies under rainfed ecosystem enabled enhanced yields of 10.12 q/ha as against 7.89 q/ha over conventional practice.

Distribution of soil health cards during World soil day celebrations on 5 December

Interventions on spacing and customised soil and moisture conservation measures

Crops and cropping systems module

- Castor production technology (DCH 519 / ICH-66) under rainfed *kharif* situations resulted in productivity of 6.5 q/ha.
- The introduction of non-shattering paddy variety, KNM-118, in *kharif* led to productivity enhancement of 19% and additional net returns of Rs. 18618/ha over the prevailing cultivar.
- Introduction of sorghum (SPH 1820) under *Zaid* in the situations of low water table resulted in productivity of 12.25 q/ha providing additional net returns of Rs.6520/ha over operational costs.

Marketing and value addition

- **Locally processed tur dal (2 households/6 q):** Price of naturally processed dal sold at Rs.100/kg as against sale of primary produce of Rs. 48-58/ kg.
- **Paddy to rice (RNR 15048) (1 household /6 q):** Price of rice sold at Rs.45/kg as against sale of paddy at Rs.18.30/kg.

Crops and cropping system modules

Other Scientific Activities

Agricultural Knowledge Management Unit (AKMU)

The activities during the period under report included designing and developing the Sunflower Knowledge Management Portal; Mobile App for seed production of sunflower. Regular updation of the web site through pertinent databases on prices and arrivals of the major APMC's trading of IIOR mandated crop; uploading of budget releases to AICRP, FLD and TSP centres, uploading of photographs of important events; press gleanings, tender documents, employment opportunities etc. were other activities undertaken under AKMU.

Priority setting, Monitoring and Evaluation (PME) Cell

The PME cell has facilitated the review of the progress of ongoing research and developmental activities by the Research Advisory Committee (RAC). It has also facilitated the review of experiments carried out under institute and externally funded projects in the field as well as in the meetings of Institute Research Council (IRC). Research Project Proforma (RPP) of 30 institute projects was reviewed as per the IRC recommendations. Two new projects were submitted for external funding. The proposals for thesis projects of 11 M.Sc. and nine Ph.D. students were processed. The Institute Publication Committee has processed 46 manuscripts (14 Research articles, 2 Book chapters, 10 Popular articles and 20 Abstracts/ lecture notes) for publication. The Institute Technology Management Unit (ITMU)/NAIF maintained the database of technologies having commercial potential and IP assets. It has facilitated the transfer of technology (DOR-Bt) to one licensee during the reporting period. Two MoUs were signed with State Agricultural Universities for student research.

AICRP on Oilseeds
(Castor, Sunflower and Safflower)

The significant achievements made under AICRP on Oilseeds are furnished here under.

Castor

During the year, significant progress with regard to varietal and hybrid development was witnessed. One hybrid and two varieties were notified by CVRC for release either all over India or in different states of the country. One state identified variety and one central identified hybrid were submitted to CVRC for notification.

Genotype	Pedigree	Duration for primary spike maturity (days)	Seed yield (kg/ha)	Specific features	Suitable areas for cultivation
GCH-9	SKP-84 x PCS-124	110-120	3820	Wilt and root rot resistant, medium plant stature, profuse branching	All over India
Jawahar Castor-4 (JC-4)	SPS-43-3 x JC-6	100-130	2640	Medium maturity, suitable for sole crop under irrigated conditions	Madhya Pradesh
Jawahar Castor-24 (JC-24)	DCS-108 x JC-5	95-110	2745	Early maturing variety suitable for sole and inter-cropping under rainfed conditions	Madhya Pradesh
Yethapur-1 (Ytp-1) YRCS-1205	TMV-6 x Salem local	115-120	1450	Can be maintained for 3 years (3 kg/plant/year)	Suitable variety for mixed/inter/perennial and sole crop under rainfed conditions of Tamil Nadu
ICH-66	SKP-84 x ICS-164	100-110	1570-3375	Wilt and leafhopper resistant	Suitable for rainfed castor growing areas of Southern India

- Supplied 1201 germplasm accessions for augmentation at Ananthapuramu and Palem, deposited 532 accessions in medium term storage (MTS), supplied 1461 accessions, 62 trait-specific inbred lines and 20 promising germplasm accessions to various AICRP centres.
- Identified 13 early and extra-early inbred lines (83-89 days); six inbred lines with high ricinoleic acid (90-92%) than the checks (88%) in multilocations.
- A total of 29 new monoecious lines (13 from Junagadh, 14 from SK Nagar, 1 each from Palem and Yethapur) and five new pistillate lines (1 from Junagadh, 2 from Navasari and 2 from Palem) have been developed as potential parents for hybrid development.
- Preliminary yield trial involving 49 new monoecious lines (15 - Junagadh; 34 - SK Nagar) as potential variety revealed that seven inbred lines *viz.*, JI-469, JI-471, JI-478, JI-479, SKI-401, SKI-413 and SKI-416 recorded significantly higher seed yield (12 to 54%) than the check variety, GC-3.
- Out of 216 new hybrids evaluated in preliminary

trials at different centres, 17 hybrids were identified with significant yield advantage (10 to 46%) over the best check.

- Among 15 OPVs evaluated for rainfed eco-system, three varieties *viz*., ICS-241 (66%), ICS-244 (19%) and JI-423 (21%) were promising at Yethapur, Palem and Bhawanipatna centres compared to the checks, DCS-107 (835 kg/ha, 1220 kg/ha) and GC-3 (721 kg/ha), respectively.
- Based on seed and oil yield (>10% over the best checks) and wilt resistance, four hybrids *viz*., SHB-1027, SHB-1021, ICH-278, ICH-515 and one variety, JI-449 were promoted to AVHT-I of 2019-20.
- SHB-1028 with resistance reaction to gray mold (21.8% compared to 100 per cent in susceptible check, DCH-519) and pooled mean seed yield (2527 kg/ha) on par with GCH-8 (2556 kg/ha) was also promoted to AVHT-I.
- A total of 3.85 q breeder seed of varieties and parental lines was produced against the DAC indent of 2.15 q by different centres to meet the demand of seed producers, progressive farmers and researchers.
- Adoption of Best Management Practices (BMPs) in rainfed castor at Palem and Yethapur resulted in significantly higher seed yield (1555 and 1390 kg/ha) as compared to that of farmers' practice. Under irrigated conditions at SK Nagar, performance of castor hybrid grown under best management practices (GCH-8 hybrid; seed treatment with PSB @ 5 ml/kg seeds adopting ideal plant geometry of 150 cm × 120 cm; soil test based nutrient supply; drip irrigation; need based plant protection, harvesting through secateurs) showed 29 per cent higher seed yield (2948 kg/ha) over farmers' practice (GCH-7). Similar trend followed in Junagadh (GCH-9) and DCH-177 hybrid in Bawal and Mandor.
- Castor + pearl millet intercropping system resulted in higher castor equivalent yield (1657 kg/ha), higher Land Equivalent Ratio (1.62) and Area Time Equivalent Ratio (ATER) (1.33) in rainfed Alfisols of Bengaluru.
- A total of 975 frontline demonstrations (FLDs) were conducted during *rabi* 2017-18 and *kharif* 2018 in seven states.
- Under rainfed conditions, seed yield improvement was to the tune of 18% with Improved Technology (IT) (946 kg/ha) as compared to FP (799 kg/ha). The additional net returns (ANR) accrued were Rs. 5193/ha. The B:C ratio was 2.59 and 2.37 with IT and FP, respectively.
- Under irrigated conditions, seed yield improvement was to the tune of 16 per cent with IT (3755 kg/ha) as compared to FP (3229 kg/ha). The ANR accrued were Rs. 21,993/ha. The B:C ratio was 3.86 and 3.37 with IT and FP, respectively.
- Pathogenic variability of isolates of *F. oxysporum* f. sp. *ricini* revealed that AP-42, AP-56 showed resistant reaction with < 20% wilt incidence while the remaining 10 genotypes showed variable reaction for all the three sources of isolates from Hyderabad, Palem and S.K.Nagar.
- Identified 12 confirmed sources of resistance to wilt, one for gray mold and four for root rot.
- Among 30 entries of Coordinated trials - SHB-1027, ICH-86, SHB-1066 were resistant to both wilt and root rot; SHB-1021 moderately resistant to reniform nematode (14.3 egg masses per root) compared to highly susceptible reaction in checks, DCH-177 (>30 egg masses per root); SHB 1028 and ICH-576 moderately resistant to gray mold with <25% disease under high disease pressure conditions.
- In integrated management of wilt disease, seed treatment with Tebuconazole + trifloxystrobin 0.4 g/kg recorded low wilt incidence (21%) and high seed yield (1032 kg/ha) compared to control (60% and 317 kg/ha) at Palem. Seed treatment with Carboxin + thiram 3 g/kg recorded low wilt incidence (37%) and high seed yield (848 kg/ha) at Yethapur compared to control (83% and 414 kg/ha). There was no significant differences among the treatments in wilt incidence at SK Nagar and root rot at Junagadh.
- In on-farm demonstration on management of root rot conducted at research farm, Junagadh, seed treatment and soil application of *T. harzianum* local isolate showed low root rot incidence (5%) with higher seed yield (3037 kg/ha) compared to control (16% and 2198 kg/ha).

- Identified confirmed sources of resistance to leafhopper with hopper burn grade of 0 to 1 on 0-4 scale as compared to grade 3 to 4 in susceptible checks; Germplasm: ICI-RG2661-7-9-1-1; Monecious line: ICS-200; Coordinated trials: JHB-1061, ICH-538, ICH-515.
- Identified two confirmed sources of resistance to white fly (RG-3233 and RG-3428) with grade of 0 to 1 on 0-5 scale in three locations (Yethapur, S.K. Nagar and IIOR, Hyderabad).
- The newer insecticide buprofezin 25SC (1.5 ml/l) was superior in reducing the whitefly infestation and resulted in higher seed yield at Yethapur (1210 kg/ha) as compared to untreated control (620 kg/ha).
- DOR Bt-127 SC formulation @ 3 ml/l was on par with commercial Btk formulation in reducing the population of semilooper and *S. litura* at Palem. DOR Bt-127 SC formulation treated plot yielded 1346 kg/ha and was on par with commercial Btk (1387 kg/ha).
- Evaluation of compatibility of recommended fungicides and insecticides revealed that carbendazim in combination with novaluron, buprofezin, acetamiprid, flonicamid, dimethoate; carbendazim 12% + mancozeb 63% in combination with acetamiprid, buprofezin, flonicamid, dimethoate and combination of propiconazole with dimethoate showed phototoxic symptoms.

Major Recommendations

- In Saurashtra region of Gujarat, application of pendimethalin 1 kg/ha (6.7 ml/l) (pre-emergence) + quizalofop ethyl 0.05 kg/ha (2 ml/l) (post-emergence at 25 DAS) + intercultivation followed by hand weeding at 60 DAS resulted in effective weed management along with higher seed yield (4310 kg/ha) and higher profitability (B: C ratio 4.12).
- In irrigated conditions of Haryana, basal application of 40 kg P_2O_5 and seed treatment with PSB (*Pseudomonas* sp.) (20 ml/kg seed) resulted in higher seed yield (4138 kg/ha) and profitability (B:C ratio 3.12).

Sunflower

- Seventy from germplasm accessions and inbreds were identified promising for agro-economic traits at different locations.
- Three powdery mildew resistant lines developed at Raichur centre, *viz.*, RGM-41, RGM-49 and PM-81 which were evaluated for 3-4 years both in field and green house conditions were confirmed for powdery mildew resistance (PDI <10%).
- Based on the passport data, the germplasm catalogue involving 3126 accessions has been published and distributed to the sunflower breeders for effective utilization of promising inbreds and germplasm accessions.
- The activity on development of open-pollinated populations/varieties has been assigned only to the centres located in Maharashtra (Akola and Latur).
- Open pollinated populations AKSFI-18-8 (1485 kg/ha), AKSFI-18-7 (1470 kg/ha), AKSFI-18-2 (1407 kg/ha), AKSFI-18-1 (1391 kg/ha) and AKSFI-18-5 (1362 kg/ha) at Akola, SS-1319 (1603 kg/ha), SS-1603 (1527 kg/ha), SS-1316 (1502 kg/ha) and SS-1713 (1468 kg/ha) in multilocation trial at Maharashtra were found superior to the checks in terms of seed yield. Coimbatore centre had developed four powdery mildew resistant (through artificial screening) inbreds *viz.*, 32-2- 13-1, 32-2-20-1, 32-2-29-1 and 32-3-31-1.
- New experimental hybrids developed at Akola (22), Bengaluru (26), Coimbatore (320), Hisar (48), Latur (39), Ludhiana (74), Nandyal (45), Nimpith (168) and Raichur (196) were evaluated in replicated trials with large plot size.
- Multilocation evaluation of experimental hybrids revealed superiority over the best check hybrids of PKVSH-977 (2371 kg/ha) and PKVSH-978 (2315 kg/ha) at Akola, SMLHT-Kh-18-03 (2512 kg/ha), SMLHT-Kh-18-02 (2486 kg/ha) and SMLHT-Kh-18-01 (2206 kg/ha) in Karnataka, HSFH-1194 (2604 kg/ha), HSFH-1594 (2462 kg/ha) and HSFH-1573 (2396 kg/ha) at Hisar, LSFH-1708 (2038 kg/ha) and SVSH-493 (1769 kg/ha) at Latur, PSH-2091 (2622 kg/ha), PSH-2080

(2566 kg/ha), PSH-2594 (2480 kg/ha) and PSH-2593 (2417 kg/ha) at Ludhiana, SH-2551 (2832 kg/ha), SH-2515 (2822 kg/ha) and SH-2384 (3203 kg/ha) at Coimbatore and SMLHT-18-10 (1995 kg/ha), SMLHT-18-14 (1853 kg/ha) and SMLHT-18-2 (1849 kg/ha) at Raichur.

- As part of the prebreeding activity, evaluation of six crosses generated using wild *H. annuus* accessions (ANN-61, ANN-98 and ANN-1114) and RCR-83Br and parental lines at Raichur showed that accessions ANN-61 and ANN-98 were found resistant to *Alternaria* leaf spot; sunflower necrosis and leaf curl diseases while ANN-1114 was found to be highly resistant to *Alternaria* leaf spot. All the six intraspecific crosses showed moderate resistant reaction to *Alternaria* leaf spot with a score of 5 and resistant to sunflower necrosis disease (range from 3.3 to 7.8%) and leaf curl virus disease (1.5 to 3.0%) under natural field condition.
- KBSH-79, IIOSH-2, PSH-2080, PSH-2091, BLSFH-15004 were promoted to the next level of testing in *rabi* 2018 and IOSH-15-20, LSFH-1751, BLSFH-15005, IIOSH-15-10 were promoted to further testing in *kharif* 2019.
- Zero tillage was successful for rice fallow sunflower only in black soils of Nandyal, Andhra Pradesh.
- Efficacy of hydrophilic polymer hydrogel on sunflower production was found in Vertisols of Akola and Latur.
- Ridges and furrow sowing at 60 x 30 cm or Broad bed and furrow - paired row planting at 45 x 40 cm over flat bed sowing was found promising in increasing sunflower yield at Akola, Latur, Nandyal and Raichur. Application of FYM @ 5 t/ha and sowing of sunflower at half way on the ridges at Raichur while flat bed sowing at Nimpith were found promising.
- Sunflower–groundnut (Coimbatore and Bengaluru) and maize-sunflower (Nandyal) were found to be the promising new cropping systems.
- Pendimethalin @ 1.0 kg a.i./ ha as pre-emergence followed by (i) use of power weeder at 30 DAS (Coimbatore) or (ii) Propaquizafop (Agil) @ 62.0 g a.i./ha at 15-20 DAS as post emergence (Akola, Bengaluru and Raichur), or (iii) Quizalofop Ethyl 10 EC @ 37.5 g a.i./ha at 15- 20 DAS (post emergence) (Latur) were effective in effective weed management.
- Good agricultural practices were yielding a minimum of 15% higher yield than farmers' practices across the locations.
- A total of 612 frontline demonstrations were conducted during *rabi*/spring 2017-18 and *kharif* 2018.
- During *rabi*, the demonstrations showed that the mean seed yield increased by 16.5% with improved technology ((IT) (1524 kg/ha) as compared to farmers' practice (1308 kg/ha) and in *kharif*, the IT (1760 kg/ha) showed 15% increase in mean seed yield as compared to farmers practice (1483 kg/ha) indicating potential for enhancing the yield of sunflower.
- It is estimated that sunflower production in the country during *rabi*/spring season can be increased to 1.77 lakh t and 2.55 lakh t from 1.34 lakh t by bridging the yield gap I (yield gap between IT and FP) and yield gap II (yield gap between improved technology and state average yield), respectively with the adoption of available improved technologies in the current area under sunflower. During *kharif*, sunflower production can be increased from 1.1 lakh t to 1.34 lakh t and 2.38 lakh t, respectively by bridging the yield gaps I and II with the complete adoption of available improved technologies without increasing the area under sunflower.
- Disease survey conducted during the *rabi* 2017-18 and *kharif* 2018-19 indicated low to moderate incidence of all major diseases. Powdery mildew incidence was moderate to high in few locations in Coimbatore and Raichur centres.
- Among the coordinated trial entries (IAHT) screened during *rabi* 2017-18, the entries IIOSH-2, NSFH-36, BLSFH-15004 and NSFH-639 showed low Alternaria severity and NSFH-639 showed minimum lesion length of charcoal rot in artificial screening. Twelve entries were found resistant to downy mildew.
- During *kharif* 2018-19, the IHT entries *viz*., KBSH-84, CSFH-15026 and IIOSH-15-20 showed

low Alternaria severity, the hybrid IIOSH-15-20 recorded lowest necrosis disease incidence (9%). Among AHT entries, LSFH-4951, IIOSH-2, IIOSH-15-10, LSFH-1751 and BLSFH-15005 recorded less Alternaria leaf spot severity. Ten entries of AHT were free from downy mildew.

