भाकृअनुप-भातिअसं ICAR-IIOR
वार्षिक प्रतिवेदन Annual Report
2022

भाकृअनुप-भारतीय तिलहन अनुसंधान संस्थान

ICAR-Indian Institute of Oilseeds Research

राजेंद्रनगर, हैदराबाद-500 030, तेलंगाना, इंडिया Rajendranagar, Hyderabad-500 030, Telangana, India

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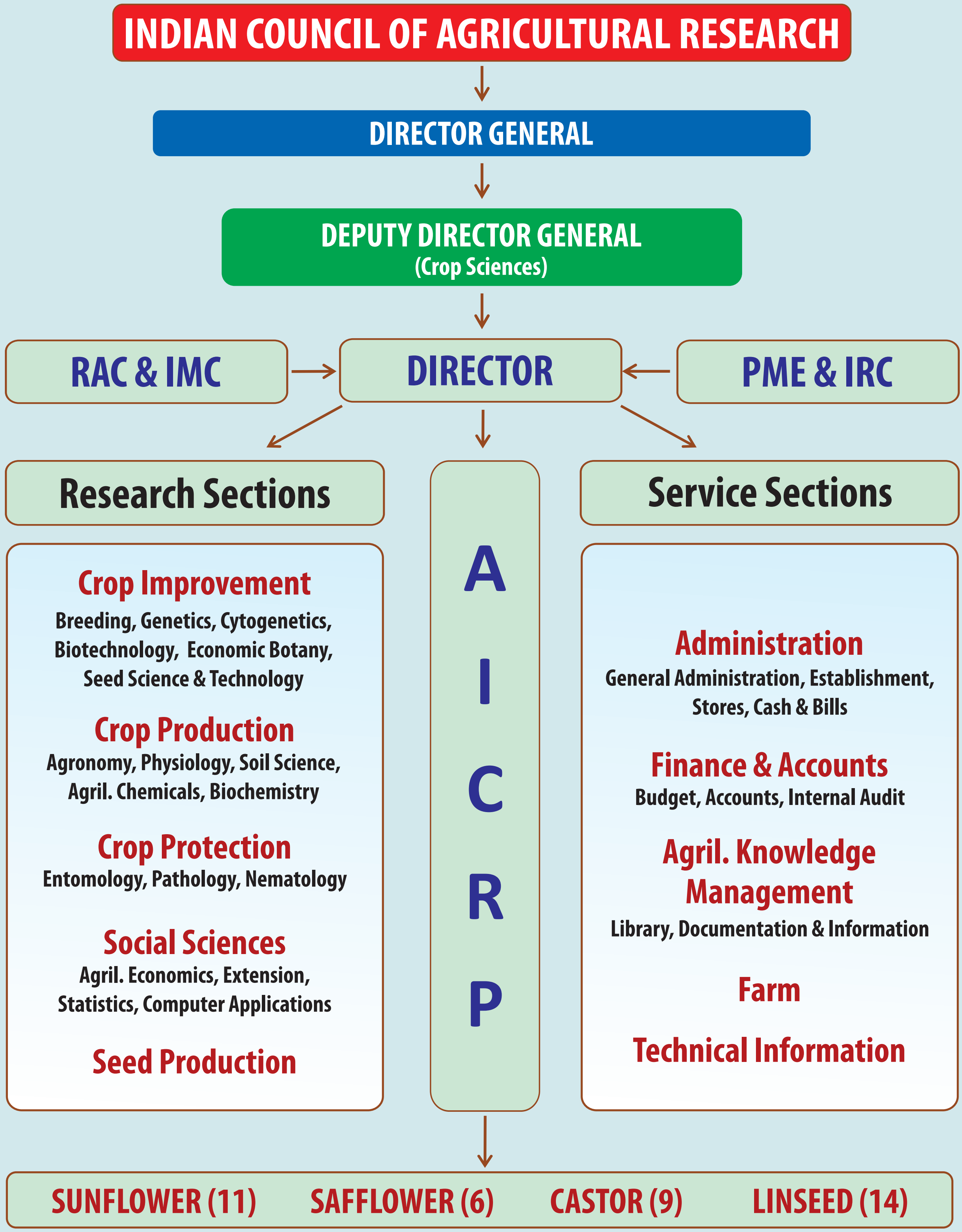

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Farm

Technical Information

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SUNFLOWER (11) SAFFLOWER (6) CASTOR (9) LINSEED (14)

ICAR-IIOR
Annual Report 2022

वार्षिक प्रतिवेदन
Annual Report
2022

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Rajendranagar, Hyderabad-500 030, Telangana, India
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Preface

I have great pleasure in presenting the Annual Report of ICAR-Indian Institute of Oilseeds Research (IIOR) for the year 2022. The report covers the significant achievements made under research, extension and training activities of the institute during 2022. Promising technologies and research achievements in the mandate oilseed crops include:

In castor, reliable and repeatable *in vitro* regeneration protocol has been optimized. Promising early (ICH-1146, ICH-440) and medium (ICH-277) duration hybrids are at various stages of testing under the coordinated trials. Three experimental hybrids with superiority in seed yield (>50%) and oil content (>49%) were identified. With respect to resistance breeding, one breeding line K-18-1-2 with gray mold resistance was identified while two breeding lines *viz.*, K-18-162 and GMM-3 recorded moderately resistant/tolerant reaction against gray mold disease under artificial epiphytotic condition. Further, a major QTL for gray mold resistance has also been validated. Five genotypes with resistant reaction against *F. oxysporum* f. sp. *ricini* (*For*) isolates from 3 centres, two genotypes with moderate resistance to leafhopper, five genotypes highly resistant to whitefly, one inbred line, K-18-45-1 for capsule borer tolerance, two drought tolerant lines have been identified. Research on conservation agriculture practices in vertisols showed on par seed yield under reduced and conventional tillage practices and the reduced tillage increased soil organic carbon content also. Castor + groundnut intercropping system registered highest castor equivalent yields.

One sunflower entry, IIOSH-566 is promoted from IHT to AHT-I and II. Interspecific derivatives with leafhopper and downy mildew resistance, seventeen gene pool and CMS lines with resistant reaction to leafhopper and eight sunflower lines with tolerance to *Alternariaster* leaf blight disease under artificial epiphytotic conditions were identified. Two parental lines, 298 R and CBE-COSF-16B, showed tolerance to drought, high temperature and the combined stresses. Pollination with pollen stored under refrigerated conditions (5^0C) resulted in good seed set and this indicated the usability of stored pollen upto seven days in sunflower hybrid seed production. A project on "Revival of sunflower cultivation" with the aim of area expansion, productivity improvement, profitability improvement of sunflower cultivation in India was sanctioned by DA&FW, Ministry of Agriculture and Farmers Welfare, GoI.

In safflower, 16 promising accessions for seed yield and eight accessions with capitulum diameter of >25 mm with >20 seeds/capitulum were identified. A total of 9 families from S5-1C-RIPE population with higher seed yield and oil content were advanced to S_6 generation while 14 bi-parental crosses were advanced to F_2 generation. The germplasm accession, EC523368-2 (GMU-7399) tolerant to aphid (*Uroleucon compositae* Theobald) was registered as a genetic stock. A set of 58 SNP markers designed using NGS data of genotypes CO-1 and EC 523368-2 were validated in a panel of 121 germplasm. A total of 29 multi-parent derived breeding lines were free from *Fusarium* wilt when screened under sick pot method. Twenty-eight accessions with tolerance to aphids were identified.

In sesame, 140 accessions received from USDA were evaluated during summer for different traits. A genotype, 'IOSG-MCPL' having multicapsules with conspicuous purple lip flower type was developed from a cross, IC-205776 x EC118591. From two multiparent crosses evaluated, MSES-434-718 recorded high oil content in *kharif* (58.8%) and summer (53.8%) seasons, respectively. Three lines for root rot resistance were confirmed through multilocation evaluation and the line, SEL-S-20-2001 recorded <10% root rot incidence consecutively over two years. One genotype, IIOS-20-3013 showed highly resistant reaction to phyllody, while SES-K-20-2016 was highly resistant to leaf webber and the genotypes SES-K-20-2010 and SES-K-20-2025 showed low incidence of whitefly and mirid bug infestation respectively and two other genotypes, SI 1802 and SI 9823 showed tolerance under moisture stress along with higher seed yield. Comparable seed yields were recorded in soybean-sesame cropping system with organic inputs.

A total of 243 selections of niger derived from third random mating cycle (developed using elite accessions) were advanced to S_4 generation. Selections derived from different random mating cycles were advanced to next higher generations to select best lines for high seed yield, oil content and earliness. Selection, RMC-S3-P338 recorded maximum seed yield (7.25 g/plant) while RMC-S3-P370 showed highest seed oil content (46.9%).

Linseed germplasm collection augmented with new accessions from different sources were multiplied off-season at ICAR-IARI Regional Station, Wellington, Tamil Nadu. Among the 223 USDA lines, one accession, PI-522932 exhibited dehiscence, a trait which is rarely found in the linseed global germplasm that has vintage value for easy threshing. One advanced breeding line, LMS 2015-31 recorded high oil content (45.6%) and eight genotypes recorded high ALA content (>58%). One line, BRLS-119 had the lowest cadmium concentration in seed (0.85 mg/kg) and RLC-153 line showed nickel content (2.71 µg/kg of seed) which was below the permissible values for flax seeds. Four high ALA lines exhibited wild allele with both the genes getting involved in ALA accumulation.

Potential entomopathogenic fungi (EPF) belonging to *Metarhizium (Nomuraea) rileyi* infecting *Spodoptera* were isolated and characterized. Chitinolytic bacteria strains IC-RB5, HD-RB20 and HD-RB21 exhibited 100% mortality against *Spodoptera litura*. Four polymer coacervates were identified for entrapment of bio-agents with entrapment efficiency of 97 to 99%. Nanocitrates of Fe and Zn showed increase in nutrient use efficiency with less environmental concerns. Lignin extraction procedure was standardised to use in extraction of lignin from agri-waste.

DUS testing was undertaken for sunflower and castor this year. A total of 864.19 q of breeder, foundation, certified and TL seed of castor, sunflower, sesame and safflower were produced during 2022.

Safflower knowledge management portal designed and developed with five major themes was populated and uploaded to the portal. *TilhanTec*: Castor-Genetic Resources Information System (*TilhanTec*: Castor-GRIS) was developed that can be accessed through https://tilhantec.icar.gov.in/Castor-GRIS/index.php.The Herfindahl-Hirschman Index (HHI) revealed the declining trend of castor area in Gujarat during TE 2021-22 over TE 2016-17 suggesting that castor is being replaced by other competing crops perhaps due to higher profitability of competing crops and related market forces as well. The economics of farm level performance of castor hybrid, GCH-7 on a cropping system/ sequence approach in three major castor growing districts of Gujarat revealed that it is imperative to intensify research efforts towards developing newer castor cultivars of short duration with high yield level and/or develop hybrids of high yield potential to compete with the different crops/cropping systems. The analysis on yield gaps in sunflower from the FLDs' conducted in four states revealed substantial yield gaps I and II (49.9% and 90.2%, respectively) during *kharif* season and 20.7% and 122.4%, respectively in *rabi* season. The knowledge test developed and administered to farmers covered under both public and private extension systems in four states revealed that farmers' under public extension had more knowledge on sunflower production technology *vis-à-vis* farmers' under private extension system. The sunflower demonstrations conducted under zero tillage conditions after harvest of paddy revealed higher B: C ratio over farmers' practice, while demonstrations conducted on optimum spacing gave additional net returns of Rs.7,200/ha over farmers' practice. Business plans developed for FPOs in Siddipet district enabled profit of Rs.10.8 lakh through input aggregation and output marketing. Interventions under the Farmers FIRST programme encompassing different NRM, crops and cropping system, marketing/value addition practices and convergence/linkages facilitated enhanced productivity and profitability of small holder agriculture in the adopted villages.

Licensing agreements were signed with three private firms for commercialization of DOR Bt-1 technology and one firm for licensing of DOR Th4d and DOR *Beauveria bassiana* SC technologies. A patent on, "A Polymer composition and a process for its preparation" was submitted for NBA clearance. ICAR-IIOR signed MoUs with seven Universities for facilitating Institutional Research and Students' training and research during the year 2022. Various capacity building and outreach activities were also conducted under the FPO programme, Farmer FIRST Programme, Tribal Sub Plan, Scheduled Caste Sub Plan, MGMG, NEH Region etc. Furthermore, the institute celebrated/conducted special programmes such as World Pulses Day, National Science Day, International Women's Day, International Yoga Day, Parthenium Awareness Week, Vigilance Awareness Week, Swachhta Pakhwada, World Soil Day, PM Krishi Unnathi, Azadi Ka Amrut Mahotsav, Hindi Pakhwada etc.

I place on record my sincere gratitude to Dr. Himanshu Pathak, Secretary, DARE and Director General, ICAR; Dr. T. Mohapatra, Former Secretary, DARE and Director General, ICAR; Dr. T.R. Sharma, DDG (CS), ICAR; Dr. Sanjeev Gupta, ADG (O&P), ICAR; Dr. D.K. Yadava, ADG (Seeds), ICAR for their guidance and unstinted support in executing the mandate of the institute. I express my gratefulness to the Chairman and the Members of Research Advisory Committee for critical assessment and guidance in improving the research programmes of the institute. I also express my gratitude to the Members of Institute Management Committee for facilitating smooth functioning and budget utilization of the institute. My sincere thanks to previous Director (Acting) Dr. M. Sujatha, all the Heads of Sections, Drs. M. Sujatha, V. Dinesh Kumar (former), G. Suresh, R.D. Prasad, S.V. Ramana Rao; Shri Pradeep Singh, i/c SAO, Shri Vinod Kumar Sahoo, SFAO, Dr. A.L. Rathnakumar, OiC, PME and Dr. T. Boopathi, OiC, TIC for their inputs in compiling the information of their respective sections. I appreciate the efforts of the editorial team of the Annual Report for bringing out this publication in time. The contribution of Smt. J. Gnana Prasuna, STA and Smt. N. Jyothsna for type setting; Shri P. Srinivasa Rao, PS for cover page design, Dr. Praduman Yadav for translation of Executive Summary in Hindi and Shri Pradeep Singh, Assistant Director (OL) for translation of the Annual Report in Hindi is duly acknowledged.

(R.K. Mathur)
Director

Hyderabad
March 01, 2023

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Executive Summary

Castor

Crop Improvement

- A total of 260 accessions were conserved in the medium-term storage (MTS), while 860 accessions rejuvenated and 200 accessions were multiplied. Three hundred improved monoecious lines (IC lines), developed during the last five decades have been multiplied by selfing and sib-mated the true to type plants and 24 pistillate lines multiplied during *rabi* 2021-2022 were conserved in medium term cold storage as well as maintained as working collection.
- 118 new crosses were generated using 15 pistillate and 23 monoecious lines; the F_1s of eight parent cross [(DPC-16 x M-571)] x (Rb-1854 x DPC-25)] and [(DPC-23 x DPC-21) x (DPC-9 x DPC-14)] were advanced to F_2 generation.
- For diversification of non-spiny monoecious gene pool, 14 non-spiny monoecious lines with desirable agro-morphological features and best combining ability were intercrossed in two sets and each set was subjected to second cycle of random mating in isolation for diversification at ICAR-IIOR and eight AICRP centres.
- For introgression of dominant genes for wilt resistance and diversification of monoecious lines, in the segregating generations of crosses between three (RG-1354, RG-2874 and RG-2944) wilt resistant germplasm lines and nine monoecious lines (ICS-169, ICS-171, ICS-177, ICS-180, ICS-182, ICS-186, ICS-200, ICS-210 and ICS-216) with best combining ability, 34 selections were advanced to F_3 generation from 27 F_2 families (500 plants each) and 58 selections were advanced to BC_1F_2 generation from 27 BC_1F_1 progenies.
- Bi-parental populations of a cross between a germplasm from farmers' collection, 'FC-167' was used for diversifying the genetic base. Seven superior and diverse selections from 102 F_5 progenies derived from 18 bi-parental crosses involving 13 superior lines were advanced to F_6 generation.
- Chemical mutagenesis using EMS was optimized for DPC-15. Twelve hours presoaking followed by either 8 hours or 12 hours of treatment with 1.0% EMS was the optimum lethal dose for EMS mutagenesis on the basis of germination (%) of the seeds, root and shoot length at 7 days and 14 days after treatment.
- Preliminary evaluation of monoecious inbred lines resulted in identification of two dwarf and early flowering (47-49 days) inbred lines (K18-39-1 and K18-48A) with significantly higher seed yield over checks; three inbred lines (K18-1-1, K18-19 and K18-48A) with high 100-seed weight (38.8 to 41.6 g); two inbred lines, K18-19 and K18-59 with high oil content (~52%) and fourteen inbreds having <20% wilt incidence.
- Out of 60 experimental hybrids evaluated under rainfed conditions during *kharif* season, 19 hybrids recorded higher seed yield (30.4 to 57.1%) than the best check, ICH-66 while three hybrids (ICH-1418, ICH-1425, ICH-1427) exhibited >50% seed yield superiority with an oil content of >49%.
- Screening advanced generation breeding lines derived from the gene pool for gray mold resistance and bi-parental crosses for reaction to gray mold through artificial screening (detached capsule technique) resulted in identification of the promising line, K18-1-2.
- A major QTL for gray mold resistance on chromosome-10 identified using the RIL population of JC-12×48-1 was validated using an independent F_2 population of the cross, RG-1673 (susceptible) x 48-1 (resistant). All the F_2 individuals when genotyped using the linked SNP marker Rc_29941-41303 indicated that out of 19 plants exhibiting resistance reaction (scale-1), 16 F_2 plants carried 48-1 allele at the SNP loci.
- A reliable and repeatable *in vitro* regeneration protocol has been developed for castor.
- Two varieties, ICS-164 (medium duration) and ICS-345 (early maturing) and three hybrids ICH-1146 (early maturing), ICH-440 (early maturing), and ICH-277 (medium duration) are under various stages of testing in coordinated trials.

Crop Production

- The seed yield of castor was significantly influenced by tillage practices and intercropping systems under rainfed conditions in Alfisols. The highest seed yield and equivalent yield of castor (CEY), was realized under conventional tillage (1758, 2452 kg/ha) which was at par with reduced tillage (1652, 2294 kg/ha) and lowest seed yield was recorded in zero tillage (1244, 1972 kg/ha). Among intercropping systems, the highest CEY was registered in castor + groundnut intercropping (2640 kg/ha) followed by castor + redgram (2389 kg/ha) and sole castor (1907 kg/ha).
- Soil organic carbon (SOC) was significantly influenced by tillage practices and the highest SOC content was found under reduced tillage (0.64%) followed by zero tillage (0.63%) and the lowest was observed in conventional tillage (0.56%). Among the inter cropping systems, highest SOC was found in castor + redgram (0.67%) followed by

castor + greengram (0.65%), castor + groundnut (0.60%) while lowest SOC was found in sole castor (0.57%).

- Four genotypes *viz.*, RG-1594, RG-1663, RG -2818 and RG-2822 out of 11 trait specific germplasm lines evaluated under imposed water stress condition (30-90 DAS), exhibited least (≤30%) reduction in seed yield with ≤0.8 DSI under stressed conditions.
- Out of 12 parental lines evaluated, 1932-1, ICS-164, ICS-200, ICS-299, IPC-42, DPC-9, 48-1 were drought tolerant (with ≤30% reduction in seed yield and <1.0 DSI). ICS-164 and 1932-1 which recorded high seed yield and oil content both under control and drought stress conditions could be exploited in breeding programme.

Crop protection

- Six parental lines *viz.*, ICS-303, ICS-304, ICS-305, ICS-319, DPC-22 and IPC-46 recorded highly resistant reaction against root rot pathogen screened under artificial inoculation method.
- One promising line K-18-1-2 was identified for gray mold resistance through detached capsule technique.
- Two breeding lines *viz.*, K-18-162 and GMM-3 recorded moderately resistant/tolerant reaction against gray mold under artificial epiphytotic condition in poly house.
- Under sick plot condition, the parental line, K 18-40-1 and 17 advanced hybrid lines (ICH-1594, ICH-1597, ICH-1455, ICH-1474, ICH-1482, ICH-1484, ICH-1488, ICH-1489, ICH-1491, ICH-1494, ICH-1496, ICH-1501, ICH-1506, ICH-1517, ICH-1519, ICH-1524 and ICH-1538) recorded highly resistant reaction against wilt incidence.
- In proteomics analysis of high virulent and less virulent isolates of *Fusarium oxysporum* f.sp. *ricini,* 12 upregulated and 8 differentially present proteins were observed in the highly virulent isolate from Palem.
- Among 20 genotypes evaluated against *F. oxysporum* f. sp. *ricini* (*For*) from Yethapur, Mandor and Junagadh, five genotypes *viz.*, AP-33, AP-48, AP-56, AP-163 and RG-3467 recorded resistant reaction for all the isolates.
- Among the 10 biotic stress resistant germplasm accessions screened against reniform nematode, (*Rotylenchulus reniformis)*, genotype RG-2781 exhibited moderate resistance.
- Eight parental lines *viz.*, DPC-27, IPC-34, IPC-35, IPC-36, IPC-46, ICS-299, ICS-317 and 1932-1 were resistant and two double bloom lines (RG-1624 and ICS-303) were moderately resistant to leafhopper.
- Seven genotypes (RG-2870, RG-3233, RG-2976, RG-3428, ICI-RG-2800-1, ICI-RG-2800-4 and ICI-RG-2800-5) were highly resistant to whitefly.
- The inbred line, K-18-45-1 recorded <20% capsule damage in castor and identified as a promising line for capsule borer tolerance.

Sunflower

Crop Improvement

- A total of 300 accessions were conserved; 350 accessions were multiplied and 166 accessions were supplied to sunflower researchers.
- Pollen storage studies indicated that higher seed set was observed when the flower heads were pollinated with pollen grains stored in refrigerator (5°C) up to seven days and hence can be effectively utilized in hybrid seed production.
- A total of 450 BC_2F_5 families of different wild *Helianthus* species like wild *H. annuus, H. debilis, H. argophyllus, H. petiolaris* and *H. praecox* were advanced from BC_2F_5 to BC_2F_6 generation through selfing during late *rabi* 2021-22.
- Preliminary evaluation of thirty advanced interspecific derivatives resulted in identification of five high oil genotypes *viz.*, PB-120 (44.3%), PB-129 (43.0%), PB-130 (42.7%), PB-128 (42.7%) and PB-127 (41.0%).
- Two stable interspecific derivatives: PMR-16 (resistant to powdery mildew) and PMS-27 (susceptible to powdery mildew) from the cross PS-2023 (susceptible parent) and *H. praecox* (PRA-1823- resistant parent) were subjected to transcriptome and RNAseq analyses. Twelve out of 37 genes were found to be differentially expressing between the resistant and susceptible mildew resistance locus (MLO) derivatives. Among them, nine genes were down regulated in the resistant PMR-16 variety suggesting their possible role in resistance. The highest difference in expression was found in the HaMlo1 gene (log2FC=-5.64). Six of these differential lines were distributed to five AICRP centres for multilocation evaluation and confirmation.
- For developing Multi-parents Advanced Generation Inter Crosses (MAGIC) population, two-way as well as four way crosses involving eight diverse maintainer lines (ARM-243B, CMS-1010B, COSF-6B, CMS-1008B, CMS-103B, CMS-1103B, HA-89B and CMS-335B), chosen on the basis of high oil content, high seed yield, tolerance to powdery mildew, earliness, lateness, high oleic content, etc. were executed during *rabi* 2021-22 and *kharif* 2022.
- A unique pale yellow colour ray floret plant was observed in CMS-67B during late *rabi* 2020-21 and multiplied through selfing. F_1s of direct and reciprocal crosses between CMS-1001B (yellow

ray floret colour) and plants with pale yellow colour ray floret indicated the dominance of this trait over normal and further back crosses are being attempted to work out the inheritance pattern.

- Five CMS lines (CMS-58B, CMS-59B, CMS-103B, CMS-901B and CMS-1103B) and five restorer gene pool inbreds (RGP-165, RGP-214-1, RGP-216-1, RGP-240 and RGP-254) identified earlier were confirmed for the high oleic (>78%) trait over four seasons.
- Two entries, IIOSH-500 and IIOSH-1490 were nominated during 2022 for initial hybrid trial (IHT) and two entries, IIOSH-434 and IIOSH-460 were promoted to higher order of testing (AHT-I and AHT-II), respectively during *kharif* 2022. The entry, IIOSH-566 was promoted from IHT to AHT-I during *rabi* 2021-22.
- A project on "Revival of sunflower cultivation" formulated by ICAR-IIOR, Hyderabad has been sanctioned by the Department of Agriculture & Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India for a period of three years from 2022-23 to 2024-25 with the objectives of area expansion, productivity improvement, profitability improvement of sunflower cultivation in India in addition to capacity building. The targeted seed production for distribution is 15000 q involving the AICRP-Sunflower centers, seed production units of SAUs and public seed agencies (NSC, HIL, NDDB, NAFED).

Crop Production

- Out of 74 genotypes evaluated for tolerance to high temperature, drought and combined stress with two sowing (normal, delayed) dates, two genotypes, 298 R and CBE-COSF-16B showed tolerance to drought, high temperature and combined stress based on seed yield under control, drought stress and the yield stability index.

Crop protection

- Screening of seven advanced interspecific derivatives resistant to leafhoppers against sunflower downy mildew (SDW) in sick plot at Latur identified three resistant derivatives *viz.*, PB-1003, PB-1005 and PB-1007 and can be utilized as donors for leafhoppers coupled with downy mildew.
- A total of eight lines *viz.*, HA-124B, PB-898, PB-904, PB-205, PB-905, ID-32, PB-889 and RGP-278-2 were tolerant to Alternariaster leaf blight disease under polyhouse conditions out of 206 genotypes screened.
- Seventeen lines (which include RGP and CMS lines) were reported to exhibit resistant reaction to leafhopper out of 63 genotypes screened.

Safflower

Crop Improvement

- A total of 340 germplasm accessions were supplied to various AICRP (Safflower) centres for multiplication, evaluation and utilization in breeding.
- Out of 164 accessions/selections evaluated over two years, 16 promising accessions/selections were identified for seed yield greater than the checks; 13 for early flowering (69-75 days); and six accessions for short plant height (36-55 cm).
- A total of 11 non-spiny accessions with orange-red corolla (GMU-7924, GMU-7926, GMU-7929, GMU-7930-2, GMU-7932-4, GMU-7936-5, GMU-7940-3, GMU-7940-4, GMU-7963, GMU-7963-1 and GMU-7973) were identified for further utilization in breeding.
- Out of 20 accessions evaluated for confirmation of large capitulum size, eight accessions [GMU-3420 (HUS-253); GMU-7994 (SSFB-2004); GMU-7991 (SSFB-2002); GMU-686 (EC-137339); GMU-7995 (SSF-1507); GMU-472-1; GMU-7990 (SSFB-2001) and GMU-7993 (SSFB-2003)] were found promising with a capitulum diameter of >25 mm and having >20 seeds/capitulum.
- A total of 200 fresh germplasm accessions obtained from ICAR-NBPGR were evaluated for seed and oil yield and 11 accessions (EC-210467, EC-199879, EC-383086, EC-321219, EC-181615, EC-398084, EC-143832-3, EC-181614, EC-182227, EC-118229 and EC-246570) showed superior seed yield (15.9 to 24.8 g/plant) and oil yield (4.81 to 8.75 g/plant) over the checks. Eight accessions *viz.*, EC-398223, EC-398229, EC-398218, EC-398259, EC-398123, EC-398270, EC-398226 and EC-398091 recorded high oil content ranging from 40-43% with seed yield ranging from 4 to 8 g/plant.
- One accession, EC 523368-2 (GMU-7399) tolerant to aphid (*Uroleucon compositae* Theobald) was registered as a genetic stock [INGR22052 (IC0643960)] by Plant Germplasm Registration Committee (PGRC), ICAR-NBPGR, New Delhi.
- A total of 9 families from S5-1C-RIPE population giving high seed yield and oil content were advanced to S_6 generation. Of the total 19 S4-2C-RIPE selections, 4 had high oil content (35.1-40.3%); high seed yield (16.7-28.3 g/plant) and 100 seed weight (3.0-4.2 g/plant).
- In the F_5 generation of cross [*C. tinctorius* (A1) x (*C. tinctorius* (Nira) x *C. oxyacantha* (IP-16)], eight best line selections with oil content (29.2-36.0%), seed yield (23.2-57.1 g/plant) and 100 seed weight (4.3-5.2 g) were made.

- A network project entitled 'Exploiting genetic diversity for improvement of safflower through genomics-assisted discovery of QTLs/genes associated with agronomic traits' under the mission mode programme on 'minor oilseeds of Indian origin' is implemented in collaboration with ICAR-NBPGR (New Delhi); AICRP-Safflower centres at Vasanthrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani (Maharashtra) and Mahatma Phule Krishi Vidyapeeth (MPKV), Solapur (Maharashtra); University of Delhi (Delhi) and Punjab Agricultural University (PAU), Ludhiana (Punjab) to develop genetic/genomic resources in safflower for enabling molecular breeding research.
- A total of 1940 inbred lines representing six mapping populations from bi-parental/multi-parent crosses developed for identification of QTLs associated with agro-morphological traits.
- The major QTL (*QUc-Ct3.1*) region on linkage group (LG)-3 with the flanking SSRs, SafM-290 and SafM-23 (~12.5cM), was reduced to ~2 cM interval with new flanking SSRs, SafM-1160 and SafM-1137, using F$_8$-RIL population of CO-1 x EC-523368-2 cross. The newly found SSR markers SafM-1160 and SafM-1137 showed strong association with tolerance to aphids based on days to wilt after aphid infestation (R^2=37-50%), chlorophyll content SPAD_1-4 (R^2=37-68%) in F$_{10}$-RIL and BC$_1$F$_3$ populations and biomass under aphid stress in F$_{11}$ RIL population (R^2=40%).
- A set of 58 SNP markers, designed using NGS data of safflower genotypes CO-1 and EC-523368-2 were validated in a panel of 121 germplasm comprising of 31 *C. tinctorius*, 64 *C. oxyacanthus* and 26 *C. lanatus* accessions. The SNPs were highly polymorphic (90%). The expected heterozygosity (0.38), observed heterozygosity (0.59), number of effective alleles (1.67) and Shannon diversity index (0.82) parameters indicated high level of diversity in the germplasm panel. The SNP markers produced species-wise distinct clustering of genotypes.

Crop Production

- Performance of three varieties of soybean *viz*., JS-93-05 (short duration), Basara (medium duration) and JS-335 (normal duration) under modified plant geometry of soybean for relay sowing of safflower were assessed on broad-bed and furrows under rainfed conditions. Seed yield of normal duration variety JS-335 was significantly the highest (1498 kg/ha) and seed yield of short (JS-93-05) and medium duration (Basara) varieties of soybean was on par. However, modified plant geometry of soybean did not differ significantly for seed yield (1252 to 1403 kg/ha).

Crop Protection

- A total of 29 multi-parent cross based breeding lines were reported to be immune to wilt with nil disease incidence screened under sick pot method.
- Twenty-eight accessions were moderately tolerant to aphids with A.I.I. of 2.4-3.0.

Sesame

Crop Improvement

- A total of 378 accessions were evaluated and characterized for major agronomic characters.
- One hundred and forty accessions received from USDA were evaluated during summer for the different traits. Seed yield/plant ranged from 0.6-27.9 g/plant (PI-200105, PI-200111), days to maturity ranged from 75-120 days (PI-320958 early maturing line) and 8 accessions (PI-231033, PI-170737, PI-170767, PI-177541, PI-238459, PI-179986, PI-170748, PI-280808) did not show any symptoms of powdery mildew under field conditions indicating tolerance to the disease.
- A sesame accession, IC-235 was identified for the presence of conspicuous dark purple dense flakes in the inner corolla tube which was absent in other germplasm collection and named as, 'IIOSG-CS-1' for distinct corolla flakes. In F$_2$ population (n=232), the trait segregated in the ratio of 3:1 (χ^2=1.37; P=0.24) indicating monogenic derivant for the trait.
- A genotype having multicapsules with conspicuous purple lip flower type was developed (IOSG-MCPL) from a cross, IC-205776 x EC118591.
- Seventy eight families of interspecific cross Swetha x *S. mulayanum* (IC-43144-1) were maintained at F$_6$ generation.
- A set of 100 lines derived from two multiparent crosses *viz*., MSES-434 ((Phule Til x RT-351)/(GT-2 x E-8)//(HT-1 x VRI-3)/(TKG-22 x Swetha) and MSES-435 ((HT-1 x RT-351)/(GT-2 x TKG-22)//(Hima x TSS-6)/(Rajeshwari x E-8) were evaluated for yield and yield related characters during late *kharif* season. 79 lines recorded >50% of oil content out of which MSES-434-718 had highest oil content of 58.8% in *kharif* and this line recorded 53.8% oil content during summer season.
- Fourteen best genotypes for yield and yield components were selected from 60 genotyes developed using four different crosses.
- Four hundred and twelve SSR marker loci were surveyed among 120 sesame genotypes to analyze DNA-level diversity and it was found that 214 among 412 marker loci showed polymorphism and were able to discriminate at least two genotypes on 4% agarose gel electrophoresis.

- rBiFC vector sets (each eight in number) were developed with *SAP54* (designated S54LP, SAP54 like protein, the effector molecule) and the two genes RNF5 (E3 ubiquitin-protein ligase) and NPY4 (BTB/POZ domain-containing protein) encoding interacting proteins from sesame. As two isoforms of RNF5 (RNF5 and RNF*5) were discovered in sesame, rBiFC vectors were developed with each isoform. Thus, in total, 24 clones – 8 with RNF5, 8 with RNF*5, 8 with NPY4, were developed and they were moved into agrobacterium strain (GV1301).
- Agroinfiltration studies in *Nicotiana benthamiana* with the developed constructs established the interaction between RNF5 and S54LP in two combinations (NN-RS and CC-SR, out of eight) and that there was no effect of the deletion of 3 amino acids in RNF5 on the interaction. Similar studies with rBiFC vectors involving NPY4 and S54LP showed that the two proteins interacted *in planta* and the interaction was noticed in three (NN-NS, CC-SN and NC-SN) combinations.

Crop Production

- In soybean-sesame cropping system, application of either castor cake (658 kg) or combined application of FYM (680 kg), vermicompost (637 kg) and goat manure (400 kg) (on equal N basis) produced comparable sesame yield as that of nutrient management through inorganic sources.
- Practicing zero tillage for sesame succeeding rice fallow was found to be unsuitable and either conventional or reduced tillage recorded higher yields and 125% RDF recorded highest yield of sesame at Odisha (466 kg/ha) and Telangana states (421 kg/ha).
- Two genotypes *viz.*, SI 1802 and SI 9823 expressed higher values for different indices of stress tolerance under moisture stress along with higher seed yield. These identified genotypes may be used in breeding programs for the development of drought tolerant varieties
- The SPAD Chlorophyll Meter Readings (SCMR) recorded at 7 days intervals showed positive correlation with seed yield in both well watered (WW) and drought stress (DS) conditions in sesame. SCMR had significant influence on sesame seed yield at 52 DAS under DS and 59 to 73 DAS under WW conditions.

Crop Protection

- Screening of advanced breeding genotypes for Macrophomina root rot through sick pot method resulted in identification of three (RR-2102, RR-3003, SES-S-20-2001) resistant lines and two (RR-1038, RR-1039) moderately resistant lines which were also confirmed through multilocation (Vridhachalam, Jabalpur, Dharwad) evaluation.
- In sick plot method, the genotype, SEL-S-20-2001 recorded <10% root rot incidence consecutively for two years.
- Phytoplasma strain infecting sesame at Hyderabad, Rajasthan, Madhya Pradesh, Gujarat, Varanasi as well as weeds like Cleome, Parthenium and *Physalis minima*, showing symptoms of phyllody and grown in sesame fields was identified as *Candidatus Phytoplasma aurantifolia*.
- One genotype, IIOS-20-3013 showed highly resistant reaction to phyllody and SES-K-20-2016 is highly resistant to leaf webber. Least incidence (per plant) of whitefly and mirid bug was noticed in SES-K-20-2010 and SES-K-20-2025, respectively. About 29 sesame genotypes were graded as resistant to gall fly.
- Studies on seasonal incidence of insect pests in different growing seasons revealed peak incidence of emerging pests *viz.*, whitefly and mirid bug during October (9.9/plant) and December (17.0/plant) months, respectively.
- Studies on effect of different nutrient management treatments in sesame on the storage insect pests revealed that the treatments that received 100% RDF [Neem oilcake + Rock phosphate] + PSB or 100% RDF [FYM + Vermicompost + Goat manure] + Rock phosphate + PSB and stored in polythene bag with 5% moisture content recorded low population and percent loss due to storage pests (rice moth, *Corcyra cephelonica* and red flour beetle, *Tribolium castaneum*).
- Seeds treated with sweet flag rhizome extract, eucalyptus leaf extract and neem seed kernel extract (2%) were found promising against rice moth and recorded least seed damage (2.5 to 3.5%). Seeds treated with sweet flag rhizome extract, *Vitex negundo* (nirgundi) leaf extract and neem seed kernel extract (2%) found promising against red flour beetle and recorded least seed damage (2.0 to 3.5%).

Niger

Crop Improvement

- For the first time in India, multiplication, characterisation and evaluation of all the 3524 accessions at 5 locations representing 2 distinct seasons (*kharif* and *rabi*) have been accomplished. Data revealed wide variation for major agronomic traits.
- A total of 243 selections that were derived from third random mating cycle (RMC) developed using elite accessions (for high seed yield, oil content and early accessions) were advanced to next S4 generation. Maximum seed yield recorded was 7.25 g/plant in RMC-S3-P338 and highest oil content 46.9% in RMC-S3-P370.

- A total of 94 selections derived from 4th RMC developed from 3rd RMC carried out with four released varieties and 480 elite populations were advanced to S_5 generation. The selection RMC-S4-P455 recorded high seed yield (8.99 g/plant) and RMC-S4-P505 recorded highest oil content (44.7%).
- New set of random mating population was developed using diverse elite lines selected for different yield related traits.
- Towards development of genetic and genomic resources, a mission mode project supported by DBT involving AICRP-Niger centres (3), ICAR-NBPGR, New Delhi, IGKV-Raipur, Osmania University with ICAR-IIOR as a lead centre is under progress.

Linseed

Crop Improvement

- A total of 213 cultivated type trait specific accessions and 6 wild accessions (imported from USDA,USA) were multiplied this year.
- Among the 223 USDA lines, one accession PI-522932 exhibited dehiscence, a trait of commercial value found rarely in the linseed global germplasm collection.
- Seeds of 92 varieties notified in India were collected from ICAR-NBPGR and the AICRP-Linseed centres and multiplied during *rabi* 2021. These were subjected to diversity analysis using linseed specific SSR primers.
- A germplasm panel developed earlier comprising 201 diverse lines was also multiplied and analysed for oil content and fatty acid composition. One advanced breeding line, LMS 2015-31 recorded high (45.6%) oil content and eight genotypes *viz*., BAU 2019-03 (59.2%), Shubhra, Jawahar Linseed- 41 (58.9%); Binwa (KL-210) and SLS 73 (58.3%); Laxmi-27 (58.2%) and 'AC CARNDUFF' of Canada (58.2%) recorded high ALA content.
- Estimation of oil content in 2,885 working collection of germplasm identified 10 accessions (Kiran, Chitar, NDL-8804, KL-160, EC-322653, SJKO-65, KL-224, KL-234, SLS-73, EC-718851) and two released varieties, LSL 93 (46.3%) and SLS 73 (48.2%) with high oil content.
- Cadmium studies in 10 popular linseed varieties indicated that BRLS-119 had the lowest Cd concentration in seed (0.85 mg/kg). While, RLC 153 had lower nickel content (2.71 µg/kg of seed).
- Three crosses involving varieties, PCL-55, Shekhar, T-397 with one low ALA variety TL-99 were effected to develop low ALA edible grade linseed oil.
- Molecular analysis with *FAD3A* and *FAD3B* genes from linseed germplasm lines indicated that four (CN100572, CN100556, CN100571, CN100570) Canadian low ALA lines/accessions exhibited a mutant allele for both the genes. Four high ALA lines namely Shubhra, Laxmi-27, Jawahar Linseed-41 and SLS-73 exhibited wild allele of both the genes and further confirmation in mapping population is in progress.

Crop Protection

- Among 77 linseed genotypes screened, three genotypes *viz*., NDL-2014-1, M-S-3 and SLS-63 recorded low infestation of both lepidopteran and sucking pests.

Biological Control

- Two marine associated endophytic bacteria, *Bacillus siamensis* (Bs_Rg7) isolated from seaweed *Gracilaria* sp. and *Bacillus velezensis* (CHB2) isolated from marine sponge *Biemna fortis* showed *in vitro* broad spectrum antagonistic activity against *Fusarium* spp. and *Macrophomina* spp. of oilseed crops.
- Secondary metabolite profiling using UPLC-MS/MS identified 61 and 42 compounds respectively and volatile organic compounds (VOCs) profiling by headspace-GCMS identified 20 and 19 compounds respectively from *Bacillus siamensis* (Bs_Rg7) and *Bacillus velezensis* (CHB2).
- Among the different chitinolytic bacteria screened *in vitro*, the strain IC-RB1 recorded strong antagonism against *Fusarium oxysporum* f. sp. *ricini*. The strains IC-RB1 and IC-RB3 exhibited more than 50% reniform nematode juvenile mortality. Three strains viz., IC-RB5, HD-RB20 and HD-RB21 exhibited 100% larval mortality against *Spodoptera litura*.
- The entomopathogenic fungi infected *S. litura* and *S. frugiperda* cadavers collected from different locations of Telangana were identified as *Metarhizium (Nomuraea) rileyi* using molecular methods. SlMr-2 isolate recorded lower LC_{50} values (1.5×10^4 - 1.5×10^7 conidia/ml) against *S. litura*.
- Compatibility studies of *M. rileyi* isolates with insecticides and fungicides revealed that fungicides were highly inhibitory (8.2 to 100%) to *M. rileyi* when compared to insecticides (2.5 to 77.4%). Carbendazim and propiconazole were highly detrimental to the growth of *M. rileyi*.
- Multilayer seed coating (chitosan 5 ml + fungicide 7.5 ml + Th4d 0.1 g) + (chitosan 5 ml + *Bradyrhizobium* sp. 0.5 g) in groundnut recorded higher germination (94.0%) and low seed rot and seedling mortality in *in vivo* germination towel test.
- *Trichoderma harzinium* transformed with GFP construct was obtained and confirmed using PCR analysis and the ability of this transformed strain to colonize roots was stabilized with confocal

microscopy. This strain will be useful to assess the ecological fitness and survival of applied *Trichoderma* in soil/plants.

- Among 40 coacervate combinations prepared and assessed to develop *Bacillus thuringiensis* and *Beauveria bassiana* microcapsules, four polymer coacervates (C-13, C-21, C-22, C-33) were identified having high yielding potential and solubility in water. The coacervate combinations *viz.*, C-21+ *B. thuringiensis* and C-33+ *B. bassiana* were found effective against *S. litura* and *A. janata*. The entrapment efficiency was 97 to 99%.

Nanosystems

- Nanocitrates were identified as stable chelators for Fe and Zn plant nutrition which can increase plant use efficiency with lesser environmental concerns. The highest Zn availability was 86.2 mg/kg of soil in Zn nanocitrates and Fe availability was 264.7 mg/kg of soil in the case of Fe nanocitrates.
- Lignin extraction has been standardized from agricultural waste and was confirmed through FTIR.

Value Addition

- Among the edible oils blended at different ratios and stored upto 12 months, sesame, rice bran oil blend had lower free fatty acids and peroxides during storage.

DUS Testing

- Under the Central Sector Scheme for Protection of Plant Varieties and Farmers Rights Authority (PPV & FRA), DUS testing activities were conducted for sunflower and safflower during *rabi* 2021-22 and castor and niger in *kharif* 2022
- In sunflower, DUS testing was undertaken for two sets of one new candidate for the second year during *rabi* 2021-22 along with two reference entries and data was recorded for 34 DUS traits and reports were submitted to PPV&FRA, New Delhi.
- In safflower, ten reference entries were maintained and multiplied during *rabi* 2021-22.
- In castor DUS testing, data of one farmer's variety along with three reference varieties for two centres was compiled and reports were submitted to PPV&FRA, New Delhi. Initial characterization of two reference varieties and maintenance and multiplication of eight reference varieties was undertaken during *kharif* 2022.
- In Niger, Under the project on 'Development of Distinctiveness, Uniformity and Stability (DUS) testing guidelines for Niger [*Guizotia abyssinica* (L.f.) Cass.]', 23 niger varieties and 109 germplasm were obtained from the developing centres and observations were recorded on 32 traits. Multiplication of varieties (23) and germplasm accessions (117) was also carried out under nets through sibbing during *kharif* 2022.

Seed Production

- A total of 864.19 q of breeder, foundation, certified and TL seed of castor, sunflower, sesame and safflower were produced during 2022.

Social Sciences

- Safflower knowledge management portal was designed and developed with five major themes *viz.*, general domain, cultivars, research domain, farmers' domain and extension domain with menus and sub menus for the respective domains. The information pertaining to the individual domains were populated and uploaded to the portal.
- *TilhanTec:* Castor-Genetic Resources Information System (*TilhanTec:* Castor-GRIS) was developed and made accessible through https://tilhantec.icar.gov.in/Castor-GRIS/index.php. The information system is designed with features enabling the users to access information on individual and/or a combination of customized characters with output in the form of spread sheet that can be downloaded by the user.
- As part of Impact assessment of varieties/hybrids of ICAR-IIOR mandate crops in varied agro ecological regions of India, the Herfindahl-Hirschman Index (HHI) computed during the present millennium for castor (GCH-7) in Gujarat state revealed an increase for TE 2011-12 and TE 2016-17 indicating the spread of area under GCH-7 hybrid. A declining trend was evidenced for TE 2021-22 over TE 2016-17 suggesting that castor is being replaced by other competing crops perhaps due to higher profitability of competing crops and related market forces.
- The economics of farm level performance of castor hybrid GCH-7 on a cropping systems/ sequence approach *vis-a-vis* competing cropping systems / sequence in Mehsana, Patan and Kachchh districts of Gujarat revealed that, in Mehsana district, the per ha returns from castor based system was higher over bajra - wheat and bajra - mustard; but not competitive with the other emerging systems/ sequences *viz.*, fennel - summer bajra; cluster bean - potato - summer bajra and green gram - potato - summer bajra.
- In Patan district, castor based system was profitable over majority of the competing cropping systems excepting green gram - fennel - summer bajra; and uradbeen - cumin - summer bajra systems respectively.