- Seed treatment with Imidacloprid 600 FS @ 5 ml/kg seed + foliar spray with Fipronil 5 SC @ 1 ml/l at 30, 45 and 60 DAS was found to be the most effective in management of viral diseases of sunflower.
- Seed treatment with the plant defense inducer salicylic acid @ 100 ppm + foliar spray of salicylic acid @ 100 ppm at 30 and 45 days after sowing was effective with less incidence of Alternaria leaf spot, necrosis and powdery mildew diseases and highest seed yield and B:C ratio.
- The charcoal rot incidence was minimum in seed treatment with *Pseudomonas fluorescens* @ 10 g/kg seed + soil application of *Trichoderma viride*@1.25 kg/ha + *P. fluorescens* @ 1.25 kg/ha fortified with 250 kg FYM + neem cake @ 250 kg/ha with maximum seed yield and B:C ratio.
- Among combination fungicides, seed treatment with Carbendazim 12% + Mancozeb 63% WP @ 2 g/kg seed followed by two foliar sprays with Zineb 68% + Hexaconazole 4% WP @ 0.25 g/l was found to be the most effective in management of Alternaria leaf spot.
- Seed treatment with *Pseudomonas fluorescens* (Pf) @ 10 g/kg seed followed by soil application of Pf 2.5 kg/ha fortified with FYM at the time of sowing + three foliar sprays of Pf @ 30, 45 and 60 DAS was effective in management of Alternaria leaf spot and necrosis diseases with the highest seed yield and B:C ratio.
- On farm validation of two trials concluded during previous season was carried out in farmer`s field. These include: A). Management of Alternaria blight through bioagents and fungicides (at Ludhiana), B). Integrated disease management of important diseases of sunflower (at Akola).
- There was moderate incidence of sucking pests like leafhoppers, whiteflies, thrips during *rabi* season in farmers' fields in Karnataka and Maharashtra. There was moderate incidence of sucking pests (thrips, whiteflies and leafhoppers) in Raichur region.
- Two lines, ARM-240B, CMS-84B from Bengaluru; 11 lines - PM-95, GMU-520, PM-2, PM-3, PM-6, PM-7, PM-40, PM-71, PM-72, PM-73, PM-87 from Raichur; 4 lines-IC-497575, EC-601935, EC-512709, EC-512724 from Latur were found resistant to leafhoppers.
- In multilocation evaluation, four entries, *viz.*, AKSFI-33, GPN-219-2, GMU-520 and ID-1079 were found resistant/moderately resistant to leafhoppers. The accessions GMU-4, GMU-339 and GMU-504 were confirmed to be resistant/moderately resistant to leafhoppers. GMU-440 was found to be resistant/moderately resistant to leafhoppers at all the locations. In coordinated trials, among the IHT entries, CSFH-14638, SVSH-498 and LSFH-1751 were found resistant/moderately resistant to leafhoppers at Akola, Latur and Raichur.
- Among IAHT entries, IIOSH-2 (AHT-1) and PSH-2080 (AHT-1) were found moderately resistant/resistant to leafhoppers at Akola, Latur and Raichur.
- Bt-127 SC formulation developed at ICAR-IIOR was found to be at par with other insecticides like, Profenofos, Chlorantroniprole, Dichlorvos and Delfin in reducing *Helicoverpa* and semilooper population at Akola and Latur.
- Diafenthiuron 50 WP @ 1 g/l was the most effective insecticide in reducing the population of whiteflies at Akola, Latur and Raichur.

Major Recommendations

- Application of 100% RDF (80:60:30 NPK kg/ha) along with hydrogel @ 2.5 kg/ha is recommended for higher seed yield and economic returns in Maharashtra.
- Sowing of the hybrid LSFH-171 on ridges and furrows at 60 cm x 30 cm spacing and application of 125% RDF (100: 75: 37.5 NPK kg/ha) is recommended for higher seed yield and economic returnsin Maharashtra.

- Incorporation of black gram crop residue, adoption of site-specific target yield of NPK with 5 t FYM/ha and application of *Trichoderma viride* to sunflower + S + limiting micro nutrient B is recommended for higher yield and economic returns in Tamil Nadu.
- Seed priming (carbendazim 2 g/kg seeds + thiamethoxam @ 0.04%) + spray of propiconazole @ 0.1 % + azadirachtin @ 0.15% as soon as disease appears and the 2nd spray 15 days later is recommendedfor effective management of Alternaria leaf spot and necrosis disease and getting higher seed yield in Maharashtra.
- Seed treatment with *Pseudomonas fluorescens*@ 10 g/ kg seed followed by spray of propiconazole @ 0.1% at 45 days and *P. fluorescens* @ 1.0% at 60 days after sowing is recommended for effective management of Alternaria leaf spot disease in Punjab.

Safflower

- In evaluation of 16 trait specific accessions for seed yield and oil content among 20 confirmed accessions at four locations. GMU-1830 and GMU-4610 at Solapur, GMU-6098 at Parbhani and GMU 1830 at Raipur were the best accessions recording 14-21% greater seed yield than the check variety A-1 at the respective centres. Nine accessions were confirmed for high oil content. GMU-7608 recorded highest oil content ranging from 37.8 to 43.5% across the four testing centres, followed by GMU-7583 (35.1-38.4%) and GMU-7574 (35.0-40.0%).
- Eighteen varieties giving 13-74% higher seed yield than the best check, A-1/PBNS-12 were developed from NCP at Parbhani (6), Indore (3), Raipur (3) and Tandur (6).
- At Parbhani, six varieties giving 22.3-32.2% higher seed yield (1560-1789 kg/ha) than PBNS-12 (1212 kg/ha) were developed.
- At Indore, three varieties developed have recorded 13-17% (2703-2800 kg/ha) higher seed yield than the check, PBNS-12 (2395 kg/ha) under irrigated conditions.
- At Raipur, three varieties possessing 34.3-35.0% oil content recorded 27-67% higher seed yield (3.5-4.6 kg/plot) than the check variety, PBNS-12 (2.75 kg/plot) under irrigated conditions.
- At Tandur, six varieties with 24-74% higher seed yield (2134-2982 kg/ha) than PBNS-12 (1715 kg/ha) and 5-47% higher seed yield than the best check A1 (2034 kg/ha) under rainfed conditions were developed.
- Sixty seven cms based hybrids were made at Parbhani, Solapur and Indore using the CMS line, A-133-II supplied by ICAR-IIOR, Hyderabad.
- The variety, ISF-867 developed by ICAR-IIOR, Hyderabad has matured 15 days earlier (DM: 122) than the normal duration check variety, A-1 (DM: 137) and gave 13% higher seed yield (2760 kg/ha) than A1 (2440 kg/ha) under rainfed conditions. Twenty eight short duration progenies tested at Raipur have matured in 112-120 days under cooler climate.
- In preliminary variety trials at different AICRP centres, 15 test varieties yielded 11 to 78% higher seed yield (842 – 2511 kg/ha) than the best check PBNS-12/SSF-708/A-1 (587-2044 kg/ha).
- A total of 1433 IPS/lines/families/bulks were selected by testing 915 progenies/families in different generations at Annigeri, Indore, Parbhani, Raipur, Solapur and Tandur.
- In PVT, four varieties at Parbhani, two varieties at Solapur, seven varieties at Raipur and two varieties at Indore recorded 11 to 78% higher seed yield than their respective best checks.
- In IVT-1, at national level, the variety SSF-17-04 recorded 9.6 % higher seed yield (2010 kg/ha) and 10.9% higher oil yield (556 kg/ha) than the best check A-1 (seed yield: 1834 kg/ha; oil yield: 501 kg/ha). The varieties ISF-116 and PBNS-184 gave 17% and 10.8% higher oil yield (587 kg/ha and 556 kg/ha) than A-1 (501 kg/ha), respectively. In Zone-I, SSF-17-04 has recorded 13.5% higher seed yield (1797 kg/ha) than the best check, A1 (1584 kg/ha) and 14.1% higher oil yield (490 kg/ha) than PBNS-12 (429 kg/ha). In Zone-II, SSF-17-01 and ISF-116 possessing 31.5% and 32.6% oil content recorded 17.9% and 17.3% higher oil yield (801 kg/ha and 797 kg/ha) than A-1 (680 kg/ha).

- In IVT-II, the variety, SSF-17-05 with 31.5% oil content gave 12.9% higher oil yield (584 kg/ha) than PBNS-12 at national level. Two high oil varieties *viz.*, ISF-87-15 and RVS-18-1 possessing 41.2% and 37.8% oil content, respectively, have recorded 18.6% and 24.8% higher oil yield (614 kg/ha and 646 kg/ha) than the best check, PBNS-12 (517 kg/ha), respectively.
- In AVT-I, SSF-16-02 possessing 30% oil content has recorded 11.9% higher seed yield (2080 kg/ha) than the best check, A-1 (1859 kg/ha) and 21.9% higher oil yield (626 kg/ha) than the best check, PBNS-12 (514 kg/ha). The variety, SSF-15-65 possessing 33.8% oil content gave 20.7% higher oil yield (620 kg/ha) than PBNS-12 (514 kg/ha).
- In AHT-I, two hybrids *viz.*, ISH-401 and ISH-402 have recorded 26.4 and 21.3% higher seed yield (2335 kg/ha and 2243 kg/ha) and 27.2 and 22.3% higher oil yield (713 kg/ha and 685 kg/ha) than the hybrid check, DSH-185 (seed yield: 1848 kg/ha; oil yield: 561 kg/ha), respectively. They recorded 25.6% and 20.6% higher seed yield than the best check, A-1 (1859 kg/ha) and 38.8 and 33.5% higher oil yield than the best variety check, PBNS-12 (514 kg/ha), respectively.
- In AVT-II, the spiny variety SSF-13-71 has recorded 13.9% higher seed yield (1951 kg/ha) and 15.6% higher oil yield (572 kg/ha) than the best check, PBNS-12 (seed yield: 1713 kg/ha; oil yield: 495 kg/ha). The non-spiny variety, ISF-1258-15 recorded 31.6% higher seed yield (1394 kg/ha) than the non-spiny check, NARI-6 (1059 kg/ha) at national level.
- A total of 46.50q breeder seed of 12 varieties was produced against the assigned target of 15.88q.
- System productivity of soybean-safflower was not affected when short duration (90-100 days) soybean was introduced in the system in place of normal duration (110-120 days) in Indore and Parbhani. System productivity of blackgram-safflower was 96% greater than fallow-safflower when rainfall received was 80% of normal at Solapur. System productivity of greengram-safflower was 13% greater than fallow-safflower when rainfall received was 67% of normal at Tandur.
- Best combination of plant spacing and IPNM identified were 4 rows/BBF (86% population) x 100% RDF + *Azotobacter* + PSB at Parbhani and 2 rows/BBF (80% population) x 100% RDF + *Azotobacter* + PSB at Tandur.
- Comparative performance of safflower cultivation under selective mechanization *vis a vis* farmer's practice indicated higher energy productivity in mechanized cultivation in Parbhani (0.49 MJ/ha) and Tandur (0.26 MJ/ha) compared to farmer's practice (0.28 and 0.16 MJ/ha).
- A total of 578 demonstrations were laid out during *rabi* 2018-19, of these 75 demonstrations were vitiated due to poor seed germination on account of severe moisture stress.
- In Whole package technologies under rainfed conditions demonstrated across five states of the country, the average productivity enhancement was 20 per cent (7.41 q/ha on IT plots and 6.15 q/ha on FP plots) resulting in accrual of additional net returns of Rs. 2939/ha. The gross monetary returns realised on IT and FP plots were Rs. 27,392 and 22,939 per ha, respectively with B:C ratios of 1.68 and 1.55 respectively on IT and FP plots. Whole package demonstrations in non-traditional areas of Kurnool and Prakasam districts revealed that the additional net returns accrued were higher (Rs.2136/ha) in safflower *vis-a-vis* chickpea primarily due to lower monetary inputs demanded by safflower crop. The productivity enhancement with whole package demonstrations in Karnataka with PBNS-12 and ISF-764 was 24 and 32%, respectively resulting to additional net returns of Rs.1453 and 2877/ha, respectively. In Maharashtra, the yield enhancement due to improved technology across different centres was 24% (22 per cent in Akola with AKS-207 and PKV-Pink to 28% in Solapur with SSF-708). In Telangana, the yield superiority due to improved technology (ISF-764) was 29%.
- Under irrigated conditions, the productivity enhancement with whole package was 55 per cent providing additional net returns of Rs. 17,502/ha. The B:C ratio recorded on IT and FP farms was 2.98 and 2.39, respectively. The productivity increase was of the order of 28 and 74% in Chhattisgarh and Uttar Pradesh, respectively.

- The component technology demonstrations conducted by Solapur centre of Maharashtra revealed yield enhancement of 15% with INM technology and 19 per cent each with improved cultivar, RDF and need based plant protection.
- Safflower production at the national level can be enhanced from the existing level of 0.55 lakh tonnes to 0.69 and 0.72 lakh tonnes by completely bridging the yield gap I and II, respectively.
- In Uniform Disease Nursery, the entry DSI-104 was moderately resistant to wilt at Solapur and Tandur. The highest seed yield was recorded by ISF-2039-15 at Solapur (652 kg/ha) and DSI-104 at Tandur (620 kg/ha). These entries can serve as most stable source of resistance to Fusarium wilt disease.
- Based on disease reaction of selected differential lines of safflower using *Fusarium* isolates from Solapur, Tandur and IIOR, Hyderabad centres, three entries *viz.*, 96-508-2-90, DSI-104 and ISF-28-15 have shown variable reaction to wilt isolates from 3 locations indicating prevalence of races in safflower growing areas.
- Seed biopriming with *Trichoderma harzianum* @ 10g/litre water for 12 h was found most effective as it recorded significantly low incidence of Fusarium wilt and Macrophomina root rot at Solapur, Tandur and Parbhani centres and Fusarium wilt at ICAR-IIOR, Hyderabad.
- In multilocation evaluation, the accession GMU-3256 was found moderately tolerant to aphids out of the 7 safflower entries tested.
- Seed treatment with either thiamethoxam 30 FS @ 10 ml/kg or imidacloprid 600 FS @ 8 ml/kg seed followed by foliar spray of pymetrozine 50WG @ 300 g/ha or difenthiuron 50WP @ 600 g/ha reduced the aphid population by 87-89% compared to untreated control and resulted in higher seed yield at Solapur.

Major Recommendations

- Released Purna (PBNS-86), a spiny safflower variety for cultivation in Marathwada region of Maharashtra under rainfed and irrigated conditions
- For effective and economical management of the seed/soil borne diseases of safflower like Fusarium wilt, Macrophomina root rot and Phytophthora seedling blight and getting higher seed yield, it is recommended to treat the safflower seed before sowing with *Trichoderma harzianum* Th4d WP @ 10 g/kg or *T. harzianum* Th4d SC @ 2 ml/kg or carbendazim + mancozeb @ 2 g/kg seed.

ICAR-IIOR

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Institutional Activities

- Extension and other Activities
- Education and Training
- Awards and Recognitions
- On-going Research Projects
- Committees
- Meetings and Events
- Human Resource Development
- Hindi Activities
- Publications
- Infrastructure Development
- Visitors
- Appointments/Superannuations
- Personnel

Extension and Other Activities

I. Tribal Sub-Plan

Niger Field day at Vishakapatnam District, Andhra Pradesh

TSP niger crop field day was conducted at Gadidhala Metta Village of Chintapalle Mandal, Vishakapatnam District, Andhra Pradesh on November 26, 2019. The niger crop was at flowering stage and about 55 farmers participated. Awareness and improved practices of niger cultivation *viz.*, improved varieties, timely sowing, importance of line sowing, cuscuta management and the profitability of niger cultivation through honey and market earnings were imparted. Honey bee boxes, tarpaulins, weeders, sieves and hedge cutters were distributed to the tribal farmers on that occasion. The utilization of niger seeds and its oil for various purposes was also explained to the farmers.

Farmers participating in the field day

Awareness programme on safflower cultivation organized at Adilabad District, Telangana

As a part of TSP programme, ICAR-IIOR, Hyderabad in association with Ekalavya Foundation organized a awareness programme on Safflower cultivation at Gudihatnoor Mandal, Adilabad District, Telangana on September 28, 2019 which were attended by 52 farmers. Importance of safflower crop, seed treatment, improved management practices and value

addition were explained by ICAR-IIOR scientists. Practical demonstration of seed treatment with *Trichoderma harzianum* in safflower was organized during the meeting. Mr. Mahesh Chary, Executive Officer, Ekalvya Foundation, Adilabad District encouraged farmers for taking up safflower cultivation and assured them of all support for its cultivation. The improved safflower variety 'ISF-764' was distributed among the beneficiary farmers.

Scientists-Farmers interaction meeting at Tribal Training Centre, Gudihatnoor Mandal, Adilabad District

Distribution of seeds of improved safflower variety 'ISF-764' among beneficiary farmers

II. Schedule Caste Sub Plan activities

To enhance the incomes of scheduled caste communities (scheduled caste farmers, farm labourers and farm woman), scheduled caste sub-plan (SCSP) was initiated during 2018-19 by ICAR-IIOR. In order to effectively implement the programme at the Institute, a core team was constituted with appropriate representation of SC employees.

Various committees comprising scientists of ICAR-IIOR, were constituted for selection of villages to implement the SCSP activities. The committees, in collaboration with local KVKs, staff of Agricultural Departments and local NGOs surveyed the villages and interacted with the SC communities. The scientists had in depth discussions with the communities in their villages and prioritized their felt needs in agriculture.

Basic information of the villages selected for implementation of SCSP activities by ICAR-IIOR

District	Mandal & Village	SC families (no.)	Crops Grown		Irrigation Facilities	Soils	Interventions identified
			Kharif	*Rabi*			
Medak	Venkatapur/ Venkatapur	138	Paddy	Paddy	Bore wells	Red soils	Improved varieties of rice, sprayers, tarpaulins, sickles, *Trichoderma*; Opportunity for back-yard poultry and training on oilseed cultivation
Wanaparthy	Wanaparthy/ Mentapally	261	Paddy, Groundnut, Red gram, Castor	Paddy	Bore wells	Red soils and chalka soils	Soil testing, access to quality seed of rice, redgram and castor, training on oilseed cultivation

District	Mandal & Village	SC families (no.)	Crops Grown		Irrigation Facilities	Soils	Interventions identified
			Kharif	*Rabi*			
Wana-parthy	Kothakota/ Kanimetta	150	Paddy, Castor, Ground-nut, Maize, Chillies	Paddy vegeta-bles	Tanks, Jurala project canal, bore wells	Chalka soils, red soils, black cotton soils	Access to improved cultivars of castor and paddy, soil testing and training on oilseed cultivation. Oppor-tunity for back-yard poultry
Wana-parthy	Pebbair/ Thomalapally	120	Paddy	Ground-nut	Nallay-enucheruvu, Jurala project canal	Red soils	Quality seed and small implements; opportunity for back-yard poultry; training on oilseed cultivation

Based on village visits and the interactions, four villages *viz.*, Venkatapur in Medak district, Thomalapally, Mentapally and Kanimetta villages in Wanaparthy district were selected for implementing SCSP activities by ICAR-IIOR. The broad guidelines followed in implementing the SCSP activities at ICAR-IIOR are as follows.

i) The details of the selected SC beneficiaries such as aadhar card, mobile no. and pattadhar pass book/caste certificate were collected for ensuring the benefits reach the SC communities.

ii) The fund allocated was utilized for the procurement of seed, farm implements (hand sprayers, tarpaulins), training of SC beneficiaries and visits to villages.

iii) Utmost care was taken in identifying the villages for implementation of SCSP activities, villages with substantial SC population were selected.

iv) The beneficiaries were selected on non-repetitive basis.

Based on the interactions, to meet the need for improved cultivars seeds of castor hybrid 'DCH-519', paddy varieties 'RNR-15048' and 'KNM-118', red gram variety 'Hanuma' were provided to the SC communities. The farm labourers and farm women were provided battery-cum-manual operated sprayers and tarpaulins. The SC communities were educated on optimum nutrient management in oilseeds, pulses and paddy and were provided the required fertilizers in the form of single super phosphate and muriate of potash.

Details of inputs distributed under SCSP by ICAR-IIOR

Seed/Input	Mentapally	Thomalapally	Venkatapur	Kanimetta	Area covered (acres)
No. of SC families	149	129	177	150	-
Paddy: RNR-15048 (acres)	103	125	0	272	500
Paddy: KNM-118 (acres)	-	-	75	0	75
Redgram: Hanuma (acres)	38	-	-	-	38
Castor: DCH-519 (acres)	-	-	-	70	70
Fertilizer: SSP (bags)	206	250	150	394	500
MoP (bags)	103	122	75	200	500
Tarpaulin (no.)	-	150	-	-	150
Sprayers (no.)	60	7	33	0	100
Poultry birds: Rajasri (no.)	900	1200	1800	1100	5000
Trainings organized (no.)	2	2	2	2	8

In order to educate the communities on latest agricultural technologies, *Vyvasaya Panchangam*, a compilation of latest information on all the crops grown by the farmers of the state in regional language, Telugu was provided. The programme was expanded to other states with the collaboration of AICRP centres.

No. of beneficiaries identified from different States for the implementation of SCSP activities by AICRP and other centres

Implementing partner	State	District	Village	No. of beneficiaries
AICRP (Safflower) centre, Raipur	Chhattisgarh	Bemetara	Mohtara	20
			Sihanpuri	2
			Kohkabod	3
			Godmarra	15
			Tiriyabhat	4
			Jamgaon	1
			Khurusbod	5
Ekalavya Foundation	Telangana	Adilabad	Dhampur	10
			Gudihathnoor	7
			Inkerguda	16
			Kolhari	6
			Sonpally	15
			Lingapur	6
			Shetti-hadapnoor	15
			Raghapoor	3
			Sirpoor-U	3
			Bussimetta	9
			Jamni	7
			Rajulguda	1
			Pawarguda	1
			Gondipator	1
ARS, Jagtial		Karimnagar	Gundlasomaram	8
			Joginepalli	8
			Chinnapur	3
			Polasa	1
			Nagunur	1
			Arpapally	10
			Thalladharmaram	15
KVK, Jammikunta		Karimnagar	Lasumannapally	49
			Mallannapally	76
ICAR-IIOR		Nagarkurnool	Madhavanipally	85
		Medak	Venkatapur	177
		Wanaparthy	Kanimetta	150
			Mentapally	149
			Thomalapally	129
AICRP-Sunflower centre, Nimpith	West Bengal	24 South Paraganas	Bazerbaria	16
			Sitarampur	34
	Total			1061

Scientists discussing with SC communities for identifying the felt needs

Distribution of poultry birds, Rajasri and feed at Kanimetta village

III. North East Hill (NEH) Region Programme

As part of the area expansion of oilseed crops in the NEH Region evaluation of the latest released varieties/ hybrids of sunflower and sesame were undertaken. Nine sunflower hybrids were evaluated in three locations of NEH region *viz.,* College of Agriculture Tripura (CAT), Lembucherra, ICAR-RCNEHR, Nagaland and ICAR-RCNEHR, Tripura during *rabi* 2018-19. At CAT, Tripura, the highest yield was recorded in KBSH-74 (2.1 t/ha) which matured in 93 days. The hybrids COSFV-5 and IIOSH-14-2 matured at 105 days and had grown tall. At ICAR-Nagaland centre, the hybrids KBSH-71, KBSH-74, PSH-1962 produced seed yield more than two tonnes per hectare and highest was in KBSH-71 (2.8 t/ha). At ICAR-Tripura centre, the yield of hybrids RSFH-1887, KBSH-78 and IIOSH-14-2 was about 2 t/ha. At this centre, it was noticed that all hybrids were prone to lodging except KBSH-78.

Details of field days organized in the NEH region

S.No.	Venue	No. of beneficiaries	Villages	Date	Crop demonstrated
1.	ICAR- RCNEHR, Nagaland centre	30	Jharnapani, Medziphema and officials from KVKs Khipre and Medziphema	February 25, 2019	Sunflower
2.	ICAR-RCNEHR, Tripura centre	70	West Tripura, Dhalai (aspirational district), Khowai and North Tripura	February 27, 2019	Sunflower and Sesame

Field Day at ICAR-Nagaland centre

Field Day at CAT, Lembucherra centre

IV. Mera Gaon Mera Gaurav (MGMG)

During the year, 92 visits were made by the MGMG Teams covering 2504 farmers in the identified villages and the following activities were conducted in the villages.

Name of activity	No. of activities conducted	No. of farmers
Visit to village by teams	92	2504
Interface meeting/ *Gosthies* /trainings	70	1401
Demonstrations conducted	113	260
Mobile based advisories (No.)	31	542
Literature support provided	11	405
General awareness created	31	889

V. Training of Farmers, Field Days and Exhibitions

Around 2670 farmers and extension officers were trained on different aspects of oilseeds cultivation during 2019.

a) Training programmes for capacity building of farmers

Topic	Venue	Date	No. of beneficiaries
Training on Seed Production Technologies in Castor, Sunflower, Safflower and Sesame	IIOR, Hyderabad	January 7-11, 2019	23
BMPs for increasing oilseeds production to input dealers of Wanaparthi Mandal, Telangana	IIOR, Hyderabad	February 15, 2019	35
Agril Skill Council of India training on Quality Seed Production	IIOR, Hyderabad in collaboration with IIRR	February 21, 2019	22
Agril Skill Council of India training on Quality Seed Production	IIOR, Hyderabad in collaboration with PJTSAU	February 25, 2019	25

b) On-Farm Training

The following on-farm training programmes were organized.

Topic	Village	District	Date	No. of beneficiaries
Technologies for increasing yield of castor	Patherched	Mahabubnagar	January 29, 2019	300
Technologies for increasing yield of sesame	Imrahimpur Hegdoli	Siddipet Nizamabad	January 10, 2019 March 11, 2019	75 50
Biocontrol of castor pests	Kanimetta	Wanaparthy	February 6, 2019	100
Techniques for increasing yield of castor during *kharif*	Kanimetta and Gudigandla	Wanaparthy	June 6, 2019	40

Topic	Village	District	Date	No. of beneficiaries
Technologies for rice-oilseeds based cropping systems	Venkatapur	Medak	June 6, 2019	140
Fertilizer management in *kharif* crops	Mentapally	Wanaparthy	June 12, 2019	100
Weed management in *kharif* crops	Thomalapally	Wanaparthy	June 17, 2019	120
Pest management in castor	Madampally	Mahabubnagar	June 28, 2019	15
Interaction meeting on castor	Jwalapuramu Village	Anantapuramu	July 10, 2019	250
Management of pests and diseases in castor	Jaklair	Mahabubnagar	August 28, 2019	20
Suitable hybrids of castor for Mahabubnagar & Wanaparthy districts	Patherched and Yankee	Mahabubnagar	September 18, 2019	65
Suitable hybrids of castor for Mahabubnagar & Wanaparthy districts	Gudigandla Kanimetta	Mahabubnagar Wanaparthy	September 28, 2019	70

c) Training on Best Management Practices (BMPs) for Increasing Oilseeds Productivity

Input dealers are the first source of information on agriculture for the farmers. In order to strengthen the information of input dealers a training programme was organized on "Best Management Practices (BMPs) for increasing oilseeds productivity" at ICAR-IIOR on February 14, 2019. Forty input dealers of Mahabubnagar and Wanaparthy districts of Telangana State participated in the training programme.

d) Field days

i) Sunflower field day-cum-interaction meeting

The rice-fallow areas of Telangana State have huge potential for oilseeds cultivation. In order to exploit this potential, frontline demonstrations on sunflower were conducted in Nizamabad district of Telangana state. A field day was organized at Hegdoli village, Nizamabad district on March 12, 2019 to create awareness among farmers, staff of agricultural department and KVK and other stakeholders on the profitability of sunflower in rice fallows. The district is one of the potential districts for cultivation of oilseeds (sunflower, safflower and sesame). The Head of Regional Research Station, Rudrur and Scientists of DAATTC and ICAR-IIOR participated in the field day and interacted with the farmers. Local Rythu Samanvaya Samithi members and local leaders also participated in the event. The programme started with the field visits of staff of agricultural department, farmers, scientists and the press followed by interaction with the stakeholders. Around 190 farmers participated and actively interacted with the scientists during the field day.

Farmer's sharing their experiences of sunflower cultivation in rice fallows

Scientists interacting with farmers

ii) Farmers' Day at Kanimetta village, Wanaparthy District, Telangana

ICAR-Indian Institute of Oilseeds Research (IIOR) organized Farmers Day on October 17, 2019 at Kanimetta village, Kothakota Mandal, Wanaparthy District, Telangana under the Scheduled Caste Sub-Plan. The programme started with the visits to farmers' fields of castor hybrid DCH-519 and paddy variety Telangana Sona (RNR 15048). Under Scheduled Castes Sub-Plan, castor hybrid DCH-519 was grown in an area of 70 acres and paddy variety, Telangana Sona (RNR 15048) was grown in 272 acres during *kharif* and *rabi* seasons. Scientists from ICAR-IIOR, PJTSAU, KVK and officials from agricultural department, local leaders, ZPTC, Vice-chairman, Chairman, Cheruku Development Committee, farmers from Kanimetta and other villages participated in the programme. Farmers shared their experiences in cultivation of castor and paddy and clarified their doubts on improving the productivity of these crops.

Director, ICAR-IIOR addressing farmers on the need for village level seed production

Felicitation of the SC farmer Sri. Nandanna, who is instrumental in implementing SCSP activities in the village

iii) Castor Field Day-cum-Exhibition

ICAR-Indian Institute of Oilseeds Research (IIOR) organized Castor Field Day on October 26, 2019 at Undyala village, C C Kunta Mandal, Mahabubnagar district in Telangana to create awareness about the newly notified castor hybrid ICH-66. ICH-66 along with the popular hybrid DCH-519 and management of castor gray mold disease were demonstrated in farmers' fields. For management of the diseases, weather based sensors were installed in various castor fields throughout cropping season to monitor temperature, relative humidity and leaf wetness etc. at every 30 minute interval. Based on the data received from sensor to the Server located in IIOR, the occurrence of gray mold disease was predicted and prophylactic spray was suggested to all the farmers before the in-

cidence of disease. The demonstrated fields are free from gray mold disease (up to 90%) compared to the surrounding unsprayed farmers' fields. A total of 575 farmers from different mandals visited the demonstration plots. An exhibition on castor, safflower and sesame technologies were also organized wherein different varieties, management practices, crop protection and biological control along with live specimens were displayed. Around 25 officers of agricultural department participated in the field day. The field visits were followed by Farmers-Scientists interaction meet. Farmers actively interacted with the scientists and clarified their doubts on castor cultivation. Scientists from ICAR-IIOR, PJTSAU, officials from DAATT centre, KVK, ZPTC, MPTC, ADAs, AOs, AEOs, local MLA and local leaders attended the programme.

Farmer-Scientist interaction during Castor Field Day-cum-Exhibition

iv) Castor Field Day at Farmers fields of Anantapuramu district, Andhra Pradesh

ICAR-IIOR Hyderabad organized Castor Field Day at Belguppa village, Kalyana Durgam, Anantapuramu district, Andhra Pradesh on November 15, 2019. The objective of the Field Day was to showcase the successful cultivation of castor (DCH-519) in farmer's fields of Sri.K.Ramanjaneyulu under rainfed conditions in Belguppa village.

The Field Day was conducted in association with Agricultural Research Station, Rekulakunta, Acharya N.G.Ranga Agricultural University (ANGRAU), All India Coordinated Research Project on Castor, Anantapuramu. Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR who chaired the session on farmers-scientists interaction stressed the importance of castor around Anantapuramu district as an alternative crop to groundnut as it was more remunerative. He assured the supply of quality seed of IIOR castor hybrids (DCH-519 and ICH-66) in the region. Dr. T. Yellamanda Reddy, Technical Director, RDT Anantapuramu expressed the need for seed production of castor hybrids through FPOs under the technical guidance from IIOR, Hyderabad. Scientists from AICRP (Castor), Anantapuramu, RARS Nandyal, ARS Rekulakunta, KVK Kalyana Durgam, KVK Banvasi and ICAR-IIOR participated and responded to farmers queries. Around 250 farmers including farm women benefitted from the programme.

Farmer-Scientist interaction at Belguppa village, Kalyana Durgam, Anantapuramu district, Andhra Pradesh

v) Week-long open Field Day-Demonstration of Oilseed crops conducted at ICAR-IIOR Rajendranagar, Hyderabad

In order to meet the growing demand of vegetable oils in the country, different oilseed institutes under ICAR/ AICRP developed suitable genotypes and improved technologies for enhancing the productivity, profitability and input use efficiency of oilseed crops. Contrast to organizing individual crop demonstrations at different locations for the crops, the best management practices developed for seven oilseed crops were showcased as week-long open field day on *"Demonstrations of oilseed crops"* during *rabi* December 16-21, 2019 at ICAR-Indian Institute of Oilseeds Research (IIOR), Hyderabad. Four varieties of groundnut (K-6, K-9, Kadiri Harithandra and Dharani); five varieties of sesame (Shwetha, JCS-1020, YLM-66, GT-10 and CUMS-17) three hybrids of sunflower (DRSH-1, NDSH-1012 and LSFH-171) and three cultivars of safflower (DSH-185, ISF-764 and PBNS-12), two varieties of niger (JNS-28 and JNS-9); four varieties of rapeseed-mustard (NRCHB-10, RH 749, PM-30 and PM-31) and four hybrids of castor (ICH-66, DCH-519, GCH-7 and GCH-8) were exhibited by following best management practices. These included varietal choice, seed treatment, thinning, adopting optimum plant population, site specific nutrient and water management. The demonstrations pertaining to drip-fertigation and hybrid seed production in castor (DCH-519) were also exhibited. In addition, the week long programme consisted of Focussed Group Discussions on relevant oilseed technologies, visit to oil expelling unit and IIOR Museum. Participation was invited across major oilseed growing states and stakeholders for the Open Day. Dr. A. Vishnuvardhan Reddy, Director IIOR and the Subject matter specialists/ scientists from IIOR facilitated the exposure visit and demonstration of relevant oilseed technologies.

A total of 700 farmers from 24 districts of three states (Telangana, Andhra Pradesh and Odisha) along with representatives from respective State Dept. of Agriculture, KVKs, ATMA and NGO's participated and benefitted.

Open field days for oilseed crops at ICAR-IIOR, Hyderabad

e) Exhibitions

In order to showcase technologies and facilitate availability of seeds of improved varieties and hybrids to farmers, ICAR-IIOR, Hyderabad stall was set up at various expos and melas as presented below.

Theme/Area	Place	Date	No. of participants
Agricultural Science Congress Expo	NASC, New Delhi	February 20, 2019 to February 23, 2019	Around 500 farmers, staff of agricultural departments and scientists from all over India visited ICAR-IIOR stall
Seed Mela	PJTSAU, Hyderabad	May 24, 2019	Around 1000 farmers from various districts of Telangana and Andhra Pradesh visited ICAR-IIOR stall

Seed Mela at PJTSAU, May 24, 2019

VI. ICAR-Seed Production in Agricultural Crops (SPAC)

The various programmes conducted for capacity building and technology dissemination under ICAR Seed Project - Seed Production in Agricultural Crops during 2019 are presented.

Title	Date	Stakeholders	No. of Beneficiaries
Training			
Interaction meeting on castor at Bawapuram, Anantapuramu district	July 10, 2019	Farmers, Scientists of ARS, KVKs, Department of Agriculture, etc.	250
Interaction cum training on Castor Seed Production technologies Yagantipalli, Banaganapalli	August, 30, 2019	Farmers, scientists, technical personnel of KVK, APSCA, etc.	60
On-farm training on castor hybrid seed production at Banaganapalli	December 9, 2019	Farmers, scientists, technical personnel of KVK, APSCA,etc.	30
Orientation training on' Seed production of sesame' under SPAC and 'Seed treatment with *Trichoderma harzianum*' under TSP programmes of ICAR-IIOR.	December 28, 2019	Farmers, seed growers, KVKs, NGOs, State Department of Agriculure etc.	200
Field day/Seed Melas/Exhibitions			
ISTA Congress at Hyderabad	June 26-28, 2019	Scientists, farmers, industry, policy makers, etc.	800

Dignitaries visiting the ICAR-IIOR stall at ISTA Congress

Interaction meeting on castor at Jwalapuramu Village, Anantapuramu

Interaction cum training on castor seed production at Banaganapally

Orientation training on seed production of sesame to TSP farmers at Adilabad

VII. National Agricultural Innovation Fund (NAIF) Activities

Component I : ITMU

Technology licensing

- Licensing of *Trichoderma harzianum* Th4d 20% SC formulation to M/s Shri Ram Solvent Extractions Pvt. Ltd, Jaspur, (U.S.Nagar) Uttaranchal.
- Additional data for the CIBRC registration of DOR Bt-1 WP 0.5% formulation was provided to M/s Multiplex Biotech Pvt. Ltd, Bengaluru, Karnataka and International Panaacea Ltd., Gurugram, Haryana

Training/Awareness programmes

Interaction meeting with castor farmers to create awareness on biopesticides in IPM

A farmers' interaction meeting on IPM in Castor was organized at Kanimetta village, Wanaparthy district, Telangana State on February 6, 2019 under the AMAAS sub-project on "Mass production of *Bacillus thuringiensis* (Bt) and *Beauveria bassiana*, formulation as oil based suspension concentrates singly and in combination and field evaluation". Around 130 farmers and local officials from the Department of Agriculture, KVK, Madanapuram and SDDPA, Wanaparthy were attended the meeting.The meeting was chaired by Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR, Hyderabad. Dr. A. Vishnuvardhan Reddy, in his address, stressed the need for eco-friendly pest management against insect pests and diseases. Scientists from ICAR-IIOR explained about the importance of the microbial insecticide, DOR Bt-127 SC formulation in pest management for farmers. and created awareness about the importance of eco-friendly pest management through microbial pesticides. Farmers used Bt-127 as a component of IPM in castor during *kharif* 2018-19 for manage-ment of lepidopteran insect pests shared their experiences. During the meeting, an exhibition was organized and awareness was created about the importance of IPM in pest management using Bt and other biopesticides.

Interaction meeting at Kanimetta village

Component II: ABI

Training /Awareness programmes

- Six programmes to create awareness and hands on experience on value addition in oilseeds to members of Self Help Groups/Community Resource Persons from Bihar, Jharkhand, Odisha and Uttar Pradesh under "Sustainable Livelihoods and Adaptation to Climate Change" programme were organized during June to September 2019.
- Training programme on enhancing farmers income through value addition in oilseeds to farmers and entrepreneurs from Odisha, Tamil Nadu and Andhra Pradesh was organized on December 18, 2019.