- In Kachhch district, majority of the cropping system revealed higher profitability over castor based system except for bajra-wheat; and bajra-mustard system. This reflects the dominance of the different cropping systems in the district.
- The analysis on yield gaps in sunflower from the FLD's conducted in various states revealed that across the states, the yield gaps I and II during *kharif* season were 19.3% and 134.4%, respectively, while the same in *rabi* season were 20.7 and 122.4% respectively.
- The knowledge test developed and administered to farmers covered under both public and private extension systems in Karnataka, Andhra Pradesh, Telangana and Chhattisgarh states, revealed that, farmers' under public extension had more knowledge on sunflower production technology *vis-à-vis* farmers' under private extension system.
- Significant differences in knowledge level between the two groups were seen in most of the package of practices of sunflower and such difference is mainly due to lower involvement of private sector in extension services related to the crop.
- During 2022-23, 25908 FLD's were conducted (18368 and 8090 during *kharif* and *rabi* seasons respectively).
- The sunflower demonstrations conducted under zero tillage conditions after harvest of paddy revealed that although the seed yield of sunflower reduced by 7.7%, the cost of cultivation decreased by Rs. 2300/ha resulting in higher B:C ratios of 5.62 as against 4.57 under the farmers' practice.
- The demonstrations in sunflower on optimum spacing of 60 cm x 30 cm resulted in improvement of seed yield by 4.5% with additional net returns of Rs.7200/ha.

Formation and promotion of Farmer Producer Organizations (FPOs)

- Business plans (BP) were developed through consultative group meetings for formation and promotion of FPOs for Chinnakodur and Narayanraopet based on resource inventory of major crops and varieties grown, input utilization, output marketing, potential for crop diversification and value addition options. The BP included, input aggregation, crop diversification and bee keeping, seed production, capacity building and output marketing.
- Input aggregation through seeds in sunflower hybrids procured directly from public sector units and private companies enabled a profit of Rs.788820/- to the FPOs.
- Crop diversification and bee keeping in sunflower in approximately 1225 ha area enabled sunflower yield enhancement by 15-20% besides providing livelihood to three entrepreneurs engaged in honey production from bee keeping. Through input aggregation and output marketing, the FPOs could earn a profit of Rs.10.8232 lakh.
- Seed production of groundnut (Girnar-5 and Kadiri Lepakshi) and sale of seed resulted in a net profit of around Rs. 2.93 lakh to the FPOs.

Farmer FIRST Programme

- With the multiple objective of reducing the cost of inorganic fertilisers and to address the issue of soil borne pathogens, seed treatment with PSB, Trichoderma and Rhizobium along with NV 92 specific strain to groundnut, were taken up in pulses and groundnut under both *kharif* and *rabi* seasons.
- In redgram, soil and moisture conservation technologies (contour cultivation/ridge and furrow method) led to 12% increase in the productivity resulting in ANR of Rs. 10240/ha.
- Integrated nutrient management in groundnut (*rabi* 2021-22) resulted in average productivity of 14.00 q/ha against 11.42 q/ha with the traditional practice and ANR of Rs. 19221/ha.
- Minikits of groundnut in early *kharif* enabled availability of the seeds for sowing by the fellow farmers during the succeeding *rabi* sowings. This initiative catalyzed larger spread under the latest cultivar (TCGS-1694) and triggered the seed village concept.
- Sorghum cultivation taken up towards diversification during *Zaid* 2021-22, led to average productivity of 14.08 q/ha providing gross returns of Rs.23570/ha.
- Technology assemblage in redgram, greengram, castor, groundnut and sorghum enabled increase in yield by 8,3,5,14 and 9%, respectively.
- With the objective of doubling farmers income, pilot studies on marketing and value addition of redgram and groundnut enabled ANR of Rs.3720/q and Rs.3150/q respectively.
- Established convergence and linkages with NABARD, Tribal Development Corporation, NGOs, ICAR-IIMR, PJTSAU and value added players for exposure visits, capacity building and technical advice.
- Capacity building/awareness/customized programmes were conducted on importance of organic inputs/use of bio-inoculants, value addition, importance of verticals, business development plans, output aggregation and output marketing.
- Towards women empowerment, customized programmes were provided for creating awareness on the verticals for value addition of pulses and oilseeds.

कार्यकारी सारांश

अरंडी

फसल सुधार

- मध्यम अवधि के भंडारण (एमटीएस) में कुल 260 प्राप्तियों को संरक्षित किया गया; 860 परिग्रहणों का कायाकल्प किया गया और 200 परिग्रहणों का गुणन किया गया। पिछले पांच दशकों के दौरान आईसीएआर-आईआईओआर में विकसित तीन सौ उन्नत मोनोसियस लाइन्स (आई सी लाइन्स) को सेल्फिंग से गुणा किया गया है और सही प्रकार के पौधों को सिब-मेट किया गया है और रबी 2021-2022 के दौरान 24 पिस्टिलेट लाइनों को गुणा करके मध्यम अवधि के कोल्ड स्टोरेज में संरक्षित किया गया है । साथ ही कामकाजी संग्रह के रूप में बनाए रखा।
- 15 पिसटीलेट और 23 मोनोएसियस लाइन्स का उपयोग करके 118 नए क्रॉस उत्पन्न किए गए; आठ पैरेंट क्रॉस का F_1s [(DPC-16 xM-571)] x (Rb-1854 x DPC-25)] और [(DPC-23 x DPC-21) x (DPC-9 x DPC-14))] F_2 पीढ़ी के लिए उन्नत किए गये ।
- गैर-कांटेदार मोनोएसियस जीन पूल के विविधीकरण के लिए, वांछनीय कृषि-रूपात्मक विशेषताओं और सर्वोत्तम संयोजन क्षमता वाली 14 गैर-कांटेदार मोनोएसियस लाइनों को दो सेटों में इंटरक्रॉस किया गया था और प्रत्येक सेट को आईसीएआर-आईआईओआर और आठ एआईसीआरपी केंद्र में विविधीकरण के लिए अलगाव में रंडम मेटींग के दूसरे चक्र के अधीन किया गया था।
- तीन (आरजी-1354, आरजी-2874 और आरजी-2944) मुरझान प्रतिरोधी जर्मप्लाज्म लाइनों, और नौ मोनोसियस लाइनों (आईसीएस-169, आईसीएस-169, ICS-171, ICS-177, ICS-180, ICS-182, ICS-186, ICS-200, ICS-210 और ICS-216) सर्वश्रेष्ठ संयोजन क्षमता के साथ, 27 F2 परिवारों (500) से F3 पीढ़ी के लिए 34 चयन उन्नत किए गए थे पौधे प्रत्येक) और 58 चयन 27 BC1F1 संतानों से BC1F2 पीढ़ी के लिए उन्नत थे ।
- किसानों के संग्रह, 'FC-167' से एक जर्मप्लाज्म के बीच एक क्रॉस की द्वि-अभिभावक आबादी का उपयोग आनुवंशिक आधार में विविधता लाने के लिए किया गया था। 13 श्रेष्ठ वंशक्रमों वाले 18 द्वि-अभिभावक संकरणों से प्राप्त 102 एफ 5 संततियों से सात श्रेष्ठ और विविध चयनों को एफ $_6$ पीढ़ी में उन्नत किया गया।
- ईएमएस का उपयोग कर रासायनिक उत्परिवर्तन डीपीसी-15 के लिए अनुकूलित किया गया था। बारह (12) घंटे पूर्वभिगोने के बाद या तो 8 घंटे या 12 घंटे के उपचार के बाद 1.0% ईएमएस के साथ ईएमएस उत्परिवर्तन के लिए इष्टतम घातक खुराक बीज के अंकुरण (%), जड़ और शूट की लंबाई के आधार पर 7 दिन और 14 दिन थी। इलाज के बाद।
- मोनोसियस अंत:प्रजनित वंशक्रमों के प्रारंभिक मूल्यांकन के परिणामस्वरूप दो बौनी और जल्दी फूलने वाली (47-49 दिन) अंतर्प्रजनित वंशक्रमों (के18-39-1 और के18-48ए) की पहचान हुई, जिनमें चेकों की तुलना में काफी अधिक बीज उपज थी; उच्च 100-बीज वजन (38.8 से 41.6 ग्राम) के साथ तीन इनब्रेड लाइन्स (K18-1-1, K18-19 और K18-48A); उच्च तेल मात्रा (~52%) के साथ दो अंतःप्रजात वंशक्रम, K18-19 और K18-59 और <20% विल्ट आपतन वाली चौदह अंतःप्रजातियां की पहचान की गयी ।
- *खरीफ मौसम* के दौरान बारानी स्थितियों के तहत मूल्यांकन किए गए 60 प्रायोगिक संकरों में से, 19 संकरों में सर्वोत्तम जांच, आईसीएच 66 की तुलना में अधिक बीज उपज (30.4 से 57.1%) दर्ज की गई, जबकि तीन संकरों (आईसीएच-1418, आईसीएच-1425, आईसीएच-1427) ने 50% बीज उपज श्रेष्ठता और >49% तेल की मात्रा पाई गयी।
- कृत्रिम स्क्रीनिंग (अलग कैप्सूल तकनीक) के माध्यम से ग्रे मोल्ड की प्रतिक्रिया के लिए ग्रे मोल्ड प्रतिरोध और द्वि-अभिभावक क्रॉस के लिए जीन पूल से प्राप्त उन्नत पीढ़ी प्रजनन लाइनों की स्क्रीनिंग के परिणामस्वरूप आशाजनक लाइन, K18-1-2 की पहचान हुई।
- जेसी-12×48-1 की आरआईएल आबादी का उपयोग करके पहचाने गए गुणसूत्र-10 पर ग्रे मोल्ड प्रतिरोध के लिए एक प्रमुख क्यूटीएल को आरजी-1673 (अतिसंवेदनशील) x 48-1 (प्रतिरोधी) क्रॉस की एक स्वतंत्र एफ 2 आबादी का उपयोग करके मान्य किया गया था। लिंक किए गए एसएनपी मार्कर Rc_29941-41303 का उपयोग करके जीनोटाइप किए जाने पर सभी F2 व्यक्तियों ने संकेत दिया कि प्रतिरोध प्रतिक्रिया (स्केल -1) प्रदर्शित करने वाले 19 पौधों में से, 16 F2 पौधों ने SNP लोसाई में 48-1 एलील को ले लिया।
- कैस्टर के लिए एक विश्वसनीय और दोहराए जाने योग्य इन विट्रो पुनर्जनन प्रोटोकॉल विकसित किया गया है।
- दो किस्में, ICS-164 (मध्यम अवधि) और ICS-345 (जल्दी परिपक्व) और तीन संकर ICH-1146 (जल्दी परिपक्व), ICH-440 (जल्दी परिपक्व), और ICH-277 (मध्यम अवधि) समन्वित परीक्षणों के तहत परीक्षण के विभिन्न चरणों में हैं ।

फ़सल उत्पादन

- अल्फीसोल्स में बारानी स्थितियों के तहत जुताई के तरीकों और इंटरक्रॉपिंग सिस्टम से अरंडी की बीज उपज काफी प्रभावित हुई थी। गौरतलब है कि पारंपरिक जुताई (1758, 2452 किग्रा/हेक्टेयर) के तहत उच्चतम बीज उपज और अरंडी की समतुल्य उपज (सीईवाई) हासिल की गई थी, जो कम जुताई (1652, 2294 किग्रा/हेक्टेयर) के बराबर थी और सबसे कम बीज उपज दर्ज की गई थी शून्य जुताई (1244, 1972 किग्रा/हेक्टेयर)। इंटरक्रॉपिंग सिस्टम में, अरंडी + मूंगफली इंटरक्रॉपिंग (2640 किग्रा / हेक्टेयर) में उच्चतम सी ई वाई दर्ज की गई, इसके बाद अरंडी + लाल चना (2389 किग्रा / हेक्टेयर) और एकमात्र अरंडी (1907 किग्रा / हेक्टेयर) दर्ज की गई।

- मृदा कार्बनिक कार्बन (एसओसी) जुताई की प्रथाओं से काफी प्रभावित था और उच्चतम एसओसी की मात्रा कम जुताई (0.64%) के बाद शून्य जुताई (0.63%) और सबसे कम पारंपरिक जुताई (0.56%) में देखी गई थी। इंटर क्रॉपिंग सिस्टम में, उच्चतम एसओसी अरंडी + लाल चना (0.67%) में पाया गया, इसके बाद अरंडी + हरी चना (0.65%), अरंडी + मूंगफली (0.60%) जबकि सबसे कम एसओसी एकमात्र अरंडी (0.57%) में पाया गया।
- 11 विशेषता विशिष्ट जर्मप्लाज्म लाइनों में से चार जीनोटाइप *अर्थात* आरजी 1594, आरजी 1663, आरजी 2818, और आरजी 2822, बीज उपज में कम से कम (≤30%) तनावग्रस्त परिस्थितियों में ≤0.8 डीएसआई कमी प्रदर्शित करते हैं।
- मूल्यांकित 12 मूल वंशक्रमों में से, 1932-1, ICS-164, ICS-200, ICS-299, IPC-42, DPC-9, 48-1 सूखा सहिष्णु थे (बीज उपज में ≤30% की कमी और <1.0 DSI के साथ)). ICS-164 और 1932-1, जिसमें उच्च बीज उपज और तेल की मात्रा दोनों नियंत्रण और सूखे तनाव की स्थिति में दर्ज की गई थी, का प्रजनन कार्यक्रम में उपयोग किया जा सकता है।

फसल सुरक्षा

- 10 जैविक प्रतिबल प्रतिरोधी जननद्रव्य प्राप्तियों में से रेनिफॉर्म सूत्रकृमि (रोटिलेंचुलस रेनिफोर्मिस) के विरुद्ध जांच की गई।, जीनोटाइप आरजी-2781 ने मध्यम प्रतिरोध प्रदर्शित किया।
- छह पैरेंटल लाइन्स *यानी* ICS-303, ICS-304, ICS-305, ICS-319, DPC-22 और IPC-46 ने कृत्रिम इनोक्यूलेशन विधि के तहत जांचे गए रूट रॉट पैथोजेन के खिलाफ अत्यधिक प्रतिरोधी प्रतिक्रिया दर्ज की।
- अलग कैप्सूल तकनीक के माध्यम से ग्रे मोल्ड प्रतिरोध के लिए एक आशाजनक लाइन के-18-1-2 की पहचान की गई थी। इसके अलावा, ग्रे मोल्ड प्रतिरोध के लिए एक प्रमुख क्यूटीएल की पहचान की गई।
- दो प्रजनन लाइनों, के -18-162 और जीएमएम-3 में मामूली प्रतिरोधी / सहिष्णु प्रतिक्रिया दर्ज की गई।
- सिक प्लॉट की स्थिति के तहत पैतृक लाइन, के 18-40-1 और 17 उन्नत संकर लाइनें (आईसीएच-1594, आईसीएच-1597, आईसीएच-1455, आईसीएच-1474, आईसीएच-1482, आईसीएच-1484, आईसीएच-1488, आईसीएच-1489, ICH-1491, ICH-1494, ICH-1496, ICH-1501, ICH-1506, ICH-1517, ICH-1519, ICH-1524 और ICH-1538) ने म्लानि रोग के प्रति अत्यधिक प्रतिरोधी प्रतिक्रिया दर्ज की।
- *फ्यूजेरियम* के उच्च विषैला और कम विषैला आइसोलेट्स के प्रोटिओमिक्स विश्लेषण में *oxysporum* f.sp ।_*रिकीनी*, 12 अपरेगुलेटेड और 8 अलग-अलग मौजूद प्रोटीन पालेम से अत्यधिक विषाणु पृथक में देखे गए थे।
- *F. ऑक्सीस्पोरम* f sp *ricini* (के लिए) के लिए मूल्यांकन किए गए 20 जीनोटाइप में से येथापुर, मंडोर और जूनागढ़ से, पांच जीनोटाइप *अर्थात* एपी-33, एपी-48, एपी-56, एपी-163 और आरजी -3467 ने सभी आइसोलेट्स के लिए प्रतिरोधी प्रतिक्रिया दर्ज की।
- *आठ* पैरेंटल लाइन्स *जो कि* डीपीसी-27, आईपीसी-34, आईपीसी-35, आईपीसी-36, आईपीसी-46, आईसीएस-299, आईसीएस-317 और 1932-1 प्रतिरोधी थे और *दो डबल ब्लूम लाइनें (आरजी-1624 और आईसीएस-303)* लीफहॉपर के लिए मध्यम प्रतिरोधी थीं।
- सात जीनोटाइप (RG-2870, RG-3233, RG-2976, RG-3428, ICI-RG-2800-1, ICI-RG-2800-4 और ICI-RG-2800-5) सफेद मक्खी के लिए अत्यधिक प्रतिरोधी थे।
- इनब्रेड लाइन, K-18-45-1 ने कैस्टर में <20% कैप्सूल क्षति दर्ज की और कैप्सूल बोरर सहिष्णुता के लिए एक आशाजनक लाइन के रूप में पहचान की।

सूरजमुखी

फसल सुधार

- कुल 300 प्राप्तियों को संरक्षित किया गया; सूरजमुखी अनुसंधानकर्ताओं द्वारा 350 प्राप्तियों का गुणन किया गया और 166 प्राप्तियों की आपूर्ति की गई।
- सात दिनों तक रेफ्रिजरेटर (5°C) में संग्रहीत पराग कणों के साथ परागित करके संकर बीज उत्पादन में प्रभावी रूप से उपयोग किया जा सकता है।
- जंगली *हेलियनथस प्रजातियों* जैसे एच. *एनुअस* , एच. *डेबिलिस*, एच. *आर्गोफिलस*, एच. *पेटियोलारिस* और एच. *प्राइकॉक्स* के कुल 450 बीसी$_2$ एफ$_5$ परिवार *को* देर से *रबी* 2021-22 के दौरान *बीसी*$_2$ एफ$_5$ से बीसी$_2$ एफ$_6$ पीढ़ी सेल्फिंग के माध्यम से उन्नत किए।
- तीस उन्नत इंटरस्पेसिफिक डेरिवेटिव के प्रारंभिक मूल्यांकन के परिणामस्वरूप पांच उच्च तेल जीनोटाइप की पहचान हुई , *जैसे* पीबी-120 (44.3%), पीबी-129 (43.0%), पीबी-130 (42.7) और पीबी-128 (42.7%) और पीबी -127 (41.0%)।
- *H. praecox* (PRA-1823-प्रतिरोधी माता-पिता) से दो स्थिर इंटरस्पेसिफिक डेरिवेटिव: PMR-16 (पाउडरी मिल्ड्यू के लिए प्रतिरोधी) और PMS-27 (पाउडरी फफूंदी के लिए अतिसंवेदनशील) ट्रांसक्रिप्टोम के अधीन थे और RNAseq विश्लेषण करता है। 37 में से 12 जीन प्रतिरोधी और अतिसंवेदनशील फफूंदी प्रतिरोध लोकस (एमएलओ) डेरिवेटिव के बीच भिन्न रूप से अभिव्यक्त होते पाए गए। उनमें से, प्रतिरोधी PMR-16 किस्म में नौ जीनों को डाउन रेगुलेटेड किया गया था, जिससे प्रतिरोध में उनकी संभावित भूमिका का पता चलता है। अभिव्यक्ति में सबसे अधिक अंतर HaMlo1 जीन (log2FC=-5.64) में पाया गया। बहुस्थानीय मूल्यांकन और पुष्टि के लिए इनमें से छह अलग-अलग पंक्तियों को पांच एआईसीआरपी केंद्रों में वितरित किया गया था।
- बहु-माता-पिता उन्नत पीढ़ी इंटर क्रॉस (मैजिक) आबादी के विकास के लिए, दो-तरफ़ा और साथ ही चार-तरफ़ा क्रॉस जिसमें आठ विविध अनुरक्षक लाइनें (ARM-243B, CMS-1010B, COSF-6B, CMS-1008B, CMS-103B, CM-1103बी, एचए-89बी,

सीएमएस-335बी) को *रबी* 2021-22 और *खरीफ* 2022 के दौरान उच्च तेल की मात्रा , उच्च बीज उपज, ख़स्ता फफूंदी के प्रति सहनशीलता, अगेती, विलंबता, उच्च ओलिक की मात्रा आदि के आधार पर चुना गया था।

- *रबी 2020-21 के दौरान CMS-67B में* एक अद्वितीय हल्के पीले रंग का रे फ्लोरेट प्लांट देखा गया और सेल्फिंग के माध्यम से गुणा किया गया। CMS- 1001B (येलो रे फ्लोरेट कलर) के बीच प्रत्यक्ष और पारस्परिक क्रॉस के F1s और हल्के पीले रंग के रे फ्लोरेट वाले पौधों ने सामान्य पर इस विशेषता के प्रभुत्व का संकेत दिया और आगे के क्रॉस को इनहेरिटेंस पैटर्न पर काम करने का प्रयास किया जा रहा है।
- पांच सीएमएस लाइनें (सीएमएस-58बी, सीएमएस-59बी, सीएमएस-103बी, सीएमएस-901बी, सीएमएस-1103बी) और पांच रेस्टोरर जीन पूल इनब्रेड्स (आरजीपी-165, आरजीपी-214-1, आरजीपी-216-1, आरजीपी-240 , RGP-254) की पहले पहचान की गई थी, जिनकी चार मौसमों में उच्च ओलिक (>78%) विशेषता के लिए पुष्टि की गई थी।
- प्रारंभिक हाइब्रिड परीक्षण (IHT) के लिए 2022 के दौरान दो प्रविष्टियाँ, IIOSH-500 और IIOSH-1490 को नामांकित किया गया था और दो प्रविष्टियों, IIOSH-434 और IIOSH-460 को परीक्षण के उच्च क्रम (AHT-I और AHT-II) में पदोन्नत किया गया था। *खरीफ 2022* के दौरान क्रमशः। प्रविष्टि, IIOSH-566 को *रबी* -2021-22 के दौरान IHT से AHT-I में पदोन्नत किया गया था।
- आईसीएआर-आईआईओआर, हैदराबाद द्वारा तैयार की गई "सूरजमुखी की खेती का पुनरुद्धार" पर एक परियोजना को कृषि और किसान कल्याण विभाग, कृषि और किसान कल्याण मंत्रालय, भारत सरकार द्वारा 2022-23 से 2024-25 क्षमता निर्माण के अतिरिक्त भारत में सूरजमुखी की खेती के क्षेत्र विस्तार, उत्पादकता सुधार, लाभप्रदता सुधार के उद्देश्यों के साथ। तक तीन साल की अवधि के लिए मंजूरी दी गई है। वितरण के लिए लक्षित बीज उत्पादन 15000 क्विंटल है जिसमें एआईसीआरपी-सनफ्लावर केंद्र, एसएयू की बीज उत्पादन इकाइयां और सार्वजनिक बीज एजेंसियां (एनएससी, एचआईएल, एनडीडीबी, नेफेड) शामिल हैं।

फ़सल उत्पादन

- उच्च तापमान, सूखे और दो बुवाई (सामान्य, विलंबित) तिथियों के साथ संयुक्त तनाव के लिए मूल्यांकन किए गए 74 जीनोटाइप में से दो जीनोटाइप, 298 R और CBE-COSF-16B ने सूखे, उच्च तापमान और बीज उपज के आधार पर संयुक्त तनाव के प्रति सहनशीलता दिखाई। सूखा तनाव और उपज स्थिरता सूचकांक को नियंत्रण में रखा गया था।

फसल सुरक्षा

- लातूर के सिक प्लॉट में सूरजमुखी डाउनी मिल्ड्यू (SDW) के खिलाफ लीफहॉपर्स के लिए प्रतिरोधी सात उन्नत इंटरस्पेसिफिक डेरिवेटिव्स की स्क्रीनिंग ने तीन प्रतिरोधी डेरिवेटिव्स *अर्थात* PB-1003, PB-1005 और PB-1007 की पहचान की और डाउनी मिल्ड्यू के साथ मिलकर लीफहॉपर्स के लिए दाताओं के रूप में उपयोग किया जा सकता है।
- जांचे गए 206 जीनोटाइप में *से कुल आठ लाईन* HA-124B, PB-898, PB-904, PB-205, PB-905, ID-32, PB-889 और RGP-278-2 पॉली हाउस स्थितियों के तहत अल्टरनेरिया स्टर लीफ ब्लाइट रोग के लिए सहिष्णु थे।
- जांचे गए 63 जीनोटाइप में से 17 वंशक्रमों (जिसमें आरजीपी और सीएमएस पंक्तियां शामिल हैं) में लीफहॉपर के प्रति प्रतिरोधी प्रतिक्रिया प्रदर्शित करने की सूचना मिली थी।

कुसुम

फसल सुधार

- गुणन, मूल्यांकन और प्रजनन में उपयोग के लिए विभिन्न एआईसीआरपी (कुसुम) केंद्रों को **कुल** 340 जननद्रव्य प्राप्तियों की आपूर्ति की गई।
- दो वर्षों में मूल्यांकन किए गए 164 प्रवेशों/चयनों में से 16 आशाजनक प्रवेशों/चयनों की जांच से अधिक बीज उपज के लिए पहचान की गई थी; 13 जल्दी फूल आने के लिए (69-75 दिन); और छोटे पौधे की ऊंचाई (36-55 सें.मी.) के लिए छह प्रविष्टियां।
- नारंगी-लाल कोरोला के साथ कुल 11 गैर-कांटेदार परिग्रहण (GMU-7924, GMU-7926, GMU-7929, GMU-7930-2, GMU-7932-4, GMU-7936-5, GMU-7940-3, GMU-7940-4, GMU-7963, GMU-7963-1, GMU-7973) प्रजनन में आगे उपयोग के लिए पहचाने गए।
- कैपिटुलम आकार की पुष्टि के लिए मूल्यांकित 20 प्राप्तियों में से आठ प्रविष्टियां [जीएमयू-3420 (एचयूएस-253); GMU-7994 (SSFB-2004); GMU-7991 (SSFB-2002); जीएमयू-686 (ईसी-137339); GMU-7995 (SSF-1507); जीएमयू-472-1; GMU-7990 (SSFB-2001; GMU-7993 (SSFB-2003))] >25 मिमी के कैपिटुलम व्यास और >20 बीज/ कैपिटुलम होने के साथ आशाजनक पाए गए।
- बीज और तेल उपज के लिए एनबीपीजीआर से प्राप्त कुल 200 ताजा जननद्रव्य प्राप्तियों का मूल्यांकन किया गया और 11 प्राप्तियों (ईसी-210467, ईसी-199879, ईसी-383086, ईसी-321219, ईसी-181615, ईसी-398084, ईसी-143832-3) EC-181614, EC-182227, EC-118229, EC-246570) ने चेकों की तुलना में बेहतर बीज उपज (15.9 से 24.8 ग्राम/पौधा) और तेल उपज (4.81 से 8.75 ग्राम/पौधा) दिखाई। आठ परिग्रहण जो कि EC-398223, EC-398229, EC-398218, EC-398259, EC-398123, EC-398270, EC-398226 और EC-398091 में 4 से 8 के बीच बीज उपज के साथ 40-43% तक उच्च तेल की मात्रा दर्ज की।
- एक परिग्रहण, ईसी 523368-2 (जीएमयू-7399) एफिड के प्रति सहिष्णु *(यूरोल्यूकॉन) कम्पोजिट* थोबाल्ड) को प्लांट जर्मप्लाज्म पंजीकरण समिति (PGRC), ICAR-NBPGR, नई दिल्ली द्वारा एक आनुवंशिक स्टॉक [INGR22052 (IC0643960)] के रूप में पंजीकृत किया गया था।
- S5-1C-RIPE जनसंख्या से उच्च बीज उपज और तेल की मात्रा देने वाले कुल 9 परिवारों को S_6 पीढ़ी के लिए उन्नत किया गया था। *कुल 19 S4-2C-RIPE चयनों में से 4 में* उच्च तेल की मात्रा (35.1-40.3%);

उच्च बीज उपज (16.7-28.3 ग्राम/पौधा) और 100 बीज वजन (3.0-4.2 ग्राम/पौधा)।

- F5 पीढ़ी में [सी. टिंक्टरियस (ए1) **x** (सी. टिंक्टरियस (नीरा) **x** सी. ऑक्सीकैंथा (आईपी-16)], तेल की मात्रा (29.2-36.0%), बीज उपज (23.2-57.1 ग्राम/पौधा) और 100 बीजों का वजन (4.3-5.2 ग्राम) के साथ आठ सर्वश्रेष्ठ लाइन चयन बनाया गया था।
- आणविक प्रजनन अनुसंधान को सक्षम करने के लिए कुसुम में आनुवंशिक/जीनोमिक संसाधन विकसित करने के लिए। आईसीएआर-एनबीपीजीआर (नई दिल्ली) ; वसंतराव नायक मराठवाड़ा कृषि विद्यापीठ (VNMKV) में एआईसीआरपी-सैफ्लॉवर केंद्र, महात्मा फुले कृषि विद्यापीठ (एमपीकेवी) परभणी (महाराष्ट्र) और, सोलापुर (महाराष्ट्र); दिल्ली विश्वविद्यालय (दिल्ली) और पंजाब कृषि विश्वविद्यालय (पीएयू), लुधियाना (पंजाब) के सहयोग से 'भारतीय मूल के लघु तिलहन' पर मिशन मोड कार्यक्रम के तहत 'जीनोमिक्स-असिस्टेड डिस्कवरी ऑफ क्यूटीएल/जीन से जुड़े एग्रोनोमिक लक्षणों के माध्यम से कुसुम के सुधार के लिए आनुवंशिक विविधता का दोहन' नामक एक नेटवर्क परियोजना लागू की गई है।
- कृषि-रुपात्मक लक्षणों से जुड़े क्यूटीएल की पहचान के लिए द्वि-माता-पिता / बहु-जनक क्रॉस से छह मैपिंग आबादी का प्रतिनिधित्व करने वाली कुल 1940 इनब्रेड लाइनें विकसित हुईं।
- CO-1 x EC-523368-2 क्रॉस की F8-RIL आबादी का उपयोग करते हुए। फ्लैंकिंग SSRs, SafM-290 और SafM-23 (~12.5cM) के साथ लिंकेज ग्रुप (LG)-3 पर प्रमुख QTL (QUc-Ct3.1) क्षेत्र को नए फ्लैंकिंग SSRs SafM-1160 और SafM-1137 के साथ ~2 cM अंतराल तक घटा दिया गया था, नए पाए गए SSR मार्कर SafM-1160 और SafM-1137 ने एफिड्स में एफिड इन्फेक्शन (R2 = 37-50%), क्लोरोफिल की मात्रा SPAD_1-4, R2 = 37-68%) के बाद मुरझाने के दिनों के आधार पर एफिड्स के प्रति सहिष्णुता के साथ मजबूत जुड़ाव दिखाया। एफ11 आरआईएल आबादी में एफिड तनाव के तहत एफ10-आरआईएल और बीसी1एफ3 आबादी और बायोमास (आर2 = 40%)।
- कुसुम जीनोटाइप CO-1 और EC-523368-2 के NGS डेटा का उपयोग करके डिज़ाइन किए गए 58 SNP मार्करों के एक सेट को 121 जर्मप्लाज्म के एक पैनल में मान्य किया गया था, जिसमें C. टिंक्टोरियस, *64 C. ऑक्सीकैंथस और 26 C. लैनाटस एक्सेस* शामिल थे। एसएनपी अत्यधिक बहुरूपी (90%) थे। अपेक्षित हेटेरोज़ायोसिटी (0.38), हेटेरोज़ायोसिटी (0.59) देखी गई , प्रभावी एलील की संख्या (1.67) और शैनन विविधता सूचकांक (0.82) पैरामीटर ने जर्मप्लाज्म पैनल में उच्च स्तर की विविधता का संकेत दिया। एसएनपी मार्करों ने जीनोटाइप के प्रजाति-वार विशिष्ट क्लस्टरिंग का उत्पादन किया।

फ़सल उत्पादन

- कुसुम की रिले बुवाई के लिए सोयाबीन की संशोधित संयंत्र ज्यामिति के तहत जेएस-93-05 (लघु अवधि), बसारा (मध्यम अवधि) और जेएस-335 (सामान्य अवधि) जैसे सोयाबीन की तीन किस्मों के प्रदर्शन का *मूल्यांकन* ब्रॉड-बेड पर किया गया था और वर्षा आधारित परिस्थितियों में खांचे। जेएस-335 की सामान्य अवधि की किस्म की बीज उपज काफी अधिक (1498 किग्रा/हेक्टेयर) थी और सोयाबीन की कम (जेएस-93-05) और मध्यम अवधि की (बसारा) किस्मों की बीज उपज बराबर थी। हालांकि, सोयाबीन की संशोधित पादप ज्यामिति बीज उपज (1252 से 1403 किग्रा/हेक्टेयर) के लिए महत्वपूर्ण रूप से भिन्न नहीं थी।

फसल सुरक्षा

- कुल 29 मल्टी-पैरेंट क्रॉस आधारित प्रजनन लाइनों को शून्य रोग घटना के साथ विलट के प्रतिरक्षित होने की सूचना दी गई थी।
- 2.4-3.0 के एआईआई के साथ अट्ठाईस परिग्रहण एफिड्स के प्रति मध्यम रूप से सहिष्णु थे।
- *ट्राइकोडर्मा* के साथ बीज लेपन के प्रभाव का अध्ययन करने के लिए बहुस्थानीय क्षेत्र परीक्षण किए गए *हार्ज़ियानम*, टीएच4डी @ 10 मिली/किग्रा बीज ने कम विल्ट और जड़ सड़न का पता लगाया और अनुपचारित नियंत्रण की तुलना में कुसुम में बेहतर बीज उपज दर्ज की।

तिल

फसल सुधार

- कुल 378 प्राप्तियों का मूल्यांकन किया गया और प्रमुख सस्यविज्ञानी लक्षणों के लिए उनका लक्षण वर्णन किया गया।
- यूएसडीए से प्राप्त एक सौ चालीस प्राप्तियों का विभिन्न लक्षणों के लिए ग्रीष्मकाल के दौरान मूल्यांकन किया गया। बीज की उपज/पौधा 0.6-27.9 ग्राम/पौधा (PI-200105, PI-200111), 75-120 दिनों से लेकर परिपक्वता तक (PI-320958 प्रारंभिक परिपक्व लाइन) और 8 परिवर्धन (PI-231033, PI-170737, PI-170767, PI-177541, PI-238459, PI-179986, PI-170748, PI-280808) में रोग के प्रति सहनशीलता का संकेत देते हुए खेत की परिस्थितियों में पाउडर फफूंदी के कोई लक्षण नहीं दिखाई दिए।
- एक तिल परिग्रहण, IC-235 की आंतरिक कोरोला ट्यूब में विशिष्ट गहरे बैंगनी घने गुच्छे की उपस्थिति के लिए पहचान की गई थी जो अन्य जर्मप्लाज्म संग्रह में अनुपस्थित था और विशिष्ट कोरोला गुच्छे के लिए 'IIOSG-CS-1' के रूप में नामित किया गया था। F_2 जनसंख्या (n=232) में, 3:1 (χ^2=1.37; P=0.24) के अनुपात में अलग-अलग गुण विशेषता के लिए मोनोजेनिक व्युत्पन्न का संकेत देते हैं।
- एक क्रॉस, IC-205776 x EC118591 से विशिष्ट बैंगनी लिप फ्लावर प्रकार के साथ मल्टीकैप्सूल वाला एक जीनोटाइप (IOSG-MCPL) विकसित किया गया था।
- इंटरस्पेसिफिक क्रॉस श्वेता तिल x एस. मुलायनुम (आईसी-43144-1) के अठहत्तर परिवारों को F6 पीढ़ी में बनाए रखा गया था।
- 100 लाइनों का एक सेट जो दो मल्टीपैरेंट क्रॉस से निकला है, जैसे MSES-434 ((PHULE TILXRT-351)/(GT-2XE-8)//(HT-1XVRI-3)/(TKG-22 X SWETHA TIL) और MSES-435 ((HT-1 X RT-351)/(GT-2 X TKG-22)//(HIMA X TSS-6)/(राजेश्वरी X E-8) का मूल्यांकन पछेती खरीफ

के दौरान उपज और उपज संबंधी गुणों के लिए किया गया था सीजन 79 लाइनों में तेल की मात्रा >50% दर्ज की गई, जिसमें से MSES-434-718 में खरीफ में सबसे अधिक तेल की मात्रा 58.8% थी और इस लाइन में गर्मी के मौसम में 53.8% तेल मात्रा दर्ज की गई।

- चार अलग-अलग क्रॉस का उपयोग करके विकसित 60 जीनोटाइप से उपज और उपज घटकों के लिए चौदह सर्वश्रेष्ठ जीनोटाइप का चयन किया गया।
- डीएनए स्तर की विविधता का विश्लेषण करने के लिए 120 तिल जीनोटाइप के बीच चार सौ बारह एसएसआर मार्कर लोकी का सर्वेक्षण किया गया और यह पाया गया कि 412 मार्कर लोकी में से 214 ने बहुरूपता दिखाया और 4% एग्रोज जेल वैद्युतकणसंचलन पर कम से कम दो जीनोटाइप में भेदभाव करने में सक्षम थे।
- rBiFC वेक्टर सेट (संख्या में प्रत्येक आठ) *SAP54* (निर्दिष्ट S54LP, SAP54 जैसे प्रोटीन, प्रभावक अणु) और दो जीन RNF5 (E3 ubiquitin- प्रोटीन लिगेज), और NPY4 (BTB/POZ डोमेन युक्त प्रोटीन) तिल से प्रोटीन परस्पर क्रिया एन्कोडिंग के साथ विकसित किए गए थे। चूँकि तिल में RNF5 (RNF5 और RNF*5) के दो आइसोफॉर्म खोजे गए थे, प्रत्येक आइसोफॉर्म के साथ rBiFC वैक्टर विकसित किए गए थे। इस प्रकार, कुल 24 क्लोन - 8 RNF5 के साथ, 8 RNF*5 के साथ, 8 NPY4 के साथ विकसित किए गए और उन्हें एग्रोबैक्टीरियम स्ट्रेन (GV1301) में ले जाया गया।
- *बेंटहैमियाना निकोटियाना में* Agroinfiltration अध्ययन ने विकसित निर्माणों के साथ दो संयोजनों (एनएन-आरएस और सीसी-एसआर, आठ में से) में आरएनएफ5 और एस54एलपी के बीच संपर्क स्थापित किया और इंटर एक्शन पर आरएनएफ5 में 3 अमीनो एसिड को हटाने का कोई प्रभाव नहीं पड़ा। NPY4 और S54LP से जुड़े rBiFC वैक्टर के साथ इसी तरह के अध्ययन से पता चला है कि दो प्रोटीनों ने *प्लांटा में परस्पर क्रिया* की और तीन (NN-NS, CC-SN और NC-SN) संयोजनों में इंटर एक्शन देखी गई।

फ़सल उत्पादन

- सोयाबीन-तिल फसल प्रणाली में, अरंडी की खली (658 किग्रा) या FYM (680 किग्रा), वर्मीकम्पोस्ट (637 किग्रा) और बकरी की खाद (400 किग्रा) (बराबर एन आधार पर) के संयुक्त अनुप्रयोग से अकार्बनिक स्रोतों के माध्यम से पोषक तत्व प्रबंधन तुलनीय तिल उपज का उत्पादन हुआ।
- तिल के बाद की धान की परती के लिए शून्य जुताई का अभ्यास अनुपयुक्त पाया गया और या तो पारंपरिक या कम जुताई में उच्च पैदावार दर्ज की गई और 125% आरडीएफ में ओडिशा (466 किग्रा/हेक्टेयर) और तेलंगाना राज्यों (421 किग्रा/हेक्टेयर) में तिल की उच्चतम उपज दर्ज की गई।
- दो जीनोटाइप *अर्थात* एसआई 1802 और एसआई 9823 ने उच्च बीज उपज के साथ नमी तनाव के तहत तनाव सहनशीलता के विभिन्न सूचकांकों के लिए उच्च मूल्य व्यक्त किए। इन पहचाने गए जीनोटाइप का उपयोग सूखा सहिष्णु किस्मों के विकास के लिए प्रजनन कार्यक्रमों में किया जा सकता है।
- एसपीएडी क्लोरोफिल मीटर रीडिंग (एससीएमआर) 10 दिनों के अंतराल पर दर्ज की गई, जिसमें तिल में अच्छी तरह से पानी (डब्ल्यूडब्ल्यू) और सूखा तनाव (डीएस) दोनों स्थितियों में बीज उपज के साथ सकारात्मक संबंध दिखाया गया। WS के तहत 52 DAS और WW परिस्थितियों में 59 से 73 DAS पर तिल के बीज की उपज पर SCMR का महत्वपूर्ण प्रभाव था।

फसल सुरक्षा

- सिक पॉट विधि के माध्यम से मैक्रोफोमिना रूट रॉट के लिए उन्नत प्रजनन जीनोटाइप की स्क्रीनिंग के परिणामस्वरूप तीन (आरआर-2102, आरआर-3003, एसईएस-एस-20-2001) प्रतिरोधी लाइनों और दो (आरआर-1038, आरआर-1039) मध्यम प्रतिरोधी की पहचान हुई लाइनें जिनकी पुष्टि मल्टीलोकेशन (वृद्धाचलम, जबलपुर, धारवाड़) मूल्यांकन के माध्यम से भी की गई थी।
- सिक प्लाट विधि में, जीनोटाइप, SEL-S-20-2001 में लगातार दो वर्षों तक <10% जड़ सड़न घटना दर्ज की गई।
- राजस्थान, मध्य प्रदेश, गुजरात, वाराणसी में तिल को संक्रमित करने वाले फाइटोप्लाज्मा स्ट्रेन के साथ-साथ क्लियोम, पार्थेनियम और *फिजेलिस मिनिमा जैसे खरपतवार*, फाइलोडी के लक्षण दिखाते हुए और तिल के खेतों में उगाए गए *कैंडिडेटस फाइटोप्लाज्मा ऑरेंटिफोलिया* के रूप में पहचाने गए।
- एक जीनोटाइप, IIOS-20-3013 ने फाइलोडी के प्रति अत्यधिक प्रतिरोधी प्रतिक्रिया दिखाई और SES-K-20-2016 लीफ वेबर के लिए अत्यधिक प्रतिरोधी है। SES-K-20-2010 और SES-K-20-2025 में क्रमशः सफ़ेद मक्खी और मिरिड बग का सबसे कम आपतन (प्रति पौधा) देखा गया। लगभग 29 तिल के जीनोटाइप को पित्त मक्खी के प्रतिरोधी के रूप में वर्गीकृत किया गया था।
- विभिन्न बढ़ते मौसमों में कीट कीटों के मौसमी प्रकोप पर किए गए अध्ययनों से उभरते कीटों की चरम घटना का पता चला अक्टूबर (9.9/पौधा) और दिसंबर (17.0/पौधा) महीनों के दौरान क्रमशः सफ़ेद मक्खी और मिरिड कीट।
- 100% RDF [नीम ऑयलकेक + रॉक फॉस्फेट] + PSB या 100% RDF [FYM + वर्मीकम्पोस्ट + बकरी खाद] + रॉक फॉस्फेट + PSB प्राप्त करने वाले उपचार और 5% नमी की मात्रा के साथ पॉलिथीन बैग में संग्रहीत कम जनसंख्या दर्ज की गई और भंडारण कीटों (चावल कीट, *कोरसिरा सेफेलोनिका* और लाल आटा बीटल, *ट्राइबोलियम कैस्टेनियम*) के कारण प्रतिशत हानि दर्ज की गई।
- स्वीट फ्लैग राइज़ोम एक्सट्रेक्ट, यूकेलिप्टस लीफ एक्सट्रेक्ट और नीम सीड कर्नेल एक्सट्रैक्ट (2%) से उपचारित बीजों को चावल के पतंगे के खिलाफ आशाजनक पाया गया और कम से कम बीज क्षति (2.5 से 3.5%) दर्ज की गई। स्वीट फ्लैग राइजोम एक्सट्रेक्ट, *विटेक्स से उपचारित बीज नेगुंडो* (निर्गुंडी) की पत्ती का सत्त और नीम के बीज की गुठली का सत्त (2%) रेड फ्लोर बीटल के विरुद्ध आशाजनक पाया गया और न्यूनतम बीज क्षति (2.0 से 3.5%) दर्ज की गई।

नाइजर

फसल सुधार

- भारत में पहली बार 5 स्थानों पर जो कि 2 अलग-अलग मौसमों का प्रतिनिधित्व करता है सभी 3524 प्राप्तियों का गुणन, लक्षण वर्णन और मूल्यांकन (*खरीफ और रबी*) पूरा किया गया है। डेटा ने प्रमुख कृषि संबंधी लक्षणों के लिए व्यापक भिन्नता का खुलासा किया।
- कुल 243 चयन जो तीसरे याद्दच्छिक संभोग चक्र (आरएमसी) से प्राप्त किए गए थे, जो उच्च बीज उपज, तेल की माला और प्रारंभिक पहुंच के लिए अभिजात्य परिग्रहण का उपयोग करके विकसित किए गए थे) को अगली Sहै4 पीढ़ी के लिए उन्नत किया गया था। अधिकतम बीज उपज 7.25 ग्राम/पी ल दर्ज की गई। RMC-S3-P338 में और उच्चतम तेल की माला RMC-S3-P370 में 46.89% दर्ज की है।
- तीसरे आरएमसी से विकसित चौथे आरएमसी से प्राप्त कुल 94 चयन चार जारी किस्मों के साथ किए गए और 480 कुलीन आबादी एस $_5$ पीढ़ी के लिए उन्नत थी। चयन RMC-S4-P455 ने उच्च बीज उपज (8.99 g/pl.) दर्ज की और RMC-S4-P505 ने उच्चतम तेल की माला (44.68%) दर्ज की।
- विभिन्न उपज संबंधी लक्षणों के लिए चुनी गई विविध एलीट वंशक्रमों का उपयोग करते हुए याद्दच्छिक संगम समष्टि का नया सेट विकसित किया गया।
- आनुवंशिक और जीनोमिक संसाधनों के विकास की दिशा में, एआईसीआरपी-नाइजर केंद्रों (3), आईसीएआर-एनबीपीजीआर, नई दिल्ली, आईजीकेवी-रायपुर, उस्मानिया विश्वविद्यालय को आईसीएआर-आईआईओआर के साथ एक प्रमुख केंद्र के रूप में शामिल करते हुए डीबीटी द्वारा समर्थित एक मिशन मोड परियोजना प्रगति पर है।