VIII. Parthenium Awareness week organized at ICAR-IIOR, Hyderabad

The ICAR-Indian Institute of Oilseeds Research, Hyderabad organized *Parthenium Awareness week* from August 16 to 22, 2019. Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR chaired the inter-active session on *Awareness programme cum Interaction meeting on Parthenium* organized at Rajendranagar farm on August 16, 2019. All the employees, students, contractual staff of ICAR-IIOR attended the session. An overview of harmful effects of Parthenium on agricultural crops, general public and livestock was presented and the need for Integrated Parthenium Management at community level was discussed. This was followed by scouting the farm by all the staff to identify and remove Parthenium from premises of IIOR. Charts, posters received from Directorate of Weed Research, Jabalpur and live samples were displayed in and around IIOR farms. On August 19, 2019, awareness programme on *Harmful effects of Parthenium and its successful control* was organized in farmers' fields/ panchayat office in MGMG village in Jaapal, Ranga Reddy district. Parthenium eradication was taken up by farmers in premises of village Panchayat building and surrounding farmers' fields. During the period of campaign (August 20-22, 2019), awareness cum action programmes on *Integrated Parthenium management* were organized in Narkhoda and IIOR-ICRISAT farm through mechanical, cultural, chemical and biological methods were discussed.

Parthenium Awareness Week organized by ICAR-IIOR

IX. Swachhta Hi Seva

As per the directive from the council, 'Swachhta Hi Seva (SHS)-2019' activities were conducted under Swachh Bharat Mission from September 11 to October 2, 2019. As per the schedule of specific activities, after attending to further/regular cleanup of the daily chores inside the office/lab premises, cleaning of outside premises of IIOR office at Rajendranagar was done to remove all the wastes – paper, plastic, debris, clearing bushes, parthenium, etc. Necessary tools – swords, bins, brooms, hand gloves, etc. were made available for the purpose. All the employees, students, contractual staff and trainee participants were participated with enthusiasm in cleaning the institute premises and surroundings. Banners of Swachhta Hi Seva were displayed for general awareness.

Elocution and quiz competitions were conducted among school children about the life of Mahatma Gandhi ji. All staff of IIOR along with school children enthusiastically participated in Swachhta Sramadan. About 350 school students, teachers and IIOR employees participated. IIOR staff motivated school children to speak about swachhta, the dream of our Father of the Nation, Mahatma Gandhi ji. Students from class 9 to 10 shared their views openly in their school assembly about swachhta and expressed that they

would each plant a tree sapling in this year. Further cleaning drive was done inside and outside the school premises by removing waste like polythene bags, covers, papers, weeds and other unwanted materials.

Awareness campaigns were organized in villages for better sanitation practices like use of toilets, hand washing, health and hygiene.

As per the schedule of activities, village level rallies were conducted at Gattepally, Gattepalythanda, Gorudodlathanda and Rampur thanda (tribal village) at Vikarabad Mandal to generate awareness and on sramdan to drive behavior change with respect to sanitation, compost-pit maintenance and neighborhood cleaning etc. Swachhta Hi Seva posters were displayed to create awareness of Swachhta. Clean-up drive, compost pit maintenance, separation of degradable and non-degradable material were undertaken at Rajendranagar campus of IIOR. Created Swachhta awareness in MGMG villages and conducted clean-up drive at Ibrahimpally, Ranga Reddy district, Telangana.

As per the schedule of activities, on October 02, 2019, the 150th birth anniversary of Mahatma Gandhi ji was celebrated; prize distribution was organized along with Swachhta awarness programme and briefing about the activities conducted. Swachhta pledge was taken by all staff, students and farm labour. Clean-up drive was undertaken at individual office rooms and a committee inspected and the best clean rooms were selected and awarded. The employees participated with great enthusiasm throughout the Pakhwada. The Swachhta Pakhwada concluded with determination for Swachh Bharat.




'Swachhta Hi Seva' activities of ICAR-IIOR

Education and Training

Details of students working for Ph.D. (2019)

Name of the student	Title of the thesis	Discipline	University
Major advisor: **Dr. M. Sujatha**			
D. Sandeep Kumar	Tissue culture studies and genetic transformation in castor (*Ricinus communis* L.) by deploying *Cry1 Aabc* gene for resistance to lepidopteran pests	Genetics	Osmania University, Hyderabad
Major advisor: **Dr. V. Dinesh Kumar**			
K. Aravind Kumar	Multigene approaches for necrotrophic fungal tolerance	Bio-technology	University of Hyderabad, Hyderabad
B. Madhu	Development of regeneration and transformation protocols in safflower (*Carthamus tinctorius* L)	Plant Sciences	University of Hyderabad, Hyderabad
S. Velu Mani	Molecular mechanisms responsible for the biological effects of *Trichoderma* on castor bean (*Ricinus communis* L) plant health	Plant Sciences	University of Hyderabad, Hyderabad
Major advisor: **Dr. M. Santha Lakshmi Prasad**			
K. Sujatha	Study of resistance mechanism and management of *Alternaria* leaf blight in sunflower	Genetics	Osmania University, Hyderabad
N. Naresh	Diversity analysis of *Alternaria* leaf blight in sunflower based on morphological, pathogenic and molecular characters	Bio-technology	JNTU, Hyderabad
E. Bharathi	Variability in pathogen population of castor wilt fungus and its management	Micro- biology	Osmania University, Hyderabad
Major advisor: **Dr. S. Senthilvel**			
J. Poornima Kumari	Genetic and molecular analysis of nematode resistance in castor (*Ricinus communis* L.)	Genetics	Osmania University, Hyderabad
Co-Major advisor: **Dr. Ratna Kumar Pasala**			
B.B. Pandey	Studies on traits associated with drought tolerance in sesame	Plant Physiology	Indira Gandhi Krishi Vishwa Vidayalay, Raipur
Co-Major advisor : **Dr. M. Santha Lakshmi Prasad**			
M. Surya Prakash Reddy	Studies on identification of source of resistance in sesame against root rot and phyllody	Plant Pathology	JNKVV, Jabalpur
Co-Major advisor : **Dr. P. Duraimurugan**			
Borkar Sundar	Studies on bio-ecology and management of storage insect pests of sesame	Agricultural Entomology	JNKVV, Jabalpur

Details of students working for M.Sc. (2019)

Name of the student	Title of the thesis	Discipline	University
Dr. P. Ratna Kumar			
A.L. Sravanthi	Characterization and confirmation of elite germplasm of sesame under drought conditions	Plant Physiology	PJTSAU, Hyderabad
E. Sonia	Effect of selected growth regulators on sesame physiology and yield	Plant Physiology	PJTSAU, Hyderabad
Dr. P.S.Srinivas			
P. Chaithanya	Identification of sources of resistance and analyzing the physiological and biochemical factors imparting tolerance in safflower to aphid, *Uroleucon compositae* (Theobald)	Agricultural Entomology	JNKVV, Jabalpur
Dr. M. Santha Lakshmi Prasad			
K. Prasindhu	Studies on sesame phyllody incited by *Phytoplasma*	Plant Pathology	ANGRAU, Andhra Pradesh

Training programmes for capacity building of scientists and other stakeholders

a) Training on Seed Production Technologies in Castor, Sunflower, Safflower & Sesame

The training programme on 'Seed Production Technologies' in Castor, Sunflower, Safflower and Sesame was organised at ICAR-IIOR, during January 7-11, 2019. Twenty one participants from SAUs, AICRP, NSC, TSSCA, IIOR, NGOs etc. attended the training. The training included seed to seed aspects starting from basic concepts of crop botany, pollination mechanism, and advances in seed production technologies for varieties, parental lines and hybrid seed production and certification. The knowledge on maintenance breeding, seed production techniques, agronomic management practices, genetic purity testing, seed certification process, post-harvest processing and storage aspects which are critical for successful seed production were imparted. Practical field exposure and hands on training was provided in all the crops with continuous interaction. Visits to seed testing and certification laboratories and Gubba cold storage facility were also organised.

Training on Seed Production Technologies

Visit to Gubba Cold Storage Unit, Hyderabad

b) Orientation-cum-Training for scientists of AICRP on Oilseeds

The programme for orientation-cum-training for newly joined scientists of AICRP for Castor and Safflower was conducted. The duration and number of participants are presented.

Crop	Dates	No. of scientists
Castor	February 4-6, 2019	6
Safflower	February 20-22, 2019	5

The scientists were imparted training on various aspects such as management and characterization of genetic resources as well as breeding methods. Techniques for screening agaist pests, diseases and their management, seed production, agronomy experimentation, physiological aspects, oil content and quality estimation, DUS testing guidelines, PGRC regulations, experimental design and statistical analysis, details of submission of AICRP data in the required format were described by the resource persons from ICAR-IIOR, Hyderabad. The training sessions comprised presentations, interactions, field and laboratory visits.

Demonstration of crossing technique in safflower

Visit to safflower hybrid seed production plot

c) Orientation-cum-training on 'A Reorientation on Breeding Perspectives for *Kharif* Oilseed Crops'

ICAR-IIOR, Hyderabad organized an interactive training programme from August 20-23, 2019 for all the AICRP's and IIOR breeders engaged in research on *kharif* oilseed crops on the breeding perspectives, finer aspects related to breeding of self and cross-pollinated crops, management of genetic resources, parental line development, varietal development, seed production and appropriate statistical designs to be followed in order to improve the quality of experimentation and in fine tuning the breeding programmes. Resource persons included renowned breeders from public, private and CGIAR institutes in addition to crop specialists from IIOR. The training was formally inaugurated by Dr. P. Raghava Reddy, Ex-Vice Chancellor, PJTSAU, Hyderabad and the valedictory session was chaired by Dr. V. Praveen Rao, Vice Chancellor, PJTSAU, Hyderabad. A total of 45 scientists had the benefit of participation in this programme.

Trainees of the Orientation-cum-Training on 'A Reorientation on Breeding Perspectives for Kharif Oilseed Crops'

d) Training on Microbial Agents of Major Insect Pests and Diseases of Crops

Ten days Hands-on Training programme on production of microbial agents of major insect pests and diseases of crops was conducted at ICAR-IIOR, Hyderabad during June 20-29, 2019. Seven participants from four states (Telangana, Tamil Nadu, Karnataka and Maharashtra) attended the training programme. Techniques for isolation, identification, mass multiplication, formulation, quality testing and maintenance and storage of entomotoxic bacterium *Bacillus thuringiensis* (Bt); entomopathogenic fungi like *Beauveria bassiana*, *Nomuraea rileyi*, *Metarhizium anisopliae*; antagonistic fungus, *Trichoderma* spp. and antagonistic bacterium, *Pseudomonas* spp. and entomopathogenic nematodes were explained to the participants.

Training on Microbial Agents of Major Insect Pests and Diseases of Crops

e) Hands-on Training on Isolation, Identification, Mass Production and Formulation of Entomopathogenic fungi

A 5 days Hands-on Training on isolation, identification, mass production and formulation of entomopathogenic fungi was organized at ICAR-IIOR, Hyderabad during July 22-26, 2019. Two participants from Coromandel International Ltd., Thiyagavalli, Cuddalore, Tamil Nadu participated in the training.

f) ICAR short course on 'Recent Advances in Organic Production Systems Involving Oilseeds for Soil Health and Export'

A short course on Organic Production Systems was organized from September 16 to 25, 2019 at ICAR-IIOR, Hyderabad. A total of 22 participants from SAUs/KVKs located in different agro-eco regions of the country were trained on advanced farming methods involving organic production systems. Field visits to IIOR and ICRISAT research farms as well as laboratories were organised during the training programme. Lectures by experts on topics *viz.,* Status of organic agriculture in the world and the potential of Indian oilseeds, organic nutrient flow studies in DSS/APSIM: a case of soybean and Rock phosphate as a source of phosphorus in organic farming were discussed in the training.

ICAR short course on 'Recent advances in Organic Production Systems Involving Oilseeds for Soil Health and Export'

Awards and Recognitions

Awards

- Dr. P. Duraimurugan received "Best Poster Award" for the paper entitled "Exploitation of the sex pheromone for monitoring of shoot and capsule borer, *Conogethes punctiferalis* Guenee (Crambidae: Lepidoptera) in castor" (authored by P. Duraimurugan and M. Sampath Kumar) during the 6th Biopesticide International Conference held at Amity University, Raipur, Chhattisgarh, India during March 6-8, 2019.
- Mrs. Chandrika, K.S.V.P received best oral presentation (First position) award for the presentation on "Sprayable starch granule formulations for Bt against *Spodoptera litura*" in the 6th Biopesticide International Conference (BIOCICON-2019), held at Amity University, Raipur from March 6-8, 2019.
- Dr. H.P. Meena, received Outstanding Scientist Award-2019 from Agricultural and Environmental Technology Development Society (AETDS), U.S. Nagar, Uttarakhand, India.
- Dr. H.P. Meena, received Excellence in Research Scientist Award for the year 2019 from Agricultural Technology Development Society (ATDS), Ghaziabad, U.P.
- Dr. Md. A. Aziz Qureshi received Commendation letter from Course Director as Best Participant in 10 days training on "Recent advances in soil carbon sequestration and stabilization for soil health improvement and climate change mitigations" during 10-19 December, 2019 at ICAR-IISS, Bhopal, Madhya Pradesh.
- Dr. Mangesh Dudhe received "Excellence in Research Award" from the Society for the Scientific Development in the Agriculture and Technology (SSDAT), Meerut (UP), India in the International Conference on GRISAAS-2019 (Global Research Initiatives for Sustainable Agriculture and Allied Sciences) at ICAR-NAARM, Hyderabad from 20-22 October 2019.
- Dr. Ratna Kumar Pasala received Best Poster Award for the article 'Water uptake and TE contributing seed yield in sesame rather structural root traits under intermittent drought' by Pandey, B.B., Ratnakumar, P., Lakshmi, G.S. and Arti, G. in the National Conference of Plant Physiology Conference at KAU, Thrissur, Kerala from December 19-21, 2019.

Institutional Awards

The staff members who were awarded for their best performance and other achievements at the ICAR-IIOR Foundation day on August 1, 2019 are as follows.

- Best Worker Technical : Sri G. Pardhasaradhi
- Best Worker (Administration) : Smt. R. Raji
- Best Worker (SSS) : Shri M. Venkatesh
- Best Worker (TSCL) : Smt. N. Venkatamma, Sri S. Nagesh, Smt. K. Kistamma
- 25 Years of Service at ICAR-IIOR: Dr. P. Lakshmamma, Dr. Lakshmi Prayaga, Dr. C. Lavanya, Dr. N. Mukta, Shri G. Raghunath
- Best Research Paper : Ms. K.S.V.P.Chandrika, Dr. R.D. Prasad, Ms. Varsha Godbole for their publication titled "Development of chitosan-PEG blended films using Trichoderma: Enhancement of antimicrobial activity and seed quality" in International Journal of Biological Macromolecules 126 (2019) : 282-290.

Recognitions

Certificate of Appreciation from ICAR

Certificate of Appreciation was awarded to Indian Institute of Oilseeds Research for proactive implementation of ICAR Research Data Managaement Guidelines and uploading of all its Publications and Technologies for the last 6 years in KRISHI Portal. This award was received from Dr. Trilochan Mohapatra, Director General, ICAR and Secretary, DARE during *"4th National Workshop of Officer Incharge, Data Management"* organized by the ICAR-Indian Agricultural Statistics Research Institute, New Delhi at the National Agricultural Science Centre Complex on December 10, 2019.

Certificate of appreciation received from ICAR

Fellowship of scientific societies

- Dr. C. Lavanya received the Fellow of the Indian Society of Genetics and Plant Breeding (ISGPB) for the year 2019 from Dr. T. Mohapatra, DG, ICAR and President, ISGPB on December 14, 2019 in the Annual General Meeting held at Coimbatore during the National Symposium on Potential Crops for Food and Nutritional Security, December 14-15, 2019, Coimbatore.
- Dr. M. Santha Lakshmi Prasad received Fellow of Indian Society of Oilseeds Research (ISOR) for the outstanding contribution in the field of oilseeds research and development in India.

Member of Committees/Panels

- Dr. M. Sujatha is a Member of DBT accreditation panel for certification of tissue culture facilities under the NCS-TCP programme.
- Dr. M. Sujatha has been nominated as member of the Technical Expert Committee of DBT for Agriculture Biotechnology for a period of three years from 2018.
- Dr. M. Sujatha is Board Member of the International Sunflower Association (ISA), Toulouse, France.
- Dr. V. Dinesh Kumar has been nominated as a member of IMC of ICAR-NRCPB, New Delhi for three years.
- Dr. V. Dinesh Kumar has been nominated as a member of IMC of ICAR-IIMR, Hyderabad for three years from 17-10-2019.
- Dr. P.S. Vimala Devi is a member of the Local Project Advisory Committee (LPAC) of DST for reviewing an ongoing project at NAARM, Hyderabad on "Agricultural Research and Development Infrastructure in Andhra Pradesh and Telangana".
- Dr. P. Duraimurugan is a DBT Nominee in the Institutional Biosafety Committee (IBSC) of M/s. Seed Works International Pvt. Ltd., Medchal Mandal, Telangana.
- Dr. H.H. Kumaraswamy is an external expert in the Institutional Biosafety Committee (IBSC) of M/s Seed Works International Pvt. Ltd., Medchal Mandal, Telangana for a period of three years from 2017.
- Dr. P.S. Srinivas was nominated by Indian Council of Forest Research and Education, Ministry of Environment and Forestry, GOI as Member, Research Advisory Group, Institute of Forest Biodiversity, Dullapally, Hyderabad, Telangana.
- Dr. P. Kadirvel was appointed as subject expert in the selection committee for the selection/ promotion of faculty members of Department of Genetics & Plant Breeding, Annamalai University, Tamil Nadu on February 17, 2019.
- Dr. G.Suresh was appointed as Expert member in selection committee for various awards constituted for faculty members of PJTSAU, Hyderabad during 2019.

Editor of Recognised Journals

- Dr. K. Anjani has been appointed as Editorial Board Member of American Journal of Agriculture and Forestry for three years from 2018.

- Dr. K. Anjani has been appointed as Editorial Board member of the Journal Probe-Botany from November 2018.
- Dr. P.S. Srinivas was recognised as Joint Editor of Indian Society of Alliums, Rajgurunagar, Pune, Maharashtra.
- Dr. V. Dinesh Kumar has been selected as a member of the Editorial Board of Journal of Plant Biochemistry and Biotechnology.
- Dr. J. Jawahar Lal is nominated as Editorial Board Member of Journal of International Academic Research for Multidisciplinary.
- Dr. P. Duraimurugan, Senior Scientist (Agricultural Entomology) has been recognized as Editorial Board Member, Journal of Food, Agriculture and Environment, WFL Publisher (Science and Technology), Finland.
- Dr. H.H. Kumaraswamy, Scientist (Biotechnology) is recognized as Editorial Member for International Journal of Agricultural Sciences, Published by Bioinfo Publications.
- Dr. Ratnakumar Pasala is Member Editor – Journal of Functional and Environmental Botany – 2019.

Examiners/Guides

- Dr. H.P. Meena has received accredition to guide M.Sc. students in Genetics and Plant Breeding of Jawaharlal Nehru Krishi VishwaVidyalaya, Jabalpur, Madhya Pradesh.
- Dr. G. Suresh has been nominated as External Examiner for final viva-voce exam for award of Ph.D. (Agronomy) of PJTSAU, Hyderabad.
- Dr. G. Suresh has been recognized as External Examiner for evaluation of Ph.D. and M.Sc., Thesis, Tamil Nadu Agricultural University, Coimbatore.
- Dr. P. Duraimurugan has been recognized as External Examiner for evaluation of the Ph.D. and M. Sc. Thesis, Tamil Nadu Agricultural University, Coimbatore.
- Dr. K.Ramesh, Principal Scientist (Agronomy) has been recognized as External Examiner for M. Sc. and Ph. D. for Agronomy in Agronomy thesis of Tamil Nadu Agricultural University, Coimbatore and Amity, University, Delhi.
- Dr. Ratnakumar Pasala has been nominated as External Examiner for final *viva-voce* exam for award of Ph.D. (Plant Physiology) of IGKV, Raipur.