अलसी का बीज

फसल सुधार

- इस वर्ष कुल 213 कल्टीवेटेड टाइप ट्रेट स्पेसिफिक एक्सेसन और 6 वाइल्ड एक्सेसन (यूएसडीए , यूएसए से आयातित) को गुणा किया गया।
- 223 यूएसडीए लाइनों के बीच, एक परिग्रहण PI-522932 ने स्फुटन प्रदर्शित किया, वाणिज्यिक मूल्य का एक लक्षण अलसी वैश्विक जर्मप्लाज्म संग्रह में शायद ही कभी पाया जाता है।
- भारत में अधिसूचित 92 किस्मों के बीज NBPGR और AICRP-अलसी केंद्रों से एकल किए गए थे और *रबी* 2021 के दौरान गुणा किए गए थे। इन्हें अलसी विशिष्ट SSR प्राइमरों का उपयोग करके विविधता विश्लेषण के अधीन किया गया था।
- पहले विकसित एक जर्मप्लाज्म पैनल जिसमें 201 विविध लाइनें शामिल थीं, को भी गुणा किया गया और तेल की माला और फैटी एसिड संरचना के लिए विश्लेषण किया गया। एक उन्नत प्रजनन लाइन, एलएमएस 2015-31 में उच्च (45.6%) तेल की माला दर्ज की गयी और आठ जीनोटाइप *जैसे* बीएयू 2019-03 (59.2%), शुभ्रा, जवाहर अलसी-41 (58.9%); बिनवा (KL-210) और SLS 73 (58.3%); लक्ष्मी-27 (58.2%) और कनाडा के 'AC CARNDUFF' (58.2%) ने उच्च ALA की माला दर्ज की।
- जर्मप्लाज्म के 2,885 कार्य संग्रह में तेल की माला का अनुमान 10 परिग्रहणों (किरण, चितर, एनडीएल-8804, केएल-160, ईसी-322653, एसजेकेओ-65, केएल-224, केएल -234 , एसएलएस-73, ईसी-718851) और दो जारी किस्में, एलएसएल 93 (46.3%) और एसएलएस 73 (48.2%) में उच्च तेल की माला की पहचान की गई।
- अलसी की 10 लोकप्रिय किस्मों में कैडमियम अध्ययन से संकेत मिलता है कि बीआरएलएस-119 के बीज में सबसे कम सीडी सांद्रता (0.85 मिलीग्राम/किग्रा) थी। जबकि, आरएलसी 153 में निकल की माला कम (2.71 माइक्रोग्राम /किग्रा बीज) थी।
- कम एएलए खाद्य ग्रेड अलसी के तेल को विकसित करने के लिए एक कम एएलए किस्म टीएल-99 के साथ पीसीएल-55, शेखर, टी-397 किस्मों वाले तीन संकरणों को प्रभावित किया गया।
- *FAD3A* और *FAD3B* जीनों के साथ आण्विक विश्लेषण ने संकेत दिया कि चार (CN100572, CN100556, CN100571, CN100570) कनाडा की निम्न ALA लाइन /एक्सेसन दोनों जीनों के लिए एक उत्परिवर्ती युग्मविकल्पी प्रदर्शित करते हैं। शुभ्रा, लक्ष्मी-27, जवाहर अलसी-41, और एसएलएस-73 नामक चार उच्च एएलए लाइनों ने दोनों जीनों के जंगली एलील का प्रदर्शन किया और मैपिंग पॉपुलेसन में आगे की पुष्टि प्रगति पर है।

फसल सुरक्षा

- जांच की गई 77 अलसी जीनप्ररूपों में से तीन जीनप्ररूपों *अर्थात* NDL-2014-1, MS-3 और SLS-63 में लेपिडोप्टेरान और चूषक कीटों दोनों का कम संक्रमण दर्ज किया गया।

जैविक नियंत्रण

- दो समुद्री संबद्ध एंडोफाइटिक बैक्टीरिया, बैसिलस सियामेंसिस (Bs_Rg7) समुद्री खरपतवार ग्रेसिलेरिया एसपी बैसिलस वेलेज़ेंसिस (सीएचबी2) से पृथक और समुद्री स्पंज बिएमना फोर्टिस से अलग किया गया Fusarium एसपीपी और मैक्रोफोमिना एसपीपी। के खिलाफ इन विट्रो ब्रॉड स्पेक्ट्रम विरोधी गतिविधि में दिखाया गया है ।
- UPLC-MS/MS का उपयोग करते हुए माध्यमिक मेटाबोलाइट प्रोफाइलिंग ने क्रमशः 61 और 42 यौगिकों की पहचान की और वाष्पशील कार्बनिक यौगिकों (VOCs) की प्रोफाइलिंग हेडस्पेस-GCMS ने *बेसिलस सियामेंसिस* (Bs_Rg7) और *बेसिलस वेलेज़ेंसिस से* (सीएचबी2 से क्रमशः 20 और 19 यौगिकों की पहचान की।
- इन विट्रो में जांचे गए विभिन्न चिटिनोलिटिक बैक्टीरिया के बीच, स्ट्रेन IC-RB1 ने फुसैरियम ऑक्सीस्पोरम f एसपी *ricini* के खिलाफ मजबूत विरोध दर्ज किया।. उपभेदों IC-RB1 और IC-RB3 ने 50% से अधिक रेनिफॉर्म नेमाटोड किशोर मृत्यु दर का प्रदर्शन किया। तीन उपभेदों, आईसी-आरबी5, एचडी-आरबी20 और एचडी-आरबी 21 ने स्पोडोप्टेरा लिटुरा के खिलाफ 100% लार्वा मृत्यु दर प्रदर्शित की।
- तेलंगाना के विभिन्न स्थानों से एकल किए गए एंटोमोपैथोजेनिक कवक संक्रमित एस. लिटुरा और एस. फ्रुगिपेर्डा शवों की पहचान मेथेरिज़ियम (*नोमुरिया*) *रिलेयी के रूप में की गई थी ।* आणविक विधियों का उपयोग करना। एसएलआर-2 आइसोलेट ने एस. *लिटुरा के मुकाबले कम एलसी*$_{50}$ मान (1.5 x 10^4 - 1.5 x 10^7 कोनिडिया/मिली) दर्ज किए।

- कीटनाशकों और फफूंदनाशकों के साथ *एम. रिलेयी आइसोलेट्स* के अनुकूलता अध्ययन से पता चला है कि *एम. रिलेयी के लिए कवकनाशी* कीटनाशकों (2.5 से 77.4%) की तुलना में। *अत्यधिक निरोधात्मक* (8.2 से 100%) *थे* कार्बेन्डाजिम और प्रोपिकोनाज़ोल *एम. रिलेयी* के विकास के लिए अत्यधिक हानिकारक थे।
- मल्टीलेयर सीड कोटिंग (काईटोसन 5 मिली + कवकनाशी 7.5 मिली + टीएच4डी 0.1 ग्राम) + (काईटोसन 5 मिली + *ब्रैडिरिज़ोबियम* एसपी। 0.5 ग्राम) मूंगफली में उच्च अंकुरण (94.0%) दर्ज किया गया और इन *विवो* अंकुरण तौलिया परीक्षण में कम बीज सड़न और अंकुर मृत्यु दर दर्ज की गई।
- *ट्राइकोडर्मा हार्ज़िनियम* GFP निर्माण के साथ रूपांतरित पीसीआर विश्लेषण का उपयोग करके प्राप्त किया गया था और इसकी पुष्टि की गई थी और इस रूपांतरित तनाव उपनिवेशित जड़ों की क्षमता को कॉनफोकल माइक्रोस्कोपी के साथ स्थिर किया गया था। यह नस्ल मिट्टी/पौधों में लागू *ट्राइकोडर्मा* की पारिस्थितिक फिटनेस और उत्तरजीविता का आकलन करने के लिए उपयोगी होगी।
- 40 कोएसर्वेट संयोजनों *तैयार किए गए* और *बेसिलस थुरिंजिएन्सिस* और *बेवेरिया बेसियाना* माइक्रोकैप्सूल *विकसित करने के लिए और मूल्यांकन किए गए*, चार पॉलीमर कोकर्वेट्स (C-13, C-21, C-22, C-33) की उच्च उपज क्षमता और पानी में घुलनशीलता की पहचान की गई। Coacervate संयोजन *अर्थात*, C-21 + *B. थुरिंजिएन्सिस* और C-33+ *B. बासियाना को S. लिटुरा* और *A. जनता* के खिलाफ प्रभावी पाया गया। फंसाने की दक्षता 97 से 99% थी।

नैनोकेमिकल्स

- नैनोसिट्रेट्स को Fe और Zn पौधों के पोषण के लिए स्थिर चेलेटर्स के रूप में पहचाना गया जो कम पर्यावरणीय चिंताओं के साथ पौधों के उपयोग की दक्षता बढ़ा सकते हैं। Zn नैनोसाइट्रेट्स में उच्चतम Zn उपलब्धता 86.2 mg/kg मिट्टी थी और Fe नैनोसाइट्रेट्स के मामले में Fe उपलब्धता 264.7 mg/kg मिट्टी थी।
- लिग्निन निष्कर्षण को कृषि अपशिष्ट से मानकीकृत किया गया है और एफटीआईआर के माध्यम से इसकी पुष्टि की गई है।

मूल्य संवर्धन

- अलग-अलग अनुपात में मिश्रित और 12 महीनों तक संग्रहीत खाद्य तेलों में, तिल और चावल की भूसी के तेल के मिश्रण में भंडारण के दौरान कम मुक्त फैटी एसिड और पेरोक्साइड थे।

डीयूएस परीक्षण

- पौधों की किस्मों और किसान अधिकार प्राधिकरण (पीपीवी और एफआरए) के संरक्षण के लिए केंद्रीय क्षेत्र की योजना के तहत *रबी 2021-22* के दौरान सूरजमुखी और कुसुम के लिए *और खरीफ* 2022 में अरंडी और नाइजर के लिए डीयूएस परीक्षण गतिविधियां आयोजित की गईं।
- दो संदर्भ प्रविष्टियों के साथ *रबी* 2021-22 के दौरान दूसरे वर्ष के लिए एक नए उम्मीदवार के दो सेट के लिए डीयूएस परीक्षण किया गया था और डीयूएस के 34 लक्षणों के लिए डेटा दर्ज किया गया था और रिपोर्ट पीपीवी और एफआरए, नई दिल्ली को प्रस्तुत की गई थी।
- कुसुम में, *रबी* 2021-22 के दौरान दस संदर्भ प्रविष्टियों को बनाए रखा गया और गुणा किया गया।
- अरंडी डीयूएस परीक्षण में, दो केंद्रों के लिए तीन संदर्भ किस्मों के साथ-साथ एक किसान की किस्म का डेटा संकलित किया गया था और रिपोर्ट पीपीवी और एफआरए, नई दिल्ली को प्रस्तुत की गई थी । *खरीफ* 2022 के दौरान दो संदर्भ किस्मों का प्रारंभिक लक्षण वर्णन और आठ संदर्भ किस्मों का रखरखाव और गुणन किया गया।
- नाइजर में , नाइजर के लिए ' विशिष्टता, एकरूपता और स्थिरता का विकास (डीयूएस) परीक्षण दिशानिर्देशों पर परियोजना के तहत [*Guizotia abyssinica* (L.f.) Cass.]', विकासशील केंद्रों से 23 नाइगर किस्में और 109 जर्मप्लाज्म प्राप्त किए गए और 32 लक्षणों पर अवलोकन दर्ज किए गए। *खरीफ* 2022 के दौरान सिबिंग के माध्यम से जाल के तहत किस्मों (23) और जर्मप्लाज्म एक्सेसन (117) का गुणन भी किया गया था।

बीज उत्पादन

- 2022 के दौरान अरंडी, सूरजमुखी, तिल और कुसुम के कुल 864.19 क्विंटल ब्रीडर, फाउंडेशन, प्रमाणित और टीएल बीज का उत्पादन किया गया।

सामाजिक विज्ञान

- कुसुम ज्ञान प्रबंधन पोर्टल पांच प्रमुख विषयों के साथ डिजाइन और विकसित किया गया था, जैसे सामान्य डोमेन, खेती, अनुसंधान डोमेन, किसानों का डोमेन और विस्तार डोमेन संबंधित डोमेन के लिए मेनू और उप मेनू के साथ। अलग-अलग डोमेन से संबंधित जानकारी भर दी गई थी और पोर्टल पर अपलोड कर दी गई थी।
- *तिलहनटेक* : कैस्टर-जेनेटिक रिसोर्स इंफॉर्मेशन सिस्टम (*तिलहनटेक*: कैस्टर-जीआरआईएस) विकसित किया गया और इसे https://tilhantec.icar.gov.in/Castor-GRIS/index.php के माध्यम से एक्सेस किया गया। सूचना प्रणाली को उन विशेषताओं के साथ डिज़ाइन किया गया है जो उपयोगकर्ताओं को व्यक्तिगत और / या स्प्रेडशीट के रूप में आउटपुट के साथ अनुकूलित वर्णों के संयोजन के बारे में जानकारी तक पहुँचने में सक्षम बनाती हैं जिसे उपयोगकर्ता द्वारा डाउनलोड किया जा सकता है।
- IIOR अधिदेशित फसलों की किस्मों/संकरों के प्रभाव मूल्यांकन के भाग के रूप में भारत के विभिन्न कृषि पारिस्थितिक क्षेत्रों में, गुजरात राज्य में कैस्टर (जीसीएच-7) के लिए वर्तमान सहस्राब्दी के दौरान गणना किए गए हेरफिंडाहल-हिर्शमैन इंडेक्स (एचएचआई) ने टीई 2011-12 और टीई 2016-17 के तहत GHC-7 संकर क्षेत्र के विस्तार का संकेत देते हुए वृद्धि का खुलासा किया। टीई 2016-17 की तुलना में टीई 2021-22 के लिए एक गिरावट की प्रवृत्ति देखी गई थी, जो यह दर्शाता है कि शायद प्रतिस्पर्धी फसलों और संबंधित बाजार की ताकतों की उच्च लाभप्रदता के कारण अरंडी को अन्य प्रतिस्पर्धी फसलों द्वारा प्रतिस्थापित किया जा रहा है।
- गुजरात के मेहसाणा, पाटन और कच्छ जिलों में प्रतिस्पर्धी फसल प्रणालियों/अनुक्रम की तुलना में एक फसल प्रणाली/अनुक्रम दृष्टिकोण पर अरंडी संकर जीसीएच-7 के खेत स्तर के प्रदर्शन के अर्थशास्त्र से पता चला है कि मेहसाणा जिले में, प्रति हेक्टेयर रिटर्न अरंडी आधारित प्रणाली

बाजरा-गेहूं और बाजरा-सरसों की तुलना में अधिक थी; लेकिन अन्य उभरती प्रणालियों/अनुक्रमों /सौंफ - ग्रीष्मकालीन बाजरा; ग्वार फली - आलू - ग्रीष्म बाजरा और मूंग - आलू - ग्रीष्म बाजरा । के साथ प्रतिस्पर्धी नहीं है।

- पाटन जिले में, क्रमशः मूंग-सौंफ-ग्रीष्म बाजरा और उरद-जीरा-ग्रीष्म बाजरा प्रणाली ।को छोड़कर अधिकांश प्रतिस्पर्धी फसल प्रणालियों पर अरंडी आधारित प्रणाली लाभदायक थी।
- कच्छ जिले में, अधिकांश फसल प्रणाली ने बाजरा-गेहूं और बाजरा -सरसों प्रणाली को छोड़कर अरंडी आधारित प्रणाली पर उच्च लाभप्रदता प्रकट की; यह जिले में विभिन्न फसल प्रणालियों के प्रभुत्व को दर्शाता है।
- विभिन्न राज्यों में किए गए एफएलडी से सूरजमुखी में उपज अंतर के विश्लेषण से पता चला है कि राज्यों में, खरीफ सीजन के दौरान उपज अंतर I और II क्रमशः 49.9 और 90.2% थे, जबकि रबी सीजन में यह क्रमशः 20.7 और 122.4% था। खरीफ मौसम के दौरान उपज अंतर I और II प्रकाशम जिले में 24.8% से लेकर चामराजनगर जिले में 140.6% तक था, जबकि रबी के तहत सीज़न में, यह लुधियाना जिले में न्यूनतम 0.8% से लेकर रायचूर जिले में 208.4% तक उच्च था।
- कर्नाटक, आंध्र प्रदेश, तेलंगाना और छत्तीसगढ़ राज्यों में सार्वजनिक और निजी दोनों विस्तार प्रणालियों के तहत कवर किए गए किसानों के लिए विकसित और प्रशासित ज्ञान परीक्षण से पता चला है कि, सार्वजनिक विस्तार के तहत किसानों को सूर्यमुखी उत्पादन तकनीक के बारे निजी विस्तार प्रणाली में किसानों की तुलना में अधिक ज्ञान था।
- दो समूहों के बीच ज्ञान के स्तर में महत्वपूर्ण अंतर प्रथाओं के अधिकांश पैकेज में देखा गया और ऐसा अंतर मुख्य रूप से फसल से संबंधित विस्तार सेवाओं में निजी क्षेत्र की कम भागीदारी के कारण है।
- धान की कटाई के बाद शून्य जुताई की स्थिति में किए गए सूरजमुखी के प्रदर्शनों से पता चला कि हालांकि सूरजमुखी की बीज उपज में 7.7% की कमी आई है, लेकिन खेती की लागत में 2300 रुपये / हेक्टेयर की कमी आई है, जिसके परिणामस्वरूप किसानों के अभ्यास तहत बीसी अनुपात 4.57 के मुकाबले 5.62 अधिक हो गया है।
- 60 सेमी x 30 सेमी की इष्टतम दूरी पर सूरजमुखी में प्रदर्शनों के परिणामस्वरूप बीज उपज में 4.5% का सुधार हुआ और 7200 रुपये/ हेक्टेयर का अतिरिक्त शुद्ध लाभ हुआ।

कृषक उत्पादक संगठनों (एफपीओ) का गठन और संवर्धन ।

- चिन्नाकोदुर और नारायणरावपेट के लिए एफपीओ के गठन और प्रचार के लिए प्रमुख फसलों और उगाई जाने वाली किस्मों की संसाधन सूची, इनपुट उपयोग, आउटपुट मार्केटिंग, फसल विविधीकरण की क्षमता और मूल्य वर्धन विकल्पों के आधार पर व्यावसायिक योजनाएँ (बीपी) विकसित की गईं । बीपी में इनपुट एकत्रीकरण, फसल विविधीकरण और मधुमक्खी पालन, बीज उत्पादन, क्षमता निर्माण और आउटपुट मार्केटिंग शामिल हैं।
- सार्वजनिक क्षेत्र की इकाइयों और निजी कंपनियों से सीधे खरीदे गए सूरजमुखी के संकरों में बीजों के माध्यम से इनपुट एग्रीगेशन से एफपीओ को 788820 रुपये का लाभ हुआ।
- लगभग 1225 हेक्टेयर क्षेत्र में सूरजमुखी में फसल विविधीकरण और मधुमक्खी पालन ने मधुमक्खी पालन से शहद उत्पादन में लगे तीन उद्यमियों को आजीविका प्रदान करने के अलावा सूरजमुखी की उपज में 15-20% की वृद्धि की है। इनपुट एग्रीगेशन और आउटपुट मार्केटिंग के जरिए एफपीओ 10.8232 लाख रुपये का मुनाफा कमा सकते हैं।
- मूंगफली का बीज उत्पादन (गिरनार-5 एवं कादिरी लेपाक्षी) और बीज की बिक्री से लगभग एफपीओ को 2.93 लाख रु. का शुद्ध लाभ हुआ।

किसान पहले कार्यक्रम

- अकार्बनिक उर्वरकों की लागत को कम करने और मृदा जनित रोगजनकों के मुद्दे को हल करने के बहुउद्देश्यीय उद्देश्य के साथ, पीएसबी, ट्राइकोडर्मा और राइजोबियम के साथ मूंगफली के लिए एनवी 92 विशिष्ट तनाव के साथ बीज उपचार, खरीफ और रबी मौसम के तहत दोनों मूंगफली और दालों में लिया गया।
- रेडग्राम में, मिट्टी और नमी संरक्षण प्रौद्योगिकियों (समोच्च खेती/मेड़ और खांचे विधि) के कारण उत्पादकता में 12 प्रतिशत की वृद्धि हुई जिसके परिणामस्वरूप रु. 10240/हे एएनआर मिला।
- मूंगफली में एकीकृत पोषक तत्व प्रबंधन (*रबी* 2021-22) के परिणामस्वरूप पारंपरिक अभ्यास और रुपये के एएनआर के साथ 11.42 क्विंटल / हेक्टेयर की तुलना में 14.00 क्विंटल / हेक्टेयर की औसत उत्पादकता हुई। 19221/हे.एएनआर मिला।
- *खरीफ* में मूंगफली की मिनीकिट से आगामी *रबी* के दौरान साथी किसानों द्वारा बुवाई के लिए बीज की उपलब्धता में मदद मिली बुवाई। इस पहल ने नवीनतम कल्टीवेटर (TCGS-1694) के तहत बड़े प्रसार को उत्प्रेरित किया और बीज ग्राम अवधारणा को जन्म दिया।
- *जायद 2021-22* के दौरान ज्वार की खेती को विविधीकरण की ओर ले जाया गया, जिससे औसत उत्पादकता 14.08 क्विंटल/हे. रही, जिससे 23570/हे. का सकल लाभ हुआ।
- प्रौद्योगिकी संयोजन मसूर, मूंग, अरंडी, मूंगफली और ज्वार से उपज में क्रमशः 8,3,5,14 और 9% की वृद्धि हुई।
- किसानों की आय को दोगुना करने के उद्देश्य से , लाल चना और मूंगफली के विपणन और मूल्यवर्धन पर प्रायोगिक अध्ययन से क्रमशः रु.3720/ क्विंटल और रु.3150/क्विंटल एएनआर सक्षम हुआ।
- नाबार्ड, जनजातीय विकास निगम, गैर सरकारी संगठनों, आईआईएमआर, पीजेटीएसएयू और मूल्य वर्धित खिलाड़ियों के साथ एक्सपोजर विजिट, क्षमता निर्माण और तकनीकी सलाह के लिए अभिसरण और जुड़ाव स्थापित किया।
- क्षमता निर्माण/जागरूकता/अनुकूलित कार्यक्रम जैविक आदानों के महत्व/जैव इनोकुलेंट्स के उपयोग, मूल्यवर्धन, कार्यक्षेत्रों के महत्व, व्यवसाय विकास योजनाओं, आउटपुट एकत्रीकरण और आउटपुट मार्केटिंग पर आयोजित किए गए।
- महिला सशक्तिकरण की दिशा में, दालों और तिलहनों के मूल्यवर्धन के लिए कार्यक्षेत्रों पर जागरूकता पैदा करने के लिए अनुकूलित कार्यक्रम प्रदान किए गए।

ICAR-IIOR

Annual Report
2022

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 at 32 research centres. Later during 1972, safflower, sunflower and niger were brought under the umbrella of AICORPO and the number of research centres were increased to 40. Realizing the need for a national institute for oilseeds, the AICORPO was elevated to the status of Directorate of Oilseeds Research (DOR) 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 2000, the AICRP on Sesame and Niger, and Linseed were separated from the administrative control of DOR. The DOR was 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 (AICRP) on Oilseeds at 29 locations across 14 states. The DOR was upgraded to ICAR-Indian Institute of Oilseeds Research (ICAR-IIOR) w.e.f. February 3, 2015 as per the approval of XII Plan EFC. During 2020, the Project Coordination (PC) Unit of AICRP on Linseed was shifted to ICAR-IIOR from ICAR-IIPR, Kanpur as per recommendations of ICAR, New Delhi. Currently, ICAR-IIOR coordinates the AICRP on Oilseeds (Castor, Sunflower, Safflower and Linseed) operating at 40 locations across 21 states. The ICAR-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 castor, sunflower, safflower, sesame, niger and linseed 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 castor, sunflower, safflower, sesame, niger and linseed.

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, 2022

Category	Sanctioned	Filled	Vacant
Scientific	43*	40	3
Technical	43	25	18
Administrative	30	18	12
Skilled supporting	77	74	3
Total	**193**	**157**	**36**

*Including one RMP post

Financial Statement

Allocation and Expenditure (2022-23)

(Rs. in lakhs)

Head of Account	Allocation					Expenditure			
	ICAR-IIOR Unified Budget	SCSP	NEH	TSP	TOTAL	ICAR-IIOR Unified Budget	SCSP	TSP	TOTAL
A. Grant-in-aid (Capital)									
Works	20.00				20.00	20.00			**20.00**
Equipment	32.00	50.00			82.00	32.80	24.28		**57.08**
Information & technology	10.00				10.00	3.11			**3.11**
Library	8.00				8.00				**0.00**
Vehicle & vessels	20.00				20.00				**0.00**
Furniture	10.00				10.00	1.54			**1.54**
B. Grant-in-aid (Salaries)									
Establishment Charges	2400.00				2400.00	2184.24			**2184.24**
Pension	300.00				300.00	203.72			**203.72**
C. Grant-in-aid (General)									
TA	20.00				20.00	16.24			**16.24**
Research & Operational Expenses	292.00	60.00	25.00	40.00	417.00	210.16	50.07	32.73	**292.96**
Administrative Expenses	278.00				278.00	225.02			**225.02**
Miscellaneous Expenses	10.00				10.00	7.00			**7.00**
TOTAL	**3400.00**	**110.00**	**25.00**	**40.00**	**3575.00**	**2903.83**	**74.35**	**32.73**	**3010.91**

AICRP on Oilseeds and AICRP on Sesame & Niger

(Rs. in lakhs)

Head of Account	AICRP on Oilseeds		AICRP on Sesame & Niger	
	Allocation	Expenditure	Allocation	Expenditure
A. Grant-in-aid (Capital)				
Equipment	4	2.6		
B. Grant-in-aid (Salaries)				
Establishment Charges	1551	1410	454.29	400.93
C. Grant-in-aid (General)				
Research & Operational Expenses	245.4	172.98	68.75	51.18
TOTAL	**1800.4**	**1585.58**	**523.04**	**452.11**

Resource Generation

Particulars	Amount (Rs.)
Sale of farm produce	87625
Licence fee (hostel room rent + quarters licence fee)	524650
Interest earned on loans & advances	79538
Receipts from schemes	5000
Analytical and testing fee	150100
Interest earned on short term deposits	66002
Training	100000
Sale of technology	520160
Other	237609
Recoveries of Loans & Advances	19000
Miscellaneous Receipts	4410832
TOTAL	**6200516**

Funds Received for Externally Sponsored Projects

Name of the Scheme	Receipt/Opening Balance (Rs.)	Expenditure (Rs.)
Externally sponsored projects	**120689396**	**60800117**

ICAR-IIOR

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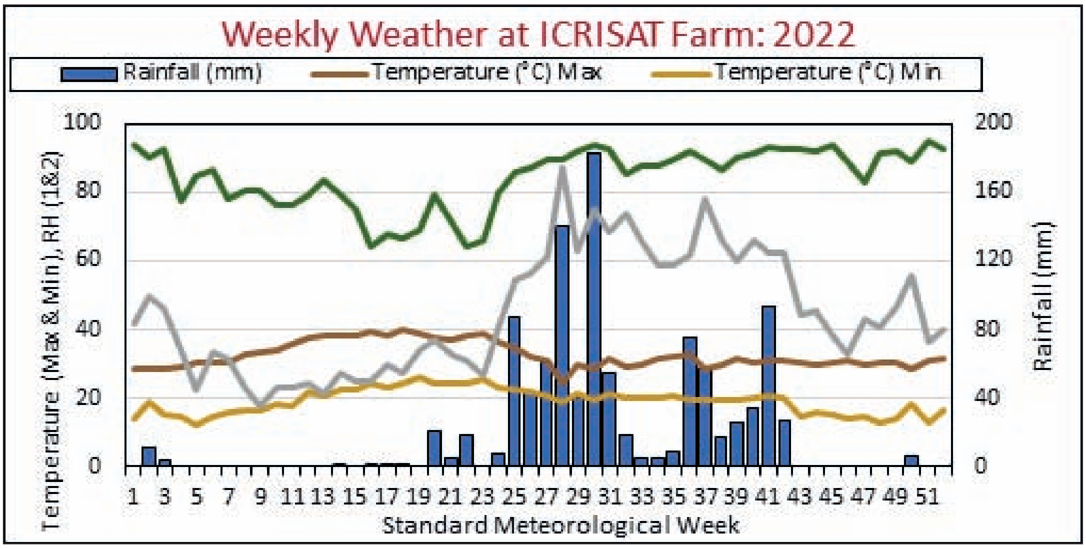
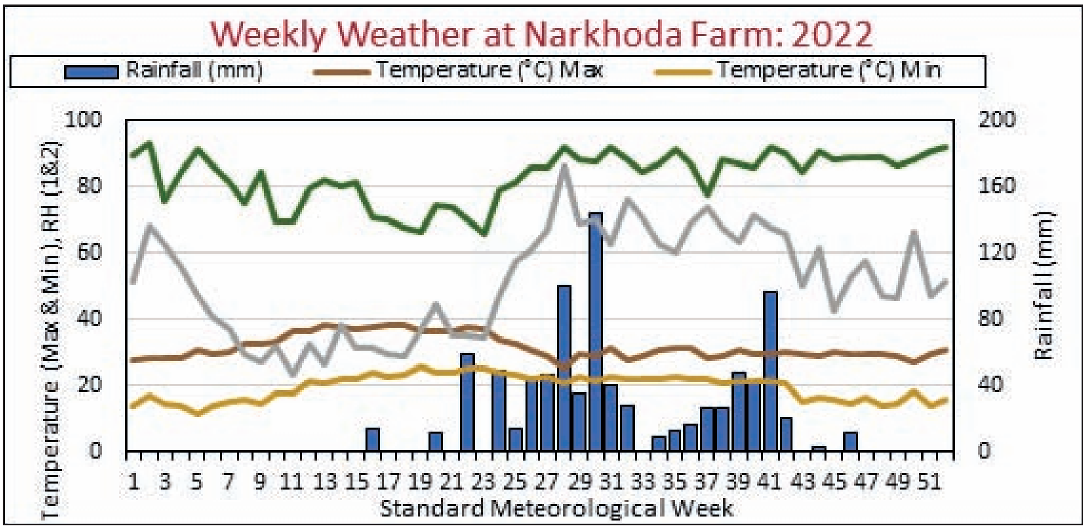
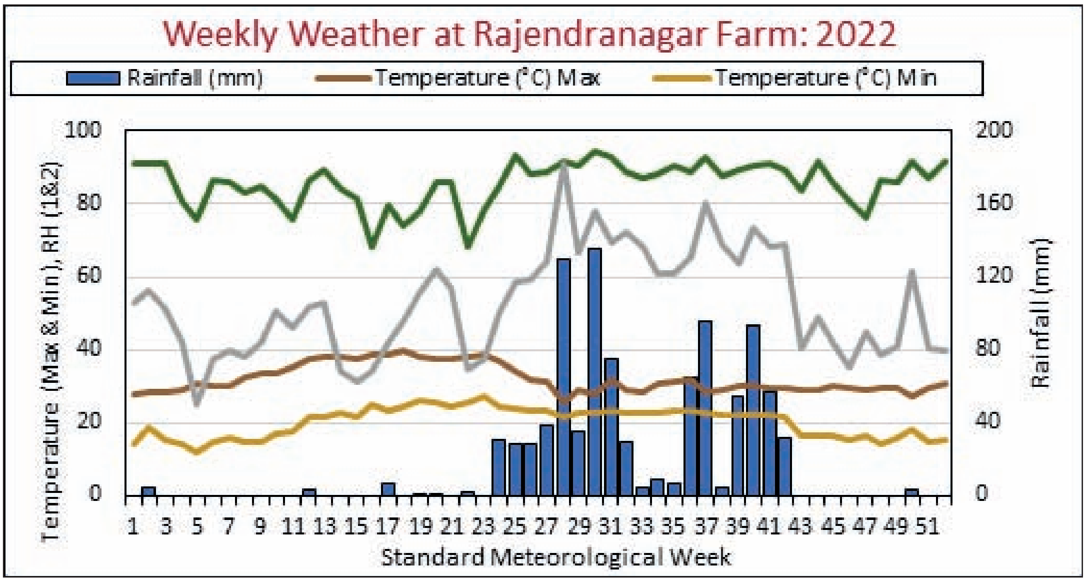
Research Achievements

- Castor
- Sunflower
- Safflower
- Sesame
- Niger
- Linseed
- Biological Control
- Nanosystems
- Value Addition
- DUS Testing and Seed Production
- Social Sciences
- AICRP on Oilseeds


Weekly Weather at ICRISAT Farm: 2022
Rainfall (mm)
Temperature (°C) Max
Temperature (°C) Min
Temperature (Max & Min), RH (1&2)
Rainfall (mm)
Standard Meteorological Week
0
20
40
60
80
100
0
40
80
120
160
200
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51


Weekly Weather at Narkhoda Farm: 2022
Rainfall (mm)
Temperature (°C) Max
Temperature (°C) Min
Temperature (Max & Min), RH (1&2)
Rainfall (mm)
Standard Meteorological Week
0
20
40
60
80
100
0
40
80
120
160
200
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51


Weekly Weather at Rajendranagar Farm: 2022
Rainfall (mm)
Temperature (°C) Max
Temperature (°C) Min
Temperature (Max & Min), RH (1&2)
Rainfall (mm)
Standard Meteorological Week
0
20
40
60
80
100
0
40
80
120
160
200
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51

Castor

Crop Improvement

Germplasm Maintenance, Evaluation and Enhancement

A total of 260 accessions were conserved in the medium-term storage (MTS) of ICAR-IIOR, Hyderabad. A total of 860 accessions were rejuvenated and 200 accessions were multiplied. Supplied 146 accessions to different AICRP centers (S.K. Nagar, Palem, Yethapur and Junagadh) for screening and confirmation of castor germplasm lines against root rot and insect pests (leafhopper, whitefly and thrips).

Characterization and evaluation of castor accessions from USDA

Characterized 82 accessions for 23 morphological traits and 17 quantitative traits. Days to 50% flowering was found in the range of 35-85 days; days to maturity, 105-114; 100-seed weight, 16-32.1 g; oil content, 32.2-53%; and seed yield/plot, 76-624 g. None of the genotypes were found superior to checks in terms of seed yield.

Variability for quantitative traits in USDA germplasm

Character	Mean	Range	Range in checks
Plant height (cm)	100.4	25-202	57.0 (DCS-9) - 70.2 (GC-3)
No. of nodes	13.7	6.6-23.0	14.6 (DCS-9) - 15.0 (GC-3)
Total length of primary spike (cm)	35.6	14-62.5	46 (GC-3) - 51 (DCS-9)
Primary spike width (cm)	7.4	6.6-8.4	6.9 (GC-3) - 8.2 (DCS-9)
Days to 50% flowering	65.2	35-85	51 (DCS-9) - 53 (GC-3)
Days to maturity	110.0	105-114	100 (DCS-9) - 112 (GC-3)
No. of secondary spikes/plant	4.0	3-5	3.2 (DCS-9) - 3.7 (GC-3)
No. of tertiary spikes/plant	4.6	2.5-8.0	4.0 (DCS-9) - 5.5 (GC-3)
Total spikes/plant	3.8	7.5-16.0	10 (DCS-9) - 12 (GC-3)
100-seed weight (g)	26.4	16-32.1	26.2 (GC-3) - 26.6 (DCS-9)
Oil content (%)	43.4	32.2-53.0	49 (GC-3) - 50 (DCS-9)
Seed yield/plot (g/plant) (5.4 sq.m.)	243	76-624	850 (DCS-9) - 1023 (GC-3)

Generation of new experimental hybrids

During *rabi* 2021-22, 118 new crosses were generated using 15 pistillate lines and 23 monoecious lines as listed below:

Female lines	Male lines
DPC-25, IPC-41, IPC-44, JP-96	GMM-43, K18-1-2, K18-10-1, K18-33-2, K18-37-2, K18-40-1, K18-102-2, K18-120, P3-5, P3-89
DPC-9, DPC-22, DPC-25, IPC-30, IPC-31, IPC-41, IPC-42, IPC-43, IPC-44, IPC-46, IPC-47	ICS-153, ICS-154, ICS-160, ICS-72, ICS-186, ICS-190, ICS-192, ICS-200, ICS-212, ICS-216, ICS-426, ICS-427, ICS-428

Development of gene pools

Random mating for diversification of pistillate lines

Pistillate line, IPC-47 was crossed with pollen mixed from 3 female parents *viz.*, DPC-9, SKP-84 and JP-86 and was subjected to random mating. Selection and generation advancement was carried out in S2:200 families, S3:180 families derived from this cross during *rabi* 2021-22.

Development of MAGIC population

F_1s of eight parent crosses developed earlier by crossing eight diverse pistillate parents [(DPC-16 x M-571)] x (RG-1854 x DPC-25)] and [(DPC-23 x DPC-21) x (DPC-9 x DPC-14)] were advanced to F_2 generation.

Advancement of segregating generations from bi-parental crosses

90 F_4 families (DPC-9 x DPC-14) and 25 F_5 families (DPC-23 x DPC-21) derived from bi-parental lines were evaluated for pistillateness and advanced to F_5 and F_6 generations, respectively.

Non-spiny monoecious gene pool

Fourteen non-spiny monoecious lines having desirable agro-mophological features and best combining ability were intercrossed in two sets and each set was subjected to second cycle of random mating in isolation for diversification at ICAR-IIOR and eight AICRP centres (300 plants at each centre). The genotype, JI-315 (R3NSp) was crossed with mixed pollen of 48-1 (R2NSp), DCS-89 (R2NSp), CI-2 (G0NSp), ICS-164 (R2NSp) and DCS-123 (G3NSp). Similarly, DCS-106 (G3NSp) was crossed with mixed pollen of CI-2 (G0NSp), RG-566, 48-1 (R2NSp), DCS-89 (R2NSp), ICS-164 (R2NSp), DCS-123 (G3NSp) and DPC-18 (R2NSp) for diversification of non-spiny monoecious gene pool.

Recombination breeding

Introgression of dominant genes for wilt resistance and diversification of monoecious lines

Segregating generations of crosses between three wilt resistant germplasm lines (RG-1354, RG-2874 and RG-2944) and nine monoecious lines (ICS-169, ICS-171, ICS-177, ICS-180, ICS-182, ICS-186, ICS-200, ICS-210 and ICS-216) with best combining ability having desirable agronomical traits were evaluated for various agro-mophological features. Both wilt resistance and desirable agronomic characters like early (<45 days) to medium (46-55 days) duration for flowering, long primary spike length and high branching with short canopy were considered for selection of the progenies. From among the segregating progenies, 34 selections were advanced to F_3 generation from 27 F_2 families (500 plants each) and 58 selections were advanced to BC_1F_2 generation from 27 BC_1F_1 (500 plants each) progenies.

Bi-parental populations of a cross between a germplasm line from Farmers' collection, 'FC-167' was used for diversification and three monoecious lines *viz.*, ICS-161, ICS-164 and ICS-186 were raised and 14 selections were made and advanced to F_5 generation from 40 F_4 progenies. Seven superior and diverse selections were also advanced to F_6 generation from 102 F_5 progenies derived from 18 bi-parental crosses involving 13 superior lines (JI-397, JI-244, ICS-341, ICS-343, ICS-345, ICS-323, ICS-324, ICS-325, 48-1, RG-588-1, RG-1963, JP-77 and FC-208).

Mutagenesis

Chemical mutagenesis

Chemical mutagenesis using EMS was optimized in DPC-15 for determining the effective duration of pre-soaking (12 and 24 hours), desired concentration (0.5, 1.0 and 1.5%) and duration (4, 8, 12 hours) with nine treatments replicated thrice with three respective controls *viz.*, without presoaking and EMS treatment (C1), without presoaking (C2) and without EMS treatment (C3). Data on germination (%) of the seeds along with root and shoot length at 7 days and 14 days after treatment indicated that 12 hours presoaking followed by either 8 hours or 12 hours of treatment with 1.0% EMS was the optimum lethal dose for EMS mutagenesis.

Physical mutagenesis

A total of 650 single plants were selected from M_1 generation of JM-6, and plants with 3 to 63 nodes up to primary spike were selfed. Two sets of M_2 population were raised during *kharif* 2022 using single seed descent method and plants with monospike were selfed for further advancement.

Preliminary evaluation

Inbred lines (monoecious lines)

A set of 25 new inbred lines isolated from advanced generation breeding populations were evaluated under rainfed conditions in three replications with checks (DCS-9, 48-1 and DCS-107) during *kharif* 2021-22. The seed yield and other agronomic traits were measured on five random plants for each inbred. Two inbred lines *viz.*, K18-39-1 and K18-48A were dwarf and early in flowering (47-49 days) with significantly higher seed yield than the early flowering check, DCS-9. Three inbred lines *viz.*, K18-1-1, K18-19 and K18-48A recorded high 100-seed weight (38.8 to 41.6 g). Two inbred lines, K18-19 and K18-59 recorded high oil content (~52%). The same set of inbred lines was also evaluated for wilt resistance in the wilt sick plot during *kharif* 2021-22. Fourteen inbreds (K18-1-1, K18-19, K18-24, K18-31-2, K18-35-1, K18-45-1, K18-46A-1, K18-50, K18-53-1, K18-59, K18-98, K18-102-2, K18-107 and K18-127-1) exhibited resistance reaction with less than 20% wilt incidence.

Promising new inbred lines in the Preliminary Evaluation Trial (*kharif* 2021)

Genotype	Days to 50% flowering	Test weight (g)	Oil content (%)	Seed yield (g/pl.)
K18-13	60.0	33.1	49.9	160.9
K18-1-1	60.0	41.6	48.3	145.0
K18-19	59.0	39.9	51.8	144.0
K18-39-1	47.0	28.1	49.2	142.6

Genotype	Days to 50% flowering	Test weight (g)	Oil content (%)	Seed yield (g/pl.)
DCS-9 (C)	54.0	24.8	45.7	61.9
48-1(C)	63.0	28.5	50.9	163.4
DCS-107(C)	63.0	33.8	49.1	130.0
Mean	55.7	30.1	49.0	98.4
SE±	1.7	1.8	1.0	14.4
CD (P=0.05)	6.7	6.9	4.0	56.5
CV (%)	3.8	7.2	2.6	18.0

Hybrids

A set of 60 experimental hybrids developed during *rabi* 2020 were evaluated during *kharif* 2021-22 under rainfed conditions with ICH-66 and GCH-8 as checks. Out of 60 hybrids evaluated, 19 hybrids recorded higher seed yield (30.4 to 57.1%) than the best check. Three hybrids (ICH-1418, ICH-1425 and ICH-1427) exhibited >50% seed yield superiority with an oil content of >49%.

Promising hybrids in the Preliminary Evaluation Trial (*kharif* 2021)

Hybrid identity	Days to 50% flowering	Test weight (g)	Oil content (%)	Seed yield (g/pl.)
ICH-1418	40.0	35.1	52.8	147.8
ICH-1425	52.3	28.0	49.8	143.7
ICH-1427	56.0	29.6	49.3	142.2
ICH-1431	55.0	29.9	49.8	139.1
ICH-1429	55.7	27.3	48.3	137.4
ICH-66(C)	58.7	31.3	50.9	94.1
GCH-8(C)	59.0	28.4	49.7	88.5
Mean	51.3	28.0	49.3	106.3
SE±	1.82	1.28	1.17	11.98
CD (P=0.05)	3.60	2.53	2.32	23.71
CV (%)	4.35	5.58	2.91	13.80

Six F_1s developed using JM-6 as a donor (a monospike plant type with wilt resistance, early maturity and dwarf male line) were evaluated for different agro-morphological characters during *rabi* 2021-22. Among the F_1s, ICH-1433 (DPC-15 x JM-6) and ICH-1434 (DPC-15 x Ytp-1) were the shortest (36 and 43 cm, respectively) with less than 10 nodes to primary spike, high seed yield (495 g and 227 g/plot, respectively) and high oil content (54% and 51%, respectively). In the single plant selections (63) of JM-6 x JI-273 raised during *kharif* 2022, node number varied from 9 to 24 while red and green stemmed plants were of almost equal frequency (~50%) in F_3 population and the primary spike length was >60 to 110 cm in most of the plants.

Assessing the combining ability of new castor inbred lines

A total of nine new inbred lines (ICS-324, ICS-341, ICS-348, ICS-350, K18-101, K18-119, K18-129, K18-93 and RG-2195) were tested for their combining ability using five pistillate lines (IPC-41, IPC-42, IPC-43, IPC-44 and JP-96). The parents and hybrids were evaluated in a field trial in RBD with three replications during *kharif* 2021. The GCA effects of lines and testers for different agronomic traits were determined and among the evaluated testers, ICS-341 was found to be a good combiner for 100-seed weight, oil content and seed yield.

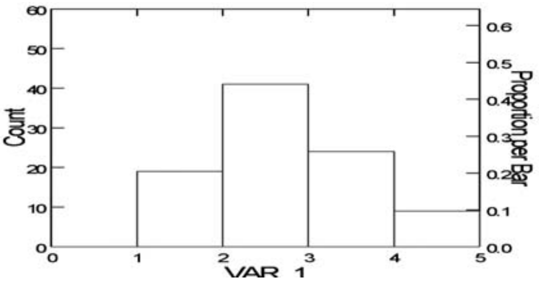
Multiplication and maintenance of male lines and pistillate lines

Three hundred improved monoecious lines (IC lines) developed at ICAR-IIOR during the last five decades have been multiplied (100-200 seeds each) by selfing and sib-mating the true to type plants and conserved in medium term cold storage and maintained as working collection. Twenty four pistillate lines *viz.*, DPC-9, DPC-15, DPC-17, DPC-18, DPC-21, DPC-22, DPC-24, DPC-25, DPC-26, DPC-27, DPC-28, DPC-29, IPC-30, IPC-31, IPC-39, IPC-40, IPC-41, IPC-42, IPC-43, IPC-44, IPC-46, IPC-47, M-619 and JP-96 were multiplied during *rabi* 2021-22 and conserved in medium term cold storage and maintained.

Validation of QTL linked to gray mold resistance in 48-1

A major QTL for gray mold resistance on chromosome-10 identified using the RIL population of JC-12×48-1 was validated using an independent F_2 population generated by crossing a susceptible line, RG-1673 with a resistant parent, 48-1. A total of 120 F_2 plants of RG-1673 × 48-1 were raised in the field during *kharif* 2021-22. The F_2 plants were evaluated for resistance to gray mold using 'Detached capsule technique' and scored on a 1–4 scale (1– resistant and 4– susceptible). All the F_2 individuals were genotyped using the linked SNP marker Rc_29941-41303. Out of 19 plants showing resistance reaction (scale-1), 16 F_2 plants carried 48-1 allele at the SNP loci. Out of 33 plants showing susceptible reaction (scale-3 or 4), 31 F_2 plants carried RG-1673 allele or heterozygous. Thus, the results indicated a reasonable level of co-segregation of phenotype with the genotype at the marker locus.

Detached capsule technique

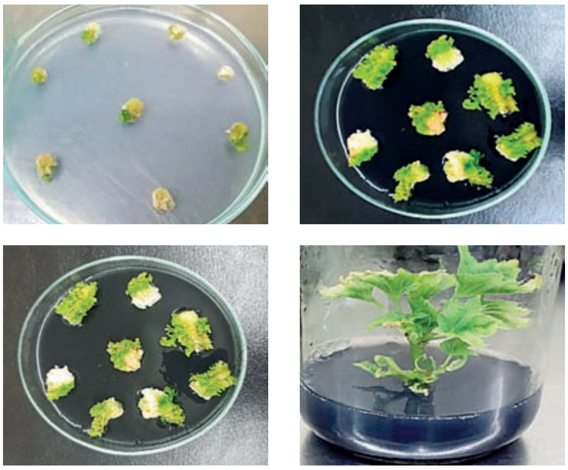


Frequency distribution of F_2 population for gray mold resistance

Efficient and highly reproducible tissue culture protocol for castor

An *in vitro* regeneration protocol, which is reliable and repeatable was developed for castor. Nine different media combinations were tried to further improve multiple shoot induction and increase the efficiency and percentage of shoot elongation. Direct regeneration of the shoots was observed with optimum results on MS media supplemented with RM30-1 (4.5 mg/l of BAP + 0.5 g/l 2-(N-morpholino) ethane sulfonic acid (MES) and 0.5 mg/l $AgNO_3$); RM6 (1 mg/l 2-iP + 1 mg/l BAP+ 0.5 mg/l TDZ + 0.5 mg/l IBA); RM28 (1.2 mg/l TDZ); RM23 (6 mg/l BAP + 1 mg/l IBA); RIM4 (4.5 mg/l BAP + 0.2 mg/l + 0.5 g/l MES + 10 g/l glucose + 20 g/l sucrose); RIM6 (4.5 mg/l BAP + 0.2 mg/l + 0.5 g/l MES + 30 g/l sucrose); RIM7 media (3 mg/l 2-ip + 80 mg/l adenine sulphate + 0.1 mg/l IAA + 0.5 g/l MES); RIM9 (3 mg/l 2iP + 1 g/l activated charcoal + 0.5 g/l MES); RIM10 (1 mg/l BAP + 50 mg/l citric acid + 0.5 g/l MES) after 30 days of inoculation. The multiple shoot induction was vigorous and shoot induction has taken fewer days with RIM9, RIM10 media combination than standardised RM30 media combination. It was concluded that pre-inoculation medium with 0.3 mg/l TDZ, regeneration media RM30-1, RIM9, and RIM10 were the ideal combinations for *in vitro* regeneration in castor.