Others

- Dr. H.H. Kumaraswamy Chaired the session on "Plant Breeding and Genetics" and conducted the proceedings in the 4th International Conference on "Agriculture and Animal Husbandry", at University of Hyderabad, Hyderabad, during August 28-30, 2019.
- Dr. Ramya, K.T Co-chaired the session on "Plant Breeding and Genetics" during the 4th International Conference on Agriculture and Animal Husbandry at University of Hyderabad from August 28-30, 2019.
- Dr. Mangesh Y. Dudhe Co-chaired the session on "Integrated Approaches in Physical, Chemical and Biological Sciences" during the International Conference on GRISAAS-2019 (Global Research Initiatives for sustainable Agriculture and Allied Sciences) at ICAR-NAARM Hyderabad from October 20-22, 2019
- Dr. K. Ramesh, Principal Scientist (Agronomy) served as member of the Zonal Project monitoring committee for the ICAR-CRIDA projects undertaken by Krishi Vigyan Kendra, Chittor, Andhra Pradesh as DDG(NRM) nominee of ICAR during September 9-10, 2019.

Patents Granted

Two patents were granted during the year.

1. Patent No. 315134 - "A process for preparing storable insecticidal formulation using a combination of microbials".
   Date of grant: 28.06.2019
2. Patent No. 316651 - "Production process for Improved yield of Trichoderma biomass".
   Date of grant: 23.07.2019

On-going Research Projects

INSTITUTE

S. No.	Project No.	Project title	Investigators
1	101-5 (IXX12584)	Exploitation of inter and intraspecific genetic resources for development of agronomically superior inbred lines and populations in sunflower	M. Sujatha H.P. Meena, M.Y. Dudhe, H.D. Pushpa, Lakshmi Prayaga R. D. Prasad P. Satya Srinivas, K. Alivelu A. Vishnuvardhan Reddy
2	102-7 (IXX12633)	Exploitation of safflower genetic resources for development of superior breeding lines with high oil yield and adaptation to stresses	P. Kadirvel N. Mukta, Md. A. Aziz Qureshi R.D. Prasad, P.S. Srinivas Praduman Yadav
3	102-8 (IXX12568)	Development of parental lines with high oil yield and wilt resistance in safflower	K. Anjani R.D. Prasad
4	102-9 (IXX12571)	Development of genetic and genomic resources and identification of genes/markers for agronomic traits in safflower	B. Usha Kiran V. Dinesh Kumar P. Kadirvel
5	103-12 (IXX12565)	Exploitation of plant genetic resources for development of superior inbred lines in castor	K. Anjani M. Santhalakshmi Prasad P. Duraimurugan, Praduman Yadav P. Lakashmamma, J. Jawahar Lal
6	103-13 (IXX12629)	Diversification of pistillate base and development of superior parental lines in castor	T. Manjunatha C. Lavanya, S. Senthilvel P. Lakshmamma
7	103-14 (IXX13518)	Development of genomic resources and tools for applications in castor breeding	S. Senthilvel R. D. Prasad, B. Gayatri M. Santha Lakshmi Prasad
8	103-15 (IXX13580)	Optimization of regeneration and transformation protocols to realize grey mold resistant transgenic castor (*Ricinus communis* L.)	V. Dinesh Kumar M. Sujatha, B. Usha Kiran H.H. Kumaraswamy Rohini Sreevathsa, (NRCPB, IARI, New Delhi)
9	104-12 (IXX12625)	Development of agroecological, situation specific, cropping system oriented technologies for different oilseed crops	S.N. Sudhakara Babu Md. A. Aziz Qureshi K. Alivelu
10	104-13 (IXX12569)	Assessing safflower based cropping systems productivity and resource use efficiency under different land configurations, crop geometry and IPNM in different Vertisol types and rainfall patterns	P. Padmavathi Md. A. Aziz Qureshi P. Ratna Kumar K. Alivelu

S. No.	Project No.	Project title	Investigators
11	104-14 (IXX13048)	Synthesis and evaluation of polymers for seed health and productivity of oilseed crops	K.S.V.P. Chandrika Praduman Yadav, R.D. Prasad S.N. Sudhakara Babu P. Padmavathi, Lakshmi Prayaga P. Ratna Kumar, Anupama Singh, (IARI, New Delhi) Tushar Jana (UoH, Hyderabad)
12	104-15 (IXX13052)	Screening and identification of potential sources of tolerance to abiotic stresses and improved physiological efficiency in sesame	P. Ratna Kumar J. JawaharLal Praduman Yadav
13	104-16	Development of best management practices for organic soybean-sesame cropping system	K. Ramesh Md. A. Aziz Qureshi Praduman Yadav, P. Duraimurugan
14	104-17	Fabrication of Fe and Zn nanosystems as efficient nutrient sources	K.S.V.P. Chandrika Md. A. Aziz Qureshi, Praduman Yadav Balaji Gopalan (Chemistry), BITS Pilani, Hyderabad Campus Anupama Singh (Agril.Chemicals), ICAR-IARI, New Delhi
15	104-18	Agronomic interventions for enhancing resource use efficiency in castor based cropping systems	G. Suresh Md. A. Aziz Qureshi
16	105-11 (IXX12567)	Development of water dispersible granular (WDG) formulation of *Bacillus thuringiensis* var. *kurstaki* for management of *Spodoptera litura*	P. S. Vimala Devi P. Duraimurugan K.S.V.P. Chandrika
17	105-12 (IXX12570)	Screening and identification of durable sources of resistance to diseases of castor and deciphering the associated mechanisms	M. Santha Lakshmi Prasad B. Gayatri, Praduman Yadav
18	105-13 (IXX12573)	Identification of potential sources of resistance to various biotic stresses and understanding the mechanism of resistance in safflower	P.S. Srinivas R.D. Prasad, P. Kadirvel N. Mukta, P. Ratna Kumar
19	105-14 (IXX09328)	Screening and identification of dependable sources of resistance to insect pests of castor and deciphering the associated mechanisms	P. Duraimurugan
20	105-15 (IXX13577)	Screening and identification of dependable/ durable sources of resistance to biotic stresses of sesame and deciphering the associated mechanisms	M. Santha Lakshmi Prasad S. Chander Rao, P. Duraimurugan H.H. Kumaraswamy
21	105-16 (IXX13582)	Exploiting the bio-efficacy of entomopathogenic nematodes against tobacco caterpillar (*Spodoptera litura*) and serpentine leaf miner (*Liriomyza trifolii*) in oilseed crops	B. Gayatri P. Duraimurugan Sunanda Patil (NIPHM), Hyderabad
22	106-2 (IXX13051)	Production and characterization of protein hydrolysates from safflower seed and validation of their utility in animal nutrition	Praduman Yadav K.S.V.P. Chandrika S.V. Ramana Rao M. Santha Lakshmi Prasad

S. No.	Project No.	Project title	Investigators
23	107-16 (IXX12572)	ICT mediated knowledge management and dissemination in different oilseed crops	P. Madhuri G.D. Satish Kumar S.V. Ramana Rao C. Sarada, C. Lavanya M. Sujatha, N. Mukta Praduman Yadav, G. Suresh S.N. Sudhakara Babu P. Padmavathi P. Duraimurugan, G. Raghunath
24	107-17 (IXX13053)	On-farm demonstrations of improved technologies and impact assessment of the adoption	S.V. Ramana Rao G.D. Satish Kumar S.N. Sudhakara Babu, P. Madhuri
25	107-18 (IXX13581)	Impact assessment of varieties/hybrids of IIOR man- dated crops in varied agro-ecological regions of India	S.V. Ramana Rao C. Sarada
26	107-19	Development of models to predict yield respons-es to climate change in oilseed crops	K. Alivelu C. Sarada
27	108-1 (IXX10460)	Development of stable cytoplasmic genetic male sterile system in sesame through wide hybridiza-tion	J. Jawahar Lal
28	108-2 (IXX13579)	Exploitation of inter and intra specific genetic resources for development of elite breeding lines in sesame	K.T. Ramya J. Jawahar Lal A.R.G. Ranganatha
29	108-3 (IXX13583)	Development of genetic and genomic resources and identification of gene/marker for different agronomic traits in sesame	H.H. Kumaraswamy M. Santha Lakshmi Prasad P. Duraimurugan P. Ratna Kumar
30	109-1 (IXX13629)	Exploitation of plant genetic resources for de-velopment of improved breeding populations in Niger [*Guizotia abyssinica* (L. f.) Cass.]	H.D. Pushpa A. Vishnuvardhan Reddy

EXTERNALLY FUNDED

Sl. No.	Project title	Investigators	Sponsoring organization	Budget (Rs. in lakh)
1	Mass production of *Bacillus thuring-iensis* (Bt) and *Beauveria bassiana*, formulation as oil based suspension concentrates singly and in combination and field evaluation	P. S. Vimala Devi P. Duraimurugan K.S.V.P. Chandrika	ICAR Network-AMAAS	7.37
2	Development of practicable techno-lo-gies for field level exploitation of consortia ofmicrobial agents as ame-liorators of biotic and abiotic stresses in crops	R.D. Prasad P. Lakshmamma Md. A. Aziz Qureshi K.S.V.P. Chandrika	ICAR Network-AMAAS	7.56

Sl. No.	Project title	Investigators	Sponsoring organization	Budget (Rs. in lakh)
3	Farmers FIRST programme: Competitive oilseeds production technologies for improving profitability and socio-economic conditions of small holders in rainfed oilseeds production system of Telangana	S.V. Ramana Rao Md. A. Aziz Qureshi P. Padmavathi P. Lakshmamma P. Duraimurugan K.T. Ramya T. Manjunatha G.D. Satish Kumar K. Alivelu S.V. Rama Rao (ICAR-PDP) S.T. Veeroji Rao (PVNRTSVU) Gnan Prakash Sarat Chandra Venkata Ramana G. Vidyasagar Reddy	KVK Scheme, Extension Division, ICAR	21.63
4	Seed production in agricultural crops	S.N. Sudhakara Babu	IISS, Mau	11.25
5	Creation of seed hubs of oilseeds for enhancing quality seeds availability of major oilseeds	A. Vishnuvardhan Reddy S.N. SudhakaraBabu	DAC-NFSM, GOI	5091.18
6	Frontline Demonstrations (FLDs) on oilseeds and other activities	G.D. Satish Kumar S.V. Ramana Rao C. Sarada	DAC-NMOOP, GOI	212.00
7	Proactive mitigation of gray mold (*Botryotinia ricini*) disease of castor (*Ricinus communis* L.) crop in Telangana State using dynamical disease forecast	R. D. Prasad C. Sarada	DST-SSTP, GOI	9.00
8	Mapping of QTLs associated with resistance to aphid (*Uroleucon compositae* Theobald) in safflower (*Carthamus tinctorius* L.) using genome-wide SNP markers	P. Kadirvel P.S. Srinivas S. Senthilvel	DST, GOI	9.00
9	Central Sector Scheme For Protection of Plant Varieties and Farmers Rights Authority (ANNUAL)	N. Mukta C. Lavanya M.Y. Dudhe	PPV&FRA, GOI	7.80
10	Developing high oleic safflower genotypes for Indian conditions and development of protocols for marker assisted selection for high oleic traits in safflower	K. Anjani P. Kadirvel Praduman Yadav B. Usha Kiran	MARICO Pvt. Ltd., Mumbai	20.39

Committees

RESEARCH ADVISORY COMMITTEE

Dr. P. Raghava Reddy	Former Vice Chancellor ANGRAU, H.No-3-1-5/41/G1 Sri Sai Nilayam, Attapur, Hyderabad- 500 048	Chairman
Dr. B. B. Singh	Former ADG (OP), ICAR 281 Utsav 1 Apartment, Flat no-201, Lakhanpur, Kanpur- 208 024	Member
Dr. Sreenath Dixit	Principal Scientist & Head, ICRISAT Development Center (IDC) ICRISAT, Patancheru Telangana- 502324	Member
Dr. V. G. Malathi	Principal Scientist (Retd.) G1 Sree Kumaran Hill Crest apartment East GKS Avenue, Thondamuthur road, Coimbatore – 641 046	Member
Dr. D.M. Hegde	Dr. D.M. Hegde Former Director, ICAR-IIOR C-108, SMR Vinay Galaxy Hoody Junction, CTPL Road, White field, Mahadevapura, Bengaluru- 560048	Member
ADG (OP), ICAR	ICAR, Krishi Bhawan, New Delhi - 110 001	Member
Director	ICAR-IIOR, Rajendranagar, Hyderabad	Member
Dr. P.S. Srinvas	Principal Scientist (Agril. Entomology) ICAR-IIOR, Rajendranagar, Hyderabad	Member Secretary

INSTITUTE MANAGEMENT COMMITTEE

Dr. A. Vishnuvardhan Reddy	Director ICAR-IIOR, Rajendranagar Hyderabad – 500 030	Chairman
ADG(OP)	Indian Council of Agricultural Research Krishi Bhawan New Delhi – 110 001	Member
Director of Research	PJTSAU, Hyderabad -500 030	Member
Director of Agriculture	Govt. of Tamil Nadu Chennai	Member
Dr. D.P. Waskar	Director of Research Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani	Member
Dr. Y.G. Prasad	Director ICAR-ATARI, CRIDA Campus Santoshnagar, Hyderabad-500 059	Member
Dr. P. Muthuraman	Principal Scientist ICAR-Indian Institute of Rice Research Rajendranagar, Hyderabad-500 030	Member
Dr. Anupama Singh	Head & Principal Scientist (Agril. Chemistry) ICAR-IARI, Pusa Campus, New Delhi – 110 012	Member
Dr. V. Dinesh Kumar	Principal Scientist ICAR-Indian Institute of Oilseeds Research Rajendranagar, Hyderabad-500 030	Member
Finance & Accounts Officer	ICAR - CTRI Rajahmundry	Member
Shri Shitanshu Kumar	Senior Administrative Officer ICAR – IIOR, Rajendranagar, Hyderabad-500 030	Member-Secretary

Meetings and Events

Research Advisory Committee (RAC)

The 32nd RAC meeting of the institute was held during January 3-4, 2019 under the Chairmanship of Dr. V. Ranga Rao, Former Director (DOR) IIOR, Hyderabad. The other RAC members, Dr. Jitender Kumar, Dean, Agriculture, GBPUAT, Pant Nagar; Dr. R. Srinivasan, Retd. Professor and Project Director, NRCPB, IARI, New Delhi; Dr. P. Ananda Kumar, Former Project Director, IIRR, Hyderabad; Dr. D.K. Yadava, Head (SST), IARI and In-charge ADG (Seeds), ICAR, New Delhi; Dr. B.S. Dwivedi, Head (SS and AC), IARI, New Delhi; Dr. Ajay Arora, Principal Scientist, Plant Physiology, IARI, New Delhi; Dr. K. Poorna Chandra Rao, Ex-Principal Scientist, ICRISAT, Hyderabad; Shri Ayyagari Bhumayya, Nirmal, Telangana and Dr. Premraj Yadav, Shamshabad, Ranga Reddy District, Telangana attended the meeting.

Dr. A. Vishnuvardhan Reddy, Director, IIOR welcomed the Chairman and Members of RAC followed by presentation on the Action Taken Report on the recommendations of 31st RAC meeting. Strategies adopted by the institute to address the researchable issues, significant achievements made under each of the research projects were presented by the Heads of each section and discussed during the interaction sessions. RAC members were also apprised of the extension activities taken up by the institute to popularize the technologies developed in the mandate crops. Apart from detailed presentation of research highlights from programme leaders, the RAC also visited the experimental fields of IIOR at Rajendranagar as well as Narkhoda to oversee the field experiments and screening/ phenotyping facilities at these research farms and had in depth interaction with the scientists concerned on their on-going research projects. Expressing happiness with the compliance of the recommendations of the previous two RAC meetings including the re-organization/ restructuring of all on-going research projects of the institute on a multi-disciplinary mission mode programme basis, RAC placed on records the satisfaction with the implementation of research programmes in tune with the mandate of the institute. The RAC also expressed that farm planning, maintenance and execution, overall tempo of research activities as well as its external visibility on multiple fronts in the form of massive seed production program of its mandate oilseed crops, large scale on-farm demonstrations and other extension programmes adopted by the institute were impressive . The RAC in its remarks wished that the institute should maintain its current tempo and pursue aggressively its on-going activities on multiple fronts for bringing about major breakthrough in oilseeds productivity, sustainability and create perceptible impact of its technologies on farmers' fields in tune with its envisaged timeframe. The Research Advisory Committee made recommendations to further improve the research outputs and deliverables.

The 33rd Research Advisory Committee of ICAR-Indian Institute of Oilseeds Research, Hyderabad was conducted during 19-20 November, 2019 under the chairmanship of Dr. P. Raghava Reddy, Ex- Vice Chancellor, ANGRAU. The others members, Dr. B.B. Singh, Ex-ADG (O&P); Dr. D.M. Hegde, Ex-Director,

ICAR-IIOR, Hyderabad; Dr. V.G. Malathi, Principal Scientist (Retd), IARI, New Delhi and Dr. Sreenath Dixit, Head, IDC, ICRISAT, Hyderabad also attended the meeting.

On November 19, 2019, Dr. A. Vishnuvardhan Reddy, Director, IIOR welcomed the committee and presented the significant achievements made by IIOR in the past three years. Significant research achievements made under nine research programmes comprising 27 research projects were presented before the committee by respective research programme leaders.

On November 20, 2019, Chairman and members of RAC visited research farms at Rajendranagar and Narkhoda to witness the ongoing research trials and farm development activities. After thorough interaction and discussion with the scientists, the Research Advisory Committee has made recommendations and other suggestions to further improve the research output.

Annual Group Meeting on Sunflower, Castor, Sesame & Niger, 2019

Annual Group Meeting of castor, sunflower, sesame and niger was conducted at Regional Agricultural Research Station (RARS), Tirupati during May 2-4, 2019. Dr. A. K. Singh, Deputy Director General (Crop Sciences), ICAR, New Delhi chaired the inaugural session. Dr. V. Damodar Naidu, Hon'ble Vice-Chancellor, ANGRAU; Dr. V. Praveen Rao, Hon'ble Vice-Chancellor, PJTSAU and Dr. D.K. Yadava, Assistant Director General (Seeds), ICAR were the guests of honour. Dr. N.V. Naidu, Director of Research, ANGRAU delivered the welcome address.

Dr.A. Vishnuvardhan Reddy, Director, ICAR-IIOR, Hyderabad presented the highlights on sunflower and castor research programmes. Dr. Rajani Bisen, Project Coordinator i/c (Sesame & Niger) presented the highlights of sesame and niger research programmes. During the session, three publications *viz.*, (1) Germplasm catalogue of sesame by Project Coordination unit (Sesame & Niger), Jabalpur; (2) Status of Oilseed Production in Andhra Pradesh by RARS, Tirupati and (3) *Madhya Pradesh ke liye Ramtil* by AICRP (Sesame & Niger), Chindwara centre were released. Dr. P. Rajasekhar, Associate Director of Research, RARS, Tirupati proposed vote of thanks. During the subsequent days, technical sessions on Genetic Resources and Breeder Seed Production, Plant Breeding, Agronomy, Pathology and Entomology were handled in each crop concurrently. The meeting of the Varietal Identification Committee was held on May 2, 2019 under the chairmanship of Dr. D.K. Yadava, ADG (Seeds), ICAR, New Delhi and variety release proposals on sesame and safflower were examined.

Brainstorming Session on National Mission on Edible Oils

A brainstorming session on ''National Mission on Edible Oils (NMEO)'' was organized by Oilseeds Section, Department of Agriculture, Cooperation and

Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, Govt. of India, New Delhi held at ICAR-IIOR, Hyderabad on June 01, 2019. The session was aimed at consulting all the stakeholders involved in edible oil production through a series of discussions in order to formulate NMEO policy and identifying appropriate strategies for its implementation. About 100 delegates from various agencies including DAC&FW, Govt. of India, New Delhi; DOD, Govt. of India, Hyderabad; Departments of Agriculture from Andhra Pradesh, Telangana, Chhattisgarh; Gujarat, Karnataka, Mizoram, Odisha and Tamil Nadu states; ICAR-IIOR, Hyderabad; ICAR-IISR-Indore; ICAR-DGR, Junagadh; ICAR-DRMR, Bharatpur; ICAR-IIOPR, Pedvegi; ICAR-CAFRI, Jhansi; ICAR-CIAE, Bhopal; MANAGE, Hyderabad; ICMR-NIN, Hyderabad; ICRISAT, Hyderabad; National Seed Corporation (NSC), New Delhi; Solvent Extractor's Association of India, Mumbai; Food Safety and Standards Authority of India (FSSAI), New Delhi; The Soybean Processors Association of India (SOPA), Indore; Coconut Development Board, Kochi; Telangana State Cooperative Oilseeds Growers Federation Ltd., Hyderabad; Rajasthan Olive Cultivation Limited (ROCL), Jaipur; Indian Vanaspathi Producers Association, New Delhi; National Agricultural Cooperative Marketing Federation of India (NAFED), New Delhi; HIL (India) Ltd., and private sector (MARICO Ltd., Mumbai, Godrej Agrovet Ltd., Mumbai etc.) took part in the deliberations and helped in formulating the policy document of NMEO. Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR, Hyderabad, in his opening remarks presented the broad perspectives on the current vegetable oil scenario in the country. Dr. Anupam Barik, Additional Commissioner, Oilseeds, DAC & FW welcomed the delegates and outlined the genesis of NMEO as well as presented the thematic structure of the entire programme. The brainstorming session was conducted in four thematic areas representing sub-missions: (i) primary sources (sub-mission-I), (ii) secondary sources (sub-mission-II), (iii) post-harvest management (sub-mission-III) and (iv) consumer awareness (sub-mission-IV). Under each of the thematic sessions, the main stakeholders presented their opinions, ideas, action points and the agencies to be involved in the implementation of the schemes. Several recommendations emerged during the deliberations for consideration under NMEO policy and its implementation.

Brainstorming Meet on Value Addition in Castor Oil

A brainstorming session on "Value Addition in Castor Oil" was organized at ICAR-IIOR, Hyderabad on November 29, 2019 by Indian Society of Oilseeds Research (ISOR), Hyderabad under the chairmanship of Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR. The meeting was attended by representatives from 11 industries involved in production of castor oil and its derivatives, SEA, IOPEPC and BIRAC. DBT, Scientists from CSIR-IICT, ICAR-IIOR and SAUs, and Executive members of ISOR. After the inaugural address by the Chairman, presentations were made by Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR, Dr. R.B.N. Prasad, Former Chief Scientist & Head, Centre for Lipid Research, CSIR-IICT, Mr. Abhay Udeshi, Chairman, Solvent Extractors' Association (SEA) of India, Dr. Prabhavathi Devi, Senior Principal Scientist and Head, Centre for Lipid Research, CSIR-IICT, Dr. Prachi Agarwal, Senior Manager (Projects), BIRAC, New Delhi and Dr. J.B. Misra Technical Adviser, IOPEPC on different aspects of value addition in castor oil, besides others.

After thorough deliberations and discussions, recommendations on increasing supply through tripling the productivity of castor for ensuring higher profitability to farmers, ensuring adequate local processing/extraction of oil, policy issues, value addition through Inter Institute Research-Industry interface.

Institute Research Committee (IRC)

The Institute Research Committee (IRC) meeting for *kharif* crops was conducted during April 22-24, 2019 and May 16, 2019 and *rabi* crops on September 11, 2019 under the Chairmanship of Dr. A. Vishnuvardhan Reddy, Director. The progress of the ongoing research projects (31) and externally funded projects (10) were reviewed. Field IRC was also conducted at Narkhoda farm on September 27, 2019 in order to review the ongoing experiments as per the technical programme finalized during *kharif* IRC-2019. The visit covered the experiments on castor (germplasm, parental lines, hybrids, physiology, agronomy), sesame (germplasm, breeding, physiology), sunflower (germplasm, breeding), niger (breeding) and seed production under various projects. The members and the concerned scientists of the projects had interactions on the experiments.

ICAR-IIOR Foundation Day Celebrations

The ICAR-IIOR, Hyderabad celebrated its Foundation Day on August 1, 2019. Dr. E.A. Siddiq, Hon'ble Chair Professor (Biotechnology), PJTSAU and Former Deputy Director General (Crop Science), ICAR, New Delhi presided over the function. Dr. S.K. Pattanayak, IAS, Former Secretary, DAC&FW, Govt. of India, New Delhi delivered Foundation Day lecture on the occasion. Dr. V. Praveen Rao, Vice-Chancellor, PJTSAU, Hyderabad and Chairman, Ekalavya Foundation, Hyderabad were the Guests of Honour. Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR welcomed the distinguished guests and the gathering. He made a brief presentation on the achievements of ICAR-IIOR. Dr. S.K. Pattanayak, IAS, Former Secretary, DAC&FW, Govt. of India, New Delhi delivered Foundation Day lecture titled "Achieving self-sufficiency in oilseeds and edible oil production". During his lecture, he highlighted that despite being the world's fifth largest producer, India is the largest importer of edible oil today. There is a tremendous potential for enhancing yield of all major oilseed crops by adopting improved technologies that are already available. Recourse to irrigation can significantly enhance the yield and ensure more predictable output. Non-traditional areas and non-traditional seasons such as rabi sunflower in West Bengal and Odisha, spring groundnut in UP, mustard in Telangana, Karnataka and Andhra Pradesh, soybean in Telangana etc. can be exploited for increasing production. Utilization of secondary sources of edible oil such as cotton seed and rice bran can be maximized through deployment of scientific processing and

advanced milling technologies. Coconut oil needs to be promoted as edible oil aggressively. As part of the Foundation Day celebrations, two publications entitled on titled 'Varieties and Hybrids of Sunflower and Edible Oils' were released and awards were distributed to the staff members for their best performance.

Annual Group Meeting on Safflower and Linseed, 2019

The Annual Group Meeting of Safflower and Linseed was organised by CSAUA&T, Kanpur from September 4-6, 2019 to review the results of research conducted under AICRP (Safflower) and AICRP (Linseed) during 2018-19 and discuss the experimental details for the next season. The meeting was attended by scientists working under AICRP (Safflower), AICRP (Linseed), officials of Central and State Department of Agriculture, Public and Private Seed Entrepreneurs and the host University. The inaugural session was graced by Dr. Sushil Solomon, Vice Chancellor, CSAUA&T, Kanpur as the Chief Guest. Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR, Hyderabad chaired the session. Dr. H.G. Prakash, Director of Research, CSAUA&T, Kanpur welcomed the delegates. During the inaugural address Dr. Solomon, Vice-Chancellor, CSAUA&T, Kanpur highlighted the opportunities that exist for intercropping of oilseed crops with sugarcane in Uttar Pradesh. He further advised to identify suitable areas for such intercropping system, which could help to enhance oilseed production. Furthermore, use of micro-irrigation system, application of micronutrients, post-harvest processing, favourable government policies, consumer awareness, sound extension system, establishing value chain model involving farmers, consumers and industry are important avenues to make oilseed sector more viable and vibrant. During the session, two publications *viz.,* (i) *Alsi Utpadan Taknik* (Technologies for Linseed Production) and (ii) *Alsi Resha Utpadanki Unnat Taknik* (Advanced Technologies for Production of Linseed Fibre) were released. Dr. O.P. Mathuria, Retired Linseed Breeder, CSAUA&T, Kanpur and Dr. R.L. Srivastava, Former Project Coordinator (Linseed), Kanpur were felicitated for their contributions to linseed research in the country.

Dr. G.P. Dixit, Project Coordinator (Linseed), Kanpur presented the research highlights of AICRP-Linseed programme. His presentation covered various research accomplishments of 2018-19 under crop improvement, breeder seed production, crop production, crop protection, front line demons-trations, biochemistry and value addition. Strategies to boost linseed production and productivity were highlighted. Two new varieties of linseed, Rajan (LCK 1009) and *Utera Alsi* (RLC 153) have been released. Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR presented research highlights of AICRP-Safflower programme under plant breeding, breeder seed production, agronomy, pathology, entomo-logy, front line demonstrations. Three new safflower varieties (ISF-764, ISF-1, SSF-12-40) have been identified for release. He also highlighted the edible oil scenario in the country and emphasised the need for improved technologies to meet the alarming situation of import dependence of vegetable oils. This was followed by the technical session on genetic resources and breeder seed production.

Technical sessions to review the discipline-wise progress pertaining to breeding, agronomy, pathology and entomology were held concurrently for the two crops on 4th and 5th Sept., 2019 and the technical programme for 2019-20 was finalised and presented in the plenary session. The plenary session held on 6th Sept., 2019 was chaired by Dr. R.K. Singh, ADG (CC), ICAR, New Delhi. The chairman appreciated the progress made by both the groups and urged the scientists to maintain a healthy competition. He highlighted that since good material has been generated, all the proposed varieties which included one safflower and four linseed varieties were identified during the Varietal Identification Meeting held on 5th September,

2019. He encouraged the scientists to work towards self-sufficiency in oilseeds and formulate action plan to substitute imports with indigenous produce.

Agricultural Education Day

ICAR celebrates 3rd December as "Agricultural Education Day'' in India to commemorate the birth anniversary of first President of Independent India and Union Minister of Agriculture, Bharat Ratna, Dr. Rajendra Prasad. This initiative aims to develop interest in agriculture and allied sciences among the school children and to choose agriculture as professional career or engage themselves in farming as agripreneuers. This year, the Agricultural Education Day was organized on December 3, 2019 at ICAR-Indian Institute of Oilseeds Research, Hyderabad.

Students of class 7 to 10, Intermediate were invited for the Education day. It was inaugurated by Dr. V. Praveen Rao, Vice Chancellor, PJTSAU in presence of Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR and Directors of sister ICAR institutes located in Hyderabad. All scientific, technical and administrative staff of IIOR were involved in coordinating the visit of students to museum, exhibition of live specimens and posters depicting the technologies in oilseed crops, crop cafeteria of 7 oilseed crops (castor, sunflower, safflower, sesame, niger, Indian mustard and groundnut) and laboratories. Young students were provided a narrative on the importance and opportunities in agriculture sector to orient towards taking up career in agriculture and allied fields. A total of 2034 students from 27 schools and colleges along with accompanying teachers visited the institute.







International Women's Day

The International Women's day was celebrated at ICAR-IIOR on March 8, 2019. Apart from focusing on women-centric developments, this day also emphasizes on the importance of gender equality. On this occasion, a lecture on campaign theme of this year's women's day, 'Balance for Better' was delivered by Ms. G. Jayalakshmi, IAS, Director General, NIPHM. The session was chaired by Dr. A. Vishnuvardhan Reddy, Director, ICAR-IIOR. Ms. Jayalakshmi emphasized the importance of women empowerment and explained about achieving the balance in gender in every aspect of life for a better nation. To achieve this, Ms. G. Jayalakshmi, IAS, emphasized change should start first at home and aspects like mutual respect, encouragement in professional growth, equal sharing of household responsibilities, bringing up children to make them responsible citizens deserve due attention. Dr. A. Vishnuvardhan Reddy stated about the equal opportunities given to women in this Institute in various institutional activities.

International Women's Day celebrations

Constitution Day celebrations

As part of the 70th year of Constitution day of India (26 November), action plan for monthly activities of Constitution Day Celebrations was prepared for 6 months (November 2019 to April 2020) to spread awareness about Indian Constitution among school children, youth, farmers and self help groups. In view of this, first programme in the series was done at Krishi School, Rajendranagar, Hyderabad on December 20, 2019. Salient points about Constitution of India, fundamental rights and fundamental duties were explained to school children.

Human Resource Development

Annual Training Plan Implementation

The details of trainings attended by different categories of ICAR-IIOR Staff alongwith physical/ financial targets and achievements are presented.

Category-wise trainings attended

S.No.	Category	Total no. of employees	No. of employees attended training
1	Scientist	35	5
2	Technical	33	8
3	Administrative & Finance	22	8
4	SSS	17	0
Total		**107**	**21**

a) Scientific staff

S. No.	Name of employee	Designation	Discipline/ Section	Name of training programme attended
1	Dr. S. Senthilvel	Principal Scientist	Crop Improvement	MDP on PME of agricultural research projects, July 18-23, 2019 at NAARM, Hyderabad
2	Dr. P. Duraimurugan	Sr. Scientist	Crop Protection	Analysis of experimental data, August 22-27, 2019 at NAARM, Hyderabad
3	Dr. C. Sarada	Principal Scientist	Social Sciences	Documenting Success Stories at MANAGE, Hyderabad during September 23-27, 2019
4	Dr. S.V. Ramana Rao	Principal Scientist	Social Sciences	Intellectual property evaluation and technology management, October 15-19, 2019 at ICAR-NAARM, Hyderabad
5	Mrs. P. Madhuri	Scientist	Social Sciences	e-office, December 5-7, 2019 at NAARM, Hyderabad
6	Dr. Md. A. Aziz Qureshi	Principal Scientist	Crop Production	"Recent advances in soil carbon sequestration and stabilization for soil health improvement and climate change mitigations" during December 10-19, 2019 at ICAR-IISS, Bhopal, Madhya Pradesh.

b) Technical staff

S. No.	Name of employee	Designation	Section	Name of training programme attended
1	Sri M. Indrasena Reddy	Technical Assistant – T3 (Tractor Driver)	Farm	Automobile maintenance, road safety, behavioural skills, ICAR-CIAE, Bhopal, January 16-22, 2019
2	Sri G.Y. Prabhakar	Technical Officer-T5	Farm	Farm management, ICAR-IIFSR, Modipuram, February 13-19, 2019

S. No.	Name of employee	Designation	Section	Name of training programme attended
3	Sri G. Raghunath	Asst. Chief Tech. Officer	Library	National level capacity building workshop for libraries of SAUs, PJSTAU, Hyderabad, February 5-9, 2019
4	Sri G. Pardhasaradhi	Sr. Technical Assistant – T4 (Driver)	Driver	Automobile maintenance, ICAR-CIAE, Bhopal, February 19-25, 2019
5	Sri. M. Bhaskar Reddy Sri. G. Balakishan	Head (FOM) & Chief Technical Officer Chief Tech. Officer	Farm	Seed Production, Quality Control and Marketing, HICC-Novotel, Madhapur, Hyderabad , June 24, 2019
6	Sri. M. Indrasena Reddy Sri K. Srinivas	Technical Assistant – T3 (Tractor Driver) Tech. Asst.-T3 (Workshop)	Farm	Farm Management" for technical staff associated with Farm Management/Farm Manager of ICAR institutes, ICAR - IIFSR, Modipuram, September 17- 23, 2019.
7	Sri. M. Bhaskar Reddy	Head (FOM) & Chief Technical Officer	Farm	Capacity building programme towards a Secure and Resilent workplace, ICAR-CPRI, Shimla, November 25-27, 2019.
8	Sri E. Ravi Kumar	Tech. Asst. Driver-T3	Driver	Automobile Maintenance Road Safety and Behavioural Skills for regular drivers, CIAE Bhopal, November 27 – December 3, 2019.

c) Administrative staff

S. No	Name of employee	Designation	Section	Name of training programme attended
1	Sri A. Prem Kumar	Jr. Accounts Officer	Administration	PFMS at ISTM, New Delhi, November 14-15, 2019.
2	Sri Shitanshu Kumar Mrs. P. Madhuri Sri A. Prem Kumar Mrs. R.A.Nalini Sri P.R. Varaprasad Rao Sri E.V.R.K. Nagendra Prasad Mrs. S. Swaroopa Rani Sri G. Rakesh Sri P. Srinivas Rao P. Srinivasa Rao	SAO Scientist JAO DDO Assistant Assistant Assistant Assistant PA ACTO		e-Office, ICAR-NAARM, Hyderabad, December 5-7, 2019.
3	Sri G. Raghava Kiran Kumar	Stenographer	Administration	Basic Training Programme for Use of Hindi on Computer sponsored by Department of Official Language, Central Hindi Training Institute, Kavadiguda, Hyderabad, December 16 -20, 2019.