Optimisation of transformation protocol was attempted with construct EHA105 (GUS and GFP) in LBA4404 at optimal conditions of *Agrobacterium* concentration O.D 0.5, 100 μM acetosyringone with pre-incubated hypocotyl explants in TDZ for 2 days and cultured in RM30-1 media (4.5 mg/l of BAP + 0.5 g/l 2-(N-morpholino) ethane sulfonic acid (MES) and 0.5 mg/l $AgNO_3$). After 15 days of culturing, GFP spots were observed under UV illumination in few of the explants but the explants are not grown further on selection media. The standardization of different parameters for increasing efficiency of transformation *viz., Agrobacterium* concentration, time of incubation, preculturing, addition of inducers, selective marker concentrations is under progress.



Comparison of multiple shoot induction after 6 days of inoculation in RM30, RIM9, RIM10 and shoot elongation on RIM9

Promising hybrids/varieties under multi-location evaluation

Two varieties, ICS-164 (medium duration) and ICS-345 (early maturing) and three hybrids ICH-1146 (early maturing), ICH-440 (early maturing), and ICH-277 (medium duration) are at various stages of testing under coordinated trials.

Crop Production

Development of conservation agricultural practices for castor-based cropping systems

Conservation agriculture (CA) is a farming system that promotes minimum soil disturbance, maintenance of soil cover (crop residues or cover crops) and diversification of plant species. CA practices (tillage and intercropping systems) were evaluated in fixed plot in castor-based cropping systems in shallow Alfisols under rainfed conditions. The cropping period experienced about 30% excess rainfall (1052 mm against normal 730 mm in 51 days). The highest weed density was recorded in zero tillage (13.41/m^2) followed by reduced tillage (12.17/m^2) and lowest weed density was recorded in conventional tillage (9.10/m^2). Among the intercropping systems, sole castor recorded highest weed density (12.8/m^2) followed by castor + redgram (12.0/m^2), castor + greengram (11.0/m^2) while the lowest weed density was recorded in castor + groundnut (10.3/m^2).

Seed yield of castor was significantly influenced due to different tillage practices and intercropping systems. Significantly highest seed yield of castor was recorded in conventional tillage (1758 kg/ha) which was on par with reduced tillage (1652 kg/ha) and lowest seed yield was recorded in zero tillage (1244 kg/ha). Among the intercropping systems, significantly highest seed yield was recorded in sole castor (1907 kg/ha) which was on par with castor + groundnut (1764 kg/ha), castor + greengram (1593 kg/ha) and castor + redgram (941 kg/ha). There was reduction of 6%, 16% and 51% of seed yield over sole cropping in castor + groundnut, castor + greengram and castor + redgram, respectively. Significantly highest stalk yield was recorded in conventional tillage (1905 kg/ha). The stalk yield obtained in reduced tillage (1516 kg/ha) and zero tillage (1496 kg/ha) were statistically at par with each other. The harvest index among the treatments ranged from 45 to 52%.

Castor Equivalent Yield (CEY) was highest in conventional tillage (2452 kg/ha) followed by reduced (2294 kg/ha) and zero tillage (1972 kg/ha). Among intercropping systems, the highest CEY was registered in castor + groundnut intercropping (2640 kg/ha) followed by castor + redgram (2389 kg/ha) and the lowest was found in sole castor (1907 kg/ha). The Rain Water Use Efficiency (RUE) was highest in conventional tillage (2.48 kg/ha/mm) followed by reduced tillage (RT) and zero tillage (ZT) practices. The highest RUE was recorded in castor + greengram (2.67 kg/ha/mm) followed by castor + redgram (2.41 kg/ha/mm), castor + groundnut (2.04 kg/ha/mm) while the lowest was with sole castor (1.93 kg/ha/mm). Soil moisture content (%) recorded during November 2021, was significantly influenced due to tillage practices and intercropping systems. The soil moisture content was higher (7.29%) in reduced tillage and castor + greengram (1:3) intercropping system. Soil organic carbon (SOC) was found to be highest in reduced tillage (0.64%) followed by zero tillage (0.63%) and the lowest was observed in conventional tillage (0.56%). Among the inter cropping systems, highest soil carbon content was found in castor + redgram (0.67%) but was on par with castor + greengram (0.65%) followed by castor + groundnut (0.60%) and the lowest was observed in sole castor (0.57%). The highest monetary returns were recorded in reduced tillage (B: C ratio 3.99) followed by conventional (B: C ratio 3.92) and zero tillage (B: C ratio 3.79). Among the intercropping systems, highest monetary returns were recorded in castor + redgram (B: C ratio 4.76) followed by castor + groundnut (B: C ratio 4.03), sole castor (B: C ratio 3.50) and castor + greengram (B: C ratio 3.32).

Screening trait specific germplasm lines for drought tolerance (Field study)

Eleven trait specific germplasm lines along with two checks (48-1 and DCH-519) were sown in the field on 1st November, 2021 and water stress was imposed from 30-90 DAS, along with irrigated control in three replications each in split plot design for the reconfirmation of results of the previous year for the same genotypes. Crop growth before relieving stress (BRS) showed reduction in plant height, number of branches, stem girth, leaf size, spike weight and total plant dry matter (TDM) under moisture stress till 90 DAS and genotypic differences were also significant for all the traits.

Primary and secondary spike length, effective spike length (ESL), capsule number, spike weight, seed weight of primary and secondary spikes except secondary spike number were affected by drought stress. There were tertiary branches in few genotypes in control at 90 DAS, while none of the genotypes produced tertiary branches in drought stressed plots even after relieving the stress. Mean seed yield (primary, secondary and total seed yield) was reduced by 27.7%, 39.7% and 36.3%, respectively under stress condition when compared to irrigated condition. Genotypes with high seed yield in control (145-195 g/plant) include RG-2781, RG-2787, RG-2818 and RG-3798; Genotypes with high seed yield in stress (80-110 g/plant) are RG-1594, RG-1663, RG-2787, RG-2818, RG-2822 and RG-3798. Genotypes with ≤30% reduction in seed yield and with ≤0.8 DSI are RG-1594, RG-1663, RG-2818, RG-2822 and 48-1. RG-2818 is the only genotype with higher seed yields under both control and stressed conditions.

Evaluation of BC_1F_4 plants of DPC-9 x RG-72 for root growth (Poly bags)

Seeds of 50 selected plants of BC_1F_4 generation were grown in poly bags as two sets of 25 each (3 plants per replication) till 90 DAS. Data on plant growth, root traits (length, volume, weight) and total dry matter production (TDM) were recorded. Strong positive correlations (>0.60) between root volume, root dry weight and total dry matter (TDM) were observed. In these plants, stem girth ranged from 10.3 to 23.4 cm with an average of 17.2 cm. Root length varied from 60 to 143 cm; root volume from 67-178 cm^3; root dry weight from 14-42 g/plant. The TDM ranged from 68-172 g/plant. Three plants, P15-8, P16-2 and P17-4 recorded highest values for root volume, root dry weight and TDM. Promising selections were made that can be advanced further to isolate castor genotypes suitable for rainfed/drought conditions.

Evaluation of parental lines for drought tolerance under field conditions

Ninety six parental lines including three checks (48-1, DPC-9, DPC-25) were sown in field during November, 2021 and subjected to water stress from 30-90 DAS along with irrigated control plots in single rows with three replications each, in a split plot design. Total seed yield among the genotypes studied ranged from 48-191 g/plant in control; and 30-147 g/plant under drought stress with a mean of 124 and 84 g/plant in control and under stress, respectively. Percent reduction in seed yield ranged from 2.6-67.5. The parental lines with 130-191g/plant seed yield in control, 100-147 g/plant under stress, with 9.4-31.5% reduction in total seed yield and with <1.0 (0.29-0.97) drought susceptibility index (DSI) were selected as best drought tolerant lines and were sown during 2022-23 for confirmation of tolerance and to identify stable lines for use in crossing programme.

Evaluation of parental lines for drought tolerance in field (2nd year)

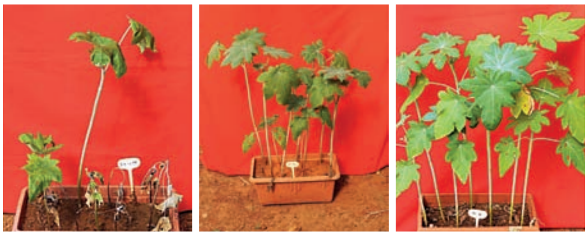
Twelve parental lines along with two checks (48-1, DCH-519) were evaluated for drought tolerance in the field for 2nd year. Crop growth before relieving stress (BRS) in terms of plant height, stem girth, number of branches and total plant dry weight (TDM) under moisture stress at 90 DAS was reduced. Three genotypes *viz.,* DPC-22, IPC-46 and 1932-1 showed less reduction in TDM under drought stress. Reduction of 29.9%, 26% and 30.7% in seed yield of primaries, secondaries and total seed yield, respectively was recorded under drought stress as compared to irrigated control. Genotypes with high seed yield in control (120-152 g/plant) and under drought stress (81-112 g/plant) include 1932-1, ICS-164, IPC-44, DPC-9, 48-1 and DCH-519. Genotypes with ≤30% reduction in seed yield and with <1.0 DSI include 1932-1, ICS-164, ICS-200, ICS-299, IPC-42, DPC-9 and 48-1. Among the genotypes, 1932-1, ICS-164, ICS-299 recorded higher oil content in control (46.0%, 47.7%, 48.1%, respectively) and drought stress (45.8%, 45.5%, 45.2% respectively) as well.

Based on two years data, two genotypes ICS-164 and 1932-1 recorded high seed yield and oil content both in control and under drought stress and are the best genotypes for both irrigated and drought stress conditions. Five more genotypes *viz.*, ICS-200, ICS-299, IPC-42, DPC-9 and 48-1 also recorded less reduction in seed yield under drought stress with low DSI values.

Crop Protection

Screening of selected parental lines of castor against root rot disease

Parental lines along with GCH-4 (susceptible check) and JI-449 (resistant check) were screened against root rot disease by sick pot method. The root rot incidence ranged from 0.0 to 96.6%. The parental lines *viz.*, ICS-303, ICS-304, ICS-305, ICS-319, DPC-22 and IPC-46 recorded <10% root rot incidence in screening over two years and the lines *viz.*, ICS-298, ICS-312 and ICS-321 recorded <20% root rot incidence. Root rot incidence was 96.6% in GCH-4 (SC) and 6.9% in JI-449 (RC) lines.



ICS-299 **ICS-303** **IPC-46**

Screening of parental lines of castor against root rot disease under pot culture condition

Identification of resistant sources against gray mold (*Amphobotrys ricini*) of castor

The advanced generation breeding lines derived from the gene pool for gray mold resistance and bi-parental crosses were evaluated for reaction to gray mold through artificial screening using detached capsule technique. The line, K18-1-2 showed promise for gray mold resistance.

Among 40 breeding lines, experimental hybrids and germplasm lines screened, the breeding lines *viz.*, K18-162 and GMM-3 have recorded disease severity of 30% and 40% showing moderately resistant/tolerant reaction under artificial epiphytotic condition in poly house. All other lines and susceptible check (SC), DCH-519 have recorded 100% disease severity.

K18-162 **GMM-3** **DCH-519 (SC)**

Reation of castor genotypes against gray mold under artificial epiphytotic conditions

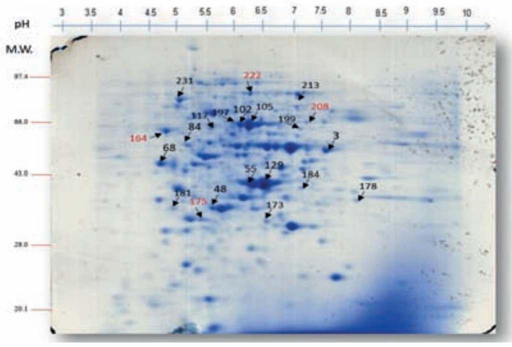
Evaluation of parental lines and advanced breeding material of castor against wilt under sick plot conditions

A total of 29 parental lines of castor were screened against wilt under sick plot conditions. Among them, K-18-40-1 recorded highly resistant reaction with <10% wilt incidence and ICS-256, P3-5 and K-18-1-2 recorded resistant reaction of <20% wilt incidence. The wilt incidence was 16.5% in 48-1 (resistant check) and 92.8% in JI-35 (susceptible check).

A total of 112 advanced hybrids were evaluated against wilt and the hybrids *viz.*, ICH-1594, ICH-1597, ICH-1455, ICH-1474, ICH-1482, ICH-1484, ICH-1488, ICH-1489, ICH-1491, ICH-1494, ICH-1496, ICH-1501, ICH-1506, ICH-1517, ICH-1519, ICH-1524 and ICH-1538 were highly resistant (<10% wilt incidence). Thirty six (36) advanced hybrids were resistant with < 20% wilt incidence. The wilt incidence was 15.0% and 91.6% in 48-1 (resistant check) and JI-35 (susceptible check), respectively.

Difference in virulent and less virulent isolates of *Fusarium oxysporum* f.sp. *ricini* as revealed by proteomics analysis

The comparative proteomic analysis of highly virulent (Palem) and less virulent (*For* 13-52, GJ) isolates of *F. oxysporum* f. sp. *ricini* revealed significant variation among them in terms of protein pattern. Image analysis results showed expression of about 200 protein spots and of them, 12 statistically significant spots ($p < 0.05$) that exhibited more than 1.5 fold increase were upregulated and in addition, 8 statistically significant spots ($p < 0.05$) were differentially present in the highly virulent isolate Palem. Proteins corresponding to spots 175, 222, 208 and 164 were differentially expressed in Palem isolate. Those were characterized using MALDI-TOF and the function of two proteins identified as degradation of host cell wall proteins and antifungal proteins and scavenger of host generated ROS and other two protein functions are unknown. Proteins in spots 129, 3, 55, 48, 102, 84, 231 and 105 were upregulated in the isolate Palem. The identified proteins were AGC/PKC protein kinase, 30 kDa heat shock protein, phosphoglycerate kinase, polyketide synthase domain containing protein, peptidase A1 domain containing protein, thioredoxin domain-containing protein, cutinase and glycoside hydrolase 45. The identified proteins showed homology with the fungal proteins that play crucial roles in pathogen penetration, colonization, invasion, degradation of plant cutin, detoxification of host-generated ROS, activation of signal transduction pathways, stress response, post-translational modification and toxin production. The work on 2D gel electrophoresis was carried out at the Department of Plant Sciences, University of Hyderabad.



2-DE CBB stained gel of mycelial proteins from *For* Palem isolate

(Protein spots exhibiting upregulation/differential regulation are marked with arrow)

Screening of selected castor genotypes against isolates of *F. oxysporum* f. sp. *ricini (For)* for identification of differential genotypes

Twenty selected castor genotypes were evaluated against *F. oxysporum* f. sp. *ricini* from Yethapur, Mandor and Junagadh. The genotypes *viz.*, AP-33, AP-48, AP-56, AP-163 and RG-3467 recorded resistant reaction (< 20%); while the genotypes AP-252, GC-3, RG-2836, ICS-125, ICS-121, RG-3105 and JI-35 recorded susceptible reaction (> 20%) to isolates of *F. oxysporum* f. sp. *ricini* from Yethapur, Mandor and Junagadh. AP-125 recorded resistant reaction to isolates of *For* from Yethapur and Mandor, but susceptible reaction to Junagadh isolate. Castor genotypes *viz.*, AP-327, RG-3041, RG-3432, RG-2820 and DCS-107 recorded resistant reaction to *For* isolate from Yethapur, but exhibited susceptible reaction to Junagadh and Mandor isolates. DCS-9 recorded susceptible reaction to Yethapur and Junagadh *For* isolates, but resistant reaction to Mandor isolate.

Screening of biotic stress resistant germplasm accessions against reniform nematode, *Rotylenchulus reniformis*

About 10 biotic stress resistant germplasm accessions were screened against reniform nematode, *Rotylenchulus reniformis* along with resistant (JC-12) and susceptible (48-1) checks on a 1-9 scale of the tested genotypes, all were susceptible except for RG-2781 with an average of 19.3 egg masses/root with a egg mass scale of 5 (moderately resistant) which was similar to that of the resistant check, JC-12.

Thrips infestation in relation to epicuticular waxy bloom types of castor and developing of damage rating scale

Reaction of 13 castor genotypes with different bloom types to thrips (*Scirtothrips dorsalis*) damage was studied during *kharif* and *rabi* seasons. High thrips infestation on leaves was reported during *rabi* season (19.8 to 45.2 thrips/top leaf) as compared to *kharif* season (10.6 to 31.8 thrips/top leaf). Double or triple bloom genotypes recorded high thrips infestation on leaves as compared to zero and single bloom genotypes. Observations on immature spike revealed high thrips infestation on spikes during *rabi* season (27.6 to 63.6 thrips/spike) as compared to *kharif* season (11.2 to 50.6 thrips/spike). Zero bloom (DPC-9) and double bloom genotypes (SKI-215 and DCS-9) recorded high thrips infestation on immature spike as compared to triple bloom genotypes. Significant negative correlation between bloom types and thrips infestation on spikes was observed in both *kharif* and *rabi* seasons. Based on the damage symptoms, a five-degree rating scale was developed to categorize thrips resistance in castor genotypes and needs further confirmation.

Confirmation of reaction of promising double bloom castor genotypes against leafhopper

Among nine promising double bloom castor genotypes screened against leafhopper, two genotypes (RG-1624 and ICS-303) were found moderately resistant to leafhopper (Grade 2 on 0-4 scale), while susceptible checks recorded maximum hopper burn grade 4 (on 0-4 scale).

Confirmation of reaction of promising castor genotypes against whitefly

Among 14 promising castor genotypes screened, seven castor genotypes (RG-2870, RG-3233, RG-2976, RG-3428, ICI-RG-2800-1, ICI-RG-2800-4 and ICI-RG-2800-5) were found highly resistant to whitefly (Grade 0 on 0-5 scale) with low population (0.2 to 3.1 whiteflies/top leaf/plant). Five castor genotypes *viz.*, RG-3041, RG-2878, ICI-RG-2800-6, ICI-RG-2800-7 and ICI-RG-2800-8 were found resistant to whitefly (Grade 1 on 0-5 scale).

Confirmation reaction of promising castor parental lines against sucking pests

A total of 23 selected castor parental lines along with susceptible and resistant checks were screened against sucking pests (leafhopper and thrips). Eight parental lines *viz.*, DPC-27, IPC-34, IPC-35, IPC-36, IPC-46, ICS-299, ICS-317 and 1932-1 were found resistant to leafhopper with hopper burn grade of 1 (on 0-4 scale), while the susceptible checks (DPC-9, DCH-177 and DCS-107) recorded hopper burn grade of 4 (on 0 to 4 scale). The resistant lines recorded low leafhopper infestation (16.1 to 34.8 /3 leaves/plant) as compared to high leafhopper infestation of 53.0 to 79.6/3 leaves/plant in susceptible checks (DPC-9, DCH-177 and DCS-107). The parental lines *viz.*, DPC-18, DPC-20, DPC-27, IPC-36, ICS-299, ICS-301, ICS-316, ICS-317 and 1932-1 recorded low thrips infestation (<10 thrips/spike) as compared to susceptible checks *viz.*, DPC-9 and DCS-9 (40.4 to 45.4 thrips/spike).

Screening of new inbred lines of castor against capsule borer

Among 20 new castor inbred lines screened against capsule borer, the capsule borer damage was reported to be ranging from 17.5 to 75.5%. The inbred line, K-18-45-1 was found promising and recorded <20% capsule damage as compared to 82.1% capsule damage in susceptible check (DCS-9).

K-18-45-1 48-1 (R) DCS-9 (S)

Reaction of castor inbred lines to capsule borer

Biology of mirid bug infesting castor

Biology of the mirid bug infesting castor was studied under laboratory conditions. Nymphs and adults pierce their stylets into the flowers, immature capsules and spikes and suck the sap. Feeding damage resulted in oozing out fluid and shedding of immature capsules. Adults are swift fliers and green in colour. Nymphs are small with light yellow or green colour and fast moving when disturbed. Nymphs emerged from terminal tender shoot and immature spikes. Eggs were laid singly. The bug had five nymphal instars (1 mm to 5 mm; wing pad developed from 2nd instar) with a mean nymphal duration of 15.3 ± 2.2 (12 to 18) days. Adults (7 mm to 10 mm) survived for 12.8 ± 3.1 (9 to 7) days.

Sunflower

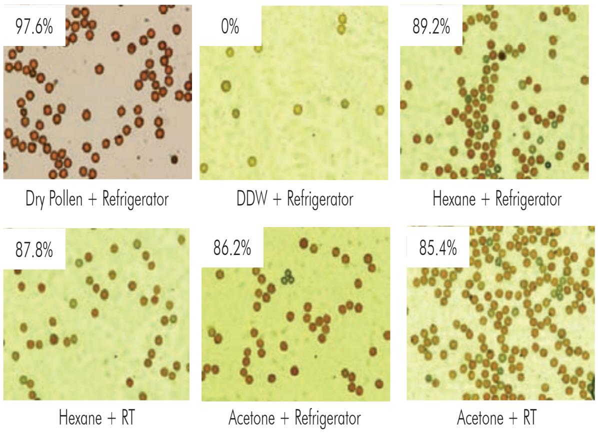
Crop Improvement

Germplasm multiplication, maintenance, characterization, evaluation & enhancement

A total of 300 accessions were conserved in the MTS of IIOR; 350 accessions were multiplied and 166 accessions were supplied to sunflower researchers.

Sunflower pollen storage study

Hybrid seed production in sunflower is a challenging task. Pollen theft by pollinators is a problem in sunflower hybrid seed production. The male parent block is always covered with a net to avoid pollinator visits. Hence, manual pollination method was recommended for good seed set and higher seed yield in sunflower. During hand pollination, shortage of pollen due to lack of synchronization between male and female parents and unfavourable weather conditions leads to poor seed set and low yield. The utilization of stored pollen grains is a viable option to ensure pollen availability during pollen scarcity periods. In this study, sunflower pollen grains were collected and stored at room temperature (RT), earthen pot under the pit in the open field, refrigerator (5^0C) and non-polar solvents (both in RT and 5^0C) for up to seven days.



Dry Pollen + Refrigerator | DDW + Refrigerator | Hexane + Refrigerator

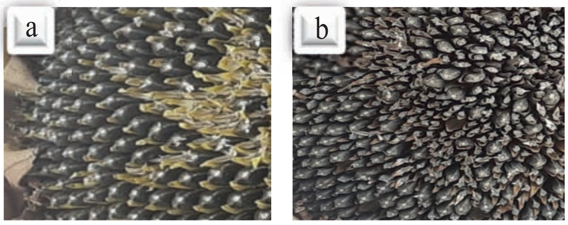
Hexane + RT | Acetone + Refrigerator | Acetone + RT

(DDW-Double distilled water, RT-Room temperature, average pollen viability per cent mentioned on the top left corner)

Sunflower pollen viability under different conditions (values in the inset indicate viable pollen percentage)

Pollen viability in different storage treatments

The viability of stored pollen was tested every day both in the laboratory (staining method) and in field conditions (hand pollination method). The staining method used for testing pollen viability was modified and standardized in laboratory conditions because of non-satisfactory results observed in existing methods. The highest pollen viability was observed in dry pollen stored at 5°C for up to 7 days. Pollen grains stored in hexane at 5°C recorded viability and seed set up to 4 days. Dry pollen grains at room temperature and in an earthen pot remained viable for two days. Though the pollen grains stored in acetone (both RT and 5°C) was showing viability in staining methods for three days, it failed to set seeds in field conditions. Higher seed set was observed in flower heads pollinated with pollen grains stored in refrigerator (5 °C). Therefore, the dry pollen grains can be effectively stored at 5°C and utilized for up to seven days in hybrid seed production of sunflower.



(a) Seed set after pollination with pollen grains stored in refrigerator and (b) Pollen grains stored in earthen pot

Pre-breeding

Generation advancement of pre-breeding lines

A total of 450 BC_2F_5 families of different wild *Helianthus* species like wild *H. annuus, H. debilis, H. argophyllus, H. petiolaris* and *H. praecox* were advanced from BC_2F_5 to BC_2F_6 generation through selfing during late *rabi* 2021-22. Wider variability was observed for morphological traits *viz.,* days to 50% flowering, plant height, leaf shape, colour, serration and blistering, head diameter and seed colour as well as seed shape, etc.

Supply of pre-bred material to different AICRP centres

About 120 advanced (BC_2F_6) interspecific derivatives derived using different accessions of annual diploid compatible wild species including *H. debilis, H. argophyllus*, *H. annuus* and *H. petiolaris* were supplied to four AICRP centres (Tornala, Akola, Coimbatore, Latur) for seed multiplication, characterization, evaluation, selection and utilization in breeding programmes.

Evaluation of advanced interspecific derivatives

Advanced interspecific derivatives (30 nos.) derived using annual diploid wild species were evaluated along with two checks *viz.,* ARM-243B and DRSF-108 for yield and yield contributing traits during *rabi* 2021-22. Most of the progenies were of medium duration, medium plant height and 100 seed weight ranged from 3.0 to 7.6 g/plant. More than 37% oil content was observed in 10 pre-bred lines. The highest oil content (44.3%) was observed in PB-120 followed by PB-129 (43.0%), PB-130 (42.7%), PB-128 (42.7%) and PB-127 (41.0%). Identified high oil content pre-bred lines will be confirmed at multilocations and utilized in breeding programmes.

MLO gene family of sunflower and their potential role in the susceptibility of sunflower to powdery mildew

The Mildew Resistance Locus (MLO) is known to facilitate powdery mildew susceptibility in plants. The MLO gene, inherited recessively provides broad spectrum resistance against powdery mildew causing ascomycete phytopathogen. The presence of MLO proteins ensures successful powdery mildew colonization. Sequencing of *Helianthus annuus* genome has provided an opportunity to identify the MLO genes across the genome. A total of 38 MLO genes were found in *Helianthus* genome by integrating the results of HMM search using MLO domain and *Arabidopsis* MLO proteins obtained through computational methods. Towards understanding their role in powdery mildew disease, two stable interspecific derivatives from the cross involving PS-2023 (susceptible to powdery mildew) and *H. praecox* (PRA-1823- resistant to powdery mildew) exhibiting differential reaction to powdery mildew, *viz.,* PMR-16 (resistant) and PMS-27 (susceptible) were selected. Transcriptomes from these genotypes in triplicate were sequenced and RNAseq analysis was carried out. Twelve out of 37 genes were found to be differentially expressing between the resistant and susceptible MLO derivatives. Among them, nine genes are downregulated in the resistant PMR-16 variety suggesting possible role in resistance. The highest difference in expression was found in the HaMlo1 gene (log2FC=-5.64). Six of these differential lines were distributed to five AICRP centres for multilocation evaluation and confirmation.

Development of MAGIC population maintainer and restorer lines

Narrow genetic base is the major problem in cultivated sunflower. A total of 8 diverse maintainer lines *viz.,* ARM-243B, CMS-1010B, COSF-6B, CMS-1008B, CMS-103B, CMS-1103B, HA-89B and CMS-335B were chosen based on high oil content, high seed yield, tolerance to powdery mildew, earliness, lateness, high oleic content, etc. for initiation of Multi-parents Advanced Generation Inter Crosses (MAGIC) population for diversification of maintainer base. Two-way crosses as well as four way crosses were attempted through hand emasculation during *rabi*-2021-22 and *kharif*-2022.

A total of 8 diverse restorer lines *viz.,* RGP-100, RHA-6D-1, RGP-136, RGP-184, RGP-236, RGP-252, RGP-253 and RGP-307 were selected as founder parents based on high oil content, high seed yield, tolerance to powdery mildew, resistance to downy mildew and moisture stress tolerance etc. for initiation of Multi-parents Advanced Generation Inter Crosses (MAGIC) population for diversification of restorer base. Two-way crosses as well as four way crosses were attempted through hand emasculation during *rabi* 2021-22 and *kharif* 2022.

Random mating in high oleic maintainer and restorer lines

A total of five high oleic (>75%) maintainer lines *viz.,* CMS-58B, CMS-59B, CMS-103B, CMS-901B and CMS-1103B were selected for forced random mating. CMS-103B was selected as female parent and other four lines as male parents. Forced random mating was attempted during *rabi* 2021-22 through hand emasculation. Bulk pollens were collected from four male parents and pollinated female line. First random mating cycle seeds were harvested from CMS-103B and completed RMC-II during *kharif* 2022. It will be further advanced through random mating in isolation for creating more genetic variability.

A total of five restorer lines *viz.,* RGP-165, RGP-214-1, RGP-216-1, RGP-240 and RGP-254 were selected based on high oleic content coupled with other agronomical traits for random mating. Line RGP-240 was used as female parent and other four lines were utilized as pollen parents. Forced random mating was attempted through hand emasculation during *rabi* 2021-22. Random mating cycle-II was attempted during *kharif* 2022. It will be advanced through random mating in isolation and selection of agronomically superior plants will be done.

Seed multiplication and generation advancement of unique genetic stock PYRS-1

A unique pale yellow colour ray floret plant was observed in CMS-67B during late *rabi* 2020-21. Of the 20 plants evaluated having yellow ray florets, one plant was observed with unique pale yellow ray floret colour. The plant was selected during the flower initiation stage and selfed to harvest seed. Subsequently, seed multiplication as well as trait confirmation was done during *rabi* 2021-22. Stable progeny of PYRS-1 was characterized for various quantitative and qualitative traits along with ARM-243B as a check during *rabi*-

2021-22 and *kharif* 2022. PYRS-1 can be utilized as a reference genotype for ray floret colour in sunflower DUS testing. Unique line has been crossed in direct and reciprocal directions with yellow ray floret colour line CMS-1001B during *rabi* 2021-22 through hand emasculation. The two F_1s were raised during *kharif* 2022 and found that yellow ray floret colour was dominant over pale yellow ray floret. Selfed seeds of both the F_1s were harvested and backcross was done to workout inheritance of ray floret colour.

PYRS-1 with pale yellow ray florets

Evaluation of the new F_1s for the maintainer/ restorer reaction

Based on the synchronization of flowering as well as specific traits of the advanced interspecific derivatives and CMS lines, crosses were attempted during late *rabi* 2021-22. A total of 120 new experimental hybrids were synthesized using advanced interspecific derivatives to understand the maintainer or restorer reaction. All 120 F_1's were sown during *kharif* 2022 to identify the new maintainers/restorers. Majority of the interspecific derivatives behaved as maintainers.

Polycross

To develop resistant/tolerant Alternariaster leaf blight and powdery mildew genotypes, a multiple resistant line TX-16R and a powdery mildew resistant line PM-81 were used as donors and ARM-243B as a recipient. For polycross, equal quantity of pollen were collected from both the donors and mixed well and pollinated on hand emasculated capitulum of ARM-243B during late *rabi* 2021-22. Harvested seed from ARM-243B was raised during *kharif* 2022 to advance Polycross generation as well as to check the reaction of Alternariaster leaf blight. Very less incidence of leaf blight was observed on lower leaves of majority of the plants. Polycross cycle will be continued during *rabi* 2022-23 as well to get agronomically superior plants resistant or tolerant to both leaf blight and powdery mildew.

Confirmation of high oleic CMS and restorers lines

A total of 5 high oleic CMS lines *viz.,* CMS-58B, CMS-59B, CMS-103B, CMS-901B and CMS-1103B and five restorer gene pool inbreds *viz.,* RGP-165, RGP-214-1, RGP-216-1, RGP-240 and RGP-254 identified during *rabi* 2020-21 were confirmed during *kharif* 2021, *rabi* 2021-22, late *rabi* 2021-22 and *kharif* 2022. Oleic content of CMS and restorer lines in different seasons are presented below.

Accession	Oleic acid content (%)		
	Rabi 2021-22	Late *rabi* 2021-22	*Kharif* 2022
CMS lines			
CMS-58B	82.2	81.6	83.1
CMS-59B	82.3	78.9	80.6
CMS-103B	81.3	78.2	80.6
CMS-901B	80.3	79.2	84.3
CMS-1103B	82.3	83.6	82.9
Restorer lines			
RGP-165	84.6	85.2	83.7
RGP-214-1	72.3	68.6	70.6
RGP-216-1	84.6	82.9	85.1
RGP-240	82.6	81.6	79.8
RGP-254	83.5	86.4	84.6

Nomination of entries

Two entries IIOSH-500 and IIOSH-1490 were nominated during 2022 for initial hybrid trial (IHT). Two entries namely, IIOSH-434 and IIOSH-460 were promoted to higher order of testing in AHT-I and AHT-II, respectively during *kharif* 2022. Entry IIOSH-566 was promoted from IHT to AHT-I during *rabi* 2021-22.

Revival of sunflower cultivation

A project on "Revival of sunflower cultivation" formulated by ICAR-IIOR, Hyderabad and sanctioned by the Department of Agriculture & Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India for a period of three years from 2022-23 to 2024-25 with the objectives of area expansion, productivity improvement, profitability improvement of sunflower cultivation in India in addition to capacity building. The targeted seed production for distribution is 15000 q involving the AICRP-Sunflower centers, seed production units of SAUs and public seed agencies (NSC, HIL, NDDB, NAFED).

Crop Production

Evaluation of inbred lines for drought, temperature and combined stress of drought and temperature tolerance

A set 74 genotypes (CMS, R lines with 5 hybrids and 3 varieties) were evaluated for tolerance to temperature, drought and combined stress under field conditions by taking two sowing dates; normal (11/01/2022) and delayed sowing (25/02/2022) to expose the crop to high temperatures. In each sowing, one set of crop was grown with irrigation, while the other set was subjected to water stress by withholding irrigation from 35-75 DAS. No rain was received during stress imposition period of normal sowing but in delayed sowing, 26.4 mm rain in 3 spells was received in 17 days after imposition of stress and therefore plants were subjected to stress till harvest. Rise in temperature due to delayed sowing was observed at all stages. The yield reduction within a sowing was more pronounced due to drought stress compared to increased temperatures between sowings. In spite of increased temperatures at all crop growth stages, seed yield per plant in both control and stress were not affected much and most of the entries recorded higher seed yield in the control of delayed sowing compared to corresponding yield in normal sowing perhaps due to lower temperatures in the initial crop growth stage of normal sowing. There was yield reduction of 53 and 55% due to water stress in normal and delayed sowing respectively. Based on seed yield in control, drought stress and yield stability index, 298 R and CBE-COSF-16B are the two genotypes that showed tolerance to drought, temperature and combined stress.

Temperature and rain during crop growth period

Crop stage	Normal sowing				Delayed sowing			
	Max. Temp. (°C)	Min. Temp. (°C)	Mean Temp. (°C)	Rain (mm)	Max. Temp. (°C)	Min. Temp. (°C)	Mean Temp. (°C)	Rain (mm)
Sowing to stress imposition	29.6	14.0	21.8	0	35.5 (+5.9)	18.1 (+4.1)	26.8 (+5.0)	0
Stress imposition to relieving stress	34.3	17.2	25.8	0	38.0 (+3.7)	23.1 (+5.97)	30.6 (+4.75)	26.4 (3 days)
Stress relieving to harvest	37.9	21.5	29.7	0	37.0 (+0.9)	24.6 (+3.1)	30.8 (+1.1)	0
Germination to harvest	33.2	16.9	25.0	0	36.9 (+3.7)	21.5 (+4.6)	29.2 (+4.2)	26.4

Promising lines for combined stress of drought and temperature

Stress type	Promising lines
Combined stress (Drought and temperature)	IR-6, LUD-CMS-70B, CBE-COSF-16B, LAT-1-CMS-PET-891B, 298R, RGP-178, 104B, TSG-366, RHA-6D-1, ARM-243B, LAT-1-CMS-207B, SCG-40, KBSH-44, BLR-CMS-144B, CBE-COSF-6B

Alleviation of drought stress in sunflower by microbials

The effect of seed treatment and soil application of microbials independently and their combination in alleviating drought stress was assessed using DRSH-1 hybrid in split plot design (Main-plot: water stress levels and sub-plot: microbial treatments) during *rabi* 2021. Control plots received irrigation as and when necessary and treatment plots were subjected to water stress by withholding irrigation from 35 DAS till harvest. Two cultures developed by ICAR-CRIDA for drought alleviation, CRIDA Resilia 1 and 2 were tried as seed treatment @ 30 g/kg seed and soil application @ 2.5 kg/ha along with another culture developed by ICAR-NBAIM, Mau as seed treatment @ 50 ml/kg seed.

No difference in days to flowering was observed either with stress or with microbial treatments. Days to harvesting was advanced by 10 days due to stress, but treatment differences were found negligible. The reduction in plant height, leaf number and stem girth due to water stress were negligible. Leaf growth (52%), TDM (41%) and seed weight (58%) reduced significantly due to stress. None of the treatments were effective in alleviating drought. However, seed treatment with ICAR-CRIDA resilia 2 increased seed yield significantly in control (35%) but not in stress.

Crop Protection

Screening of pre-bred lines against downy mildew

Seven advanced interspecific derivatives found resistant to leafhoppers were screened against downy mildew in sick plot at Latur centre to identify multiple resistant lines. Three interspecific derivatives *viz.,* PB-1003, PB-1005 and PB-1007 were found resistant to downy mildew. These three lines can be utilized as donors for leafhoppers coupled with downy mildew.

Augmented screening of sunflower inbreds for Alternariaster leaf blight disease under poly house conditions

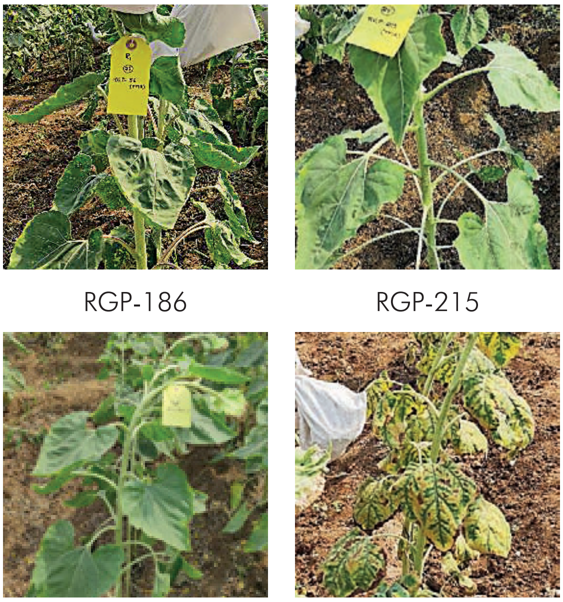
A total of 206 sunflower inbreds developed through random mating, prebred derived using diploid wild species *H. annuus* (wild), *H. debilis, H. petiolaris, H. argophyllus* and maintainer lines were used for screening against Alternariaster leaf blight. Sowing was taken under controlled poly house condition on 16th June, 2022 in Randomized Block Design with 45 x 15 cm spacing. Sunflower accession TSG-208 was used as susceptible check.

Sunflower genotypes before and after artificial inoculation of pathogen

Artificial inoculation of pathogen was performed with spaying pathogen spore suspension on 30 and 45 days after sowing (DAS). Regular agronomic practices were followed and the temperature of 28°C and 90% RH were maintained during the cropping season. Disease scoring was performed on three randomly selected and marked plants at every weekly interval from date of pathogen inoculation using 0-9 scale. Results revealed that none of the sunflower genotypes tested showed resistance to Alternariaster leaf blight. However, 8 lines *viz.,* HA-124B, PB-898, PB-904, PB-205, PB-905, ID-32, PB-889 and RGP-278-2 were tolerant and able to set seeds even under high pathogen pressure under poly house screening.

Identification of sources of resistance to leafhopper in sunflower

A total of 63 sunflower lines including 46 R gene pool lines (RGP) and 15 CMS lines were evaluated during summer 2021-22 for their reaction to leafhopper. Entries were sown during last week of January, 2022 with two replications following 60 x 30 cm spacing. Each entry was raised in a single row of 3 m length. Test entries were sandwiched between susceptible checks (NDCMS-2B/KBSH-44) in 2:1 ratio to increase pest load. Leafhopper counts were taken on three leaves (top, middle and bottom) per plant. One week after the peak infestation, injury rating was given on 5 randomly selected plants on 0-5 scale. 0-Free from leafhopper injury; 1-yellowing on leaf edges up to 30%; 2-yellowing and browning up to 40%; 3-yellowing and browning up to 60%; 4-yellowing and browning up to 80%; 5- yellowing and browning of leaves up to 100%. Mean Scale Index (MSI) was calculated and entries were categorized as: Highly resistant (MSI: 0); Resistant (MSI: 0.1-1.0); Moderately resistant (MSI: 1.1-2.5); Susceptible (MSI: 2.6-3.5); Highly susceptible (MSI: 3.6-5.0). Leafhopper population per 3 leaves per plant was 3.7-10.8, the highest being in susceptible check, NDCMS-2B. Seventeen lines (RGP-162, RGP-172, RGP-178, RGP-184, RGP-186, RGP-189, RGP-200, RGP-201-2, RGP-215, RGP-216, RGP-236, RGP-252, RGP-306, CMS-1010-B, IB-6, EC-585833, EC-116212) were found resistant to leafhoppers while another 31 lines were moderately resistant to leafhopper. A total of 10 lines were reported with susceptible reaction and 3 lines with highly susceptible reaction. KBSH-44 and NDCMS-2B were found susceptible and highly susceptible to leafhopper, respectively.



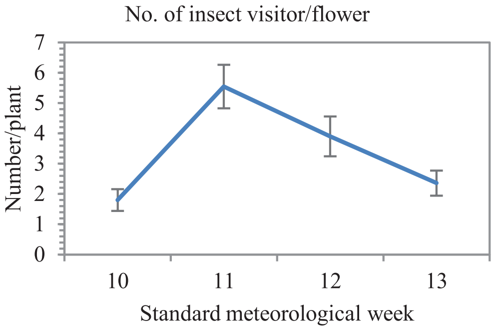
RGP-186 RGP-215

CMS-1010B NDCMS-2B(SC)

Reaction of different sunflower lines to leafhopper infestation in summer

Floral visitor insects of sunflower

A field experiment was conducted to study the number of floral visitor insects (per min) visited the flowers (*n* = 10) and the mean time spent (s/flower) (*n* = 50) by the floral visitor insects at the sunflower blooming stage. The highest sunflower flowers visited by the floral visitor insects (±standard error) was noticed during third week of March (5.55). The time spent (s/flower) by stingless bee was recorded during first week of March (48.61).



Safflower

Crop Improvement

Germplasm Maintenance, Evaluation and Enhancement

A total of 7027 safflower germplasm accessions are conserved in the Medium Term Storage Module at ICAR-IIOR, Hyderabad. Sowing was taken up for 950 accessions for rejuvenation and 1712 promising accessions for multiplication during *rabi* 2022-23. A total of 385 samples of 340 germplasm accessions were supplied to various AICRP (Safflower) centres for multilocation evaluation and utilization in breeding.

Evaluation of trait specific accessions

Fresh exotic accessions/selections

A set of 164 accessions/selections were evaluated during *rabi* 2020-21 and 2021-22 and the range of variability was recorded as follows: days to 50% flowering (69-112), days to maturity (106-154), plant height (36.1-139.1 cm), number of branches/plant (4-14), number of capitula/plant (6-80), number of seeds/capitula (1-62), diameter of main capitula (10.5-29.9 mm), seed yield/plant (1.2-26.7 g), 100-seed weight (1.8-7.0 g) and oil content (16.8-38.5%).

Based on consistent performance, 16 promising accessions/selections were identified for seed yield greater than the checks; 13 accessions (GMU-7962-1, GMU-7962, GMU-7936-1, GMU-7945-2, GMU-7946, GMU-7946-2, GMU-7948-2, GMU-7950-1, GMU-7944, GMU-7936, GMU-7946-1, GMU-7948 and GMU-7948-1) for early flowering (69-75 days); and six accessions (GMU-7962-1, GMU-7967-P1, GMU-7944, GMU-7980, GMU-7970-3 and GMU-7968-P11) for short plant height (36-55 cm). A total of 11 non-spiny accessions with orange-red corolla (GMU-7924, GMU-7926, GMU-7929, GMU-7930-2, GMU-7932-4, GMU-7936-5, GMU-7940-3, GMU-7940-4, GMU-7963, GMU-7963-1, GMU-7973) were also identified for further utilization in breeding.

Promising safflower accessions identified for seed yield

Accession	Days to 50% flowering	Plant height (cm)	No. of branches/plant	No. of capitula/plant	No. of seeds/ capitula	Dia. of main capitula (mm)	Seed yield / plant (g)	100-seed weight (g)	Oil content (%)
GMU-7926 (EC-938659)	94	124.1	6	23	15	26.5	26.7	5.1	23.2
GMU-7956 (EC-938689)	91	104.2	6	13	53	29.9	26.2	4.3	28.5
GMU-7953 (EC-938686)	91	112.7	10	29	19	27.5	22.6	4.9	24.3
GMU-7957 (EC-938690)	91	99.4	7	20	57	29.1	20.7	3.3	29.9
GMU-7939 (EC-938672)	85	79.2	6	22	10	21.0	19.9	6.5	22.3
GMU-7967-P13 (EC-938700-P13)	88	82.0	6	19	21	23.2	19.8	4.8	29.0
GMU-7963-1 (EC-938696-1)	95	83.1	10	30	11	20.0	19.3	4.1	29.7
GMU-7960 (EC-938693)	89	89.6	8	28	8	21.3	18.7	4.3	38.5
GMU-7950 (EC-938683)	77	59.3	7	31	23	19.3	18.7	3.8	29.2
GMU-7955 (EC-938688)	91	98.7	8	23	35	23.4	18.4	2.6	27.5
GMU-7930-4 (EC-938663-4)	81	73.8	9	38	4	20.3	17.4	5.8	27.2
GMU-7928-1 (EC-938661-1)	90	72.0	4	13	13	25.9	17.3	4.1	30.0
GMU-7934-1 (EC-938689)	98	124.5	6	19	24	21.3	16.9	4.2	23.0
GMU-7928 (EC-938661)	91	87.0	4	15	31	27.4	16.6	4.3	23.6
GMU-7929-1 (EC-938662-1)	103	100.4	6	25	17	23.3	16.4	4.4	26.8
GMU-7934 (EC-938667)	96	89.9	7	28	15	22.9	16.1	4.1	25.9
A-1 (Check)	84	67.0	7	23	10	19.5	12.1	7.1	24.8
PBNS-12 (Check)	83	64.9	7	26	11	19.7	11.8	6.5	27.7

Evaluation of accessions for bold capitula

A set of 20 accessions were evaluated for confirmation of large capitulum size. Among them, eight promising accessions were identified for >25 mm diameter and >20 seeds/capitulum.