Other trainings attended

Name	Training Programme	Venue	Date
Dr. K. Anjani	Analysis of Experimental Data Using R	ICAR-NAARM, Hyderabad	February 21-26, 2019
Dr. C. Sarada	Documenting Success Stories	MANAGE, Hyderabad	September 23-27, 2019

Participation in National Conference/Seminars/Symposium/Workshops/Meetings

a) National

Name	Programme	Venue/Place	Date
Dr. S.N. Sudhakara Babu	170th RCGM meeting of DBT	DBT, New Delhi	January 8, 2019
Dr. N. Mukta	XXXIX Meeting of Plant Germplasm Registration Committee (PGRC)	ICAR-NBPGR, New Delhi	January 28, 2019
Dr. P.S. Vimala Devi	Annual Conference of Vice Chancellors of Agricultural Universities and Directors of ICAR Institutes	NASC, New Delhi	January 30, 2019 to February 1, 2019
Dr. S.V. Ramana Rao	Kharif price policy meeting	CACP, New Delhi	February 7, 2019
Dr. N. Mukta Dr. P. Padmavathi	Brain storming session for online course in Plant Bio-security under MOOCs Platform	NIPHM, Hyderabad	February 13, 2019
Dr. G.D. Satish Kumar	Agricultural Science Congress	IARI and NASC, New Delhi	February 20-23, 2019
Dr. G. Suresh Dr. P. Duraimurugan	Kisan Samman Nidhi Programme	ICAR-IIRR, Hyderabad	February 24, 2019
Dr. M. Santha Lakshmi Prasad	National Symposium on Recent Challenges and Opportunities in Sustainable Plant Health Management	BHU, Varanasi	February 26-28, 2019
Dr. S.V. Ramana Rao	Workshop on Impact Assessment of Project Interventions	ICAR-NRRI, Cuttack	March 2, 2019
Dr. H.H. Kumaraswamy	Sustainability of Small Farmer in the changing of Agricultural Scenario	PJTSAU, Hyderabad	March 6-8, 2019
Dr. C. Sarada	Databases on oilseeds research for *KRISHI Portal* in User's Workshop on "ICAR KRISHI Geoportal – A Digital Platform for Sustainable Agriculture".	ICAR-NBSS&LUP, Nagpur	March 7-8, 2019
Dr. G. Suresh Dr. P. Duraimurugan	Interaction Meeting of Scientists and farmers with Shri Gajendra Singh Shekhawat, Hon'ble Union Minister of State for Agriculture & Farmers' Welfare	ICAR-NAARM, Hyderabad	March 9, 2019

Name	Programme	Venue/Place	Date
Dr. Lakshmi Prayaga Dr. S. Senthivel	Workshop on preparation of EFC/ SFC proposals	ISTM, New Delhi	March 11-13, 2019
Dr. Praduman Yadav	National Conference on POSHAN Abhiyan organized by Ministry of Women and Child Development	The Ashok Hotel, New Delhi	March 15, 2019
Dr. G.D. Satish Kumar	State Level Interaction Workshop for Stakeholders of Castor	CCSHAU, Hisar	March 15-16, 2019
Dr. S.N. Sudhakara Babu	171st RCGM meeting of DBT	DBT, New Delhi	March 29, 2019
Dr. S.N. Sudhakara Babu	Joint Annual Group Meeting of 34th ACRP-NSP (Crops) and 14th ARM ICAR Seed Project	CCSHAU, Hisar, Harayana.	April 7-8, 2019
Dr. N. Mukta	15th Review Meeting of DUS Test Centres for *kharif* crops conducted by PPV&FRA	NASC, New Delhi	April 25-26, 2019
Dr. M. Sujatha	Brainstorming Session on Indigenous Oilseed Crops Improvement Initiative	NBPGR, New Delhi	April 27, 2019
Dr. M. Sujatha Dr. R.D. Prasad	Core expert consultation meeting of UNDP on access and benefit sharing (ABS) implementation in India	NBA, Chennai	May 6, 2019
Dr. V. Dinesh Kumar	22nd RAC meeting	Indian Institute of Soybean Research, Indore	May 29, 2019
Dr. M. Sujatha, Dr. H.P. Meena Dr. P. Lakshmamma Dr. G.D. Satish Kumar	Brainstorming Session on National Mission on Edible Oilseeds	ICAR-IIOR, Hyderabad	June 1, 2019
Dr. S.V. Ramana Rao	Stakeholders Meeting on Price Policy for Rabi Crops 2020-21 season	CACP, Krishi Bhavan, New Delhi	June 18, 2019
Dr. M. Sujatha	INSA Inspire Fellowship Review Meeting	Chennai	June 27-29, 2019
Dr. V. Dinesh Kumar	Biochemical and Molecular Techniques (BMTs): New Approaches for Homogeneity in Seed Testing,	HICC Novotel, Madhapur, Hyderabad	June 29, 2019
Dr. C. Sarada	Seminar on "Introduction to Block Chain Technologies and Government Applications"	NIRDPR, Hyderabad	June 29, 2019
Dr. V. Dinesh Kumar	Discussion on collaborative project between ICAR-IIOR and Delhi University	National Agricultural Science Foundation, KAB 1, New Delhi	July 5, 2019
Dr. S.V. Ramana Rao Dr. G.D. Satish Kumar	Review meeting of FLDs on oilseeds and other extension activities	Krishi Bhavan, New Delhi	July 9, 2019

Name	Programme	Venue/Place	Date
Dr. V. Dinesh Kumar	DPC meeting for the promotion of scientist in Biotechnology discipline at ICAR-DGR as DG's nominee	ICAR-DGR, Bharatpur	July 15, 2019
Dr. Mangesh Y. Dudhe	91st Foundation Day of ICAR, Award Ceremony on July 16, 2019	NASC Complex, Pusa, New Delhi	July 16, 2019
Dr. S.N. Sudhakara Babu	Rabi crop plan meeting at DAC, New Delhi	Shastri Bhawan, New Delhi	July 24, 2019
Dr. H.P. Meena	Oilseeds Seed Hub review meeting	ICAR-IIOR, Hyderabad	July 19-20, 2019
Dr. V. Dinesh Kumar	IMC meeting of ICAR-IIRR, Hyderabad	ICAR-IIRR, Hyderabad	August 8, 2019
Dr. S.N. Sudhakara Babu	Review meeting of Seed Hub projects with DG, ICAR	NBPGR, New Delhi	August 22, 2019
Dr. N. Mukta Dr. H.P. Meena	Interface Meeting on Protection of Plant Varieties and Farmers Rights Authority with Seed Sector	PJTSAU, Hyderabad	August 26, 2019
Dr. P. Duraimurugan Dr. R.D. Prasad Dr. P.S. Vimala Devi	Annual Review Workshop of the Net-work Projects on AMAAS 2019	NASC, New Delhi	August 29-30, 2019
Dr. S.V. Ramana Rao	National Food Security Mission Executive Council meeting	Krishi Bhavan, New Delhi	September 3, 2019
Dr. G.D. Satish Kumar	Subject expert for the Annual Action Plan Workshop of KVKs of Telangana organized by ATARI, Hyderabad	Water Technology Centre, Hyderabad	September 13, 2019
Dr. M. Sujatha Dr. H.H. Kumaraswamy	8th Training Workshop for Insti-tutional Biosafety Officers & Principal Investigators Engaged in Development of GM crops on "Regulatory Requirements for Product Commercialization and Dossier Development"	NRCPB, New Delhi	September 20, 2019
Dr. M. Sujatha	3rd TEC Meeting on Agricultural Biotechnology	New Delhi	September 26, 2019
Dr. K. Ramesh	Best Nutrient Management Practices for Sustainable Soil Health	ICAR-IISS, Bhopal.	September 27, 2019.
Dr. M. Sujatha	Regional Expert Consultation on Gene Editing and its regulation	ICRISAT, Hyderabad	October 10-11, 2019
Dr. G. Suresh Dr. Md. A. Aziz Qureshi	FAI Workshop on Fertilizer Policy for Encouraging Integrated Nutrient Management and for Smooth Implementation of DBT (Direct Benefit Transfer)	Hotel Central Court, Hyderabad	October 16, 2019

Name	Programme	Venue/Place	Date
Dr. S.V. Ramana Rao	Intellectual Property Valuation and Technology Management	NAARM, Hyderabad	October 15-19, 2019
Dr. G.D. Satish Kumar	Review Meeting of FLDs on Oilseeds & other Extension Activities	Krishi Bhavan, New Delhi	October 18, 2019
Dr. K. Ramesh	Workshop on Targeting Rice Fallow Area (TRFA)	Kolkata, West Bengal	October 21, 2019
Dr. P.S. Srinivas	Insecticide Registration	DAC&FW, Krishi Bhavan, New Delhi	22 October, 2019
Dr. M. Sujatha	STAG meeting of DBT	New Delhi	November 8, 2019
Dr. V. Dinesh Kumar Dr. M. Sujatha Dr. G. Suresh Dr. S. Senthilvel Dr. S.N. Sudhakara Babu Dr. Praduman Yadav Dr. S.V. Ramana Rao Dr. C. Sarada, Dr. K. Alivelu Dr. G.D. Satish Kumar Dr. P. Duraimurugan	Brainstorming Meet on Value Added Products in Castor (ISOR & IC-AR-IIOR, Hyderabad)	ICAR-IIOR, Hyderabad	November 29, 2019
Dr. C. Lavanya	National Symposium on Potential Crops for food and nutritional security (ISGPB)	TNAU, Coimbatore	December 14-15, 2019
Dr. M. Sujatha	Apex Meeting of DBT	New Delhi	December 18, 2019
Dr. Ratnakumar Pasala	National Conference of Plant Physiology	KAU, Kerala	December 19-21, 2019
Dr. M. Sujatha	Symposium on Science and Technology based Entrepreneurship Development	NAARM, Hyderabad	December 21-23, 2019
Dr. M. Sujatha Dr. G. Suresh Dr. K. Alivelu Dr. S. Senthilvel Dr. V. Dinesh Kumar Dr. S.N. Sudhakara Babu Dr. Praduman Yadav Dr. K. Ramesh Dr. C. Sarada	National Workshop on Oilseeds and Oil Palm Production, Processing, Value Addition & Marketing	WTC, PJTSAU, Hyderabad	December 23, 2019

b) International

Name	Programme	Venue/Place	Date
Dr. P.S. Srinivas	International Symposium on "Edible Alliums: Challenges and Opportunities"	ICAR-DOGR, Rajgurunagar, Pune	February 9-12, 2019
Dr. P. Duraimurugan Mrs. K.S.V.P. Chandrika Mrs. G. Varsha Mrs. V. Vineela	6th Biopesticide International Conference (BIOCICON-2019)	Amity University, Raipur	March 6-8, 2019
Dr. A. Vishnuvardhan Reddy Dr. S.N. Sudhakara Babu Dr. C. Lavanya Dr. H.P. Meena Dr. T. Manjunatha Dr. Ramya, K.T. Sri N. Prabhakara Rao	32nd ISTA International Congress-2019	Novotel, Hyderabad	June 26-28, 2019
Dr. J. Jawaharlal	International Sesame Conference	Henan Sesame Research Centre, Henan Academy of Agricultural Sciences, Zhongzhou, China	August 20-24, 2019
Dr. K. Anjani Dr. Ramya, K.T. Dr. H.H. Kumaraswamy	4th International Conference on Agriculture and Animal Husbandry	University of Hyderabad, Hyderabad	August 28-30, 2019
Dr. Mangesh Y. Dudhe	International Conference on Global Research Initiatives for sustainable Agriculture and Allied Science (GRISAA -2019)	NAARM, Hyderabad	October 20-22, 2019
Dr. M. Sujatha	Plant Pathology Seminars in the College of Horticulture and Plant Protection of IMAU	Inner Mongolia Agril. University, Hohhot, Inner Mongolia P.R. China	November 1-6, 2019
Dr. P. Duraimurugan	XIX International Plant Protection Congress (IPPC 2019)	ICRISAT, Hyderabad	November 10-14, 2019

हिन्दी गतिविधियाँ

नराकास के सदस्य कार्यलयों के लिए नार्म में कार्यशाला का आयोजन

नगर राजभाषा कार्यान्वयन समिति-2, केंद्रीय सरकार, हैदराबाद के सदस्य कार्यालयों के अधिकारियों एवं कर्मचारियों के लिए एक दिवसीय कार्यशाला का आयोजन 05 फरवरी, 2019 को भाकृअनुप – राष्ट्रीय कृषि अनुसंधान प्रबंध अकादमी, राजेंद्रनगर, हैदराबाद के सम्मेलन कक्ष में किया गया।

कार्यशाला का शुभारंभ नगर राजभाषा कार्यान्वयन समिति-2 की सदस्य-सचिव श्रीमती अनिता पांडे, सहायक निदेशक (रा.भा), राष्ट्रीय ग्रामीण विकास एवं पंचायती राज संस्थान, राजेंद्रनगर, हैदराबाद ने विभिन्न कार्यालयों से आए सभी प्रतिभागियों का स्वागत करते हुए कहा किइस तरह की कार्यशाला विभिन्न कार्यालयों में करने का मुख्य उद्देश्य सभी सदस्य कार्यालय के अधिकारियों/कर्रमाचारियों को अन्य कार्यालयों की गतिविधियों को करीब से देखने का अवसर मिलता है।

इस कार्यशाला में डॉ. आर. वी. एस. राव, प्रधान वैज्ञानिक, राष्ट्रीय कृषि अनुसंधान प्रबंध अकादमी, राजेंद्रनगर, हैदराबाद ने आधुनिक कार्यालयी जीवन शैली में कार्यकुशलता एवं क्षमता निर्माण पर कक्षा चलाई। आपने बताया कि कैसे हम अपने बॉस से तालमेल बना कर रख सकते है। कई बार हम छोटी समस्या को काफी बडी और गंभीर बना लेते है। जीवन के साथ-साथ कार्यालय में भी उतार-चढाव आते जाते रहते है, जरुरत है धैर्य से उनका सामना करने की। विषय से संबध्द कुछ लघु फिल्मों के प्रदर्शन से डॉ. राव ने अपनी बात काफी प्रभावशाली ढंग से प्रस्तुत की।

इस कार्यशाला का समन्वयन एवं संचालन श्री. प्रदीप सिंह,अतिरिक्त प्रभार, नार्म एवं सहायक निदेशक (रा. भा), भाकृअनुप – भारतीय तिलहन अनुसंधान संस्थान, राजेंद्रनगर, हैदराबाद ने किया।

राजभाषा पखवाडा

संस्थान में 01-14 सितंबर, 2019 तक राजभाषा पखवाडा का आयोजन किया गया। पखवाड़े के दौरान विभिन्न प्रतियोगिताओं का आयोजन किया गया। जिसमें संस्थान के वैज्ञानिक, अधिकारी एवं स्टॉफ सदस्यों ने उत्साह से भाग लिया।

राजभाषा पखवाडा का समापन समारोह 21 सितंबर, 2019 को आयोजित किया गया। समापन समारोह का शुभारंभ सहायक निदेशक (राजभाषा) श्री. प्रदीप सिंह के स्वागत भाषण से हुआ। इसके पश्चात वरिष्ठ प्रशासनिक अधिकारी श्री. शीतांशु कुमार ने राजभाषा कार्यान्वयन की रिपोर्ट प्रस्तुत की। उन्होंने बताया कि किस तरह पिछले वर्ष हमने राजभाषा विभाग, गृह मंत्रालय द्वारा जारी वार्षिक कार्यक्रम के सभी अंशों पर संतोषजनक कार्य किया है।

प्रभारी निदेशक डॉ. एम. सुजाता ने पखवाडे के दौरान आयोजित प्रतियोगिताओं के विजेताओं में प्रथम, द्वितीय, तृतीय एवं कुछ प्रोत्साहन पुरस्कार के साथ-साथ हिन्दी में सर्वाधिक कार्यालयीन कार्य करने वाले अधिकारी एवं स्टॉफ सदस्यों में नगद पुरस्कार वितरित किए। डॉ. प्रद्युम्न यादव, वरिष्ठ वैज्ञानिक ने विजेता प्रतिभागियों के नामों की घोषणा की।

अपने अध्यक्षीय संबोधन में डॉ. सुजाता जी ने बताया कि हिन्दी में कार्य करना प्रत्येक कर्मचारी का संवैधानिक दायित्व है। इस दायित्व का पूरी निष्ठा से अनुपालन करें। हिन्दी का सम्मान, राष्ट्र का सम्मान है।

डॉ. हरिप्रकाश मीना, वरिष्ठ वैज्ञानिक के धन्यवाद ज्ञापन से कार्यक्रम का समापन हुआ।

राजभाषा कार्यशालाओं का आयोजन

रिपोर्ट की अवधि के दौरान हिन्दी का कार्यसाधक ज्ञान प्राप्त अधिकारी व कर्मचारियों के लिए नियमानुसार प्रत्येक तिमाही में एक कार्यशाला का आयोजन किया गया। कार्यशालाएँ क्रमशः 05 फरवरी, 2019; 15 जून, 2019; 06 सितंबर, 2019 एवं 29 नवंबर, 2019 को आयोजित की गई।

तिमाही बैठकों का आयोजन

राजभाषा विभाग गृह मंत्रालय के निर्देशानुसार प्रत्येक तिमाही में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन किया गया। बैठके क्रमशः 29 मार्च, 2019; 29 जून, 2019; 28 सितंबर, 2019 एवं 14 जनवरी, 2020 को आयोजित की गई।

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- BMPs for castor cultivation – Leaflet in seed packets
- BMPs for sunflower cultivation – Leaflet in seed packets

Presentation in Conference/ Symposia /Workshops/Trainings

Name of the presenter	Title	Place	Date
Dr. H.P. Meena	Parental seed production and hybrid seed production in sunflower in Training programme on 'Seed Production Technologies in Castor, Sunflower, Safflower and Sesame'.	ICAR-IIOR, Hyderabad	January 7-11, 2019
Dr. K. Anjani	Varietal seed production and hybrid seed production in safflower in Training programme on 'Seed Production Technologies in Castor, Sunflower, Safflower and Sesame'	ICAR-IIOR, Hyderabad	January 7-11, 2019
Dr. K.T. Ramya	Seed production in Sesame in Training programme on 'Seed Production Technologies in Castor, Sunflower, Safflower and Sesame'.	ICAR-IIOR, Hyderabad	January 7-11, 2019
Dr. P. Duraimurugan	Integrated Pest Management in Oilseed Crops in training programme on 'Seed production technologies in Castor, Sunflower, Safflower and Sesame'.	ICAR-IIOR, Hyderabad	January 7-11, 2019
Dr. T. Manjunatha	Parental seed production and hybrid seed production in castor in Training programme on 'Seed Production Technologies in Castor, Sunflower, Safflower and Sesame'.	ICAR-IIOR, Hyderabad	January 7-11, 2019
Dr. P. Duraimurugan	Delivered a lecture on 'Techniques of screening for resistance in castor and other oilseed crops against insect pests' to the Ph.D. students from Department of Entomology, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad visited ICAR-IIOR, Hyderabad.	ICAR-IIOR Hyderabad	January 29, 2019
Dr. P. Duraimurugan	Delivered lecture on 'Bio-ecology and management of insect pests in castor' during the 'Orientation-cum-training ogramme in Castor' for the newly joined scientists of AICRP (castor) at Palem, Anantapur & Bengaluru centres.	ICAR-IIOR, Hyderabad	February 5, 2019
Dr. P.S. Srinivas	Insect pest management in onion and garlic: Advances and challenges.2019, at International Symposium on Edible Alliums: Challenges and Opportunities	Indian Society of Alliums and ICAR-DOGR, Rajgurunagar, Pune	February 9-12, 2019
Dr. P. S. Srinivas	IPM in oilseed crops in Training programme on Best management practices for increasing oilseed production.	ICAR-IIOR, Hyderabad	February 14, 2019
Dr. S.N. Sudhakara Babu	Special invited lecture on Technologies for increasing oilseeds production at inaugural 'Education/Technology Days'	PJTSAU, Hyderabad	February 23, 2019

Name of the presenter	Title	Place	Date
Dr. M. Santha Lakshmi Prasad	Identification of resistant sources in germplasm accessions against castor wilt disease in National symposium on 'Recent Challenges and Opportunities in Sustainable Plant Health Management'.	IAS, BHU, Varanasi	February 26-28, 2019
Mrs. K.S.V.P. Chandrika	'Sprayable starch granule formulation of *Bacillus thuringiensis* against *S. litura*' in 6th Biopesticide International Conference.	Amity University, Raipur, Chhattisgarh	March 6-8, 2019
Dr. P. Duraimurugan	Large scale field evaluation of Bt-127 SC formula lation as a component of IPM in soybean & castor in 6th Biopesticide International Conference.	Amity University, Raipur, Chhattisgarh	March 6-8, 2019
	Exploitation of the sex pheromone for monitoring of shoot and capsule borer, *Conogethes punctiferalis* Guenee (Crambidae: Lepidoptera) in castor in 6th Biopesticide International Conference	Amity University, Raipur, Chhattisgarh	March 6-8, 2019
Mrs. V. Vineela	Identification of virulent isolates of *Bacillus thuringiensis* var. *kurstaki* effective at high temperature for management of Lepidopteran Pests in 6th Biopesticide International Conference.	Amity University, Raipur, Chhattisgarh.	March 6-8, 2019
Dr. P. Duraimurugan	Delivered a lecture on 'Microbial Control of Insect Pests in Oilseed Crops' to the M.Sc. and Ph.D. students from Department of Entomology, College of Agriculture, ANGRAU, Tirupati visited ICAR-IIOR, Hyderabad.	ICAR-IIOR, Hyderabad	March 21, 2019
Dr. M. Sujatha	Writing research proposals/projects and tips for publishing papers in high NAAS rated journals	PJTSAU, Hyderabad	April 20, 2019
Dr. Md. A. Aziz Qureshi	Activities of ICAR-IIOR for area expansion in North Eastern Hill Region since 2016. *In* Annual workshop of AICRP on Sunflower, Sesame, Niger and Castor	RARS, Tirupathi	May 5-6, 2019
Dr. P. Duraimurugan	Delivered lecture on 'Microbial Control of Insect Pests in Oilseed Crops' to the trainees of National Institute of Plant Health Management, Hyderabad visited ICAR-IIOR.	ICAR-IIOR, Hyderabad	June 14, 2019
Dr. G. Suresh	Harmful effects of Parthenium and its successful control during Parthenium Awareness week	ICAR-IIOR, Hyderabad	August 16, 2019
Dr. K. Anjani	Genetic resources management-castor during a Training programme on 'A Reorientation of Breeding Perspectives of kharif Oilseed Crops'.	ICAR-IIOR, Hyderabad	August 20-23, 2019
Dr. H.H. Kumaraswamy	4th International conference on 'Agriculture and Animal Husbandry'.	University of Hyderabad, Hyderabad	August, 28-30, 2019

Name of the presenter	Title	Place	Date
Dr. G. Suresh	Natural resource management in oilseed based cropping systems for livelihood improvement to trainees of International Training on NRM of NIRDPR, Hyderabad.	ICAR-IIOR Hyderabad	September 18, 2019
Dr. V. Dinesh Kumar	Delivered a lecture on 'RNA seq and its applications in Agriculture' to the participants of the training programme 'Recent Bioinformatics Tools for Genome and Proteome Analysis'	ICAR-NAARM, Hyderabad	September 19, 2019
Dr. P. Duraimurugan	Delivered lecture on 'Opportunities in organic methods of pest management in oilseed crops' during ICAR Short Course on Recent advances in organic production systems involving oilseeds for soil health and export.	ICAR-IIOR, Hyderabad	September 16-25, 2019
Dr. V. Dinesh Kumar	Delivered a lecture on Introduction to gene cloning and applications to the participants of the training programme on 'Techniques in Molecular Biology'.	Agri Biotech Foundation, Hyderabad	September 23, 2019
Dr. P. Duraimurugan	Delivered lecture on Pest and Disease Management in Oilseed Crops during the Training on Seed Production, Certification, Processing and Quality assurance in Field crops.	ICAR-IIMR, Hyderabad	September 23 to October 5, 2019
Dr. K. Ramesh	Invited talk on Best management practices for sustainable soil health at Model Training course on'Balanced nutrient management for sustainable crop production and soil health'.	ICAR-Indian Institute of Soil Science, Bhopal	September 27, 2019
Dr. K. Ramesh	Invited talk on Organic farming	ICAR-Directorate of Poultry Research, Hyderabad	October 2, 2019
Dr. M. Sujatha	Ploidy manipulations in genetic improvement of crop plants. Presented during the Prof. N.C. Subrahmanyam Commemorative Symposium	University of Hyderabad	October 3, 2019
Dr. G. Suresh Dr. S.N. Sudhakara Babu Dr. Md. A. Aziz Qureshi	Best Management Practices for enhancing Resource Use efficiency in Oilseed crops. Presented during FAI National Workshop on 'Fertilizer Policy for encouraging Integrated Nutrient Management and for smooth implementation of Direct Benefit Transfer'.	Hotel Central Court, Hyderabad	October 16, 2019
Dr. Praduman Yadav	Lecture on oil quality of edible oils. In ICAR short course on Recent Advances in organic production systems involving oilseeds for soil health and export	ICAR-IIOR, Hyderabad	October 16-24, 2019

Name of the presenter	Title	Place	Date
Dr. K. Ramesh	Invited talk on Strategy for cultivation of oilseeds in rice fallow areas including best package of practices along with suitable varieties for eastern India at workshop on Achievements and future strategy on pulses and oilseeds under Targeting rice fallow area in eastern India	Kolkata, West Bengal	October 21, 2019
Dr. H.H. Kumaraswamy	Biosensors and their applications in agriculture	Institute of Biotechnology, PJTSAU Hyderabad	October 29, 2019
Dr. M. Sujatha	Introgression of disease resistance in sunflower during the Plant Pathology Seminars	IMAU, Hohhot, P.R. China	November 4, 2019
Dr. P. Duraimurugan	Oral Presentation on 'Identification of sources of resistance in castor parental lines to leafhopper (*Empoasca flavescens*)', XIX International Plant Protection Congress on Crop Protection to Outsmart Climate Change for Food Security & Environmental Conservation	ICRISAT, Hyderabad	November 10-14, 2019
Dr. H.H. Kumaraswamy	Applications of biotechnology in medicine, veterinary and animal husbandry.	Institute of Biotechnology, PJTSAU, Hyderabad	November 19, 2019
Dr. S.N. Sudhakara Babu	Invited paper presentation on Organic cultivation of oilseeds	Institute of Organic Farming UAS, Raichur	December 7, 2019
Dr. Ratna Kumar Pasala	Delivered lecture for postgraduate diploma course on topic 'Crop Physiology in relation to water and nutrient uptake'	NIPHM, Hyderabad	December 10 and 17, 2019
Dr. G. Suresh	Improved cultivation practices in Oilseed crops to trainees of WALAMTARI, Hyderabad	ICAR-IIOR Hyderabad	December 18, 2019
Dr. Ratnakumar Pasala Sri. Brij Bihari Pandey Dr. Praduman Yadav Dr. A. Vishnuvardhan Reddy	Diversity in traits expression of sesame germplasm under intermittent drought at National Conference of Plant Physiology	KAU, Kerala	December 19-21, 2019
Dr. Ratna Kumar Pasala	Delivered lecture on 'Crop adaptations and mitigation strategies under drought'	Crop Physiology Dept., IGKV, Raipur	December 27, 2019

Infrastructure Development

Library and Documentation

The Library and Documentation unit continued to collect, store, organize and disseminate information on all aspects of crop improvement, crop production, crop protection and utilization of oilseed crops. An amount of Rs. 9,00,000/- was spent during the period under report to acquire 46 books and for subscription to 60 periodicals, 2 databases *viz.*, India Patent and India Agri. Stat. A total of 80 publications were received on gratis, besides newsletters and annual reports from different organizations. New records of books were added to the computerized library catalogue database. The KOHA Integrated Library Management Software has been in operation at IIOR. Four issues of 'IIOR Newsletter' and 250 electronic article delivery though e-mails have been brought out and circulated to all scientists working in AICRP (Sunflower, Safflower and Castor) centres across different states. Literature searches have been carried out in the mandate crops using in-house database, CROP CD, AGRIS on CD AGRICOLA.

Civil Works

The following civil works have been carried out at ICAR-IIOR during the period under report.

Works/Repairs
• Renovation of Plant Breeding Laboratory (Old Pathology and Biotech Labs)
• Minor Repairs of Farm Building Complex at Narkhoda Farm
• Repairs and Extension of Committee Room at IIOR, Rajendranagar
• Repairs to civil structure of Old Glass House at Rajendranagar
• Minor Repairs of Main Building, Annex Building and Seed Stores
• Processing Lab for Seed, Bt and Bio-Pesticides
• Construction of Seed Processing cum Storage Unit
• Construction of Rain-out shelter at IIOR Research Farm, Narkhoda
• Repairs and modifications in Social Science Section
• Renovation of Canteen/Kitchen, VIP Suits, White Washing of Hostel and Renovation of Toilets etc. at IIOR Canteen/Hostel
• Repairs in old Tissue culture room for making as Visitors Room
• Repair of main drian channel from C-4 to F-4 and G-3 at Rajendranagar Farm

Visitors

- During the year under report, about 1400 farmers from different states and nearly 3400 students from SAUs, Colleges and schools belonging to different states visited this Institute and interacted with the scientists.
- Shri Surya Pratap Shahi Ji, Hon'ble Minister for Agriculture, Government of Uttar Pradesh visited ICAR-IIOR on August 29, 2019 for interaction meeting with the Scientists.

- Dr. Trilochan Mohapatra, Director General, ICAR & President, ISOR visited ICAR-IIOR on August 31, 2019 in connection with meeting of ISOR.

- Twenty three international participants of the International Training Programme on *'Natural Resource Management for Sustainable Rural Livelihoods'* which was organized at National Institute of Rural Development and Panchayati Raj (NIRDPR), Hyderabad visited ICAR-IIOR on September 18, 2019.

Field visit of international participants to ICAR-IIOR

Appointments/Superannuations

Appointments

Name	Designation	Date
Sri Demudu Naidu Panchada	Technical Assistant (T-3)	16.03.2019 (FN)
Sri J. Ashok	Technician T-1	01.04.2019 (FN)
Sri S. Venu	Technician T-1	01.04.2019 (FN)
Smt. G. Sailaja	Technician T-1	01.04.2019 (FN)

Superannuation

Name	Designation	Date
Dr. Durgamadhab Pati	Technical Information Officer	31.01.2019
Dr. A.R.G. Ranganatha	Principal Scientist (Plant Breeding)	31.01.2019
Sri B.V. Noble	Assistant Chief Technical Officer	28.02.2019
Sri G. Rajamouli	Skilled Supporting Staff	31.03.2019
Sri K. Sayendra	Technical Officer	31.05.2019
Sri P. Sunil Kumar	Technical Officer	31.05.2019
Sri B.V. Rao	ACTO	31.05.2019
Sri D. Narasimha	SSS	30.06.2019
Sri Y. Rama Govinda Reddy	ACTO	30.06.2019
Sri P. Ashok	Technical Officer	31.07.2019
Dr. P. S. Vimala Devi	Principal Scientist	31.08.2019
Dr. G. Annapurna	ACTO	31.08.2019
Sri G. Srinivasa Rao	AAO	31.08.2019
Sri M. Pandu Ranga Rao	Technical Officer	31.12.2019

Demise

Name	Designation	Date of Death
Sri P. Krishna	SSS	08.08.2019

Personnel

Dr. A. Vishnuvardhan Reddy	Director

Director's Cell

Dr. Durgamadhab Pati	Chief Technical Officer
Sri P. Srinivasa Rao	Personal Assistant
Sri G. Srinivas Yadav	Personal Assistant

Research Sections

Crop Improvement

Dr. A.R.G. Ranganatha	Principal Scientist (Pl. Breeding)
Dr. M. Sujatha (Genetics & Cytogenetics)	Head & Principal Scientist
Dr. K. Anjani (Plant Breeding)	Principal Scientist
Dr. V. Dinesh Kumar (Biotechnology)	Principal Scientist
Dr. N. Mukta (Economic Botany)	Principal Scientist
Dr. C. Lavanya (Plant Breeding)	Principal Scientist
Dr. Senthilvel Senapathy (Plant Breeding)	Principal Scientist
Dr. Kadirvel Palchamy (Genetics)	Principal Scientist
Dr. A.L. Rathnakumar (Plant Breeding)	Principal Scientist
Sri H.H. Kumaraswamy (Biotechnology)	Scientist
Dr. Mangesh Y. Dudhe (Plant Breeding)	Sr. Scientist
Mrs. B. Usha Kiran (Biotechnology)	Scientist SS
Dr. J. Jawaharlal (Plant Breeding)	Scientist SS
Dr. H.P. Meena (Plant Breeding)	Scientist SS
Dr. T. Manjunatha (Plant Breeding)	Sr. Scientist
Dr. Ramya, K.T. (Genetics and Plant Breeding)	Scientist
Dr. Pushpa, H.D. (Genetics and Plant Breeding)	Scientist
Sri K. Sayendra	Technical Officer T-5 (F/F)
Sri P. Gopinadhen	Technical Officer T-5 (F/F)
Sri P. Sunil Kumar	Technical Officer (Lab. Tech.)
Sri G. Srinivasa Rao	Sr. Tech. Assistant (F/F)
Mrs. P. Mary	Technician T-1
Sri J. Narasimha	Technician T-1

Crop Production

Dr. G. Suresh (Agronomy)	Head & Principal Scientist
Dr. P. Padmavathi (Agronomy)	Principal Scientist
Dr. P. Lakshmamma (Plant Physiology)	Principal Scientist
Dr. Lakshmi Prayaga (Plant Physiology)	Principal Scientist
Dr. Md. A. Aziz Qureshi (Soil Science)	Principal Scientist

Dr. K. Ramesh (Agronomy)	Principal Scientist
Dr. Ratna Kumar Pasala (Plant Physiology)	Senior Scientist
Dr. Praduman Yadav (Biochemistry)	Scientist
Mrs. K.S.V.P. Chandrika (Agricultural Chemicals)	Scientist
Mrs. Ch.V. Haripriya	Chief Tech. Officer (F/F)
Sri S. Narsimha	Tech. Officer (T-5)

Crop Protection

Dr. P.S. Vimala Devi (Agricultural Entomology)	Head & Principal Scientist (upto 31.8.2019)
Dr. R.D. Prasad (Plant Pathology)	Head & Principal Scientist
Dr. M. Santhalakshmi Prasad (Plant Pathology)	Principal Scientist
Dr. P. Satya Srinivas (Agricultural Entomology)	Principal Scientist
Dr. P. Duraimurugan (Agricultural Entomology)	Senior Scientist
Mrs. B. Gayatri (Nematology)	Scientist
Dr. K. Sakthivel (Plant Pathology)	Scientist
Sri Ch. Anjaiah	Sr. Technician (F/F)
Sri S. Saida Reddy	Sr. Technician (F/F)

Social Sciences

Dr. S.V. Ramana Rao (Agricultural Economics)	Head & Principal Scientist
Dr. C. Sarada (Agricultural Statistics)	Principal Scientist
Dr. G.D. Satish Kumar (Agricultural Extension)	Principal Scientist
Dr. K. Alivelu (Agricultural Statistics)	Principal Scientist
Mrs. P. Madhuri (Computer Applications)	Scientist SS

Seed Section

Dr. S.N. Sudhakara Babu (Agronomy)	Head & Principal Scientist
Sri T. Veeraiah	Sr. Technical Asst. T4 (F/F)

Support Services

AKMU Cell

Sri P. Srinivasa Rao	Asst. Chief Tech. Officer (Engg. & Workshop)

Library & Documentation

Sri G. Raghunath	Asst. Chief Tech. Officer
Sri V. Sambasiva Rao	Asst. Chief Tech. Officer

Art & Photography

Sri B.V. Rao	Asst. Chief Tech. Officer
Sri B.V. Noble	Asst. Chief Tech. Officer

Technical Coordination Cell

Mrs. R. Raji	Private Secretary

Farm Section

Sri M. Bhaskar Reddy	Head (FOM) & Chief Tech. Officer (F/F)
Sri G. Balakishan	Chief Tech. Officer (F/F)
Sri Y. Rama Govinda Reddy	Asst. Chief Tech. Officer (F/F)
Sri M. Panduranga Rao	Tech. Officer (F/F)
Sri G.Y. Prabhakar	Tech. Officer (T-5)
Sri C. Prabhudas	DMO
Sri Surender Prasad	Tech. Officer T-5 (Workshop)
Sri A. Srinivasa Raju	Tech. Asst. (AC Mechanic) T3
Sri N. Vasanth	Tech. Asst. (Workshop) T3
Sri K. Srinivas	Tech. Asst. (Workshop) T3
Sri Demudu Naidu Panchada	Tech. Asst. T3
Sri M. Indrasena Reddy	Tech. Asst. (Tractor driver) T3
Sri Y. Venkateshwar Rao	Tech. Asst. (Tractor driver) T3
Sri T. Bichanna	UDC
Sri J. Ashok	Technician T-1
Sri S. Venu	Technician T-1
Smt. G. Sailaja	Technician T-1

Administration

Sri Shitanshu Kumar	Sr. Administrative Officer
Sri Pradeep Singh	Assistant Director (OL)
Sri G. Srinivasa Rao	Asst. Admn. Officer
Dr. G. Annapurna	ACTO (Press & Edi.)
Mrs. C. Lalitha	Personal Assistant
Mrs. R.A. Nalini	Assistant
Sri P.R. Varaprasada Rao	Assistant
Sri E.V.R.K. Nagendra Prasad	Assistant
Sri B. Giri	UDC
Mrs. P. Swapna	LDC

Stores

Sri Rakesh Geeda	Assistant
Sri G.B. Nagendra Prasad	Assistant
Mrs. G. Maheshwari	LDC

Audit & Accounts

Sri K. Srinivasa Rao	Finance & Accounts Officer
Sri A. Prem Kumar	Jr. Accounts Officer
Shri G. Raghava Kiran Kumar	Stenographer
Mrs. S. Swarupa Rani	Assistant
Mrs. B. Gyaneshwari	UDC

Drivers

Sri V. Yadagiri Swamy	Sr. Tech. Asst. Driver, T4
Sri G. Ramulu	Tech. Asst. Driver, T-I-3
Sri G. Pardhasaradhi	Sr. Tech. Asst. Driver, T4
Sri E. Ravi Kumar	Tech. Asst. Driver, T3

Skilled Supporting Staff

Sri G. Mallesh	Skilled Supporting Staff
Sri D. Narasimha	Skilled Supporting Staff
Sri M. Venkatesh	Skilled Supporting Staff
Sri A. Rambabu	Skilled Supporting Staff
Sri G. Rajamouli	Skilled Supporting Staff
Sri M. Ramulu	Skilled Supporting Staff
Sri P. Krishna	Skilled Supporting Staff
Sri D. Balaiah	Skilled Supporting Staff
Mrs. B. Kistamma	Skilled Supporting Staff
Sri K. Sanjeeva	Skilled Supporting Staff
Sri B. Vishnu	Skilled Supporting Staff
Mrs. G. Bharathamma	Skilled Supporting Staff
Sri J. Narsimha	Skilled Supporting Staff
Sri B. Gyaneshwar	Skilled Supporting Staff
Sri P. Srinivas	Skilled Supporting Staff
Mrs. K. Kalavathi	Skilled Supporting Staff
Mrs. A. Lalitha	Skilled Supporting Staff
Mrs. K. Suseela	Skilled Supporting Staff
Mrs. K. Narsamma	Skilled Supporting Staff
Mrs. G. Chennamma	Skilled Supporting Staff


DEMONSTRATION OF
OILSEED CROPS

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