Accession	Days to 50% flowering	Plant height (cm)	No. of branches/ plant	No. of capitula/ plant	Diameter of main capitula (mm)	No. of seeds/ main capitula	Seed yield/ plant (g)	100-seed weight (g)	Oil content (%)
GMU-3420 (HUS-253)	89	115.0	11	53	32.2	43	23.0	4.6	36.6
GMU-7994 (SSFB-2004)	90	86.6	5	8	31.1	35	9.3	4.8	32.7
GMU-7991 (SSFB-2002)	94	95.5	5	11	29.6	37	13.7	4.8	31.0
GMU-686 (EC-137339)	87	105.2	5	14	29.5	26	25.7	6.7	28.3
GMU-7995 (SSF-1507)	89	81.6	6	11	28.6	32	16.9	5.4	32.5
GMU-472-1	79	83.8	6	9	27.1	41	17.8	5.1	31.9
GMU-7990 (SSFB-2001)	93	96.9	9	23	26.8	26	21.6	5.3	28.6
GMU-7993 (SSFB-2003)	86	90.9	8	21	25.1	24	14.9	4.7	29.1
A-1 (Check)	84	67.0	7	23	19.5	10	12.1	7.1	24.8

Evaluation of accessions for seed and oil yield

A total of 200 fresh germplasm accessions obtained from ICAR-NBPGR were evaluated along with two checks (A-1 and PBNS-12) for seed and oil yield. Among them, 11 accessions *viz.*, EC-210467, EC-199879, EC-383086, EC-321219, EC-181615, EC-398084, EC-143832-3, EC-181614, EC-182227, EC-118229 and EC-246570 were promising for seed yield (15.9 to 24.80 g/plant) and oil yield (4.81 to 8.75 g/plant) performing better than the checks A-1 (seed yield 15.5 g/plant; oil yield 4.8 g/plant) and PBNS-12 (seed yield 12.7 g/plant; oil yield 4.1 g/plant). Eight accessions *viz.*, EC-398223, EC-398229, EC-398218, EC-398259, EC-398123, EC-398270, EC-398226 and EC-398091 recorded high oil content ranging from 40-43% with seed yield ranging from 4 to 8 g/plant.

Evaluation of *Carthamus* wild species accessions

A total of 16 accessions of *Carthamus oxyacanthus* and four accessions of *C. lanatus* were evaluated for agro-morphological traits; promising accessions were identified based on data for two seasons (2020-2022).

Promising accessions identified in *Carthamus oxyacanthus* and *C. lanatus*

Accession	Days to 50% rosette termination	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches/plant	No. of capitula/ plant	No. of seeds/ capitula (cm)	Diameter of main capitula (mm)	Seed yield/ plant (g)	100-seed weight (g)	Oil content (%)
Carthamus oxyacanthus											
IC-344880 (DPYGR-173)	92	120	177	31.7	9	48	8	8.9	7.1	1.2	21.6
IC-344883 (DPYGR-176)	87	118	183	43.3	11	59	3	8.4	3.9	1.3	19.2
IC-344875 (DPYGR-168)	84	114	173	34.0	9	62	6	9.0	3.8	1.0	22.2
IC-344896 (DPYGR-189)	90	121	182	34.5	10	60	5	8.8	3.7	1.2	22.5
IC-344882 (DPYGR-175)	96	119	177	32.8	9	52	8	8.8	3.6	1.1	20.6
IC-344904 (DPYGR-197)	97	122	184	31.5	8	43	9	8.3	3.5	0.9	21.5
IC-344889 (DPYGR-182)	91	120	183	33.0	11	61	2	8.8	3.2	1.3	20.1
Carthamus lanatus											
EC-478305 (PI 202728)	139	167	204	44.9	5	9	8	13.1	0.4	1.9	-
EC-478309 (PI 426181)	130	147	191	57.5	5	11	12	15.9	4.1	3.4	13.4

Germplasm Registration

Safflower germplasm accession, EC 523368-2 (GMU-7399) was registered as INGR22052 (IC0643960) by Plant Germplasm Registration Committee (PGRC), ICAR-NBPGR, New Delhi for tolerance to safflower aphid (*Uroleucon compositae* Theobald).

EC523368-2 **CO-1 (SC)**

Development of inbred lines from RIPE populations

A total of 9 families from S5-1C-RIPE population giving high seed yield and oil content were advanced to S_6 generation. The range for oil content (34.1 – 41.0%), seed yield/plant (28.2 - 43.9 g) and 100-seed weight (3.2 - 5.7 g) for the best selections from RIPE-18-542 and RIPE-18-611 *vis-à-vis* checks indicate superiority for seed yield (13.3-16.8 g/plant) and oil content (31.5-34.2%). From S_6-1C-RIPE populations, 35 lines with high oil content (38-41%), 29 lines with high seed yield (30-40 g/plant) and 11 lines with high test weight (4.1-5.2 g) were selected.

Inbreds were also developed from different cycles of RIPE populations. Of the total 19 S4-2C-RIPE selections, 4 were selected and oil content ranged from 35.1-40.3%; seed yield from 16.7-28.3 g/plant and 100 seed weight from 3.0-4.2 g/plant. In 3rd cycle RIPE (3C-RIPE) of the total 23 S_3-3C-RIPE selections, 16 families were selected with oil content from 32.8-45.8%, seed yield from 15.0-48.4 g/plant and 100 seed weight from 2.6-5.6 g/plant. In 4th cycle RIPE (4C-RIPE) populations, of the total 62 families, 43 families were selected. In the checks, oil content ranged from 28.7-45.8%, seed yield is from 15.5-49.6 g/plant and 100-seed weight ranged from 3.1-7.4 g.

Development of interspecific inbred lines

In order to transfer biotic and abiotic stress resistance from wild species of *Carthamus* (*C. oxyacantha* and *C. palaestinus*), direct crosses and back crosses were attempted with cultivated safflower variety (A1) which are in different stages as listed below.

- F_5 generation of [*C. tinctorius* x (*C. tinctorius* x *C. oxyacantha*)]
- F_3 generation of [(*C. oxyacantha* x *C. palaestinus*) *C. tinctorius*]
- F_2 of (BC_1 x F_1): [(*C. tinctorius* x *C. oxyacantha*) *C. tinctorius*) x (*C. tinctorius* x *C. palaestinus*)]
- BC_2-F_3 of [(*C. tinctorius* x *C. oxyacantha*) *C. tinctorius*]
- BC_1F_2 of [(*C. tinctorius* x *C. palaestinus*) *C. tinctorius*]

In the F_5 generation of [*C. tinctorius* (A1) x (*C. tinctorius* (Nira) x *C. oxyacantha* (IP-16)], eight best line selections, with oil content (29.2-36.0%), seed yield (23.2-57.1 g/plant) and 100 seed weight (4.3-5.2 g.), in the F_3 generation of (*C. oxyacantha* (IP-16) x *C. palaestinus* (PI-235662-1) *C. tinctorius* (A1), nine best selections with oil content (32.3-72.7%), seed yield (16.0-27.9 g/plant) and 100 seed weight (4.0-5.6 g), from BC_2-F3 of (*C. tinctorius* x *C. oxyacantha*) *C. tinctorius*], seven best selections for oil content (24.3-33.5%), seed yield (17.0-38.2 g/plant) and 100-seed weight (4.2-6.0 g) were selected. The range for oil content, seed yield and 100-seed weight in the checks (A1, ISF-764, PBNS-12) was 27.6-33.2%, 12.1-18.5 g/plant and 4.6-6.2 g, respectively.

Generation advancement of new crosses

A total 14 new bi-parental crosses were advanced to F_2 generation. Parents were selected based on traits like early maturing and high oil lines, high yielding lines, high yielding and high oil lines, high oleic lines, and non-spiny with high oil-high yielding lines.

Maintenance of trait-specific inbred lines

Lines moderately tolerant to aphids *viz.*, ISF-51-15, ISF-161-15, R-sel-05-63-4-5-19, ISF-1305-sel-15, ISF-158-15, ISF-121-sel-15 and ISF-3840-sel-15; wilt differentials *viz.*, 96-508-2-90, DSF-4 (9.5 to 14.1% WI), DSI-116/ISF-116, DSI-104, ISF-2305, ISF-2258-17; Alternaria tolerant lines *viz.*, ISF-1749-1-5-2016/ISF-1475, ISF-1703-2-1-2016/ISF-1479; Fusarium wilt resistant lines *viz.*, ISF-2342, ISF-2413-17 and ISF-2417-17 were multiplied.

Hybrid Development

A total of 17 newly generated safflower experimental hybrids were screened against Fusarium wilt resistance and all hybrids showed resistance reaction (4.5 – 12.5). In order to purifiy the contaminated A-133-1A male sterile line, 65 paired crosses were attempted.

Confirmation of interspecific hybrids through morphological characters

A total of 13 out of 15 interspecific hybrids germinated successfully. All interspecific hybrids along with parental lines were characterized for 12 quantitative and 7 qualitative traits to confirm true interspecific hybrids. Leaf shape and flower colour were intermediate in interspecific hybrids. Total number of branches was more in interspecific hybrids than the female parent. Interspecific hybrids were early in flower initiation and 50% flowering compared to both the parents. Total flowering duration was more in all interspecific hybrids than parents. Capitulum number was more (at least 3 times more) in interspecific hybrids than both the parents. Number of seeds in main capitulum was more in female parent than interspecific hybrids and male parents. Back crossing (BC_1) was attempted to remove undesirable traits as well as selfing was attempted in true interspecific hybrids. BC_2 as well as F_2 generations were raised during *rabi* 2022-23.

Variation in quantitative characters in interspecific hybrids

	Pollen fertility (%)			Days to 50% flowering			Diameter of main capitula (mm)		
	Female parent (5)	Male parent (3)	F_1 hybrids (13)	Female parent (5)	Male parent (3)	F_1 hybrids (13)	Female parent (5)	Male parent (3)	F_1 hybrids (13)
Minimum	92.69	95.03	66.48	82.00	111.0	62.0	20.05	7.81	12.89
Maximum	96.30	98.10	93.83	89.00	119.0	82.0	23.85	8.92	16.24
Mean	95.08	96.40	85.95	86.00	114.6	73.7	21.80	8.41	14.11
	Plant height upto main capitula (cm)			Seed number/main capitula			Capitlum number/Plant		
	Female parent (5)	Male parent (3)	F_1 hybrids (13)	Female parent (5)	Male parent (3)	F_1 hybrids (13)	Female parent (5)	Male parent (3)	F_1 hybrids (13)
Minimum	64.40	30.00	51.00	12.20	0.60	0.00	24.60	7.20	54.60
Maximum	74.20	37.60	66.00	34.20	7.20	15.00	52.90	31.20	222.50
Mean	70.00	33.28	58.42	25.09	3.40	3.51	37.91	21.28	136.76

Plant vigour Spines Leaf

Flower colour No. of capitula and branching Pollen fertility

Morphological variability in interspecific hybrids for different traits

Exploiting Genetic Diversity for Improvement of Safflower through Genomics-Assisted Discovery of QTLs/Genes Associated with Agronomic Traits

A network project entitled 'Exploiting genetic diversity for improvement of safflower through genomics-assisted discovery of QTLs/genes associated with agronomic traits' under the mission mode programme on 'minor oilseeds of Indian origin' is implemented in collaboration with ICAR-NBPGR (New Delhi); AICRP-Safflower centres at Vasanthrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani (Maharashtra) and Mahatma Phule Krishi Vidyapeeth (MPKV), Solapur (Maharashtra); University of Delhi (Delhi) and Punjab Agricultural University (PAU), Ludhiana (Punjab) to develop genetic/genomic resources in safflower for enabling molecular breeding research.

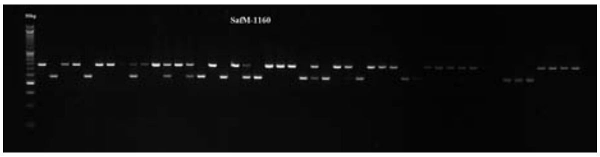
Development of molecular core set of safflower: At ICAR-NBPGR, a total of 6983 accessions of safflower germplasm were assembled and purified through selfing. GBS using ddRAD with MSeI+EcoR1 combination has been completed for 3500 accessions.

Draft genome sequencing of safflower: At University of Delhi, genome sequencing of a safflower parental line has been completed using a combination of Illumina and PacBio platforms and the primary contigs level assembly with the contiguity of 8.91 Mb has been generated.

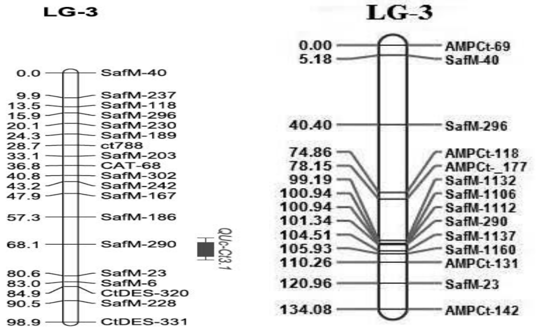
Development of mapping populations: At ICAR-IIOR, a total of 1940 inbred lines representing six mapping populations from bi-parental/multi-parent crosses developed for identification of QTLs associated with agro-morphological traits including yield components, oil content and tolerance to aphid in safflower were advanced.

Fine-mapping and validation of major QTL associated with tolerance to aphids

The major QTL (*QUc-Ct3.1*) region on linkage group (LG)-3 with the flanking SSRs, SafM-290 and SafM-23 (~12.5cM), was reduced to ~2 cM interval with new flanking SSRs, SafM-1160 and SafM-1137, using F_8-RIL population of CO-1 x EC-523368-2 cross. In the first step, a SNP marker, AMPCt-131, was mapped between SafM-290 and SafM-23. Subsequently, the genomic region between SafM-290 and AMPCt-131 was extracted (positions 96355236 to 98198566) from the safflower reference genome sequence using SAM tools. A total of 97 SSR primer pairs were designed from this region; of these, 12 were polymorphic between parents, which were further used for genotyping the F_8-RIL population. The refined map position of the major QTL on LG-3 is shown below. The newly found SSR markers SafM-1160 and SafM-1137 showed strong association with tolerance to aphids based on days to wilt after aphid infestation (R^2=37-50%), chlorophyll content SPAD_1-4, (R^2=37-68%) in F_{10}-RIL and BC_1F_3 populations and biomass under aphid stress in F_{11} RIL population (R^2=40%).



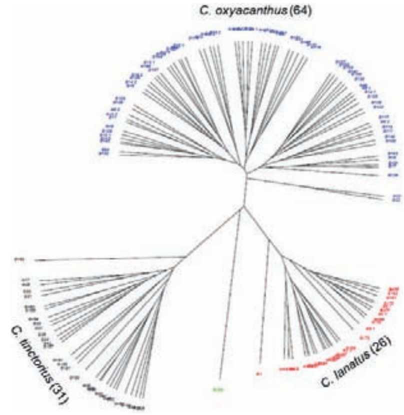
Segregation of SSR marker SafM-1160 in F_{10}-RIL population of CO-1 x EC-523368-2 cross



Map position of major QTL, *QUc-Ct3.1* associated with tolerance to aphids in safflower

Validation of SNP markers in safflower germplasm

A set of 58 SNP markers designed using NGS data of safflower genotypes CO-1 and EC-523368-2 were validated in a panel of 121 germplasm comprising of 31 *C. tinctorius*, 64 *C. oxyacanthus* and 26 *C. lanatus* accessions. The SNPs were highly polymorphic (90%). The expected heterozygosity (0.38), observed heterozygosity (0.59), number of effective alleles (1.67) and Shannon diversity index (0.82) parameters indicated high level of diversity in the germplasm panel. The SNP markers produced species-wise distinct clustering of genotypes.



Diversity in safflower germplasm revealed by SNP markers

Crop Production

Modifying planting geometry of soybean for relay sowing of safflower on broad bed and furrow (BBF) method of land configuration under rainfed conditions

A field experiment was conducted in broad bed (1.2 m) and furrow (0.3 m) method of land configuration (BBF) in deep Vertisols in split plot design with four replications under rainfed conditions. The main plot treatments consisted of four modified plant geometries of soybean-safflower and three safflower based cropping systems *viz.*, soybean (short duration)-safflower; soybean (medium duration)-safflower and; soybean (normal duration)-safflower were arranged in subplot treatments.

Three varieties of soybean *viz.*, JS-93-05 (short duration), Basara (medium duration) and JS-335 (normal duration) were sown with the onset of monsoon under rainfed conditions. An amount of 1000 mm of rainfall was received during cropping season (June to December). Seed yield of normal duration variety JS-335 was significantly the highest (1498 kg/ha). Modified plant geometry of soybean did not differ significantly for seed yield (1252 to 1403 kg/ha). Interaction was not significant. Due to extended monsoon, safflower could not be sown as relay crop and sown as sequence crop in all the treatments on 9 November, 2022.

Crop Protection

Screening of breeding lines for wilt reaction

Thirty multi-parent cross based breeding lines were screened for evaluation of resistance against wilt under glass house conditions by sick pot method. Among thirty lines, 29 lines (M-F7-3, M-F7-6, M-F7-9, M-F7-11, M-F7-12, M-F7-21, M-F7-25, M-F7-27, M-F7-31, M-F7-32, M-F7-33-2, M-F7-35, M-F7-38, M-F7-40, M-F7-42, M-F7-47, M-F7-50, M-F7-51, M-F7-53, M-F7-57, M-F7-59, M-F7-60, M-F7-62, M-F7-66, M-F7-69, M-F7-71, M-F7-75, MF7-76 and M-F7-78) were immune to wilt with 0% disease incidence and one breeding line *viz.*, M-F7-17 reported as moderately susceptible to wilt with 30% disease incidence. While the susceptible check (NIRA) and resistant check (TSF1) showed 100% and 0% wilt incidence respectively.

M-F7-78 and NIRA

M-F7-3 and NIRA

Reaction of safflower wilt resistant breeding lines to aphids

A total of 200 germplasm accessions that were resistant to wilt were evaluated for their reaction to aphids during *rabi* season of 2021-22. Susceptible CO-1 variety was raised separately in infester block in November. When test entries attained stem elongation stage, infester plants were cut and distributed evenly. When susceptible CO-1 was killed, plant injury rating due to aphids was awarded on 5 randomly selected plants in each entry on a 0-5 scale. Aphid Infestation Index (A.I.I) was calculated and the entries were categorized. Twenty-eight accessions were found moderately tolerant to aphids with an A.I.I. of 2.4-3.0. Susceptible check, CO-1 was found highly susceptible (A.I.I: 5.0).

Reaction of different safflower accessions against aphids

Accessions	A.I.I	Category
EC-182022, EC-199879, EC-199909, EC-210581, EC-211459, EC-211468, EC-246570	2.4	Moderaltely Tolerant (MT)

EC-199909 EC-199879

Different safflower accessions screened against aphids

Floral visitor insects of safflower

A field experiment was conducted to study the number of floral visitor insects (per min) visited the flowers (*n* = 10) and the mean time spent (s/flower) (*n* = 50) by the floral visitor insects at the safflower blooming stage. The highest flowers visited by the floral visitor insects (±standard error) was noticed during third week of March (8.30). The time spent (s/flower) by rock bee was observed during last week of March (8.27).

Sesame

Crop Improvement

Germplasm maintenance, characterization, evaluation and enhancement

A total of 2090 germplasm accessions and 75 released varieties are being maintained at IIOR. Among them, 378 accessions were evaluated and characterized for major agronomic characters.

Characterization of germplasm accessions for major agronomic characters during summer season

Trait	Range	Promising accessions	Value of checks
Days to flowering	30-55	IC-205718 (30), IC-205784 (30)	40 (Swetha, GT-10)
Number of nodes to first capsule	1-5	CT 50, IC 204843 (3)	4 (Swetha, GT- 10)
Height of the first capsules (cm)	10-66	NIC-7832 (10), C-1, IC-205746 (11)	Swetha (22), GT-10 (35)
Plant height (cm)	60-131	GRT-8245, IC-500542	Swetha (122), GT-10 (82)
Length of capsule (cm)	2.2-3.4	IC-14146, IC-17477	Swetha (2.5), GT-10 (2)
Oil content (%)	25.6-54.2	IC-500492 (54.2), S-366 (53.4), TKG-22 (52.9), NIC-16120 (52.9), ES-49-1-84 (52.6), IC-500518 (52.2)	Swetha (41.3), GT-10 (36.4)
Seed yield (g/plant)	1.5-17.5	VCR/82/101N (19.5), SI-1188 (16.5), S-157-A-1 (17.5), IC-413200 (16.5), NIC-16227-B (16.5), EC-108936 (15), KMR-48 (14.5), NIC-17301 (13.5), IC-395814 (12.5), KMR-14-A (12.5), IC-500403 (11.5).	Swetha (8.5), GT-10 (6.5)

Evaluation of sesame accessions from USDA, USA

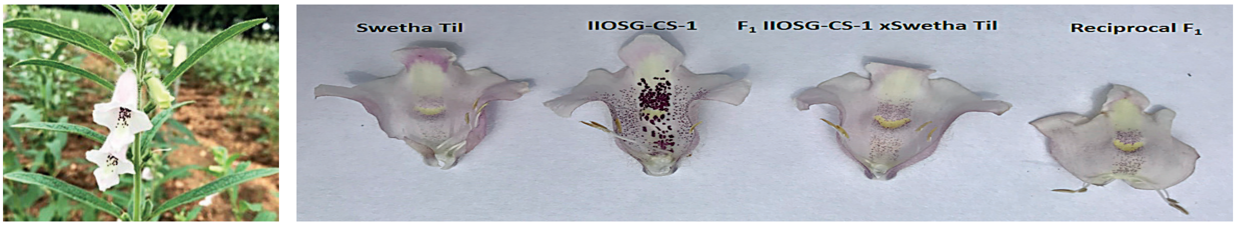
One hundred and forty accessions received from USDA were evaluated during summer for the trait specific accessions. Seed yield per plant ranged from 0.6-27.9 g/plant (PI-200105, PI-200111), days to maturity ranged from 75-120 days (PI-320958 early maturing line) and 8 accessions (PI 231033, PI-170737, PI-170767, PI-177541, PI-238459, PI-179986, PI-170748, PI-280808) did not show any symptoms of powdery mildew indicating tolerance to the disease.

Fatty acid levels of sesame accessions from USDA

Trait	Range	Promising accessions	Range (%) published in literature
Oil content (%)	16.9-56.8	PI-202726 (56.8), PI-238470 (55.5), PI-238453 (54.4)	32.3-55.3
Oleic acid (%)	30.7-51.2	PI-250892 (51.2), PI-152498 (50.3)	38.2 to 47.3
Linoleic acid (%)	36.5-57.8	PI-238427 (57.8), PI-263470 (56.2)	30.8-51.6
Oleic/Linoleic ratio (%)	0.53-1.40	PI-250892 (1.4), PI-152498 (1.3)	0.82-1.07
Stearic acid (%)	3.3-6.1	PI-186411 (6.1), PI-179034 (6.0), PI-153517 (5.9)	4.6-6.5
Palmitic acid (%)	6.6-9.8	PI-280815 (9.8), PI-158900 (9.7), PI-182293 (9.6)	8.0-10.3
ALA (Omega-3) (%)	0.12-1.3	PI-186411 (1.3), PI-263462, PI- 263463, PI-158900, PI-179034 (1.2)	0.28-0.40

Identification of a rare morpho-type

Among the germplasm accessions maintained at IIOR, one accession, IC-235 was identified for the presence of conspicuous dark purple dense flakes in the inner corolla tube. The selection was named as, 'IIOSG-CS-1' for distinct corolla flakes. This morphological trait of IC-235 was very distinct from other accessions and released varieties. The F_1's of IIOSG-CS-1 x Swetha til and its reciprocal plants did not exhibit this conspicuous dark purple dense flakes in the interior corolla tube indicating recessive expression of the trait. In F_2 population (n=232), the trait segregated in the ratio of 3:1 (χ^2=1.37; P=0.24) indicating monogenic control of the trait. Further analysis of expression of anthocyanin genes will give better understanding on the variation of floral characters in sesame.



Inheritance of conspicuous corolla speckles in crosses of IIOSG-CS-1 x Swetha til and its reciprocals

Development of multicapsule plant types with conspicuous purple lip flower

A genotype having multicapsules with conspicuous purple lip flower type was developed (IOSG-MCPL) from a cross, IC-205776 x EC118591. The genotype was evaluated for the stable expression of multicapsules at every leaf axil and there were 1-3 capsules at each leaf axil on main stem and also on branches.

Genotype IOSG-MCPL with multicapsule and conspicuous purple lip flower

Pre-breeding

Development of interspecific population

Seventy eight families of interspecific cross Swetha til x *S. mulayanum* (IC-43144-1) were maintained at F_6 generation. Two families expressed sturdy and thicker stem over the parents.

Development of MAGIC populations

A set of 100 lines derived from two multiparent crosses *viz.*, MSES-434 ((Phule Til x RT-351)/(GT-2 x E-8)//(HT-1 x VRI-3)/(TKG-22 x Swetha) and MSES-435 ((HT-1 x RT-351)/(GT-2 x TKG-22)//(Hima x TSS-6)/(Rajeshwari x E-8) were evaluated for yield and yield related characters during late *kharif* season. Around 79 lines recorded >50% oil content out of which MSES-434-718 had highest oil content of 58.8% and this line recorded 53.8% of oil content during summer season.

Superior MAGIC lines for oil content and seed yield/plant

Line	Days to flowering	Days to maturity	Seed yield/ plant (g)	Oil content (%)
MSES-434-718	39	99	10.5	58.8
MSES-434-673	39	99	11.2	57.5
MSES-434-719	39	99	10.2	57.1
MSES-434-677	39	99	9.2	57.0
MSES-435-732	41	101	12.5	54.9
JCS-1020	40	100	5.5	56.5
Swetha	41	101	5.8	56.7
GT-10	33	93	6.5	48.9
Mean	41	101	9.2	52.3
SE (mean)	2.40	2.40	2.0	2.9
Minimum	35	95	5.0	40.0
Maximum	50	110	12.8	58.8
CV (%)	5.9	2.4	21.6	5.6
CD (P=0.05)	1.6	1.4	1.7	5.8

Varietal development

Sixty genotypes developed from four crosses *viz.*, CSES1-17 (IS-49-1A x RT-346), CSES2-17 (CT-55 x CT-57), CSES3-17 (EC-30344-1B x TKG-22) and CSES6-18 (DSTA-1-A x VRI-3) were evaluated for yield and its components in replicated trials along with checks (GT-10 and Swetha) during *kharif* season. The data on yield and its components for the best 14 genotypes superior over checks is presented.

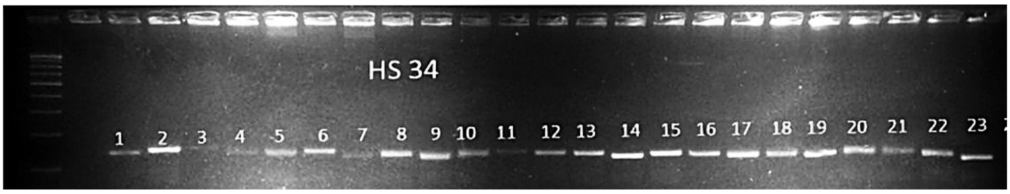
Yield and its components of 14 superior genotypes along with checks

Entries	DFI	DM	DF	CN	OC (%)	PB	PH (cm)	SYP (g)	SYH (kg)
CSES1-17-31	42.0	104	84	97.5	39.9	6	133.5	471.6	1164.4
CSES1-17-9	43.5	106	86	109.5	43.0	6	128.0	471.6	1164.4
CSES3-17-4	40.5	103	83	119.0	44.3	6	159.0	471.6	1164.4
CSES3-17-2	41.5	106	86	114.5	41.7	7	128.0	468.0	1155.6
CSES2-17-23	41.5	107	87	125.0	43.2	6	126.5	462.6	1142.2
CSES6-18-16	41.0	105	85	79.5	43.3	2	154.5	451.8	1115.6
CSES1-17-10	41.0	102	82	103.0	44.6	4	129.0	448.2	1106.7
CSES1-17-25	40.5	108	88	115.5	42.6	6	138.5	446.4	1102.2
CSES1-17-86	39.0	103	83	125.5	43.1	6	137.0	446.4	1102.2
CSES3-17-7	43.5	99	79	134.5	42.2	6	135.0	432.0	1066.7
IIOS-1101	45.0	101	81	105.0	41.8	6	135.5	504.72	1246.2
IIOS-1102	44.0	117	85	102.0	44.4	6	127.0	642.6	1586.7
IIOS-3101	45.0	106	87	99.0	44.3	6	118.5	484.2	1195.6
IIOS-3102	46.0	118	87	121.0	44.5	6	124.5	592.2	1462.2
Swetha (C)	57.0	118	98	99.0	41.7	8	133.5	340.2	840.0
GT-10 (C)	35.0	105	85	116.0	41.9	11	110.0	325.8	804.4
General Mean	42.0	106.4	85.6	99.4	43.5	4.9	135.8	420.3	1037.7
p-Value	<.0001	<.0001	<.0001	<.0001	0.005	<.0001	<.0001	0.09	0.2
CV (%)	2.6	1.9	2.2	7.9	3.4	9.2	5.2	20.9	51.6
SE(d)	1.1	2.1	1.9	7.8	1.5	0.5	7.1	87.8	216.7
LSD at 5%	2.21	4.19	3.93	16.00	3.03	0.92	14.52	NS	

Days for flower initiation (DFI), days to maturity (DM), duration of flowering (DF), capsule number (CN), oil content (OC %), estimated seed yield (SYH kg/ha), primary branches/plant (PB), plant height (PH), seed yield per plot (SYP).

Molecular diversity of sesame based on microsatellite marker loci

Four hundred and twelve SSR marker loci were surveyed among 120 sesame genotypes to analyze DNA-level diversity and it was found that 214 among 412 marker loci showed polymorphism and were able to discriminate at least two genotypes on 4% agarose gel electrophoresis. Forty-seven markers were able to discriminate at least 10 genotypes and were deployed in DNA-fingerprinting of sesame varieties to establish their identity in relation to referred genotype.



A microsatellite marker HS34 discriminating 23 genotypes

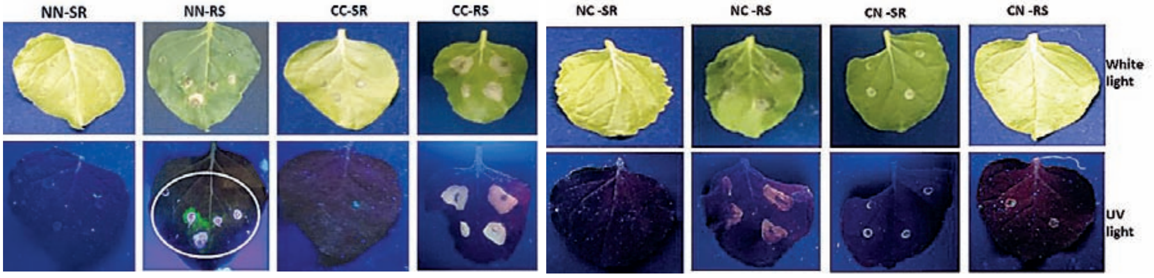
Cloning of effector and interacting protein encoding genes

In the preliminary Y2H experiments at DU, two proteins RNF5 E3 ubiquitin-protein ligase (LOC105167488), and NPY4 BTB/POZ domain-containing protein (LOC105158596), had been identified to be interacting with SAP54 ortholog (S54LP). Therefore, cloning of the EM (S54LP – SAP54 like protein), RNF5 and NPY4 was carried out using the genomic DNA isolated from infected sesame plants using specific primers. *SAP54* cloned from infected sesame plants of the cultivar Swetha from ICAR-IIOR (Rajendranagar research farm), showed that it was exactly same as that reported by DU*RNF5* (genomic clone) and *NPY4* (cDNA clone) and were confirmed by sequencing and both were also amplified without the stop codon to facilitate the C- terminus translational fusion of the fluorescent protein (GFP) in rBiFC vectors.

RNF5 was isolated from different genotypes (GT-10, Swetha and CUMS-15) that had shown differential intensity of phyllody manifestation. Comparison of the sequences sprang some surprise. In two of the genotypes, there was a deletion of in-frame 9 bases (571 to 579) while it was exactly same as that which is deposited with NCBI (XM_011087244.2) in Swetha genotype. Therefore, it was decided to develop two sets of rBiFC vectors with both the isoforms (RNF5 and RNF*5 - isoform with the deletion) of *RNF5*. All three gene fragments of *SAP54* (the effector molecule) and the two genes encoding interacting proteins RNF5 & RNF*5 and NPY4 with the confirmed sequence were cloned in rBiFC destination vector system using gateway cloning to achieve all combinations of NN, CC, NC and CN vectors. In total, 24 clones – 8 with RNF5, 8 with RNF*5, 8 with NPY4, were developed and moved into *Agrobacterium* strain (GV1301). Agroinfiltration technique was optimized using control vector that expressed full length EGFP under 35 promoter (pEff vector).

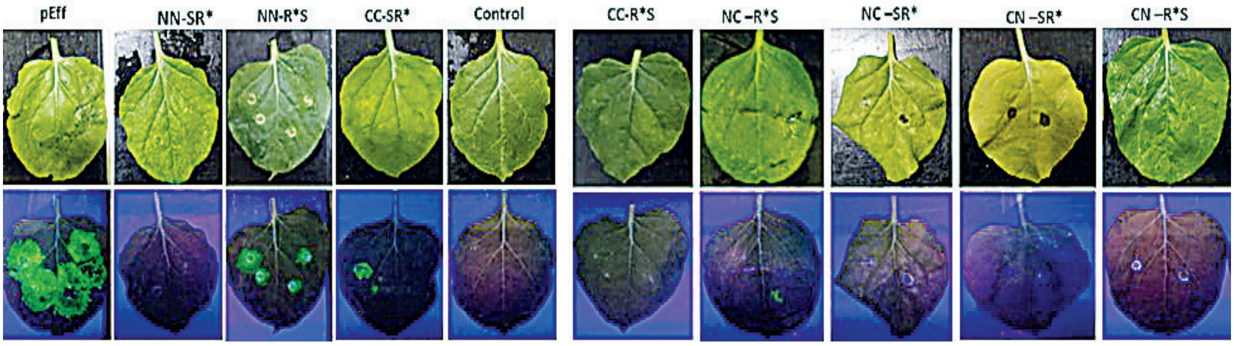
In planta transformation and confirmation of the interaction of EM and interacting partners (IP) through microscopy of *Nicotiana benthamiana*

The confirmed Agro strains carrying the developed rBiFC vectors were used for agro-infiltration using *Nicotiana benthamiana* leaves. With the first set of vectors with RNF5 as the IP and SAP54 as EM, the fluorescence was noticed in two NN-RS and CC-SR out of eight combinations of the vectors which demonstrated that it was necessary to include all combinations for the experiments. This trial was repeated several times with all the eight vectors and every time only the two combinations gave clear fluorescence and these results clearly established the interaction between RNF5 and S54LP.



Agro-infiltration with the set of 8 vectors carrying S54LP and RNF 5 –only two combinations NN-SR and CC-SR showed fluorescence

The second set of rBiFC vectors with the RNAF*5 (deposited with NCBI, Genbank ID: ON811685.1 allotted) was developed and the *in planta* agro-infiltration studies demonstrated that the deletion did not affect the interaction between RNF5 and SAP54. Again, the same two combinations NN-R*S and CC-SR* gave the fluorescence as seen in the earlier set of vectors. Repeated experiments also confirmed the results and suggested that both, RNF5 and RNF*5 showed similar and clear interaction with SAP54 in *N. benthamiana* indicating no effect of the deletion on the interacting domain of RNF5.



Infiltration with the set of 8 vectors for S54LP and RNF*5 – only two combinations (same as in RNF5) showed fluorescence

With NPY4 rBiFC vectors, the fluorescence was noticed in three (NN-NS, CC-SN and NC-SN) out of the eight combinations. These were validated with repeated (at least 3) experiments and the trials established interaction between E3 ubiquitin-protein ligase (both isoforms RNF5 and RNF5*), NPY4 BTB/POZ domain-containing protein and SAP54.

The leaf infiltration studies with periwinkle as well as sesame seedlings have not given any clear results so far as the leaves show necrotic reaction after the infiltration. As a future line of work, to understand the domains of the host proteins involved in the interaction with effector protein, only the gene fragments encoding specific domains of IPs will be cloned in rBiFC vectors along with SAP54.

Crop Production

Development of best management practices (BMPs) for organic soybean-sesame cropping system

A field experiment was conducted in Vertisols under irrigated conditions in a fixed plot layout with eight nutrient management options to study the comparative performance of sesame under organic, inorganic and integrated management conditions and to study the soil health under organic input conditions since 2018 for soybean (cv. Basara) - sesame (cv. Swetha) cropping system. A plot size of 45 m^2 was maintained per treatment. Organic BMPs included: seed treatment with *Trichoderma viride* 4g/kg; cultivation of sorghum and dhaincha along the border; prophylactic spray with neem oil/ neem formulations at fortnightly interval; "T" perch for predation of insect larvae; Panchagavya spray @ 3% two times at 15 days interval and; nutrient supplementing biofertilizers *viz.*, PSB, Rhizobium for both the crops wherever applicable.

The initial soil status of the experimental field was: pH-8.14, EC-0.57 dsm^{-1}, OC-0.42%, Available N-186.7 kg/ha, Available P-12.8 kg/ha, Available K-865.7 kg/ha, DTPA Zn-1.2 ppm, Fe-7.3 ppm, Cu-1.6 ppm and Mn-9.2 ppm.

Effect of nutrient management options in sesame

Treatment	Seed yield (kg/ha)	OC (%)
Control	318	0.32
Organic: 100% RDF (FYM* + Rock phosphate) + PSB	565	0.47
Organic: 100% RDF (Green leaf manure + Rock phosphate) + PSB	500	0.38
Organic: 100% RDF (Castor cake + Rock phosphate) + PSB	744	0.61
Organic: 100% RDF (Neem cake + Rock phosphate) + PSB	666	0.37
Organic: 100% RDF (FYM + vermicompost + Goat manure + Rock phosphate) + PSB	762	0.44
Towards organic: 50% inorganic + 50% organic (through FYM + Rock phosphate)	779	0.42
Inorganic: 100% RDF (Urea, DAP, MOP)	813	0.40
CD (p=0.05)	72	0.11

*as *Trichoderma viride* compost; OC-Organic carbon

During the 4th year of study, organic sesame in the soybean-sesame cropping system responded well to organic modules with temporal variations. Substitution of sesame nutrient requirement through castor cake, one third each of FYM, vermicompost and goat manure produced comparable yield to that of nutrient management through inorganic means. Perceptible differences in the soil health was noticed in terms of soil organic carbon content as an indication of the improvement in soil health and inclusion of castor cake has consistently recorded higher values.

Management practices for enhancing sesame productivity under rice-sesame cropping system

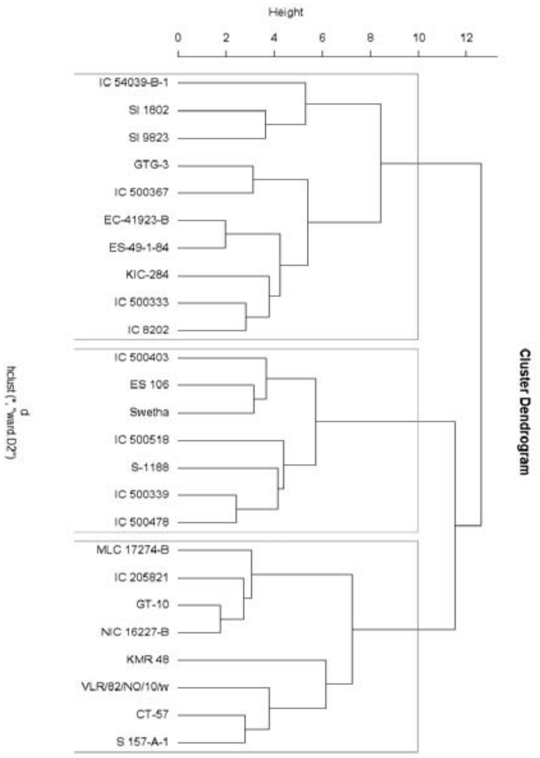
A field experiment was conducted in four locations *viz.*, Hyderabad (Telangana), Ragolu (Andhra Pradesh), Aduturai (Tamil Nadu) and Mahisapet (Odisha) to find out the optimum tillage and nutrient requirement for rice fallow sesame with tillage management as main factor (Reduced tillage, Conventional tillage and Zero tillage) and; nutrient management as sub-factor (Control, 25% RDF, 50% RDF, 75% RDF and 100% RDF) with recommended dose of fertilizers at different centres ((Hyderabad (30:30:20), Mahisapet (50:30:20), Aduturai (35:23:23) and Ragolu (40:40:20)). The experiment was conducted in a split plot design with three replications. The results reported for Hyderabad and Mahisapet have indicated that zero tillage resulted in significantly lowest yield while conventional tillage was superior. Application of 125% RDF registered highest yield of sesame at Mahisapet (Odisha), albeit on par with 100 and/or 125% RDF for Hyderabad (Telangana).

Effect of tillage and nutrient management on yield (kg/ha) and yield attributing parameters of rice fallow sesame (2021-22)

Treatment	Mahisapet (Odisha)			Hyderabad (Telangana)		
	No. of capsules/plant	Seed yield (kg/ha)	Biomass (kg/ha)	No. of capsules/plant	Seed yield (kg/ha)	Biomass (kg/ha)
Tillage practices						
Reduced tillage	43.51	403	1524	45.4	361	1755
Conventional tillage	49.36	430	1620	47.9	394	1861
Zero tillage	32.28	273	1054	43.4	336	1631
SEm±	0.16	1.11	19.1	0.7	7.0	33
CD (P=0.05)	0.62	4.36	75.0	2.7	27.0	128
Fertilizer management						
Control	31.02	292	1115	40.4	288	1445
25% RDF	33.44	303	1181	41.6	317	1567
50% RDF	38.31	323	1259	43.1	364	1750
75% RDF	45.09	394	1481	48.5	385	1840
100% RDF	50.27	434	1640	50.0	407	1918
125% RDF	52.16	466	1721	53.3	421	1974
SEm±	0.36	13.3	48.2	1.8	15.0	64
CD (P=0.05)	1.05	38.3	139.4	5.1	44.0	185

Physiological traits to identify tolerant genotypes in sesame under deficit soil moisture conditions

Experiments were conducted under well watered (WW) and deficit soil moisture (WS) stress conditions with a set of twenty-five sesame genotypes. Severe moisture deficit drastically affected the crop growth and yield. The physiological traits like gas-exchange parameters, relative water content (RWC), leaf area ratio (LAR) and intrinsic water use efficiency (iWUE) increased in drought stress conferring the moisture stress tolerance. Seed yield decreased by 54% under WS compared to WW conditions; however, genotypes SI 1802 and SI 9823 had maximum seed yield of 17.98 g/plant and 15.90 g/plant under WW and 11.47 g/plant and 11 g/plant under WS conditions respectively. Different indices conferring drought tolerance were derived based on the yield under irrigated (Yp) and stress (Ys) conditions such as stress tolerance index (STI), mean productivity index (MPI), geometric mean productivity (GMP), yield index (YI), stress tolerance (TOL) and yield stability index (YSI). The factor analysis revealed that the genotypes SI 1802 and SI 9823 expressed higher values for indices i.e., STI, MPI, and GMP under moisture stress along with higher seed yield. These identified genotypes may be used in breeding programs for the development of varieties.

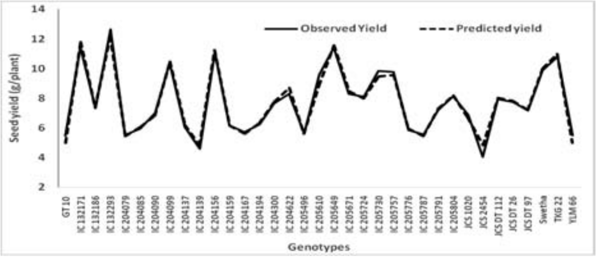


Grouping of sesame genotypes based on physiological traits and indices using cluster analysis.

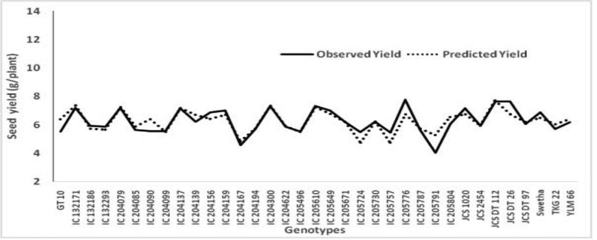
Dynamics of Leaf chlorophyll content in water-stressed vs. well-watered sesame accessions and its relationship with seed yield

Leaf chlorophyll content is directly related to tolerance and higher productivity under water stress. The SPAD Chlorophyll meter is an excellent tool for rapid analysis of crop chlorophyll content. Establishing relationship between leaf chlorophyll content and seed yield is crucial in sesame, particularly under deficit moisture stress. Thirty seven (37) sesame genotypes, mostly land races with similar phenology and maturity duration adapted to different agro-ecological zones along with two national checks (GT-10 and TKG-22) that are better seed yielders and a local check (SwethaTil) were evaluated under well water (WW) and deficit moisture stress (WS) conditions during *summer* 2022 to study SCMR variations.

The SPAD readings were recorded ten (10) times each at every seven days intervals from the juvenile/first bud (30-35 DAS) to ripening/physiological maturity (95-100 DAS) stage. Analysis of variance revealed the presence of significant variation in SPAD readings due to treatments (WW and WS), genotypes, and interaction effects. The SPAD readings at all stages were positively correlated with seed yield in both WW and WS. Correlation coefficients were high at 52 (r: 0.672) and 59 (r: 0.655) DAS under WS and at 59 (r: 0.960), 66 (r:0.972) and 73 (r: 0.974) DAS under WW at one percent significance level ($p<0.01$), which coincides with the mid-bloom stage of the sesame crop. The best-fit multiple regression model revealed the significant influence of sesame seed yield by SPAD reading at 52 DAS under WS and 59 to 73 DAS under WW. Both these models provide a good fit with the chi-square test, which compares the predicted and observed yield.



Observed and predicted seed yield under well-watered conditions



Observed and predicted seed yield under water-stressed conditions

Crop Protection

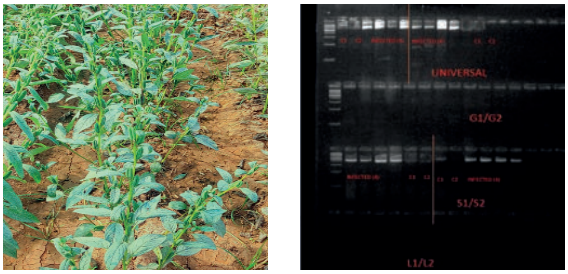
Screening of sesame genotypes against root rot disease by sick pot method

Different sesame genotypes were tested against root rot by sick pot method under pot culture conditions. The root rot incidence ranged from 5.4 to 83.7% in different entries. The genotypes SEL-S-20-2001, PR-2102, PR-3003, PR-1030 and PR-1019 recorded root rot incidence of <10%, while RT-389, RT-390, OSM-19-07, OSC-79-13-3, PR-1038, PR-1039 and JCS-3890 showed root rot incidence of <20%. The entry SEL-S-20-2001 recorded <10% root rot incidence consecutively for two years. The root rot incidence was 83.7% in VRI-1 (susceptible check) while 6.7% in GT-10 (Resistant check).

Macrophomina root rot screening through sick pot method of advanced breeding genotypes resulted in identification of resistant lines *viz.*, RR-2102, RR-3003 and SES-S-20-2001 and moderate resistant lines *viz.*, RR-1038, RR-1039. These lines were evaluated in Multilocation (Vridhachalam, Jabalpur and Dharwad) to confirm for disease reaction.

Identification of resistant sources for powdery mildew in sesame

A field experiment was conducted to evaluate the germplasm (n=446) of sesame including USDA germplasm. Among the germplasm evaluated, IC-500445 was found to be resistant to powdery mildew under natural infection. The same was confirmed with molecular methods which showed that susceptible germplasm (infected powdery mildew) was amplified than resistant germplasm (IC-500445).



(a) (b)

(a) Germplasm, IC-500445 showing resistance to powdery mildew and (b) Amplification of powdery mildew in susceptible germplasm

Characterization of Phytoplasma strain infecting sesame

Phytoplasma strain infecting sesame at Hyderabad, Rajasthan, Madhya Pradesh, Gujarat, Varanasi as well as weeds like Cleome, Parthenium and *Physalis minima,* showing symptoms of phyllody and grown in sesame fields were identified as *Candidatus Phytoplasma aurantifolia*. This indicated prevalence of the strain and provided clue for continued availability of inoculum for sesame crop.

Identification of resistant sources for major insect pests of sesame

The sesame genotypes were screened for phyllody, leafhopper, leaf webber, gall midge and other insect pests (whiteflies and mirid bug) in field. The sesame genotypes (n=60) graded for phyllody as highly resistant (1), resistant (12), moderately resistant (20), tolerant (13), moderately susceptible (12) and susceptible (2) based on incidence. Genotype, IIOS-20-3013 showed highly resistant reaction to phyllody with no symptoms. Similarly, the sesame genotypes (n=60) graded for leafhopper as resistant (27), moderately resistant (32) and moderately susceptible (1) based on population/incidence. The sesame genotypes (n=60) graded for leaf webber as highly resistant (1), resistant (17), moderately resistant (28), susceptible (13) and highly susceptible (1) based on incidence. Genotype SES-K-20-2016 showed highly resistant reaction (0-10%) to leaf webber incidence in field. The sesame genotypes (n=60) graded for gall fly as resistant (29), moderately resistant (22), moderately susceptible (8) and susceptible (1) based on incidence.

The populations of whitefly (per leaf) and mirid bug (per plant) ranged from 0.69 to 1.56 and 6.6 to 26.0, respectively. The least incidence of whitefly (per leaf) and mirid bug (per plant) was noticed in SES-K-20-2010 (0.69) and SES-K-20-2025 (6.6), respectively. However, the highest populations of whitefly (per leaf) and mirid bug (per plant) were observed in SEL-S-2018-1010 (1.56) and SES-K-20-2014 (26.0).

Reaction of sesame genotypes to phyllody under open field conditions

Category	Percent disease incidence	Number of sesame genotypes	Genotypes
Highly resistant	No symptoms	1	IIOS-20-3013
Resistant	0.1-10%	12	ISWG-20-05, RT-372, SES-K-20-1051, SEL-S-2018-1010, SES-K-20-1052, SES-K-20-2022, SES-K-20-2025, GT-10, SES-K-20-2014, Long knog-2, IC-16239, SES-K-20-1063

Reaction of sesame genotypes to leaf webber under open field conditions

Category	Percent leaf webber incidence	Number of sesame genotypes	Genotypes
Highly resistant	0-10%	1	SES-K-20-2016
Resistant	11-20%	17	SES-K-20-1056, SES-3-19-3014, SES-K-20-1063, SES-S-19-1013, SES-K-20-1050, SES-K-20-1057, Julang sesame, Long knog-1, Long knog-2, SES-K-20-1072, SES-K-20-2021, SES-K-20-2022, SES-K-20-2027, RT-372, SES-K-20-1058, IC-16239, SES-K-20-2023

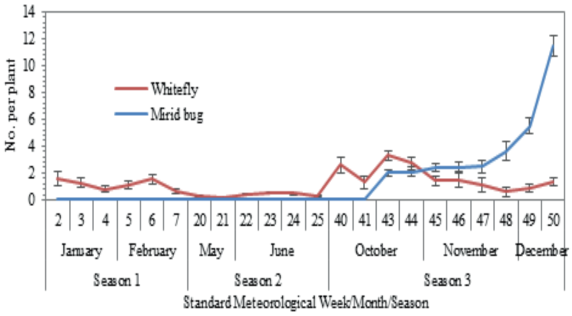
Symptoms and nature of damage and seasonal incidence of insect pests of sesame

Field experiments were carried out to demonstrate the symptoms and nature of damage and seasonal incidence of emerging pests, whitefly, mirid bug and other insect pests in sesame during three seasons, season 1 (January to February, 2022), season 2 (May to June, 2022) and season 3 (October to December, 2022). Mirid bugs caused huge damage to sesame by sucking sap from leaves, terminal buds, flowers and capsules. Apart from sucking sap, they also inject some toxins. If attacked before fruit set, plants can lose their terminal bud, leading to stunted growth. Feeding damage on young flowers can cause drying and blasting within 3-4 days. A lesion is formed at the puncture site due to toxic secretions. Lesions on leaves are dark and generally clustered towards the leaf centre adjacent to veins. Lesions just below the

Different stage of mirid bug and its symptoms and nature of damage

growing tip may result in tip death. Heavy mirid bug infestation can arrest the crop growth by killing most tips.

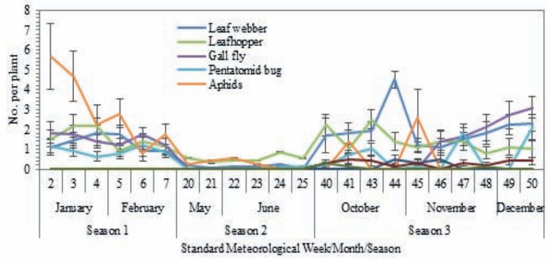
Whitefly population (per plant) was observed during all three seasons and the population reached maximum during October (9.9). Mirid bug incidence (per plant) appeared during season 3 (October to December, 2022) and reached peak during November (10.9) and December (17.0).



Incidence of mirid bug and whitefly in sesame during three seasons

(Error bars represent standard error of the means as determined by Tukey's post hoc test at $P \leq 0.001$)

Incidence of leaf webber and leafhopper appeared during all three seasons. Leaf webber population (per plant) was found highest during winter months (27.8), January (4.3), February (3.5), October (9.9), November (5.6) and December (4.5) with peak during October (9.9) and reached lowest during May (0.2), June (0.4). Leafhopper incidence (per plant) was found highest during winter months (21.2), January (5.8), February (3.5), October (7.1) and November (4.7) with peak during October (7.7) and lowest during May (0.8). Gall fly incidence (per plant) was reported to be highest during winter months (20.0), January (4.9), February (4.1), November (5.1) and December (5.8) and attained peak during December (5.8), reached zero during May and October. Similarly, Pentatomid bug incidence (per plant) was found highest during winter months (11.4), January (2.7), February (2.8), October (1.9), November (1.9) and December (2.1) and attained peak during February (2.8) and reached zero during May. Aphids incidence (per plant) was found highest during January (12.5) and February (5.3) and reached zero during December.



Seasonal Incidence of insect pests of sesame during three seasons

(Error bars represent standard error of the means as determined by Tukey's post hoc test at $P \leq 0.001$)

Impact of different seed colour varieties on insect pests and coccinellids of sesame

A field experiment was carried out to study the effect of different seed colour varieties CUMS-17 (reddish), RJR-170 (brown), GT-10 (black) and Swetha (white) on populations of insect pests and natural enemies in sesame. Incidence of insect pests were highest in reddish cv. CUMS-17 (153.0). Populations (per plant) of leaf webber (25.3), leafhopper (20.6), gall fly (26.1), pentatomid bug (13.8), whitefly (18.3) and aphids (48.6) were found highest in cv. CUMS-17. The least incidence of leaf webber (2.3), leafhopper (11.8), gall fly (0.2), pentatomid bug (1.5), and aphids (4.3) were noticed in brown colored cv.RJR-170. However, least incidence of whitefly was observed in white seeded cv. Swetha (6.8). Population (per plant) of coccinellids was found highest in cvs. GT-10 (98.17) and Swetha (98.0). The least abundance of coccinellids was noticed in RJR-170 (14.3).

Effect of nutrient management treatments in sesame on storage insect pests under room temperature

In sesame, a field trial in Agronomy was conducted in vertisols under irrigated conditions in a fixed plot layout with eight nutrient management options to study the comparative performance of sesame under organic, inorganic and integrated management conditions. Seed samples were collected from different treatment plots of this experiment. The storage treatments include: storing seed in polythene bags with moisture content of 5% and in cloth bag with moisture content of 9%. Data on insect pests was recorded after six months of storage. *Tribolium* and rice moth infested the sesame seeds during the experiment period.

Tribolium and rice moth infesting sesame seeds

(a) Cloth bag with the moisture content of 9%

Effect of different pre-harvest nutrient management treatments against storage insect pests of sesame was studied under room temperature in cloth bags with moisture content of 9%. The population (no.) and % loss by *Tribolium* varied from 12.0 to 23.3 and 29.7 to 37.3%, respectively. Lowest population no. (12.0) were noted in T5 treatment (organic: 100% RDF (Neem cake + Rock phosphate) + PSB) and lowest % loss by *Tribolium* (29.7%) were noted in T6 (organic: 100% RDF (FYM + vermicompost + Goat manure + Rock phosphate) + PSB). However, the highest population (23.3) and the highest % loss (37.3) by *Tribolium* were observed in T1 (Control) and T7 (Towards organic: 50% inorganic + 50% organic (through FYM + Rock phosphate). The lowest population (10.7) and lowest % loss (55.3) by rice moth were observed in T6 (Organic: 100% RDF (FYM + vermicompost + Goat manure + Rock phosphate) + PSB) and T5 (Organic: 100% RDF (Neem cake + Rock phosphate) + PSB), respectively. However, the highest population (20.0) and % loss (73.8) by rice moth were observed in T2 (Organic: 100% RDF (FYM + Rock phosphate) + PSB) and T3 (organic: 100% RDF (Green leaf manure + Rock phosphate) + PSB).

(b) Polythene bag with the moisture content of 5%

Effect of different pre-harvest nutrient management against storage insect pests of sesame was studied under room temperature in polythene bags with the moisture content of 5% against storage insect pests of sesame. The population (no.) and % loss by Tribolium ranged from 10.7 to 22.0 and 25.3 to 33.0%, respectively. The lowest population (10.7) and % loss (25.3) by *Tribolium* were noted in T3 (organic: 100% RDF (Green leaf manure + Rock phosphate) + PSB) and T1 (control), respectively. However, the highest population (22.0) and % loss (33.0) by Tribolium were observed in T7 (Towards organic: 50% inorganic + 50% organic (through FYM + Rock phosphate) and T4 (Organic: 100% RDF (Castor cake + Rock phosphate) + PSB), respectively. The lowest population (2.7) and % loss (48.7 %) by rice moth were observed in T1 (Control) and T4 (organic: 100% RDF (Castor cake + Rock phosphate) + PSB). However, the highest population (11.3) and % loss (69.6) by rice moth were observed in T7 (Towards organic: 50% inorganic + 50% organic (through FYM + Rock phosphate) and T3 (organic: 100% RDF (Green leaf manure + Rock phosphate) + PSB).

The lowest population and % loss by *Tribolium* and rice moth were noted in polythene bag storage than the cloth bag storage. Storage of sesame seeds in polythene bag may be recommended to reduce the storage losses by the insect pests. Organic management practices showed reduction in storage losses which needs to be confirmed.

Evaluation of botanical extracts as seed protectant against storage insect pests of sesame

Among nine different botanical extracts @ 1 and 2% (w/w) evaluated against storage insect pests, sesame seeds treated with sweet flag rhizome extract, eucalyptus leaf extract and neem seed kernel extract (@ 2%) were found promising against rice moth (*Corcyra cephelonica*) and recorded least seed damage (2.5 to 3.5%) as compared to untreated control (25%) at 6 months after storage. Among botanical extracts evaluated against red flour beetle (*Tribolium castaneum*), sweet flag rhizome extract, *Vitex negundo* (nirgundi) leaf extract and neem seed kernel extract (@ 2%) found promising and recorded least seed damage (2.0 to 3.5%) as compared to 30% seed damage in untreated control at 6 months after storage.

Niger

Crop Improvement

Germplasm maintenance, characterization, evaluation and enhancement

Characterization and evaluation of entire niger genetic resources (3524 accessions) available in India for 10 qualitative and 18 quantitative traits was successfully completed. Wide range of variation was observed for traits including crop duration (days to 50% flowering from 28 to 85 days), number of capitula (12 to 62 per plant), seed yield (2.1 to 18.5 g/plant) and oil content (11.5 to 45.2%). Variation for other morphological traits includes plant height and ray florets.

Preliminary evaluation

Preliminary evaluation of germplasm resulted in identification of eight early maturing accessions (85 days to maturity), 20 self-compatible lines, two male sterile accessions and 27 high yielding (>10 g/plant) accessions. Attempts were made to augment exotic germplasm, which includes 15 breeding lines from USDA, USA and 4 varieties from Ethiopia. These exotic lines were of late duration (120-130 days for maturity), tall with high number of capitula (195) and had high seed yield.

IC 856 IC 0585545

Male sterile accessions

Development of gene pool through random mating

A total of 243 selections that were derived from third random mating cycle (developed using elite accessions for high seed yield, oil content and early accessions) are advanced to S_4 generation. Maximum seed yield recorded was 7.25 g/plant in RMC-S3-P338 and highest oil content 46.89% in RMC-S3-P370.

A total of 94 selections that were derived from fourth random mating cycle (developed using four released varieties and 480 elite population from third cycle random mating) were advanced to S_5 generation. Maximum seed yield recorded is 8.99 g/plant in RMC-S4-P455 and highest oil content 44.68% in RMC-S4-P505.

New set of random mating population was developed using diverse elite lines for high seed yield, high oil content, high number of capitula per plant, high number of branches per plant, early flowering and self-compatible plant types. Among the selections, 16 accessions had high seed yield which ranged from 8-12 g/plant; 8 accessions with high oil content (>42%); 12 accessions with high capitula number/plant (>40); 9 accessions with high seed number/head (30/head); 5 accessions with early flowering (<39 DFF); and 4 self-compatible accessions.

Broadening the genetic base of niger through pre-breeding

Towards development of genetic and genomic resources in niger, IIOR mission mode project supported by DBT involving AICRP-Niger centres (3), ICAR-NBPGR, New Delhi, IGKV-Raipur, Osmania University with ICAR-IIOR as a lead centre is under progress. Data revealed wide variation for major agronomic traits like days to 50% flowering (34-100 days), seed yield/plant (1.1-16.9 g), 1000 seed weight (2.09-6.84 g), harvest index (3.1-61.14%) and oil content (19.3-58.3%).

Seeds of four accessions of *Guizotia scabra* (EC-1077607, EC-1077608, EC-1077609 and EC-1077610) were obtained from Kenya of which only EC-1077609 and EC-1077610 have germinated hence, these accessions were used for the characterization studies.

Guizotia scabra* ssp. *scabra

Crop Protection

Floral visitor insects of niger

A field experiment was conducted to study the number of floral visitor insects (per min) visited the flowers and the mean time spent by the floral visitor insects at the niger blooming stage. The highest flowers visited by the floral visitor insects was noticed during third week of March (10.50). The time spent (s/flower) by Indian bee was noted during last week of March (6.12).

Linseed

Crop Improvement

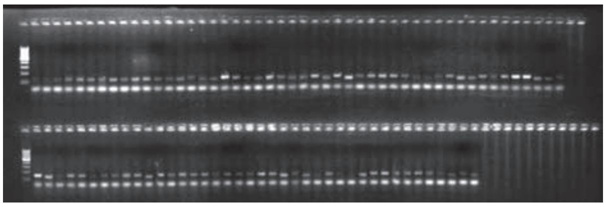
Germplasm augmentation, maintenance, evaluation and enhancement

A total of 213 cultivated type trait specific accessions (Ethiopian forage type-1; 27 early maturing types; 7 fibre type flax; 50 high alpha linolenic acid types; 16 high oil types; 4 low oil types; 32 high seed number types; 13 spring type seed flax; 20 high seed weight types; 28 wilt resistant lines; 7 winter type seed flax; 23 yellow seed flax) and six wild accessions (*L. flavum, L. bienne, L. catharticum, L. tenuifolium, L. pallaescens*) were imported (augmented from USDA, USA). The same were sown for multiplication during off-season (June-October, 2022) at IARI Regional station, Wellington, Tamil Nadu.

Among the 223 USDA lines, one accession PI-522932 exhibited dehiscence, a trait which is rarely found in the linseed global germplasm collection. The trait is not only important from academic point of view but also has a commercial application especially for easy threshing.

Capsules of PI-522932 exhibiting dehiscence

Seeds of 92 linseed varieties notified in India were collected from NBPGR and the AICRP-Linseed centres and multiplied during *rabi* 2021. These were subjected to diversity analysis using linseed specific SSR primers. A germplasm panel developed earlier comprising 201 diverse lines (germplasm accessions, exotic lines, advanced breeding lines and released varieties) were also multiplied for characterization and further evaluation.



SSR Primer LU6 showing polymorphism among 92 released varieties

A total of 2885 accessions of working collection maintained by the erstwhile PC Unit were multiplied at three AICRP-Linseed centres *viz.*, Kanke, Raipur and Raichur. A complete set of 2885 accessions were received from Kanke centre and 1000 and 2400 accessions from Raipur and Raichur, respectively. About 400 promising accessions were also identified by these centres during the preliminary evaluation which will be further validated during the ensuing *rabi* 2023 season.

The germplasm panel comprising 201 diverse germplasm multiplied at ICAR-IIOR, Hyderabad during *rabi* 2020-21 were analysed for oil content and fatty acid composition. One advanced breeding line, LMS 2015-31 recorded high (45.6%) oil content and eight genotypes recorded high (>58%) ALA content *viz.*, BAU 2019-03 (59.2%), Shubhra, Jawahar Linseed-41 (58.9%); Binwa (KL-210) and SLS 73 (58.3%); Laxmi-27 and 'AC CARNDUFF' of Canada also recorded high ALA (58.2%) content. The variety, SLS 73 had both high oil (48.2%) and high ALA (58.3%) content. All 2,885 germplasm accessions which were multiplied at BAU, Kanke were also analysed for oil content. Ten accessions had very high oil content of more than 48% and two released varieties LSL 93 (46.3%) and SLS 73 (48.2%) also exhibited very high oil content.

High oil content linseed accessions identified

Oil content	Accessions
46-48%	BS-32, EC-41740, EX-3, EX-53-9B, Silwani, KL-1, LCK-9436, LMH-90-7, NL-91, NL-93, RSJ-3, NP(RR)-260, NP(RR)-405, EC-1529, EC-4163, EC-322652, SJKO-70, NDL-5, LMS-2007-4, LSL-93, EC-718846, KL-190, LCK-9313, LCK-9319
> 48%	Kiran, Chitar, NDL-8804, KL-160, EC-322653, SJKO-65, KL-224, KL-234, SLS-73, EC-718851

To understand the cadmium accumulation in linseed, initially, 10 popular linseed varieties cultivated widely by farmers in different growing regions of India were analysed for cadmium (Cd) concentration along with other toxic heavy metals *viz.*, Nickel (Ni) and Lead (Pb). The study indicated that the cultivar, BRLS-119 had the lowest Cd concentration in seed (0.85 mg/kg) and the highest level of concentration was observed in the cultivar, 'Shekhar' (1.03 µg/kg of seed). Based on the stipulations of European Food Safety Authority, the recommended weekly maximum dietary intake of Cd is 2.5 microgram per kilogram of body weight. This works out to be an intake of 150 micrograms per week for a person weighing 60 kg. The nickel content was also well below the limit values for flax seeds according to the Food Codex of the Slovak Republic and was the lowest in RLC-153 (2.71 µg/kg of seed). Further studies involving the entire collection of released varieties are in progress.

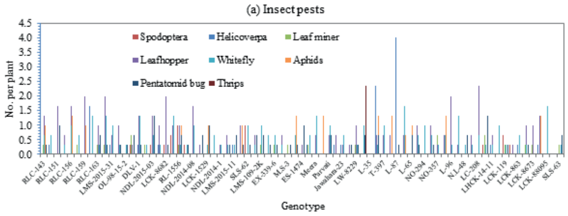
Development of low ALA edible grade linseed oil breeding lines

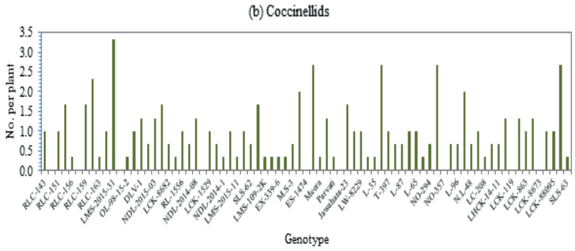
To develop low ALA edible grade linseed oil which can go in to the oilseed kitty for blending with other edible oils, three crosses involving popular linseed varieties, PCL 55, Shekhar, T 397 with one low ALA variety TL 99 were effected. For identification of molecular markers associated with low ALA, DNA from 20 linseed germplasm lines (10 high and 10 low ALA Canadian germplasm accessions) were extracted and subjected to PCR analysis with reported linked markers of ALA and PCR products were sequenced for identification of sequence variation for indels/SN. Alignment of deduced amino acid sequences of *FAD3A* and *FAD3B* genes from linseed germplasm lines indicated that four Canadian low ALA lines/accessions *viz.*, CN100572, CN100556, CN100571 and CN100570 exhibited a mutant allele for both the genes. Four high ALA lines namely Shubhra, Laxmi-27, Jawahar Linseed-41, and SLS-73 exhibited wild allele with both the genes. Whereas, two low ALA lines, TL 99, and Suvee showed the wild allele, which may be due to heterozygosity or admixtures, which needs to be confirmed.

Crop Protection

Identification of resistant sources for major insect pests in linseed

The linseed genotypes (n=77) were screened for *Spodopatera, Helicoverpa*, leaf miner, leafhopper, whitefly, aphids, pentatomid bug and thrips. The populations (per plant) of *Spodopatera*, *Helicoverpa* and leaf miner ranged from 0 to 1.0, 0 to 4.0 and 0 to 0.67, respectively. The populations (per plant) of leafhopper, whitefly, aphids, pentatomid bug and thrips ranged from 0 to 2.33, 0 to 1.67, 0 to 1.33, 0 to 1.33 and 0 to 2.37, respectively. The populations (per plant) of coccinellids ranged from 0 to 3.33. The linseed genotypes graded as 66, 62, 58, 24, 17, 63 and 38 highly resistant to *Spodoptera*, *Helicoverpa*, leaf miner, leafhopper, whitefly, aphids and pentatomid bug, respectively based on incidence.





Incidence of (a) insect pests (*Spodopatera, Helicoverpa*, leaf miner, leafhopper, whitefly, aphids, pentatomid bug and thrips) and (b) abundance of coccinellids on different genotypes (n=77) of linseed. Error bars represent standard error of the means as determined by Tukey's post hoc test at $P \leq 0.001$.

Seasonal incidence of insect pests of linseed

A field experiment was conducted to study the seasonal incidence under Hyderabad conditions during 2021-2022. Population (per plant) of *L. trifolii* varied from 0.6 to 1.7 and reached highest during first week of January 2022 (1.7±0.30). Populations (per plant) of *B. tabaci*, leafhopper, and *Aphis gossypii* reached maximum during last week of December 2021 (1.5±0.27), first week of January 2022 (1.7±0.30) and first week of January 2022 (6.3±0.65), respectively. *S. exigua* population reached maximum during last week of December 2021 (1.2±0.13/plant). Population (per plant) of *H. armigera* ranged from 0 to 1.3 and reached highest during first week of January 2022 (1.3±0.21). *Hyposidra talaca* incidence (per plant) varied between 0 to 0.9 and reached maximum during second week of January 2022 (0.9±0.10).

Abundance of coccinellids in linseed

A field experiment was conducted to study the abundance of a coccinellid in linseed feeding on sucking pests during 2021-22. The coccinellid population (per plant) ranged from 1.0 to 1.7 and reached maximum during first and second weeks of February 2022 (1.7/plant). Abundance of coccinellid (per plant) reached lowest during second week of January 2022 (1.0±0.15).

Biological Control

Isolation and characterization of *Metarhizium (Nomuraea) rileyi* in different cropping systems

The *Metarhizium rileyi* infected *Spodoptera litura* and *Spodoptera frugiperda* larvae were collected from different agro ecosystems and locations in Telangana. The fungal culture was characterized at molecular level using rDNA ITS universal primer and confirmed as *Metarhizium (Nomuraea) rileyi* and the nucleotide sequences submitted to the Gene Bank (ON060879, ON060880, ON038355). The extent and rate of growth of *M. rileyi* on *S. frugiperda* larva after inoculation was studied through SEM to compare the biocontrol efficacy of *M. rileyi* local isolates along with an untreated control. Complete conidial development on the insect body was observed in 7 days after treatment. Pathogenicity of *Metarhizium rileyi* isolates revealed that the *M. rileyi* SlMr-2 isolate recorded lower LC$_{50}$ values (1.5×10^4 to 1.5×10^7 conidia/ml) against *Spodoptera litura*. *M. rileyi* SfMr-4 isolate recorded LC$_{50}$ values of 1.4×10^4 to 1.7×10^6 conidia/ml against *Spodoptera frugiperda.*

Effect of insecticides and fungicides on the growth and sporulation of entomopathogenic fungi, *Metarhizium (Nomuraea) rileyi*

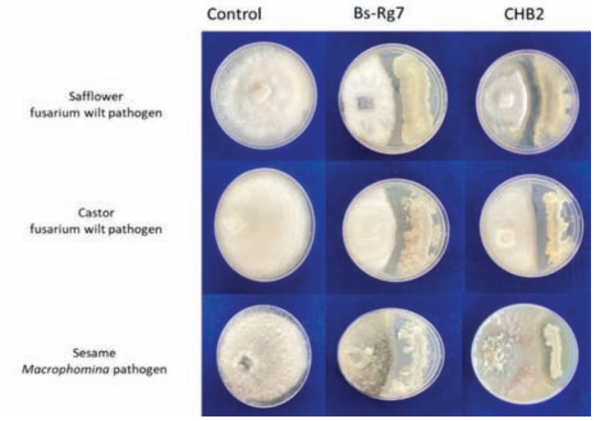
Compatibility studies of chemical pesticides and biocontrol agents are necessary for their integrated use. The effect of nine commonly used insecticides and five fungicides on mycelial growth and sporulation of *M. rileyi* was tested under laboratory conditions. All the insecticides and fungicides inhibited the growth of *M. rileyi* significantly. Overall inhibition of fungal growth by insecticides and fungicides ranged from 2.5 to 100%. The results indicate that fungicides were highly inhibitory (8.2 to 100%) to *M. rileyi* as compared to insecticides (2.5 to 77.4%). Carbendazim and propiconazole were found highly detrimental to *M. rileyi* by retarding the growth totally. Chlorantraniliprole, flubendiamide, azoxystrobin and tebuconzole were found safer as compared to other insecticides and fungicides.

Effectiveness of native isolates of entomopathogens against castor hairy caterpillar, *Euproctis fraterna*

Among the entomopathogenic fungi, *B. bassiana* recorded high pathogenicity against *E. fraterna*, while moderate pathogenicity was observed with *M. rileyi*. *B. bassiana* recorded the least median lethal concentration (LC$_{50}$) for *E. fraterna* (4.4×10^5 conidia/ml) as compared to *M. rileyi* (LC$_{50}$ at 5.8×10^6 conidia/ml). *B. bassiana* also recorded the shortest median lethal time (LT$_{50}$ value of 3.9 days) to cause the larval mortality in *E. fraterna*, while *M. rileyi* recorded LT$_{50}$ value of 4.5 days.

Screening marine endosymbiotic bacteria for broad spectrum antagonism against fungal pathogens of oilseed crops

Two marine associated endophytic bacteria namely *Bacillus siamensis* (Bs_Rg7) isolated from seaweed *Gracilaria* sp. and *Bacillus velezensis* (CHB2) isolated from marine sponge *Biemna fortis* were screened and found having excellent *in vitro* broad spectrum antagonistic activity against fungal pathogens (*Fusarium oxysporum* f.sp. *ricini* and F.o. f.sp. *carthami* and *Macrophomina phaseolina*) of oilseed crops. The inhibition zone produced by the *Bacillus* strains against fungal pathogens were found persistent for more than a month and till discard of plates confirmed the release of strong secondary metabolites *in vitro* by the *Bacillus* strains.



In vitro screening of bacterial isolates against different fungal pathogens

Secondary metabolite profiling by UPLC-MS/MS

Ultra Performance Liquid Chromatography-Tandem Mass Spectrometry (UPLC-MS/MS) was performed for *Bacillus siamensis* (Bs_Rg7) and *Bacillus velezensis* (CHB2) to identify the secondary metabolites responsible for antagonistic activity.

The GNPS networking identified approximately 61 compounds from Bs_Rg7 strain. Preliminary analysis of those compounds revealed the presence of seven antimicrobial lipopeptides namely Surfactin B, Surfactin C, Surfactin A, Surfactin C13, Plipastatin, Surfactin C15 and Maribasin B and in addition to the antimicrobial peptides, other antimicrobial compounds such as Pheophytin, Sarmentoside B, Baccatin III were also reported from the bacteria. Similarly in CHB2 strain, 42 compounds were identified. Among them, eight were antimicrobial peptides such as Surfactin B, Surfactin C, Surfactin C14, Plipastatin, Surfactin D, Surfactin A, Surfactin C15 and Maribasin B and in addition Pheophytin was found present in CHB2 strain.

Volatile organic compounds (VOCs) profiling by headspace-GCMS

A total of 20 different volatile compounds have been documented in Bs_Rg7 strain out of which compounds namely, Oxalic acid, Phenylephrine, (-)-Norephedrine, Cyclobutanol, Silanediol, Octodrine, Actinobolin, Cyclotrisiloxane hexamethyl were found to possess direct antimicrobial properties in preliminary literature search. Among the 19 different volatile compounds documented from CHB2 strain, four VOCs were reported with antimicrobial properties namely 2, 3-Butanedione, Acetoin, Silanediol, Cyclotrisiloxane hexamethyl and in addition few other antimicrobial like compounds have been identified in preliminary literature search.

Whole genome sequencing of marine endosymbiotic bacteria

Whole genome sequencing of marine endosymbiotic bacterias, *Bacillus siamensis* (Bs_Rg7) and *Bacillus velezensis* (CHB2) were performed using Illumina Hiseq platform. The high quality reads were processed for submission in NCBI and deciphering of bacterial whole genome for its antimicrobial and plant growth promotion gene analysis.

Assessment of efficacy of chitinolytic bacteria against major pests, diseases and nematodes associated with castor

Laboratory experiments against *S. litura* were carried out using leaf dip bioassay method. Among the different chitinolytic bacterial isolates tested against *S. litura* larvae, three isolates namely, IC-RB5, HD-RB20 and HD-RB21exhibited 100% mortality, while 10 bacterial isolates namely, IC-RB1, IC-RB 2, IC-RB8, IC-RB18, OD-RB2, OD-RB20, DOR-RB3, AR-RB26, HD-RB13 and *B. liquefaciens* exhibited 80-99% mortality. About 34 isolates have shown 50-79% mortality and remaining isolates recorded the mortality range below 50%.

The chitinolytic bacterial isolates were tested for their *in vitro* efficacy against *Fusarium oxysporum* f. sp. *ricini* through dual plate assay and observations were made based on the per cent inhibition of mycelia over control to identify the effective bacterial isolates. The bacteria, IC-RB1(44.4% inhibition of mycelial growth over control) recorded strong antagonism against the fungus, while the three isolates namely, IC-RB3, IC-RB7 and AR-RB3 recorded moderate antagonism (28.9, 23.1 and 29.8 % inhibition of mycelial growth over control) and the remaining isolates recorded weak antagonism.


IC-RB1 Control

Inhibition of fungal mycelium by effective bacterial isolate

In vitro assay of chitinolytic bacteria was studied against reniform nematode, *Rotylenchulus reniformis*. About 2 ml of cell free culture filtrates of the chitinolytic bacteria were tested against fourth stage juveniles of *R. reniformis* (J_4) and three isolates namely, IC-RB1 (65.0%), IC-RB3 (60.7%) and IC-RB5 (52.7%) exhibited maximum mortality after 72 h of incubation over the other isolates.

Characterization of the chitinolytic bacteria

The effective 9 bacteria were observed for their morphological characteristics *viz.*, colour, surface, shape, elevation and edge (Berger's manual of systematic bacteriology, 1986). In gram staining, four bacteria were reported to exhibit positive reaction while five exhibited negative reaction. Biochemical characterization *viz.*, KOH, oxidase, gelatinase, catalase, starch hydrolysis, siderophore, HCN, PO_4 solubilisation, NH3 production, indole, methyl red, voges proskaure's, citrate utilization, glucose, adonitol, arabinose, lactose, sorbitol, mannitol, rhamnose, sucrose, organic acid and protease were carried out by following the procedure of Cappuccino and Sherma (2007) to assess the mechanism of the bacteria. Plant growth promotion studies of the effective isolates (n=9) were tested in paper towel method (Pradhan and Mishra, 2015). Among the 9 isolates tested, IC-RB2 recorded the highest vigour index of 3952.0 while control plants recorded the least vigour index (2194.0).

Plants treated with bacteria

Qualitative assay of Chitinase

A total of 9 effective isolates were screened for the qualitative assay of chitinase and among them, AR-RB3 reported the maximum diameter of halo zone (8.4±0.02) formation followed by IC-RB5 (8.2±0.04).

Collection of potential biocontrol bacterial cultures

Bacterial cultures, Ba-Abi, Bs_Adg, Bs_Ahv, Ls_Agu, RM1-2, RB1, RU3 were collected from different national laboratories and preserved for further analysis of chitinolytic, nutrient mobilizing and biocontrol potential in oilseed based agro ecosystems.

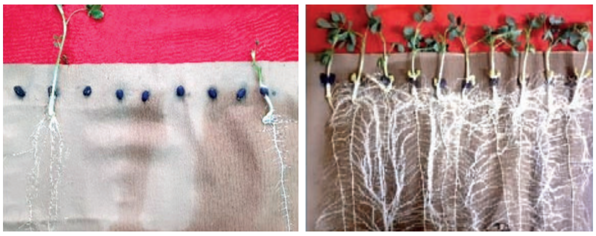
Multilayer seed coating in oilseeds for integrated disease and nutrient management

Effect of penflufen + trifloxystrobin and *Trichoderma* at lower doses on seed germination and disease incidence in multilayer coated groundnut seed tested against collar rot (*Aspergillus niger*) and stem rot pathogen (*Sclerotium rolfsii*) was studied in germination towel assay. Multilayer coated groundnut seed with recommended and lower dose of penflufen + trifloxystrobin (recommended dose 7.5ml/kg; lower dose 5ml/kg seed), *T. harzianum* (Th4d) (recommended dose 0.1g/kg; lower dose 0.05g/kg) are tested for their effectiveness against collar rot (*Aspergillus niger*) and stem rot (*Sclerotium rolfsii*) diseases. Significant difference in disease incidence and germination were not observed in seeds coated with recommended and lower dose. The performance of *Trichoderma* was better at recommended dose only (0.1g/kg seed).

Evaluation of double-layer seed coatings with biopolymer chitosan, fungicide and biocontrol agents and their combinations on seed quality and stem rot of groundnut *(S. rolfsii)*

In *in vivo* germination towel tests, the maximum germination (94.0%) was recorded in T_5 treatment (chitosan 5 ml + fungicide 7.5 ml + Th4d 0.1 g) + (chitosan 5 ml + *Bradyrhizobium* sp. 0.5 g), while the lowest (64.0%) was recorded in T_1 treatment (untreated control). The maximum seed vigour index (3190) was recorded in T_5, while T_1 treatment (untreated control) recorded lowest seed vigour index (1709). All the treatments were found effective in reducing the seedling mortality as compared to control. The lowest per cent seed rot and seedling mortality was recorded in T_5 treatment (10.7%), while the highest (75.2%) was recorded in T_1 treatment.

In the field experiment, the highest seed germination was recorded in T_5 treatment (chitosan 5 ml + fungicide 7.5 ml + Th4d 0.1 g) + (chitosan 5 ml + *Bradyrhizobium* sp. 0.5 g) of 91.9%, whereas T_1 treatment (untreated control) recorded lowest of 70.9%. Among all the treatments, T_5 treatment (chitosan 5 ml + fungicide 7.5 ml + Th4d 0.1 g) + (chitosan 5 ml + *Bradyrhizobium* sp. 0.5 g) recorded significantly highest number of root nodules (279.0) and least number was observed in T_1 treatment (125.0). The stem rot incidence was observed to be minimum in T_5 treatment (chitosan 5 ml + fungicide 7.5 ml + Th4d 0.1 g) + (chitosan 5 ml + *Bradyrhizobium* sp. 0.5 g) with 5.2%, while the maximum disease incidence was noted in T_1 treatment (untreated control) with 29.9%.



Pathogen check (stem rot) Double layer coated seed

Effect of double coated seed on germination and sclerotium root rot disease incidence of groundnut under *in vitro* conditions

T_5 treatment T_1 untreated control

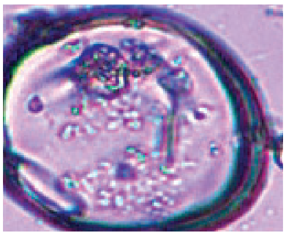
Effect of double coated seed on germination and sclerotium root rot disease incidence of groundnut under *in vivo* conditions

Ecological fitness and survival of applied *Trichoderma* in soil/plants by GFP gene tagging and by qPCR targeting specific genes

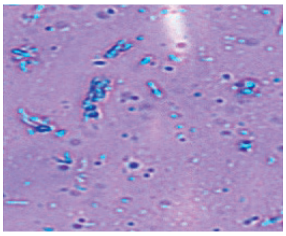
To better understand the *Trichoderma* colonization patterns in soil and plant system, the *Agrobacterium* mediated *Trichoderma* transformation is carried out with pCAMBIA1305.2 and pEff plasmids containing β-Glucoronidase gene (Auxotrophic marker gene), Hygromycin gene (Antibiotic resistant marker gene) and Green fluorescent protein gene respectively. The histo-chemical assay was performed with X-gluc (5-bromo-4-chloro-3-indolyl-beta-D-glucurnic acid) and microscopic observations of indigo blue stained mycelium are documented. Fluorescing mycelium of mitotically stable GFP transformed *Trichoderma* are captured under UV lamp. Further studies on saprophytic survival ability and its competence in the rhizosphere of various oilseed crops, biocontrol activities are under progress

Development of *Bacillus thuringiensis* and *Beauveria bassiana* microcapsules by coacervation process

Microencapsulation of microbials using natural polymers has been recently attracted to reduce the dose requirement and to increase the stability and efficacy of the formulations. Hence, compatibility testing of biopolymers, standardization of encapsulation, entrapment efficiency and bioassays were studied. Standardization of various polymer combinations (40) was carried out through coacervation process. The prepared polymers were utilized for entrapment of bioagents (*B. thuringiensis* and *B. bassiana*). Among 40 coacervate combinations evaluated, 4 polymer coacervates were identified *i.e.*, C-13, C-21, C-22, C-33 having high yielding potential and solubility in water. The entrapment efficiency was found to be 97 to 99%. The samples were also characterized through compound and electron microscope for its entrapment. Among different polymers tested, C-21+ *B. thuringiensis* and C-33+ *B. bassiana* were found effective against *Spodoptera litura* and *Achaea janata*.



B. thuringiensis **spores with C-21 polymer coating**

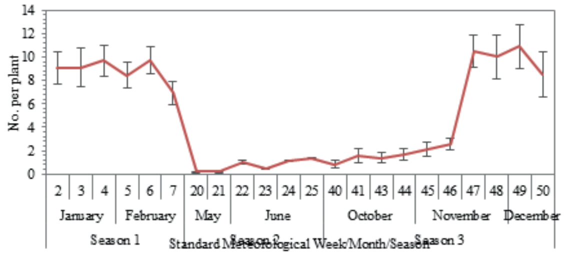


B. thuringiensis **spores without polymer coating**

Illeis sp.: A potential coccinellid predator of powdery mildew in sesame

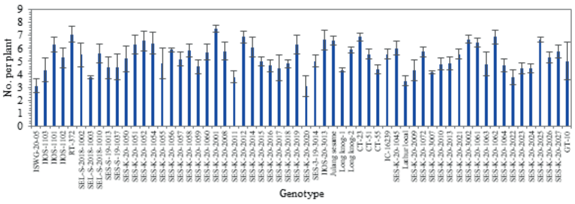
Field experiment was conducted to study the abundance of a coccinellid (*Illeis* sp.) in sesame feeding on powdery mildew during three seasons, season 1 (January to February, 2022), season 2 (May to June, 2022) and season 3 (October to December, 2022). *Illeis* sp. was recorded during all the three seasons. The population (per plant) was found highest during winter months (97.4) which coincides with the infection of powdery mildew in sesame. Abundance of *Illeis* sp. (per plant) reached lowest during May (0.4), June (3.9) and reached peak during November.

Illeis **sp., a potential coccinellid predator of powdery mildew**



Abundance of coccinellid predator, *Illeis* sp. of powdery mildew in sesame during three seasons (Error bars represent standard error of the means as determined by Tukey's post hoc test at $P \leq 0.001$)

Another field experiment was conducted to study the abundance of a coccinellid (*Illeis* sp.) feeding on powdery mildew on different genotypes (n=60) of sesame. The abundance of *Illeis* sp. (per plant) ranged from 3.09 to 7.47. The least and highest abundance of *Illeis* sp. (per plant) was noticed in SES-K-20-2020 (3.09) and SES-K-20-2001 (7.47), respectively.



Abundance of coccinellids on different genotypes (n=60) of sesame (Error bars represent standard error of the means as determined by Tukey's post hoc test at $P \leq 0.001$)

Nanosystems

Fabrication of Fe and Zn nanosystems as efficient nutrient sources

Mobility and leaching studies in soil column: Certain constraints for effective utilization of plant nutrients in the soil are fixation, mobility, leaching and reaction with soil colloids etc. Nanochelators in the form of nanocitrates for plant nutrition were formulated through physical synthetic approach for soil application. The nanocitrates of Fe and Zn nutrients synthesized were further tested in a soil column to evaluate mobility potential of Fe and Zn and leaching in the reconstructed soil profile. In the studied soil, the leaching of nanocitrates did not depend on the incubation duration. An increase in release profiles upto 90 days of incubation for zinc and the highest iron release upto 60 days of incubation with a decrease further at 90th day was observed. The availability of Fe and Zn was more prominent in soil depth of 0-15 cm followed by 15-30 cm. The highest Zn availability (86.26 mg/kg of soil) in Zn nanocitrates and Fe availability (264.7 mg/kg of soil) in Fe nanocitrates was observed. The results were compared with commercial micro and nano samples. Hence, nanocitrates were found as stable chelators for Fe and Zn plant nutrition which can increase plant use efficiency with lesser environmental concerns.

Release of Fe and Zn (percentage) from nutrients in the soil for 90 days

Treatment	10 days	30 days	60 days	90 days
Nutrient-Zn				
BFZ(4:6)- 8	0.06	17.26	18.19	10.79
BFZ(5:5)- 2	0.11	14.64	16.19	12.42
BFZ(5:5)- 6	0.32	10.74	14.32	9.41
BFZ(8:2)- 4	5.75	6.37	8.96	3.37
BFCZ(1:1:1)- 6	36.51	33.04	24.79	2.14
BZC(1:3)- 6	0.04	24.69	27.13	31.05
Nano Zn	65.82	61.56	52.00	38.09
Chelated-Zn	16.71	9.88	6.57	5.44
Nutrient-Fe				
BFZ(4:6)- 8	14.08	22.06	127.61	32.46
BFZ(5:5)- 2	10.38	12.88	130.13	31.29
BFZ(5:5)- 6	12.85	22.12	107.48	30.17
BFZ(8:2)- 4	18.38	21.03	105.77	14.60
BFCZ(1:1:1)- 6	18.72	22.29	121.46	25.31
BFC(1:1)- 6	19.23	20.90	116.51	28.00
Nano Fe	15.18	27.39	92.54	27.45
Chelated-Fe	11.99	7.17	5.71	3.71

Fe and Zn content in citrates

The amount of Fe and Zn in the synthesized combined and individual citrates was estimated using XRF. The Fe content ranged from 10.6 to 21.5%, whereas the Zn content ranged between 14.2 to 29.8%. The value range finds potential good sources of Fe and Zn as plant nutrients in citrates. The Fe and Zn content available within citrates are in the range of market available micronutrients and nanonutrients.

Standardization of lignin extraction from agricultural waste

Standardized lignin extraction from different agri-wastes like pulses, oilseeds and sugarcane bagasse with alkaline solution at 90°C for 4 h in azeotropic solution of water and ethanol mixture from 40% (w/w) NaOH in distilled water. The lignin content varied from 9.5 to 31% based on the type of agri-waste chosen for extraction. The lignin extracted was confirmed through FTIR.

Lignin content in different agri-waste

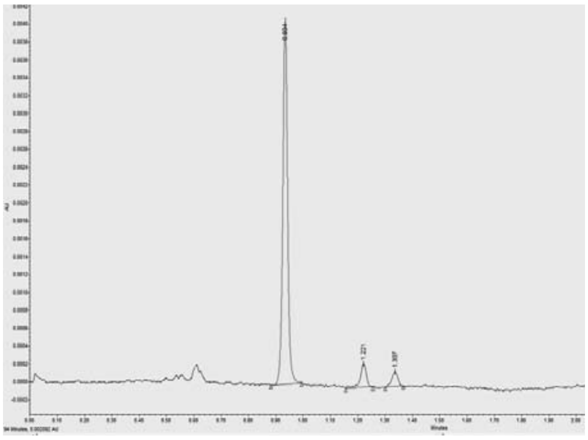
Crop waste	Lignin (%)
Groundnut (stem)	23.0 – 28.4
Groundnut (shell)	27.1 – 31.0
Castor (stem)	17.6 – 19.3
Castor (shell)	14.5 – 16.7
Sugarcane bagasse	12.0 – 20.7
Pulses (green gram pod husk)	9.5 – 11.6
Pulses (red gram stems)	17.8 –18.2
Rice husk	13.8 – 14.5
Sunflower (stem)	11.2 – 13.1

Value Addition

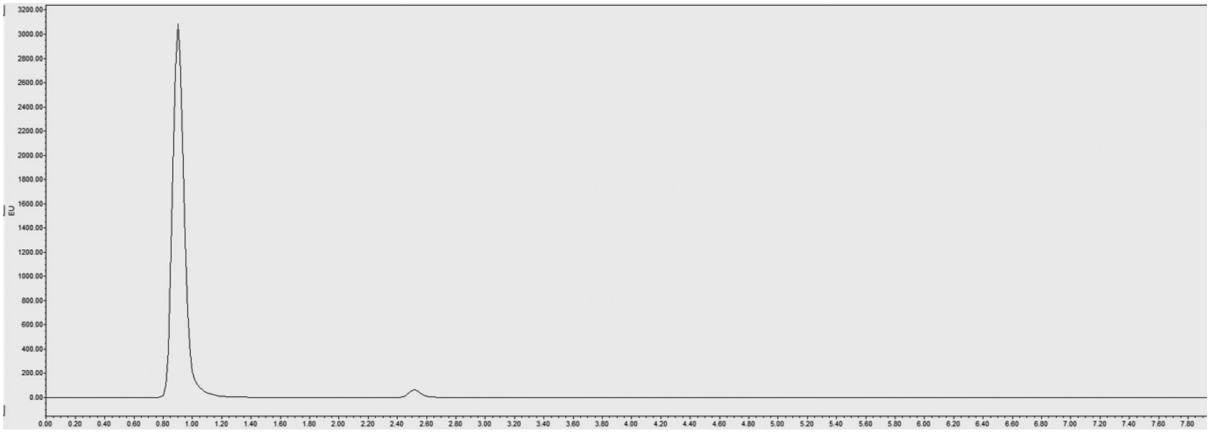
Blending of edible oils with rice bran oil (RBO) and linseed oil for enhanced nutritional quality and stability

Oil was extracted from the seeds by solvent extraction/ expeller method. Safflower, sunflower, groundnut, sesame and palm oil were blended with rice bran and linseed oil in 20:80; 30:70; 40:60; 50:50; 60:40; 70:30; 80:20 ratio for optimized fatty acid composition. The blends were stored for up to 12 months. Nutritional parameters (oryzanol, phytosterols, tocopherols), lignans (sesamin, sesamol, sesamolin) and oil stability and rancidity indicators such as free fatty acids, acid value, peroxide value, trans fats, viscosity were measured monthly. Activities of lipase and lipoxygenase enzymes were also determined during storage. Results showed an increase in free fatty acids, peroxide value, and acid value during storage with higher values observed in the linseed oil blends compared to rice bran oil blends. Sesame rice bran blend had lower free fatty acids and peroxides during storage, while palm oil and linseed blend had the highest. Lipase and lipoxigenase activity was also high in linseed oil blends compared to the rice bran blends. Sesamin was the predominant lignan. The composition of tocopherol and lignans decreased during storage of oils.

Blended Oils



Chromatogram showing alpha, beta and gamma tocopherol



Chromatogram showing sesamin content in sesame oil

DUS Testing & Seed Production

DUS Testing

Under the Central Sector Scheme for Protection of Plant Varieties and Farmers Rights Authority, DUS testing activities were conducted for sunflower and safflower during *rabi* 2021-22 and castor and niger in *kharif* 2022. In sunflower, DUS testing was undertaken for two sets of one new candidate for the second year during *rabi* 2021-22 along with two reference entries and data was recorded for 34 DUS traits and reports were submitted to PPV&FRA, New Delhi. In safflower, ten reference entries were maintained and multiplied during *rabi* 2021-22. In castor, DUS testing data of one farmer's variety along with three reference varieties of castor for two centres was compiled and reports were submitted to PPV&FRA, New Delhi. Initial characterization of two reference varieties and maintenance and multiplication of eight reference varieties was undertaken during *kharif* 2022. In niger, under the project on 'Development of Distinctiveness, Uniformity and Stability (DUS) testing guidelines for Niger [*Guizotia abyssinica* (L.f.) Cass.]', 23 niger varieties and 109 germplasm were obtained from the developing centres and observations were recorded on 32 traits. Multiplication of varieties (23) and germplasm accessions (117) was carried out under nets through sibbing during *kharif* 2022.

Seed Production

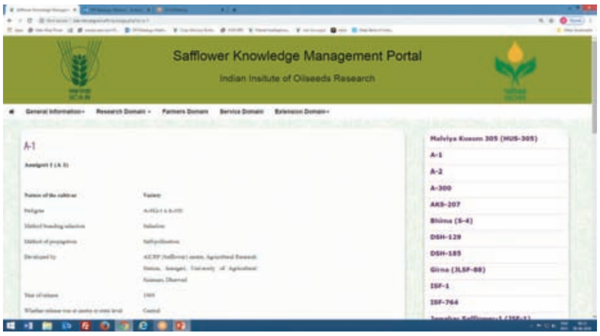
In castor, 80 kg breeder seed of DPC-25 (IPC-25); 100 kg of ICS-164, 250 g nucleus seed and 20 kg foundation seed of SKP-84 were produced. In Sunflower, a total of 4.0 kg of nucleus seeds of ARM-243A and 8 kg of ARM-243B and 500 g of RHA-6D-1 was produced during *rabi* 2021-22. A total of 18 kg nucleus seed of male parent (RGP-100) of newly released hybrid, TIlhanTech-SUNH-1 was also produced during *rabi*-2021-22. In safflower, nucleus seed of A-133-I, B-133-1, A-133-II, B-133-II, ISF-1, ISF-764 and MGMS-7 was produced. A total of 864.19 q of breeder, foundation, certified and TL seed of castor, sunflower, sesame and safflower were produced.

Seed Production of different oilseed crops at ICAR-IIOR

Crop	Variety/ Hybrid/ Parent	Quantity (q)
Castor	ICS-164 (Male Parental line) (BS)	39.10
	SKP-84 (Female Parental line) (BS)	1.60
	ICH-66 (Hybrid) (CS)	18.41
	Total	**59.11**
Sunflower	243 A (Female Parent)	0.30
	243 B (Female maintainer line)	0.28
	6 D-1 (Male Parent)	0.22
	RGP-100	0.40
	DRSH-1 (Hybrid) (TL)	9.65
	Total	**10.65**
Sesame	SwethaTil (TL)	4.30
	CUMS-17 (V) (BS)	2.20
	JCS-1020 (V) (TL)	2.30
	Total	**8.80**
Safflower	NARI-96 (V) (BS)	3.50
	ISF-764 (V) (BS)	10.00
	ISF-764 (V) (TL)	165.08
	ISF-764 (V) (CS)	599.75
	ISF-1	2.20
	RVSAF 18-1 (BS)	5.00
	DSH-185 (H) (TL)	0.10
	Total	**785.63**
	GRAND TOTAL	**864.19**

Safflower Knowledge Management Portal

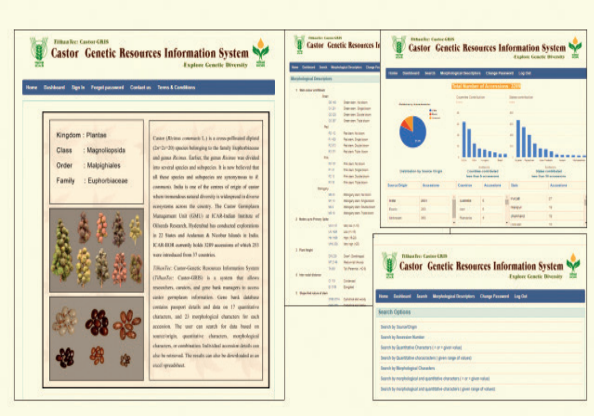
Safflower knowledge management portal was developed with five major themes *viz.,* General, Cultivars, Research, Farmers and Extension domains. Each domain has menus and respective sub menus to provide the detailed information. The "general domain" provides information about the crop, agronomic practices, seed production technologies, insect pests, diseases and uses of safflower. Under the "cultivar" domain, details pertaining to duration of the crop, average seed yield, specific traits and oil content related to the cultivars are provided. The "research domain" provides information on research carried out in breeding, biotic and abiotic stresses besides providing information about the AICRP centres. The "farmers domain" provides information about the various government schemes. Under the "extension domain", information on market prices from major APMCs trading safflower in major growing states, extension activities *viz.,* POPs, contingency plans, FAQs and FLDs are given. The portal was designed to benefit researchers, academicians, farmers, students, extension workers and NGOs and is hosted on a dynamic mode.



Safflower knowledge management portal

TilhanTec: Castor-Genetic Resources Information System (*TilhanTec*: Castor-GRIS)

TilhanTec: Castor-GRIS, an information system was developed that can be accessed through https://tilhantec.icar.gov.in/Castor-GRIS/index.php. It enables researchers in AICRP (Castor), curators, and gene bank managers to access castor germplasm information. Gene bank database contains passport details and data on 18 quantitative characters and 23 morphological characters for each accession. The users can search data as per their need and requirement. The system is designed in such a way that it can provide information for both individual and combination of characters. The results can also be downloaded as an excel spreadsheet.



TilhanTec: Castor-genetic resources information system

Impact assessment of oilseed technologies

Impact assessment of varieties/hybrids of ICAR-IIOR mandate crops in varied agro ecological regions of India

The Herfindahl-Hirschman Index (HHI) was computed for Castor in Gujarat state on a Triennium approach during this millennium. The analysis showed an increase in HHI for TE 2011-12 and TE 2016-17 indicating the spread of area under GCH-7 hybrid. However, a declining trend for TE 2021-22 over TE 2016-17 suggest that castor is being replaced by other competing crops perhaps due to higher profitability of competing crops and related market forces as well.

To examine the farm level performance of castor hybrid GCH-7 as against the competing crops, primary data was collected in Gujarat from 60 farmers each in three important castor growing districts *viz.,* Mehsana, Patan and Kachchh.

In Mehsana district, the average productivity of castor hybrid GCH-7 was 22.09 q/ha providing additional net returns of Rs. 55425/ha over operational costs. The per ha additional income for the competing crops varied from Rs. 9175/ha in green gram to Rs. 88630/ha in fennel.

Economics of castor (GCH-7) and competing crops in Mehsana district

Crop	Productivity (q/ha)	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	Profitability Ratio
Castor	22.09	95985	40560	55425	2.37
Bajra	21.32	43450	29580	13870	1.47
Cotton	15.08	75120	50044	25076	1.50
Cluster bean	11.25	47025	21098	25927	2.23
Green gram	6.45	29025	19850	9175	1.46
Tobacco	20.47	102278	59350	42928	1.72
Fennel	13.28	144303	55673	88630	2.59
Mustard	19.74	74973	32804	42169	2.29
Cumin	8.29	99555	45890	53665	2.17
Wheat	42.37	83554	39857	43697	2.10
Potato	230.25	233013	98760	134253	2.36
Summer bajra	28.35	63647	32850	30797	1.94

Since the duration of castor crop is for almost 240-270 days, it is imperative to examine the net returns accrued on a systems / sequence mode. Green gram-castor cropping sequence is the most predominant and hence, the combined returns accrued from the above sequence *vis-a-vis* other predominant cropping systems are compared to quantify the farm level income of castor hybrid. The comparative economics are indicated in the table below. A perusal of the table reveals that the returns from castor based system is higher over bajra-wheat and bajra-mustard, but is not competitive with the other emerging systems/ sequences *viz.,* fennel - summer bajra, cluster bean - potato - summer bajra and green gram - potato - summer bajra.

Economics of castor based system *vis-à-vis* competing cropping systems / sequence in Mehsana district (Rs/ha)

Cropping sequence / cropping system	Season	Gross returns (Rs/ha)	Operational Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	Difference in net returns (Rs/ha)
Green gram - Castor	Late *Kharif* + *Rabi* (Late July - Mid April)	125010	60410	64600	-
Bajra - Wheat	*Kharif* + *Rabi*	127004	69437	57567	+ 7033
Bajra - Mustard		118423	62384	56039	+ 8561
Fennel - Summer bajra		207950	88523	119427	- 54827
Cluster bean - Potato - Summer bajra	*Kharif* + *Rabi* + *Summer*	343685	152708	190977	- 135552
Green gram - Potato - Summer bajra		325685	151460	174225	- 118800

The economics of castor hybrid (GCH-7) in Patan district is detailed in table below. The average productivity of castor was 26.25 q/ha providing net additional income of Rs. 83880/ha over operational costs. The additional net returns of the competing crops ranged from Rs. 8605/ha in sorghum to as high as Rs. 117258/ha in tobacco.

Economics of castor (GCH-7) and competing crops in Patan district

Crop	Productivity (q/ha)	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	Profitability Ratio
Castor	26.25	116385	32505	83880	3.58
Black gram	7.10	43000	20570	22430	2.09
Fennel	15.18	97500	42050	55450	2.32
Bajra	19.58	37555	28573	8982	1.31
Green gram	5.67	30618	20500	10118	1.49
Cotton	17.19	84200	38570	45630	2.18
Cluster bean	14.13	74450	20900	53550	3.56
Sorghum	13.05	27300	18695	8605	1.46
Tobacco	27.5	156478	38950	117528	4.02
Cumin	6.75	74250	43700	30550	1.70
Mustard	15.71	57642	29850	27792	1.93
Wheat	28.69	54798	36780	18018	1.49
Summer bajra	30.56	87096	35802	51294	2.43

A perusal of the net returns of castor based system over the competing cropping systems / sequences in the district revealed that castor based system was profitable over majority of the competing cropping systems except green gram-fennel-summer bajra and urad -cumin-summer bajra systems respectively.

Economics of castor based system *vis-à-vis* competing cropping systems / sequence in Patan district (Rs/ha)

Cropping sequence / cropping system	Season	Gross returns (Rs/ha)	Operational Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	Difference in net returns (Rs/ha)
Green gram - Castor	*Late Kharif* (Mid Aug –Mid April)	147003	53005	93998	-
Urad - Cumin	*Kharif + Rabi*	117250	64270	52980	+ 41018
Green gram - Fennel		128118	62550	65568	+ 28430
Cluster bean - Cumin		148700	64600	84100	+ 9898
Urad - Wheat		97798	57350	40448	+ 53550
Green gram - Cumin		104868	64200	40668	+ 56330
Cotton - Wheat		138998	75350	63648	+ 33350
Bajra - Wheat		92353	65533	26820	+ 70178
Bajra - Mustard		95197	58423	36774	+ 57224
Green gram - Fennel - Summerbajra	*Kharif + Rabi + Summer*	215214	98352	116862	- 22864
Green gram - Cumin - Summer bajra		191964	100002	91962	+ 2036
Urad - Cumin - Summer bajra		204346	100072	104274	- 10276

The economics of castor hybrid (GCH-7) *vis-à-vis* competing crops in Kachhch district is presented in table below. The average productivity of castor was 20.91 q/ha providing net additional income of Rs. 55731/ha over operational costs. The additional net returns of the competing crops ranged from Rs. 20200/ha in sorghum to as high as Rs. 88883/ha in fennel.

Economics of castor (GCH-7) and competing crops in Kachhch district

Crop	Productivity (q/ha)	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	Profitability Ratio
Castor	20.91	93266	37535	55731	2.48
Fennel	12.64	132403	43520	88883	3.04
Bajra	28.98	55584	30540	25044	1.82
Cotton	15.16	72813	40850	31963	1.78
Cluster bean	10.47	39785	19585	20200	2.03
Sorghum	14.08	38536	16580	21956	2.32
Green gram	7.68	42019	21580	20439	1.95
Sesame	4.34	46629	19850	26779	2.35
Cumin	9.57	109299	43860	65439	2.49
Isabgul	13.9	110899	40580	70319	2.73
Mustard	20.48	72992	32090	40902	2.27
Wheat	44.04	84027	38750	45277	2.17
Summer bajra	32.85	87053	33285	53768	2.62

The economics of castor based system *vis-à-vis* competing cropping systems / sequence in Kachhch district revealed that majority of the cropping systems prevailing in the district provided higher profitability over castor based system excepting for bajra-wheat and bajra-mustard system. This reflects the dominance of the different cropping systems in the district. This calls for efforts to develop newer castor cultivars of short duration with higher yield level or develop hybrids of high yield potential to compete with the different crops/cropping systems.

Economics of castor based system vis-à-vis competing cropping systems / sequence in Kachhch district (Rs/ha)

Cropping sequence / cropping system	Season	Gross returns (Rs/ha)	Operational Cost of cultivation (Rs/ha)	Net Returns (Rs/ha)	Difference in net returns (Rs/ha)
Green gram - Castor	Late *Kharif, rabi* summer (Mid Aug - Mid March)	135285	59115	76170	-
Green gram - Fennel	*Kharif + Rabi*	174422	65100	109322	- 33152
Sorghum - Isabgul		149435	57160	92275	- 92275
Cluster bean - Isabgul		150684	60165	90519	- 14349
Green gram - Cumin		151318	65440	85787	- 9708
Cotton - Wheat		156870	79600	77270	- 1100
Bajra - Wheat		139611	69290	70321	+ 5849
Bajra - Mustard		128576	62630	65946	+ 10224
Sesame - Isabgul		157528	60430	97098	- 20928
Green gram - Fennel - Summer bajra	*Kharif + Rabi +* Summer	261475	98385	163090	- 86920
Green gram - Cumin -Summer bajra		238371	98725	139646	- 63476

Analysis of yield gaps and developing suitable extension strategy for reducing yield gaps in oilseeds

It was observed that during *rabi*, the yield gap-I ranged from 8% in Ludhiana, to 30% in Muzaffarpur with an average of 20.7% across different districts; while the yield gap-II ranged from 0.8% in Ludhiana to 208.4% in Raichur with an overall average of 122.4% across other districts. During *kharif*, the yield gap ranged from 13.9% in Chamrajnagar to 49.9% in Prakasam with an average of 19.3% across other districts. The yield gap-II ranged from 24.8% in Coimbatore to as high as 410.6% in Akola with an overall average of 134.4% across other districts.

Yield gaps observed in major sunflower growing districts of India

District	No.	Yield (kg/ha)		Yield Gap-I	Yield Gap-II
		IT	FP		
Muzaffarpur	122	1677	1288	30.2	15.5
Ludhiana	198	1831	1694	8.1	0.8
Raichur	288	1706	1488	14.7	208.4
24-South Paraganas	731	1595	1269	25.7	51.6
Akola	115	1451	1173	23.6	180.0
Prakasam	335	1790	1481	20.8	57.4
Coimbatore	50	1708	1450	17.8	79.6
Nizamabad	241	1841	1509	22.0	6.4
All India (*rabi*)	**2080**	**1692**	**1402**	**20.7**	**122.4**
Akola	86	1499	1245	16.4	410.6
Chamrajnagar	188	2021	1775	13.9	80.2
Coimbatore	140	1764	1390	26.9	24.8
Prakasam	25	1268	846	49.9	90.2
All India (*kharif*)	**439**	**1784**	**1495**	**19.3**	**134.4**

IT=Improved practices; FP=Farmers' practices; Yield gap-I (%) = Increase in seed yield of IT over FP; Yield gap II = Increase in seed yield of IT over District Average Yield

Knowledge level of farmers on sunflower cultivation

A knowledge test was developed based on the guidelines of Suresh Verma *et al.* (2018) and administered to farmers covered by public (183 farmers) and private (167 farmers) extension systems in Chikballapur, Kadapa, Nizamabad and Raigarh districts of Karnataka, Andhra Pradesh, Telangana and Chhattisgarh states, respectively.

It was observed that farmers under public extension had more knowledge on sunflower production technology *vis-à-vis* farmers under private extension system. There were significant differences ($P<0.01$) in knowledge level between farmers of public and private extension systems on most suitable period for sowing of sunflower, suitable hybrids, application of boron, bee keeping, best season to grow sunflower crop ($P<0.05$), application of fertilizers ($P<0.05$), management of pests and diseases ($P<0.05$). The knowledge level of farmers under public and private extension systems were similar with respect to suitable soils for cultivation of sunflower, seed treatment and time of harvesting.

Farmers availing the public extension services had higher levels of knowledge compared to private extension services mainly due to lower involvement of private sector in extension services related to sunflower. The services offered by the private extension were limited to sale of hybrid seed and the plant protection chemicals. Very limited activities related to capacity building of farmers were undertaken by the private extension system.

Knowledge level of Public and private extension system farmers

S. No.	Knowledge items	Public F (%) n=183	Private F (%) n=167	Z-value
1	Suitable soils for sunflower	139 (75.9)	123 (73.6)	0.49 ^{NS}
2	Best season to grow sunflower crop	142 (77.6)	115 (68.9)	1.84*
3	Most suitable period for sowing sunflower crop in *Rabi*	149 (81.4)	117 (70.0)	2.48**
4	Name of sunflower hybrids	132 (72.1)	101 (60.5)	2.2**
5	Name of the chemical for seed treatment and dosage	139 (75.9)	119 (71.3)	0.99 ^{NS}
7	Seed rate for sowing of sunflower	137 (74.9)	124 (74.3)	0.13 ^{NS}
8	The critical period of weed competition in sunflower	136 (74.3)	118 (70.6)	0.76 ^{NS}
9	Recommended dose of NPK for sunflower under rainfed conditions	141 (77.0)	106 (63.5)	2.78*
10	Recommended dose of NPK for sunflower under irrigated conditions	139 (75.9)	125 (74.9)	0.24 ^{NS}
11	Uses of foliar application of Boron	141 (77.0)	109 (65.3)	2.44**
12	Management of pests in sunflower	145 (79.2)	116 (69.5)	2.09*
13	Management of diseases in sunflower	134 (73.2)	108 (64.7)	1.73*
14	Role of apiary in increasing sunflower production	152 (83.0)	114 (68.3)	3.24**
15	Optimum stage of harvesting sunflower crop	155 (84.7)	131 (78.4)	1.50 ^{NS}

* = Significant at 0.05 level of probability; ** = Significant at 0.01 level of probability and NS = Non-significant

Frontline demonstrations (FLDs) on oilseeds

During 2022-23, 25908 FLDs were conducted (18368 and 8090 during *kharif* and *rabi* respectively). The conduct of demonstrations were coordinated and organized by various oilseed Institutes, Directorates, AICRPs and their respective centres and ICRISAT.

Season-wise allotment and conduct of FLDS on oilseeds and oilseeds based farming systems

Crop	No of FLDs allotted			No of FLDs conducted		
	Kharif	*Rabi*	Total	*Kharif*	*Rabi*	Total
Castor	500	100	600	625	50	675
Sunflower	100	1600	1700	-	1700	1700
Bee keeping		200	200	-	200	200
Linseed	-	1000	1000	-	1000	1000
Safflower	-	400	400	-	400	400
Soybean	1800	-	1800	-	1618	1618
Groundnut	600	500	1100	615	-	615
Sesame	850	250	1100	-	700	150
Niger	400		400	400	-	400
Sesame (ICAR-IIOR)	300	-	300	-	200	200
Niger (ICAR-IIOR)	50	-	50	50	-	50
Rapeseed-mustard	6000	-	6000	6300	-	6300
ICRISAT	-	12500	12500	-	12500	12500
Oilseed based farming systems	100	-	100	100	-	100
Total	10700	16550	27250	8090	18368	25908

FLDs on sunflower conducted during *rabi* 2021-22

Sixty FLDs on sunflower were conducted during *rabi* 2021-22 in Nizamabad and Siddipet districts of Telangana State. In Nizamabad district, FLDs were conducted under zero tillage conditions after harvest of paddy in Hegdoli village. In Siddipet, FLDs were conducted with optimum spacing (60 cm x 30 cm). The productivity potential and profitability are presented below.

Productivity potential and profitability of component technologies in sunflower

Technology demonstrated /location	FLDs (No.)	Mean Seed Yield (kg/ha)		% increase in seed yield over FP	Cost of cultivation (Rs./ha)		Gross Monetary Returns (Rs./ha)		ANR (Rs./ha)	BCR	
		IT	FP		IT	FP	IT	FP		IT	FP
Nizamabad											
Zero tillage	30	1950	2100	-7.7	21,500	28,500	1,20,900	1,30,200	-2,300	5.62	4.57
Siddipet											
Optimum spacing	30	2200	2100	4.5	28,500	29,500	1,36,400	1,30,200	7,200	4.79	4.41

IT = Improved Technology; FP = Farmers' Practice; ANR= Additional Net Returns; BCR = Benefit Cost Ratio

Growing sunflower under zero tillage conditions reduced the seed yield by 7.7%, but the cost of cultivation was also reduced and the B: C ratio is 5.62 as compared to farmers' practice of sowing after tillage (4.57). Optimum spacing of 60 cm x 30 cm in sunflower resulted in meagre improvement in seed yield by 4.5% with additional net return of Rs.7,200/ha.

Sunflower under zero tillage conditions of Nizamabad

Demonstration of optimum spacing in sunflower in Siddipet

Farmer FIRST Programme

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

Activities undertaken under the project envisaged on enhancing the farm level productivity and income through various on-farm and off-farm interventions

NRM module

Contour cultivation/soil and moisture conservation in redgram

In redgram, soil and moisture conservation technologies (contour cultivation/ ridge and furrow method) led to 12 per cent increase in productivity resulting to additional net returns of Rs. 10240/ha.

Use of bio-inoculants as seed treatment: With the multiple objective of reducing the cost of inorganic fertilisers by making available the phosphorus fixed in the soil to the plants and for fixation of atmospheric nitrogen and to address the issue of soil borne pathogens, seed treatment with PSB, *Trichoderma* and *Rhizobium* along with NV 92 specific strain to groundnut were taken up in pulses and groundnut under both *kharif* and *rabi* seasons.

Distribution of bio-inoculants

Integrated Nutrient Management in groundnut (*rabi* 2021-22) resulted in average productivity of 14.00 q/ha as against traditional practice of 11.42 q/ha. Additional net returns accrued were Rs. 19221/ha.

Cropping system module

With the objective of making available the quality seeds of the latest groundnut variety for *rabi* sowings, early *kharif* sowing (2022-23) of groundnut was taken up as mini kit trials on 35 farmers fields. For 16 kg of kernel supplied to each farmer, the yield ranged from 2.66 to 3.50 q. The seed obtained were used by the farmers and fellow farmers during *rabi*, 2022-23. This initiative triggered for the seed village concept in the villages.

Sorghum cultivation taken up towards diversification during *Zaid* 2021-22, led to average productivity of 14.08 q per ha providing gross returns of Rs.23570/ha.

Technology assemblage for redgram, greengram, castor, groundnut and sorghun were provided to the farmers in the adopted viilages. The technology assemblage enabled increase in the yield by 8,3,5,14 and 9% in the aforesaid crops respectively.

Monitoring of standing crops (Groundnut and Castor)

Convergence and linkages were established with NABARD, Tribal Development Corporation, NGOs, ICAR-IIMR, PJTSAU and value added players for exposure visits, capacity building and technical advice.

Capacity building and Interaction meetings

Handholding the Farmers' Producer Company: Provided all technical and logistic support for creation of detailed project proposals, business development plans and providing periodical training programmes on the importance of input and output marketing, value addition, crop diversification and use of bio agents for better soil health.

Women empowerment: Customized programmes were provided to women towards creating awareness on the verticals for value addition of pulses and oilseeds.

Creation of awareness among women farmers on value addition

Marketing and value addition

With the objective towards doubling farmers income, pilots on marketing and value addition were initiated under the project.

Locally processed tur dhal (**9 households/18 q**): Value addition from redgram to dhal enabled additional net returns of Rs.3720/q.

Groundnut pods to Kernel (8 households/30 q): Conversion of groundnut pods to kernel led to additional income of Rs. 3150 /q.

Agricultural Knowledge Management Unit (AKMU)

During the period under report, the website was designed and developed as per the guidelines of GIGW. The website contains information about the institute, Directors, staff (Scientific, technical, administration and accounts) and services like trainings, consultancies etc. The different events organized at ICAR-IIOR were uploaded periodically in the website with photographs. The tender documents, job opportunities are uploaded to the website at regular intervals. The research achievements including that of AICRP were also provided in the website. The financial releases with regard to the AICRPs, FLDs are uploaded regularly. The different mobile applications developed were also redesigned and provided in the web site. The minimum support price announced by the Government for the *kharif* and *rabi* oilseed crops were uploaded to the website. The market prices and arrivals of castor in the major APMC's trading castor crop are uploaded in the website. Regular webinars and online meetings / conferences were also facilitated 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 in the institute and externally funded projects in the Institute Research Council (IRC) meetings. The proposals for thesis/project works of 12 Internship, 13 M.Sc. and 10 Ph.D. students were processed. The Institute Publication Committee has processed 93 manuscripts (15 Research articles, 2 Book chapters, 1 popular article, 3 books, 1 Technical Bulletin, 9 e-Publications and 62 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 technologies (DOR-Bt, Th4d, *Bb* 30% SC formulation) to 5 firms during the reporting period. Two tripartite agreements were done between UAS-B and other public agencies for commercialization of sunflower hybrids (KBSH-41, KBSH-78). Two agreements were done with different firms for contract and collaborative research. A MoU was signed with 7 State Agricultural Universities/ other Universities for facilitating Students' Training/Postgraduate Research/ Ph.D.

AICRP on Oilseeds

Salient Achievements under AICRP on Oilseeds, 2021-22

ICAR-IIOR is mandated to work on six annual oilseed crops *viz.*, Castor, Sunflower, Safflower, Sesame, Niger and Linseed which have immense potential as high quality edible oils, unique industrial oils and for export as seeds. These crops have proven potential for hybrid development and quality improvement to cater to niche markets and organic cultivation both for domestic use and export promotion. The stagnating productivity limited due to biotic and abiotic stresses and quality and value addition are being addressed at strategic locations jointly with the multidisciplinary team of scientists working in different SAUs under four different AICRPs namely Castor, Sunflower, Safflower and Linseed, while Sesame and Niger are being addressed separately by a Project Coordinator, located at JNKVV, Jabalpur. Through the AICRPs, ICAR-IIOR plans, conducts and coordinates multidisciplinary research on the four crops to develop technologies for enhancing productivity in various agro-climatic conditions. Currently there are 40 regular centres with 120 scientists working at strategic locations spread across the country besides few voluntary centres for validation. The research are conducted on crop improvement, crop production and crop protection aspects besides organizing Front Line Demonstrations (FLDs) on improved technologies. AICRP-Linseed, also has a unique centre (BVDU, Pune) working on value addition to promote linseed as a crop of nutraceutical, pharmaceutical and functional properties. Thus, the salient achievements made in all the four AICRPs during 2021-22 are presented.

1. Improved varieties/hybrids notified in sunflower, safflower and linseed

A total of 16 varieties/hybrids have been released in different oil seed crops and notified for different states and production systems *viz.*, sunflower (3), safflower (7) and linseed (6) the details of which is provided. Among these varieties, 9 were of central release and 7 were state releases.

Sl. No.	Variety/ Hybrid	Notification No.	Developed by	Average Yield (kg/ha)	Maturity duration (days)	Oil content (%)	Salient features	Recommended region
Sunflower								
1	BLSFH-15004 (LG 5081)	S.O. 4065(E); 31.08.2022	Limagrain India Private Limited, Secunderabad, Hyderabad (Telangana)	1959	95-100	37.8	Resistant to downy mildew; moderately resistant to *Alternaria* and powdery mildew	Bihar, Haryana, Punjab, Orissa, Chhattisgarh, Maharashtra, Karnataka, Telangana
2	ARKO PROVO (WBSH-2021)	S.O. 4065(E); 31.08.2022	Pulses and Oilseeds Research Station, Berhampore (West Bengal)	3245	105-110	38.5	Resistant to leaf curl, collar rot diseases; moderately resistant to *Alternaria* leaf spot, powdery mildew and downy mildew	West Bengal

Sl. No.	Variety/ Hybrid	Notification No.	Developed by	Average Yield (kg/ha)	Maturity duration (days)	Oil content (%)	Salient features	Recommended region
3	KBSH-85	S.O. 4065(E); 31.08.2022	UAS, Bengaluru (Karnataka) and ICAR-IIOR, Hyderabad (Telangana)	1829	90-100	35.7	Resistant to downy mildew; moderately resistant to leafhoppers	Suitable for rainfed conditions of Karnataka Maharashtra, Andhra Pradesh, Tamil Nadu, Telangana, Gujarat
Safflower								
1	PBNS-184	S.O. 4065(E); 31.08.2022	VNMKV, Parbhani (Maharashtra)	1531	120-124	31.3	Moderately resistant to *Fusarium* wilt, tolerant to aphid	Zone I (Maharashtra, Andhra Pradesh, Telangana, Karnataka) for rainfed situation
2	Raj Vijay Safflower 18-1 (RVSAF 18-1)	S.O. 8(E); 24.12.2021	RSKVV, Indore (Madhya Pradesh)	1746	127-131	39.0	High oil variety; moderately resistant to *Fusarium* wilt	Zone I (Maharashtra, Andhra Pradesh, Telangana, Karnataka) and Zone II (Madhya Pradesh, Chhattisgarh) for irrigated situation
3	Phule Gold (SSF-15-65)	S.O. 8(E); 24.12.2021	MPKV, Solapur (Maharashtra)	1665	122	34.6	Moderately resistant to *Fusarium* wilt	Zone I (Maharashtra, Andhra Pradesh, Telangana, Karnataka)
4	Phule Kiran (SSF-16-02)	S.O. 8(E); 24.12.2021	MPKV, Solapur (Maharashtra)	2058	132	30.6	Moderately tolerant to aphid	Zone I (Maharashtra, Andhra Pradesh, Telangana, Karnataka) and Zone II (Madhya Pradesh, Chhattisgarh) for irrigated situation
5	DSAF-1 (ANG-18-02)	S.O.8(E); 24.12.2021	UAS, Annigeri (Karnataka)	1802	125-127	28.2	Moderately resistant to *Fusarium* wilt	Zone I (Maharashtra, Andhra Pradesh, Telangana, Karnataka)
6	Annigeri-2020 (ANG-17-102)	S.O.8(E); 24.12.2021	UAS(D), Annigeri (Karnataka)	1795	123-130	28.6	-	Zone I (Maharashtra, Andhra Pradesh, Telangana, Karnataka) for rainfed situation
7	Raj Vijay Safflower 14-1 (RVSAF 14-1)	S.O.8(E); 24.12.2021	RSKVV, Indore (Madhya Pradesh)	2000	121-137	29-30	-	Madhya Pradesh
Linseed								
1	Birsa Tisi-1 (BAU-15-03)	S.O.8 (E); 24.12.2021	BAU, Kanke (Jharkhand)	1141	128-130	41.8	Resistant to wilt and powdery mildew; moderately resistant to *Alternaria* blight, rust and bud fly	Jharkhand for rainfed conditions

Sl. No.	Variety/ Hybrid	Notification No.	Developed by	Average Yield (kg/ha)	Maturity duration (days)	Oil content (%)	Salient features	Recommended region
2	Priyam (BAU-2012-1)	S.O.8(E); 24.12.2021	BAU, Kanke (Jharkhand)	1253	128-130	40.7	Resistant to rust and wilt; moderately resistant to *Alternaria* blight, powdery mildew and bud fly	Zone-I (Himachal Pradesh, Jammu and Punjab; and Jharkhand) for irrigated conditions
3	Divya (BAU-06-3)	S.O.8(E); 24/12/2021	BAU, Kanke (Jharkhand)	1538	128-130	39.8	Resistant to rust and wilt; moderately resistant to Alternaria blight, powdery mildew and bud fly	Zone-I (Himachal Pradesh, Jammu and Punjab; and Jharkhand) for irrigated conditions
4	SHUATS Alsi-2 (SHA-2)	S.O.8(E); 24.12.2021	SHUATS, Naini, Prayagraj (Uttar Pradesh)	1110	123-125	37.4	Resistant to powdery mildew and rust; moderately resistant to wilt and *Alternaria* blight	Uttar Pradesh for irrigated conditions
5	Sabour Tisi-3 (BRLS 107-1)	S.O.8(E); 24.12.2021	BAU, Sabour (Bihar)	547	118	38.2	Resistant to wilt, powdery mildew; moderately resistant to rust	For *Utera* cultivation in Uttar Pradesh, Bihar, Jharkhand, West Bengal, Assam, Nagaland, Madhya Pradesh, Rajasthan, Maharashtra, Chhattisgarh, Odisha, Karnataka
6	Sabour Tisi-2 (Sabour-101)	S.O.8(E); 24.12.2021	BAU, Sabour (Bihar)	1883	122	37.8	Resistant to wilt and rust; moderately resistant to *Alternaria* blight	Bihar for irrigated regions

2. Crop production technologies recommended

Fourteen production technologies have been recommended during 2021-22 for different agro-climatic conditions and production systems in all the four crops which included: one combination of plant geometry and drip fertigation of nitrogen fertilizer in castor; reduced and zero tillage practices for rice-fallow sunflower (2); land configuration (2); pre-emergence application of weedicide (1) and moisture conservation practice (1) in sunflower; one each of irrigation and nutrient management, intercropping and selective mechanization in safflower; and one each of application of post-emergence herbicide, soil application of micro-nutrient ($ZnSO_4$) and application of plant growth regulator in linseed.

Sl. No.	Technology developed / recommendation	Centre
Castor		
1	Response of castor hybrid (GCH-9) to plant geometry and drip irrigated N fertigation resulted in significantly higher seed yield (2869 kg/ha) at 150 cm x 60 cm plant geometry. Application of 120 kg N /ha with 25% as basal; remaining 75% through drip fertigation in the form of urea in five equal splits recorded the highest seed yield (2772 kg/ha) and profitability (3.74).	JAU, Junagadh (Gujarat)
Sunflower		
1	Reduced tillage (1 cultivator, 1 rotavator, 1 harrowing) as an improved practice over conventional tillage for rice fallow sunflower for higher yield (12%) and net returns	UAS, Raichur (Karnataka)
2	Follow zero tillage as an improved practice over conventional tillage for rice fallow sunflower for higher B: C ratio (4.5:1) over conventional tillage (2.49:1) at Nimpith, West Bengal	RA-KVK, Nimpith (West Bengal)
3	Sowing in ridges and furrows at 60 cm x 30 cm spacing and application of 125% RDF (75 N, 75 P_2O_5, 37.5 K_2O kg/ha) to obtain higher yield (1271 kg/ha) and profit in vertisols of Nandyal, Andhra Pradesh	ANGRAU, Nandyal (Andhra Pradesh)
4	Sowing in ridges and furrows at 60 cm x 30 cm spacing and application of 100% RDF (90 N, 90 P_2O_5, 45 K_2O kg/ha) for higher yield (2135 kg/ha) and profit in vertisols of Latur, Maharashtra	VNMKV, Latur (Maharashtra)
5	Pre-emergence application of pendimethalin 30 EC @ 1.0 kg a.i./ha followed by quizalofop ethyl 10 EC @ 37.5 g a.i./ha at 15-20 DAS as post emergence herbicide to obtain higher yield (1892 kg/ha) in vertisols Latur, Maharashtra	
6	Application of hydrogel @ 2.5 kg/ha at the time of sowing of *rabi* sunflower to increase sunflower yield at Latur, Maharashtra	
Safflower		
1	Irrigation at rosette termination (45-50 DAS) and flowering stage (90-95 DAS) of safflower increased the seed yield by 20% (1391 kg/ha) compared to one irrigation at 30-35 DAS and is recommended for Chhattisgarh plains	IGKV, Raipur (Chhattisgarh)
2	Intercropping of fenugreek in safflower in a 1:1 ratio as additive series enhanced the system productivity by 34% (2086 kg/ha) and net returns by 39% (Rs. 77118/ha) with B:C ratio of 2.9 compared to sole safflower and it is recommended for Chhattisgarh plains under irrigated conditions	
3	Site specific nutrient management (STCR equation based nutrient application) for safflower improved the seed yield by 29% (1750 kg/ha) and net returns by 32% (Rs. 66210/ha) with B:C ratio of 3.6 and it is recommended for southern Telangana	PJTSAU, Tandur (Telangana)
4	Selective mechanization (sowing, intercultivation, spraying and harvesting) improved the seed yield by 16% (1750 kg/ha) and net returns by 32% (Rs. 77592/ha) with B:C ratio of 5.4 and it is recommended to reduce the cost of cultivation of safflower in Telangana	

Sl. No.	Technology developed / recommendation	Centre
Linseed		
1	Application of post-emergence herbicide clodinafop + metsulfuron methyl @ 0.06 + 0.004 Kg a.i./ha (400 g ha-1) at 2-3 leaf stage of weed (20-25 DAS) for effective weed control and higher yields	CSKHPKV, Palampur (Himachal Pradesh)
2	Soil application of ZnSO4 @ 25 kg/ha and borax @ 1.5 kg/ha at the time of sowing is recommended for higher seed yield	RARS, AAU, Shillongani, Nagaon-(Assam)
3	Auxin (IAA) applied at vegetative and reproductive stage either @ 2.0 or 1.0 ppm as plant growth regulator for higher yield	NU, SASRD, Medziphema Campus, Dimapur (Nagaland)

3. Crop protection technologies

Ten crop protection technologies were recommended in all the four crops which included: management of thrips (1), application of bio-insecticides for management of semilooper and *Spodoptera litura* and other lepidopteran insects (1) in castor; management of *Alternariaster* leaf spot (4), management of *Alternariaster* leaf spot and sunflower necrosis disease (1), management of sunflower necrosis disease and leaf curl (1) and management of sunflower necrosis disease (1); and one in linseed for management of powdery mildew

Sl. No.	Technology developed /recommendation	Centre
Castor		
1	Application of flonicamid 50 WG @ 0.2 g/l for management of thrips in castor	SDAU, SK Nagar (Gujarat)
2	Application of bio-insecticides viz., DOR Bt-127 SC @ 3 ml/l or commercial *Bacillus thuringiensis* var. *kurstaki* (Btk) @ 1g/l for management of semilooper and *Spodoptera litura*	TNAU, Yethapur (Tamil Nadu) and SDAU, SK Nagar (Gujarat)
Sunflower		
1	Seed treatment with carbendazim 12% + mancozeb 63% WP @ 2 g/kg followed by two foliar sprays with difenoconazole 25% + propiconazole 25% @ 0.25 ml/l (first spray at the onset of incidence or 45 DAS and second spray 15 days after 1st spray) for the management of *Alternariaster* leaf spot	UAS, Raichur (Karnataka)
2	Seed treatment with *P. fluorescens* @ 10 g/kg seed + soil application of *P. fluorescens* @ 2.5 kg fortified with 250 kg FYM + three foliar sprays of Pf1 @ 30, 45 and 60 DAS for the management of *Alternariaster* leaf spot and sunflower necrosis disease	
3	Seed treatment with imidacloprid 600 FS @ 5 ml/kg seed + foliar spray with flonicamide 50WG @ 0.25 g/l at 30, 45 and 60 DAS for the management of sunflower necrosis disease and leaf curl	
4	Seed treatment with carbendazim 12% + mancozeb 63% WP (SAAF 75WP) @ 2 g/kg seed followed by two foliar sprays with trifloxystrobin 25% + tebuconazole 50% @ 0.25 g/l (first spray at the onset incidence or 45 days after sowing and second spray 15 days after 1st spray) for the management of *Alternariaster* leaf spot	ANGRAU, Nandyal (Andhra Pradesh)

Sl. No.	Technology developed /recommendation	Centre
5	Seed treatment with carbendazim 12% + mancozeb 63% WP @ 2 g/kg seed followed by two sprays with tricyclozole 18% + mancozeb 62% @ 1g/l for the management of *Alternariaster* leaf spot.	PDKV, Akola (Maharashtra)
6	Seed treatment with imidacloprid 600 FS @ 5 ml/kg seed and foliar spray with triazophos 40 EC @ 1 ml/l at 30, 45 and 60 DAS for the management of sunflower necrosis disease	
7	Seed treatment with *Pseudomonas fluorescens* @ 10 g/kg seed followed by spray of propiconazole @ 0.1% at 45 days and *P. fluorescens* @ 1% at 60 days after sowing for the management of *Alternariaster* leaf spot	PAU, Ludhiana (Punjab)
Linseed		
1	For management of powdery mildew disease, seed treatment with salicylic acid (SA) at 100 ppm + foliar spray of salicylic acid (SA) at 100 ppm at 30 and 45 DAS; seed treatment with salicylic acid (SA) at 50 ppm + foliar spray of salicylic acid (SA) at 100 ppm at 30 and 45 DAS); foliar spray with hexaconazole (0.1%), first spray at initiation of disease and second spray with 10 days intervals found effective	Kangra (Himachal Pradesh), Kanke (Jharkhand), Kanpur (Uttar Pradesh), Nagpur (Maharashtra), Raichur (Karnataka), Raipur (Chhattisgarh), Shillongani (Assam)

4. Value addition (Linseed)

To diversify the use of linseed oil through blending with other edible oils like coconut oil, palm olein and rice bran oil, a technology has been developed which included optimizing blending ratio to improve the ratio of omega-6 to 3 and application of antioxidant to control lipid peroxidation effectively and recommended.

Sl. No.	Technology developed /recommendation	Centre
1	Four years of experimentation on blending of linseed oil with coconut oil, palm olein and rice bran oil in the ratio of 80 (edible oils):20 (linseed oil), was found to improve the ratio of omega-6 to 3 to almost ≤3:1 in all experimental blends (i.e. coconut oil, palm olein and rice bran oil blends with linseed oil). The antioxidant, Ascorbyl palmitate (500 mg/1 kg of oil) was found to control lipid peroxidation effectively	BVDU, Pune (Maharashtra)

ICAR-IIOR

Annual Report
2022

Institutional Activities

- Committees
- Extension and Other Activities
- Meetings and Events
- Education and Training
- Awards and Recognitions
- Human Resource Development
- Publications
- On-going Research Projects
- Infrastructure Development
- Hindi Activities
- Promotions/ Transfers/ Superannuations
- Personnel
- Press Coverage

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, Telangana.	Chairman
Dr. B.B. Singh	Retd. ADG (O&P), ICAR, 281 Utsav 1 Apartment, Flat No. 201, Lakhanpur, Kanpur-208 024, Uttar Pradesh.	Member
Dr. Sreenath Dixit	Principal Scientist & Head, ICRISAT Development Center (IDC), ICRISAT, Patancheru-502 324, Telangana.	Member
Dr. V.G. Malathi	Retd. Principal Scientist, G1 Sree Kumaran Hill Crest Apartment, East GKS Avenue, Thondamuthur Road, Coimbatore-641 046, Tamil Nadu.	Member
Dr. D.M. Hegde	Former Director, ICAR-IIOR, C-108, SMR Vinay Galaxy Hoody Junction, CTPL Road, White field, Mahadevapura, Bengaluru-560 048, Karnataka.	Member
ADG (O&P)	ICAR, Krishi Bhawan, New Delhi-110 001.	Member
Director	ICAR-IIOR, Rajendranagar, Hyderabad-500 030.	Member
Dr. P.S. Srinivas	Principal Scientist (Agricultural Entomology), ICAR-IIOR, Rajendranagar, Hyderabad-500 030, Telangana.	Member-Secretary
Shri Kondela Saya Reddy	H.No. 11-1-1815, Maruthi Nagar, Nizamabad-503 002, Telangana.	Ex-officio Member
Shri K. Yadagiri Reddy	H. No. 16-2-751/C/14, FF-1, Shreys Apartment, Asmangad, Malakpet, Hyderabad-500 036, Telangana.	Ex-officio Member

Up to September 2022

Institute Management Committee

Director	ICAR-IIOR, Rajendranagar, Hyderabad-500 030, Telangana.	Chairman
ADG (OP)	ICAR, Krishi Bhavan, New Delhi-110 001.	Member
Shri Koti Lingam	Regional Manager, Telangana State Seed Development Corporation Ltd., Jeedimetla, Quthubullapur Mandal, Ranga Reddy-500 055, Telangana	Member
Director of Agriculture	Department of Agriculture, Sheshadri Road, K.R. Circle, Bengaluru-560 001, Karnataka.	Member
Dr. R. Jagadeshwar	Director of Research, Prof. Jayashankar Telangana State Agril. University, Rajendranagar, Hyderabad-500 030, Telangana.	Member
Shri K. Yadagiri Reddy	H.No. 16-2-751/C/14, FF-6, Shreys Apartments, Asmangad Malakpet, Hyderabad-500 036, Telangana.	Member (Non-official)
Shri. Kondela Saya Reddy	H.No: 11-1-1815, Maruthi Nagar, Nizamabad-503 002, Telangana.	Member (Non-official)
Dr. C. Aruna	Principal Scientist (Plant Breeding), ICAR-Indian Institute of Millets Research (IIMR), Rajendranagar, Hyderabad-500 030, Telangana.	Member
Dr. Pankaj Sharma	Principal Scientist (Plant Pathology), ICAR-Directorate of Rapeseed Mustard Research (DRMR), Sewar, Bharatpur-321303, Rajasthan.	Member
Dr. Sammi Reddy, K.	Director, ICAR-NIASM, Baramati-413115, Maharashtra.	Member
Dr. A.K. Singh	Head (Agricultural Engineering), ICAR – Indian Institute of Sugarcane Research (IISR), Rae Bareli Road, Lucknow-226 002, Uttar Pradesh.	Member
Finance & Accounts Officer	ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad-500 030, Telangana.	Member
Sr. Administrative Officer	ICAR-IIOR, Rajendranagar, Hyderabad-500 030, Telangana.	Member Secretary

Extension and other Outreach Activities

Activities under Tribal Sub Plan (TSP)

TSP programme was implemented in 22 aspirational districts in 6 states *viz.,* Telangana, Andhra Pradesh, Maharashtra, Chhattisgarh, Jharkhand and Nagaland. A total of 1300 tribal farmers were benefitted. Tribal farmers in targetted districts were encouraged to take up traditional oilseed crops *viz.*, safflower, sesame, niger, castor and linseed by providing improved seed of safflower (ISF-764), sesame (YLM-66 and Swetha), niger (KGN-2) and linseed (NL-260, RLC-92 and RLC-131). In addition, organized field demonstrations, capacity development programmes and field days. The required need based critical inputs and plant protection chemicals, small implements were distributed to tribal farmers. The state wise activities are presented.

Telangana

Under TSP program, the ICAR-Indian Institute of Oilseeds Research, Hyderabad in association with "Vikasith Rythu Samkkshema Samsthan", Adilabad organized 125 demonstrations with improved cultivars along with best management practices in castor (ICH-66/GCH-7); safflower (ISF-764); sesame (Sweta) and organized "Castor, Safflower and Summer Sesame Field Day" in Indravelly mandal Keslapur Village of Adilabad (Dist.) on 14/03/2022. Castor + groundnut intercropping and line sowing of summer sesame (Sweta) were also demonstrated. Distributed the battery sprayers, tarpaulins and seed drill pipes to tribal farmers. The event registered a total footfall by about 200 tribal farmers.

Demonstration of safflower (ISF-764) in soybean-safflower cropping system

Andhra Pradesh

ICAR-IIOR in association with RARS, Chintapally; ARS, Vizianagaram; ARS Yelamanchili and DAATTC, Vizianagaram organized field demonstrations, capacity development programmes to niger growing tribal farmers and also organized field days on sesame and niger. Sesame (YLM-66) was introduced as summer crop to improve the income from unit area of land in Boddavara Panchyat and Srungavarapukota Mandal located in foot of Araku valley. A total of 58 demonstrations were organized. Five capacity building programmes were conducted on summer sesame and vegetable raising in backyards. The tribal farmers were encouraged to grow the vegetables on field bunds and their backyards. The need-based assets *viz.,* tarpaulins (15), oil expellers (5; one for group of 30 families), sickles (100) and spades (100) were distributed.

Pre-demonstration awareness programme conducted at Marupalle, S.Kota (Mandal), Vizianagaram District

Niger field day cum interaction meeting was organized in Killoguda Village, Aruku Mandal of Vishakhapatnam, Andhra Pradesh on November 25, 2022. Information was shared with the farmers about improved varieties, timely sowing, line sowing, cuscuta management, potential of niger cultivation and bee keeping for additional returns through honey. During the occasion, tarpaulins, bio-pesticides, neem oil, and hedge cutters were distributed to the tribal farmers. The QRT team of ICAR-IIOR under the chairmanship of Dr. A.R. Pathak along with the Director, ICAR-IIOR and PC, AICRP on Sesame & Niger graced the occasion.

Niger field day cum interaction meeting

Chhattisgarh, Maharashtra, Jharkhand and Nagaland

A total of 580 demonstrations on linseed were conducted by ICAR-IIOR in association with AICRP-Linseed Centres in tribal areas of Raipur, Chhattisgarh (270); Nagpur, Maharashtra (150); Ranchi, Jharkhand (100) and Medziphema, Nagaland (60) with the objective of empowering the tribals economically in linseed growing areas. Out of 580, 460 demonstrations under whole package rainfed/limited irrigation condition, 86 under whole package *Utera* condition and 34 under whole package irrigated condition were conducted. The whole package demonstration under rainfed/limited irrigation conditions registered an increase in seed yield of 56.1% at Raipur followed by 34.3% at Nagpur Centre over farmers' practice. Higher additional expenditure (Rs. 2762/ha) and additional net returns (Rs. 8738/ha) were realized at Raipur centre. However, the highest IBCR (4.82) was resulted in Nagpur centre. The highest seed yield (780 kg/ha), mean yield (726 kg/ha) and percent increase (42.4%) over farmers practices were recorded under improved technology at Nagpur centre. The impact of improved *Utera* on tribal farmers' fields at Nagpur centre resulted in the highest seed yield (650 kg/ha) over farmer's practice (480 kg/ha). There was an increase of 33.47% in yield through IT over FP. The additional cost of cultivation incurred due to improved *Utera* was Rs. 1438/ha as compared to farmers practices, an additional net monetary return (NMR) of Rs. 7252/ha with IBCR of 5.04 was obtained through improved *Utera*.

Activities under Scheduled Caste Sub Plan (SCSP)

A total of 1900 SC farmers were benefitted during 2022 directly and >2500 were benefitted indirectly through participation in awareness programmes, getting the required literature on oilseed crops and visiting the demonstration plots of crops and oil expellers.

Activity	Farmers covered
Capacity building/skill development	250
Demonstrations	1100
Critical inputs and small farm implements	400
Soil health cards	150
Total	1900

Capacity building progrmmmes on value chain development of oilseeds, improved production technologies for realizing higher yields in oilseed crops, prospects of value addition and marketing in oilseeds crops, bee keeping in sunflower, promoting FPOs, post-harvest management of vegetable crops and soil health management were organized. Demonstrations were organized on oilseed production technologies such as castor hybrids, ICH-66, YRCH-2; safflower variety ISF-764; sesame variety JCS-1020. The SC farmers, farm labourers and farm women were provided small farm implements such as battery-cum-manual operated sprayers, tanks for preparation of decomposers, drums for preparing the spray fluid and tarpaulins for protecting the harvested produce.

Hands-on-experience training on oil expelling and improved technologies of oilseed crops to SC communities

Activities in NEH Region

Evaluation of 6 linseed varieties was taken up during 2021-22 in 4 locations (Basar in Arunachal Pradesh, Medziphema in Nagaland, Tadong in Sikkim and Lembuchera in Tripura) and the data for 3 locations is presented.

1. Basar Centre, Arunachal Pradesh

The linseed crop was grown during *rabi* 2021-22. Under Basar conditions, Priyam variety recorded highest seed yield (13.76 q/ha) which was at par with the seed yields of RLC-153 (13.05 q/ha) and T-395 (13.15 q/ha).

Performance of different linseed varieties under Basar (Arunachal Pradesh) conditions

2. Nagaland Centre

Performance of linseed varieties were carried out under Nagaland conditions at ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema, Nagaland. The performance of linseed variety LSL-93 was superior with highest seed yield of 878 kg/ha over others. However, the yield of JLS-95 (839 kg/ha) and T-397 (868 kg/ha) were at par with LSL-93.

Performance of different linseed varieties at Nagaland conditions

3. Sikkim Centre

A field study was carried out to evaluate the performance of six linseed varieties at Research Farm of ICAR Research Complex for NEH Region, Sikkim Centre, Tadong, Gangtok, Sikkim during *rabi* season of 2021-22. The data pertaining to growth parameters, yield attributes and yield of linseed varieties were influenced significantly under organic management condition except harvest index. Highest dry matter accumulation (16 g/plant) was noted in LSC-93 which was statistically at par with Priyam and significantly higher than other varieties. Maximum 1000 seed weight (8.21 g) was recorded in LSC-93 which was statistically at par with JSL-95 and significantly higher than other varieties. Significantly highest seed yield (746 kg/ha) was recorded in Priyam followed by LSC-93 and RLC-153.

Performance of linseed varieties under organic management conditions at Sikkim

Performance of linseed varieties under organic management conditions at Tadong, Sikkim

Variety	Plant height at harvest (cm)	Dry matter accumulation at harvest (g/plant)	Total number of branches/ plant	Number of capsuls/ plant	Number of seeds/ capsule	1000 seed weight (g)	Seed yield (kg/ha)	Harvest Index (%)
RLC-153	71.2	10.0	15.2	66.0	6.90	6.38	733	32.7
Sekhar	76.4	12.0	18.4	99.4	6.00	7.54	716	31.3
LSC-93	72.6	16.0	24.0	106.4	8.31	8.21	740	32.2
Priyam	62.6	15.0	30.6	113.7	8.80	6.41	746	31.7
JSL-95	69.4	9.40	16.4	62.0	7.90	8.03	630	31.1
T-395	55.4	11.0	25.2	90.8	6.80	5.56	680	31.2
SEm±	1.30	0.35	0.74	2.41	0.17	0.15	6.93	0.32
LSD (p=0.05)	3.98	1.10	2.25	7.31	0.52	0.44	20.8	NS

Mera Gaon Mera Gaurav (MGMG)

A total of 48 visits were made by the MGMG teams covering nearly 2600 farmers in the forty identified villages and the following activities were conducted in the villages.

Name of activity	No. of activities conducted	No. of farmers benefitted
Visit to villages by teams	48	590
Interface meeting/ *Goshthies*	12	450
Demonstrations conducted	35	190
Mobile based advisories	120	812
Literature support provided	20	200
Awareness created	15	350

Capacity Building and Technology Dissemination

Five trainings were conducted for skill development among the seed producers for quality maintenance of oilseed crops varieties and hybrids programme in Andhra Pradesh, Telangana and Maharashtra. A total of 332 seed growers and farmers were benefitted through these training programmes.

Name of the training programme	Venue	Date	Stakeholders	No. of Beneficiaries
Orientation training programe on sunflower hybrid seed production technology	TSSDC, Hyderabad, Telangana State	March 02, 2022	Staff of TSSDC	20
On farm training on post-harvest technologies of safflower seed production	Mariapur village, Pudur Mandal, Ranga Reddy Dist, Telangana state	March 21, 2022	Farmers, Seed growers, Agriculture department, NGO	170
Training on Good Agricultural Practices and Seed Production in Safflower, Maharashtra State	Online	December 06, 2022	Farmers, Seed growers, Agriculture department, NGO	98
Training on Bee keeping in oilseeds for increasing productivity	ICAR-IIOR	December 20-21, 2022	Farmers, FPO members	19
Orientation training program on castor hybrid seed production technology	Yagantepalle, Andhra Pradesh	December 30, 2022	Farmers, Seed producers	25

Trainings/ Field days/ Capacity building under SCSP/ TSP/ Seed/ NEH/ FFP/ FPO

Title/ Purpose	Venue	Date
Soil testing	Narayanraopet, Chinnakoduru	January 25 and June 8, 2022
World Pulse day	Gurudhotla	February 10, 2022
Field day on oilseeds technology	Chinnakoduru	February 11, 2022
Safflower Field Day	Sherigudem Village	February 25, 2022
Accounts and book keeping for FPO	Chinnakoduru & Narayanraopet	March 15 and August 5, 2022
On farm training on post-harvest technologies of safflower seed production	Mariapur	March 21, 2022
Hands on experience on value addition of pulses and oilseeds to women entrepreneurs	ICAR-IIOR, Hyderabad	March 26, 2022
Formation and promotion of 10000 FPOs	Narayanraopet, Chinnakoduru	March 29 and Sept. 24, 2022

Title/ Purpose	Venue	Date
Hands-on Training on Mass Production and Formulation of *Bacillus thuringiensis*	ICAR-IIOR, Hyderabad	April 27-29, 2022
Motivation about oilseed crops	Chinnakoduru, Narayanraopet	May 11 and June 7, 2022
Farmers' mela organized by ICAR-IIOR and IOPEPC	Rajkot, Gujarat, Mahoba, U.P and TNAU, Vridhachalam	May 19, June 26 and Aug. 11, 2022
Groundnut crop awareness	Chinnakoduru	May 21, 2022
Business plan for FPOs	Narayanraopet, Chinnakoduru	May 21 and Nov. 25, 2022
Awareness about Drone technology	Chinnakoduru	June 1, 2022
Seed production of oilseed crops	Chinnakoduru	June 18, 2022
National level campaign on balanced use of fertilizers	Narayanraopet	June 21, 2022
Use of leaf colour chart (LCC)	Narayanraopet	September 22, 2022
Awareness about crop diversification	Narayanraopet, Chinnakodur	October 8 and 22, 2022
Use of animal and bird control sound box	Chinnakoduru, Narayanraopet	October 12 and 27, 2022
Value addition on oilseeds to Women farmers	Gurudhotla	October 15, 2022
Value addition on oilseeds to Progressive farmers /Directors, Vikarabad Farmer Producer Company Limited	ICAR-IIOR, Hyderabad	October 17, 2022
Vigilance Awareness Week conducted to Sarpanch(s)/ gram panchayat members/ village leaders and farmers	Gurudhotla and Rampur Thanda	November 4, 2022
Capacity building programme to tribal households on enhancing farmers income through creation of verticals	Rampur Thanda	December 1, 2022
World Soil day	Rampur Thanda, Malyala	December 5, 2022
Awareness on the importance of forming the FPOs	Kadhandavaopally	December 20, 2022
Training on Apiculture	Chinnakodur and Narayanraopet	December 21-23, 2022
Orientation training programme on castor hybrid seed production technology to farmers	Yagantepalle	December 30, 2022

FPO formation: ICAR Institutes have shown the way to FPO farmers

The ICAR institutes and extension organizations have shown the way for developing viable business ventures to the "*Chinnakodur Ryhtu Uthpathidarula Paraspara Sahaya Sahakara Sangam Limited*" under the project on "Formation and Promotion of Farmer Producer Organizations" during the field day organized on March 5, 2022 at Chinnakodur village, Siddipet district, Telangana State. In the field day organized by ICAR-IIOR, Hyderabad, the scientists from ICAR-IIOR, ICAR-NAARM, PJTSAU, Private companies, NGOs and local public representatives, farmers and FPO members participated. Crop diversification, possibilities of developing complete value of sunflower and groundnut through value added products, oil expelling, branding and marketing were discussed. Awareness was created on drone-based spraying in crops and demonstrated pesticide spray in paddy during the field day. Before the field day, the participants visited the seed production fields of groundnut and paddy and sunflower fields with honey bee boxes.

Sunflower fields of FPO members

Input aggregation and output marketing

In order to encourage crop diversification, the FPOs were educated to take up sunflower crop during *rabi* season in identified villages of Chinnakodur and Narayanraopet blocks. Accordingly input aggregation (seed) was done for 1000 acres and the seed (Siri hybrid, Swathi, DRSH-1 and KBSH-78), fertilizer and chemicals were procured directly from public sector units and private companies enabling a profit of Rs.7,88,820/- to the FPO. During the first year of its formation, the FPOs could earn a profit of Rs.10.8232 lakhs and the equity grant of 21 lakhs were secured from GoI.

Crop diversification and bee keeping

Around 1225 ha of sunflower was sown during *rabi* 2022-23 in two mandals of Siddipet district, Telangana state. Keeping in view the increasing area under sunflower, apiary was introduced in two mandals. Three entrepreneurs were provided the opportunity for bee keeping in sunflower fields and around 930 bee boxes were maintained. Farmers perceived that the yield of sunflower increased by 15-20% due to bee activity and provided livelihood to the local entrepreneurs involved in honey production.

Bee keeping in sunflower in Siddipet

Seed production and capacity building

Seed production of Girnar-5 and Kadiri Lepakshi was taken up in 1 ha and the seed was sold to members and other farmers in different states. The FPOs could earn a profit of around Rs. 2.93 lakhs due to seed production and sale.

Various capacity building programs *viz.*, on-field, online and on-campus were organized for the members and the office bearers with the support of TSSOCA, PJTSAU and ICAR institutes. Field days and interaction meetings were organized to create awareness about the improved technologies of oilseed crops.

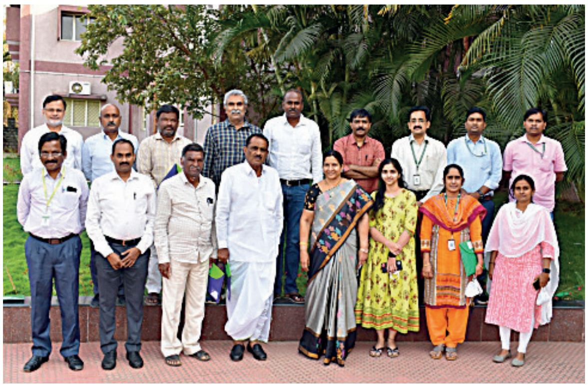
Capacity building programmes organized

Input aggregation and output marketing of the FPOs during 2021-22

Activity	Quantity (kg/litres)	Purchase price (Rs.)	GMR (Rs.)	Profit (Rs.)
Input aggregation				
1. Sunflower hybrids	2360	10,23,000	17,70,000	6,82,000
2. Fertilizers	1,06,700	12,07,891	13,06,050	98,158
3. Plant protection chemicals	72.5	56,658	65,320	8,662
Output marketing				
Groundnut	5000	3,00,000	4,30,000	2,93,500
Total		**25,87,549**	**35,71,370**	**10,82,320**

Business plan development

The workshop on development of business plan for FPOs was organized in hybrid mode (online and offline) by ICAR-Indian Institute of Oilseeds Research on February 22, 2022. Around 60 scientists from ICAR institutes, KVKs, NIPHM, PJTSAU, SKLTSHU, staff of Kotak Mahindra Bank, NCDC and board of directors and members of FPOs participated in the workshop. The directors of the ICAR institutes had highlighted the available technologies from their respective institutes for the benefit of the FPO communities and stressed on the importance of value addition for improving the business of the FPOs. The participants highlighted the importance of capacity building of the members of the FPOs and board of directors.



Participation of scientists, bankers and FPO members (offline) during the workshop on Business plan development for the FPOs

Skill Development Programme

ICAR-IIOR has conducted the skill development programme on "Bee keeping in oilseeds for increasing the productivity and income of farmers" during 21-23, December 2022. A total of 19 farmers, prospective entrepreneurs and FPO members from various districts *viz.*, Siddipet, Karimnagar, Warangal, Rangareddy and Hyderabad of Telangana attended the skill development programme. As part of skill development programme, farmers were provided the exposure on oilseeds scenario in Telangana state, technologies for enhancing productivity of oilseeds, management of insect pests of oilseed crops and role of apiary in increasing productivity of oilseeds by various resource persons of ICAR-IIOR and Api Culture Technology Centre, PJTSAU. The participants were given complete hands on training at Api Culture Technology Center (Bee Keeping), PJTSAU on rearing of bees, foraging behaviour of bees, role of bees in cross pollination and increasing the yields of oilseed crops, identification of queen bee, safety measures and risks involved in bee keeping. Field visits to Narkhoda and Rajendranagar farms and oil expeller unit at ICAR-IIOR were organized for participants.

Hands on training on Bee keeping and distribution of certificates

Training on Mass Production and Formulation of *Bacillus thuringiensis*

A "Hands-on Training on Mass Production and Formulation of *Bacillus thuringiensis*" was organized by the Crop Protection Section, ICAR-IIOR, Hyderabad, during April 27-29, 2022. The participants were given hands-on training on isolation, identification, mass production, formulation, quality testing and contamination problems of *Bacillus thuringiensis*.

Participation in Exhibitions

- ICAR-IIOR participated in the International Conference on "System of crop Intensification for climate-smart Livelihood and Nutritional Security" organized by ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad from December 12-14, 2022, to exhibit ICAR-IIOR technologies.
- ICAR-IIOR participated in the International Conference on "Reimaging Rainfed agro-ecosystems: Challenges & Opportunities (ICRA-2022)" organized by ICAR-CRIDA, Hyderabad during December 22-24, 2022, to exhibit ICAR-IIOR technologies and received best Stall award.

National Agricultural Innovation Fund (NAIF) Activities

ITMU: NAIF (Component I)

Technology licensing and commercialization: An amount of Rs. 12.0 lakh was generated through licensing of DOR Bt-1 technology to private firms *viz.*, M/s Biofac inputs Private Limited, Hyderabad (February 19, 2022); M/s Anand Agricultural university (AAU), Anand (March 26, 2022); and M/s Warkem Biotech Private Limited, Mumbai (April 1, 2022).

Signing of MoA with M/s Warkem Biotech Private Limited, Mumbai for licensing of DOR Bt-1 technology

An amount of Rs. 1.5 lakh and Rs. 3.0 lakh was generated through licensing of DOR Th4d technology and DOR *Beauveria bassiana* (Bb) 30% SC technology to M/s Siddaganga Oil & Bio Industries LLP., Tumkur, Bengaluru. Licensing agreement was signed on June 20, 2022 and November 19, 2022.

Signing of MoA with M/s Siddaganga Oil & Bio Industries LLP., Tumkur, Bengaluru

ICAR-IIOR, University of Agricultural Sciences (UAS), Bengaluru signed MoA with National Dairy Development Board (NDDB), Karnataka regarding commercialization of sunflower hybrid KBSH-78 on December 19, 2022. An amount of Rs. 2.5 lakh was generated as ICAR-IIOR Share.

Intellectual Property Rights (IPR)

Patent

Patent application entitled "A Polymer composition and a process for its preparation" was sent for NBA clearance on September 12, 2022.

Memorandum of Understandings (MoUs)

ICAR-IIOR signed MoU's with University of Agricultural Sciences (UAS), Bengaluru (March 31, 2022), Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur (April 27, 2022), Maharana Pratap University of Agriculture and Technology (MPUA&T), Udaipur (May 27, 2022), Sanskriti University, Mathura, UP (July 07, 2022), Dr. Panjabrao Deshmukh Krishi Vidyapeeth (Dr. PDKV), Akola (November 23, 2022), Tamil Nadu Agricultural University (TNAU), Coimbatore (December 12, 2022), Loyola Academy, Hyderabad (December 21, 2022) for facilitating Institutional Research and Students' Training and Research.

ICAR-IIOR, Hyderabad & Project Coordinator, AICRP Sesame and Niger, Jabalpur signed MoA with IOPEPC for Sustainable development, enhancing production, yield and quality of oilseeds on May 26, 2022. ICAR-IIOR, University of Agricultural Sciences (UAS), Bengaluru signed MoA with Karnataka Co-operative Oilseeds Growers Federation Limited (KOF) Bengaluru & National Dairy Development Board (NDDB), Karnataka regarding commercialization of sunflower hybrids KBSH-53 and KBSH-41 on June 27, 2022. An amount of Rs. 2.5 lakh was generated as ICAR-IIOR Share. ICAR-IIOR signed MoA with M/s Valagro India Pvt. Ltd, Hyderabad on October 11, 2022 for Contract Research Services on "Studies on bio efficacy of *Trichoderma* against castor root rot and groundnut stem rot". An amount of Rs. 7.198 lakh was generated.

Signing of MoU with Sanskriti University, Mathura, UP

Copy Rights

ICAR-IIOR, Hyderabad submitted four copy rights *viz.,* ICAR-IIOR-Castor mobile app (June 30, 2022); and ICAR-IIOR-Sunflower; ICAR-IIOR-Safflower; ICAR-IIOR-Sesame mobile apps (November 23, 2022).

Trademarks

ICAR-IIOR, Hyderabad submitted two trademarks *viz.,* TilhanTec, under class 01 and class 31 (September 30, 2022).

PPV&FRA

ICAR-IIOR, Hyderabad submitted applications with PPV&FRA for registration of Sunflower hybrid, TilhanTec-SUNH-1 on August 13, 2022 and Castor hybrid, ICH-5 on September 30, 2022.

Varieties released

Sunflower variety, Arko Provo (WBSH-2021) (Pulses and Oilseeds Research Station, Berhampore); sunflower Hybrid, KBSH-85 (UAS, Bengaluru and ICAR-IIOR); safflower varieties, PBNS-184, Parbhani Suvarna (PBNS-154) - State release (AICRP, VNMKV, Parbhani); RVSAF 18-3 - State release (RVSKVV, College of Agriculture, Indore, MP) were notified and released through SO 4065 (E) Dated 31.08.2022.

ABI: NAIF (Component II)

Customized training programme and hands on training was imparted on value addition in oilseeds to prospective entrepreneurs, farmers and FPO board of Directors with the purpose of enhancing the farmers income and insulate them for setting up of small scale/ cottage level verticals towards producing quality edible oils.

Parthenium Awareness Week

The Parthenium Awareness Week was conducted at ICAR-IIOR, Hyderabad from 16-22 August, 2022. During the week, awareness was created among the farm workers on ill effects of Parthenium and ways and means of controlling its spread. The significance of uprooting the weed before flowering was also stressed upon. A Parthenium removal drive was also organized during the week in all three farms of ICAR-IIOR.

World Soil Day

Dr. R.K. Mathur, Director and interdisciplinary team of scientists from ICAR-IIOR, Hyderabad in association with Agriculture department and FPO members organized "World Soil Day" on December 5, 2022 at Rampur Thanda, Vikarabad District; Malyal Village Narayanraopet Mandal and Chinnakoduru Mandals of Siddipet District. Three awareness programmes were conducted on the theme "Soils: Where Food Begins" on (i) importance of soils (ii) soil degradation problem/loss of nutrients (iii) importance of use of organics for improving the soil health and need for enhancing resource use efficiency in the long run. Field visits were also organized in farmer's fields of castor, groundnut and sunflower and suitable suggestions were made for maintaining soil health and enhancing productivity of oilseed crops. A total of 230 farmers attended the meeting.

ICAR-IIOR, Hyderabad organized World Soil day in Vikarabad and Siddipet districts of Telangana

Swachhata Pakhwada

Swachhata Pakhwada activities were conducted during 16 to 31 December 2022 within and outside ICAR-IIOR such as planting of tree saplings, display of banners, cleaning drives in MGMG villages, Kisan Diwas (23rd December 2022), etc. Programs on awareness about swachhata among school children by conducting quiz programmes, separate disposal of bio-degradable and non-bio-degradable waste, cleaning drives in farmers first villages and ICAR-IIOR research farms of Rajendranagar, Narkhoda and weeding of physical files etc. The ICAR-IIOR personnel, farmers, students and civilians took part in the Swachhata Pakhwada programmes.

Swachhata Special Campaign 2.0

Swachhata Special Campaign 2.0 for disposal of pending matters of ICAR activities was conducted from 2nd to 31st October, 2022 at ICAR-IIOR, Hyderabad. Swachhata commitment and cleaning activities were organized in the Institute. All ICAR-IIOR employees including scientists, technicians, office personnel, contract workers and students participated in the cleaning drives with commitment and interest.

Field Days

Safflower field days

- Safflower field day was conducted at Sherigudem village, Nawabpet mandal, Vikarabad (Dist.), Telangana on February 25, 2022 to demonstrate the potential of safflower variety ISF-764 grown as sole crop in 300 acres. A total of 270 farmers attended the field day and meeting. ICAR-IIOR Director, scientists, personnel from agriculture department, KVKs, NGO (Seva Spoorthi Foundation), ATMA participated and interacted with farmers.

Safflower Field Day at Sherigudem Village, Vikarabad District, Telangana

- Safflower field day on Post harvest Technology was conducted at Mariapur village, Pudur mandal, Ranga Reddy (Dist.) on March 21, 2022. ISF-764 seed production was taken up in 100 acres. On farm training was given to farmers about post harvest operations to be adopted in safflower and also about the importance of seed production. Brief description of varietal characters of ISF-764 variety, best management practices to get higher yields were also explained. A total of 170 farmers from Mariapur, Kankal, peddaummenthal, ummenthal, raakamcherla villages attended the field day. Scientists from IIOR, DAO, ADA, Vikarabad, AO, AEO of Pudur mandal, NGO (Seva Spoorthi Foundation), ATMA, Vikarabad staff participated and interacted with farmers.

Sesame Farmer's Melas

IOPEPC along with ICAR-IIOR organized sesame farmer's melas at Rajkot, Gujarat (May 19, 2022), Mahoba, Uttar Pradesh (June 25, 2022), Vriddhachalam, Tamil Nadu (in association with RRS, TNAU) (August 11, 2022). The purpose of these melas was to promote export quality sesame and also to strengthen the value chain of sesame; Good Agricultural Practices (GAP) for seame cultivation were explained. Farmers (150-Rajkot, 300-Mahoba, 1000-Vriddhacahlm), scientists from ICAR-IIOR, IOPEPC, PC unit (Jabalpur), local administratives, traders, export council attended the farmer's mela. Pamphlets on sesame package of practices for summer cultivation were distributed to farmers.

Kisan Diwas

ICAR-IIOR celebrated Kisan Diwas on December 23, 2022 at Rajendranagar, Hyderabad. A total of 100 farmers from various districts of Telangana participated. Field visits to Rajendranagar and Narkhoda farms were organized and the scientists of ICAR-IIOR explained about the recent technologies in oilseed crops. A farmers-scientists interaction meeting was organized at ICAR-IIOR. Dr. R.K. Mathur, Director, ICAR-IIOR has urged the farmers to use the water resources judiciously and the knowledge on the critical stages of the crop under limited resources is of immense use to the farmers. He advocated to grow the oilseed crops as intercrops in horticultural crops for additional income. He urged the farmers to adopt the latest technologies for improving the yield of the oilseed crops.

Farmers visit to ICAR-IIOR under Kisan Diwas

Balanced Use of Fertilizers (including Nano-Fertilizers)

Farmers of Jakkapur village in Siddipet district (on June 21, 2022) were educated on various aspects of balanced use of fertilizers that included (i) supplying the crops with the essential nutrients, (ii) importance of soil testing in balanced use of fertilizers, (iii) judicious use of fertilizers (including nano-fertilizer) using 4-R's principle, (iv) importance of organic fertilizers, (v) drip fertigation and (vi) crop residue management with bio-fertilizers. Farmers were requested to take up green manure crops like sunhemp and diancha. About 100 farmers and other stakeholders were benefitted from the programme.

Awareness Programme on Region Specific Agroforestry and Seed and Organic Certification

The importance of agroforestry was elaborated and the need for planting of region-specific trees like Neem, Pongamia and Tamarind were highlighted. Dignitaries planted neem, pongamia and tamarind tree saplings in the premises of Panchayat office in Jakkapur village (on June 21, 2022). Importance of quality seed and tips for efficient and quality seed production in farmer's fields were highlighted by scientists of ICAR-IIOR and other dignitaries.

Awareness programme on region specific agroforestry

PM Kisan Sammelan

The institute had organized PM Kisan Sammelan activities on October 17, 2022 in the villages and also at ICAR-IIOR. The farmers were made aware on the importance of the startups in the agricultural sector. Hands on experience training was provided to the farmers and FPO members at the institute.

Visitors' Information

During the year 2022, a total of 2629 people visited and interacted with the scientists of ICAR-IIOR which include farmers, Agricultural Departmental Personnel of different states, agricultural graduate, post graduate, Ph.D. students and their staff of different Agricultural Universities across India. Trainees undergoing different training programmes at various ICAR as well as other organizations like NIPHM, MANAGE and NIRD also visited. Visitors were taken to ICAR-IIOR museum, various labs including soil testing, quality and biotechnology labs, oil expelling units and ICAR-IIOR Tilhan shoppee etc. and the activities were explained. Farmers showed keen interest in perceiving, understanding the recent technologies available with the institute related to the oilseeds crops.

Farmers visit to ICAR-IIOR

Meetings and Events

MEETINGS

Institute Research Committee (IRC)

Dr. M. Sujatha, Director (A) chaired the IRC-2022 meetings held during April 21-22, 2022 and April 28-29, 2022 for *Kharif* crops and on September 28, 2022; October 28, 2022 and November 03, 2022 for *Rabi* crops. Progress of the ongoing research projects was reviewed, new project proposals were presented and the technical programme for 2022-23 was finalized.

Research Advisory Committee (RAC)

The 35th Research Advisory Committee meeting of ICAR-IIOR was conducted during 10-11 May, 2022 under the chairmanship of Dr. P. Raghava Reddy, Former Vice Chancellor, ANGRAU. The meeting was conducted in hybrid mode due to COVID-19 pandemic. Physical meeting was conducted at ICAR-IIOR, Hyderabad. Members of the committee, Dr. B.B. Singh, Ex-ADG (O&P); Dr. D.M. Hegde, Ex- Director, ICAR-IIOR, Hyderabad; Dr. V.G. Malathi, Principal scientist (Retd.), ICAR-IARI, New Delhi; Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi; Dr. M. Sujatha, Director (A), ICAR-IIOR and two ex-officio members, Sh. K. Saya Reddy, Nizamabad and Sh. K. Yadagiri Reddy, Hyderabad attended the meeting. On 10th May, 2022, Dr. M. Sujatha, Director (A), ICAR-IIOR welcomed the committee and gave a presentation on the significant achievements made by ICAR-IIOR during the year. Dr. P.S. Srinivas, Member Secretary has presented ATR on recommendations of 34th RAC. Significant research achievements made under different research projects (of crop improvement, crop production, crop protection and social sciences) were presented before the committee by the Heads of the Sections and scientists. On 11th May, 2022, respective PIs of the AICRP sunflower, safflower, castor and linseed have presented the research highlights of the previous year. After a thorough interaction and discussion with the scientists, RAC has made recommendations and suggestions.

Annual Group Meeting of AICRP on Oilseeds (Castor, Sunflower) and AICRP on Sesame and Niger-2022

The Annual Group Meeting of AICRP on Oilseeds (Castor, Sunflower) and AICRP on Sesame and Niger was organized at ICAR-IIOR, Rajendranagar, Hyderabad from May 25-27, 2022 through Hybrid mode. The inaugural session was graced by Dr. T.R. Sharma, DDG (Crop Science), ICAR, New Delhi; Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi; Dr. D.K. Yadava, ADG (Seeds), ICAR, New Delhi. Dr. M. Sujatha, Director (A), ICAR-IIOR, Hyderabad welcomed the dignitaries and delegates and presented the research highlights of AICRP on Oilseeds (Castor, Sunflower). Dr. Rajani Bisen, in-charge, PC Unit, Jabalpur presented the research highlights of AICRP on Sesame and Niger (2021-22). The PIs and Co-PIs made presentations of AICRP on Oilseeds (Castor, Sunflower) and AICRP on Sesame and Niger, which covered various research accomplishments under crop improvement, seed production, crop production including FLDs and crop protection during 2021-22. The technical program for the year 2022-23 was finalized after thorough discussions by Chairman, Co-Chairman and Subject Experts. The Varietal Identification Committee meeting was held on May 25, 2022, through Hybrid mode and four proposals, *viz*., sesame (2), sunflower (1) and niger (1) were recommended for identification. The plenary session was chaired by Dr. P. Raghava Reddy, Chairman, RAC, ICAR-IIOR, Hyderabad and Co-chaired by Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi on 27-05-2022. Over all proceedings of individual crops were presented by the PIs concerned. Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi participated online and shared his suggestions on the way forward for the programme. The following recommendations emerged during the course of deliberations: Redefining ideal plant types, utilization of trait specific germplasm to develop heterotic hybrids, reassembling traits, bio-intensive management modules for various crops and production systems, and identification of surrogate traits for major diseases like gray mold in castor.

Quinquennial Review Team Meetings

The QRT of ICAR-IIOR, AICRP on Oilseeds (Castor, Sunflower Safflower, Linseed) and AICRP on Sesame and Niger for the period from 2017-2021 was constituted by ICAR under the chairmanship of Dr. A.R. Pathak, Former Vice Chancellor, JAU, Junagadh with the members: Dr. P Ananda Kumar Ex-Director, ICAR-NIPB, New Delhi; Dr. D.M. Hegde, Former Director, ICAR-IIOR, Hyderabad; Dr. V.K. Baranwal, Professor and Head (Virology), Division of Pathology, ICAR-IARI, New Delhi; Dr. K.L. Dobariya, Oilseed Specialist, JAU, Junagadh; Dr. K.V. Deshmukh, Retired Professor and Head (Agril. Economics), VNMKV, Prabhani. Dr. Kadirvel Palchamy, Principal Scientist (Genetics), ICAR-IIOR, Hyderabad served as Member Secretary.

The team conducted eight meetings since the first meeting (virtual) of Dr. A.R. Pathak, Chairman with Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi on July 11, 2022. The team reviewed the research achievements of ICAR-IIOR and six AICRPs (Castor, Sunflower, Safflower, Linseed, Sesame and Niger) operating at 56 centres across 19 states. The review of ICAR-IIOR, Hyderabad was conducted during August 04-05, 2022. Dr. M. Sujatha, Director (A) made a presentation on the overall achievements of ICAR-IIOR during the review period. Subsequently, detailed presentations on the research achievements section wise were made. Review meetings of the AICRPs *viz*., sunflower, castor, sesame, linseed, niger and safflower were conducted at the centres *viz*., Coimbatore (August 24-25, 2022), Junagadh (September 13-14, 2022), Mandore (October 10-12, 2022), Raipur (November 09-11, 2022), Araku (November 24-25, 2022) and Dharwad (December 09, 2022), respectively. Overall achievements of the respective AICRP was presented by the concerned Project Coordinator/Principal Investigator followed by centre-wise presentations. During review, the QRT noted the significant achievements of each AICRP and made critical observations. The final meeting of the QRT was conducted during December 17-20, 2022 at ICAR-IIOR, Hyderabad and the draft report/ recommendations were finalized.

Annual Group Meeting of AICRP on Oilseeds (Safflower and Linseed)-2022

The Annual Group Meeting of AICRP on Oilseeds (Safflower and Linseed) was organised by College of Agriculture, Dr. PDKV, Nagpur on September 1 to 2, 2022 to review the results of research conducted under AICRP on Oilseeds (Safflower and Linseed) during 2021-22 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 on 1st Sept. was chaired by Dr. V.M. Bhale, Vice Chancellor, Dr. PDKV, Akola. Dr. T.R. Sharma, DDG (CS), ICAR, New Delhi was the Chief Guest and Dr. Sanjeev Gupta, ADG (O&P), ICAR, New Delhi, Dr. D.K. Yadava, ADG (Seeds), ICAR, New Delhi, Dr. V.K. Kharche, Director of Research, Dr. PDKV, Akola and Dr. M. Sujatha, Director (A), ICAR-IIOR, Hyderabad were the guests of honour.

Dr. M. Sujatha, Director (A), presented the research highlights of AICRP-Safflower and Linseed programmes. Her presentation covered various research accomplishments of 2021-22 under plant breeding, breeder seed production, agronomy, pathology, entomology, front line demonstrations. The major recommendations which emerged from this session include intensification of mechanisation in safflower and linseed crops, more focus on development of soil moisture conservation techniques and development of good agro-technologies for Utera cultivation in linseed. It was also stressed that development of cultivars with at least 15 days less duration and thermo-tolerance should be done on priority. Projects should also be submitted to DAC to revive safflower and linseed.

This was followed by the technical sessions on crop improvement for safflower and linseed which included presentations on breeding, genetic resources and breeder seed production. In the afternoon, concurrent technical sessions for crop protection in safflower and crop production in Linseed were held. Varietal Identification Committee meeting was conducted and three varieties of linseed were identified.

Technical session to finalise the technical programme for safflower breeding was on 2nd Sept. and was followed by crop production session. The session on crop protection in linseed was held concurrently. The plenary session held on September 2, 2022 was chaired by Dr. C.D. Mayee, Ex. Chairman, ASRB, New Delhi. The proceedings of the various technical sessions and the finalised technical programme for 2022-23 was presented in this session. The chairman appreciated the progress made by both the groups and urged the scientists to focus on organic agriculture. It was also suggested that massive programme on minor oilseeds should be initiated. Rice fallow linseed should be promoted in Vidharba region of Maharashtra. Composite wilt sick plots are needed to address the wilt problem. He encouraged the scientists for Public-Private Partnerships.

EVENTS

National Science Day

The National Science Day was celebrated on February 28, 2022. The programme was organized through video conferencing. Mrs. K. Padmavathi and Mr. K. Narasanna, Aranya Agricultural Alternatives, Hyderabad, Telangana delivered an invited talk on "Permaculture and Food Forest". They have explained how to create a low-maintenance, permaculture garden with edible rewards. The Samskruthi Foundation organized a visit for about 35 students from Siddhartha College of Science and Technology to ICAR-IIOR on the occasion of National Science Day. An overview of the mandate of the Institute and the research projects carried out in accordance with those mandates was presented. Scientists explained the importance of National Science Day and briefed about the research work being carried out at ICAR-IIOR. To provide the students hands-on experience learning about the crops, a visit to our museum and ICAR-IIOR research field were arranged.

World Pulse Day

World Pulse Day was organized on the topic "Pulses to empower youth in achieving sustainable agri food systems" in Gurudhotla on February 10, 2022. Scientists explained the importance of pulses in agri food systems and the role of youth to promote pulse production and how it helps in improving soil health and also about value addition in pulses was explained to the farmers. Many of the young and middle aged women expressed interest to start verticals on a small scale.

International Women's Day

International Women's Day was celebrated on 8th March, 2022 at the Institute. This year theme is "Gender equality today for a sustainable tomorrow". Interaction among the staff on Gender sensitization event was conducted with a debate competition (Just a Minute) on topics *viz.*, the role of women as the real architect of the society, ways to improve gender equality, dual role of women, inspiring women in the society and tips to tackle the mental stress while doing multiple tasks by women etc. An online interaction meeting was conducted in the afternoon in which about 50 people participated. Lead speaker Dr. Sabita Misra, Principal Scientist (Agricultural Extension), ICAR-Central Institute of Women in Agriculture, Bhubaneshwar delivered a talk on "Women in Agriculture-Challenges ahead". ATMA, Agri-Clinics & Agri-Business Centers, one day specially allocated to cover areas of core competence of women farmers in programmes of All India Radio & Doordarshan, Mission for Integrated Development of Horticulture (MIDH), National Mission on Oilseeds & Oil Palm (NMOOP) etc. Three women farmers *viz.*, Ms. Aleti Kanthamma, Ms. Gajula Triveni and Ms. Anandi Vijaya from Siddhipet district shared their experiences in sunflower and groundnut cultivation, handling farm, labour and household all alone (online).

Women in Agriculture-Challenges Faced

Dr. Sabita Mishra
Principal Scientist (AE)
ICAR-CIWA, Bhubaneswar, Odisha

Talk by Dr Sabita

National Girl Child day

ICAR-IIOR organized a webinar on National Girl Child Day on January 24, 2022 to sensitize and spread public awareness about inequities that girls face in Indian society.

International Day of Yoga

The International Day of Yoga was celebrated on June 21, 2022 with theme "Yoga for Well-Being". A lecture on "Yoga in Daily Life" was delivered by Smt. D.B. Kameswari, Yoga Teacher, Hyderabad. She has explained about yoga, practices of asana and protocol for yoga practice and the benefits of practicing yoga on health, happiness and well-being. She also guided and demonstrated different yoga mudras, relaxing exercises and asanas for different ailments and day to day stress. All scientists, administrative staff, technical staff and supportive staff of ICAR-IIOR attended and practiced yoga along with yoga teacher.

ICAR-IIOR Foundation Day

The 45th Foundation Day of ICAR-IIOR was celebrated on August 1, 2022. Dr. A. Vishnuvardhan Reddy, Vice Chancellor, ANGARU, Guntur, Andhra Pradesh was the Guest of Honour. The Foundation Day Lecture was delivered by Dr. Hemalatha, R., Director, ICMR-NIN, Hyderabad on the topic "Recommended Dietary Allowances and Dietary Guidelines on Oils and Fats". Another lecture on "Stress management in work place-Happy well-being" was delivered by Psy. Vishesh, Counselling Psychologist, Genius Gym, Ameerpet, Hyderabad, Telangana. During the occasion, awards to the best workers, research paper, etc. were presented and the ICAR-IIOR staff completing 25 years of service were felicitated.

Vigilance Awareness Week

Vigilance awareness week was observed from 31 October 2022 to 6 November 2022 at ICAR-IIOR with the theme "Corruption free India for a developed Nation". The staff of ICAR-IIOR took 'Integrity Pledge' on 31 October 2022. To spread awareness on vigilance aspects, posters on corruption, its ill effects and need for fighting corruption were displayed in the Institute's premises during the awareness week. "Gram Sabhas'' were conducted in Grudhotla and Rampur thanda of Vikarabad District for sensitizing the villagers on the corruption and its impacts and the complaint mechanisms. A quiz programme was organized for the students, staff and other clients of ICAR-IIOR covering various aspects of Prevention of Corruption Act, 1988 and its amendment, complaining procedures, Vigilance Commission and its functioning, etc.

ICAR-IIOR staff taking Integrity pledge

Azadi Ka Amrit Mahotsav

Twelve programmes which include webinars, guest lectures, farmer's ghosti were organized to commemorate 75 years of India's Independence. Scientists of ICAR Institutes, staff of ICAR-IIOR and farmers participated in different programs.

Topic	Experts	Date
Permaculture	Mr. K. Narsanna, Aranya Agriculture Alternatives	January 31, 2022
Permaculture and food forest	Mrs. K. Padmavathi, Mr. K. Narasanna, Aranya Agricultural Alternatives, Hyderabad, Telangana.	February 28, 2022
Understanding the brain as a phantastic organ	Dr. G. Venkatasubramanian, Professor of Psychiatry and Head of the Department of Clinical Neurological Sciences, NIMHANS, Bengaluru, Karnataka	March 23, 2022
Schizophrenia: disorder of perceiving and believing	Dr. Suhas Satish, Assistant Professor of Psychiatry, Community Psychiatry and Telemedicine Unit, Department of Psychiatry, NIMHANS, Bengaluru, Karnataka	
Meeting nutrient requirement of oilseeds under the challenges of unsustainable dependence on fertilizers	Dr. S.N. Sudhakara Babu, Principal Scientist (Agronomy) & Head, Crop Production, ICAR-Indian Institute of Oilseeds Research, Rajendranagr, Hyderabad.	April 11, 2022
Physical health, mental health and social well-being through pranayama, prana mudralu and meditation	Shri A. Srinivasa Reddy, Amma Meditation and motivation guru, Hyderabad	May 07, 2022
Yoga in daily life	Smt. D.B. Kameswari, Yoga teacher, Hyderabad	June 21, 2022
Balanced use of fertilizer (including nano-fertilizer) and awareness program on region specific agro-forestry at Jakkapur village, Narayanraopet Mandal, Siddipet District	Mr. Yella Reddy (ZPTC- Siddipet Dist.), Shri Prithvi Raj (TS- Seed certification officer and Organic Farming certification officer)	June 21, 2022
Plant breeding in business environment - market led approaches to new variety design	Dr. Sharan Angadi, Director at ATPBR - Foundation for Advanced Training in Plant Breeding and R&D adviser to Ankur Seeds, Formerly Head of Breeding, Asia Pacific, Nunhems Seeds, Netherlands	July 26, 2022
Agricultural education: Status and challenges	Dr. A.R. Pathak, Chairman, QRT, ICAR-IIOR, and Former Vice-Chancellor, JAU	December 19, 2022
Plant viruses: Innovations in diagnostics and characterization	Dr. V.K. Baranwal, National Professor & Former, Prof. & Head (Virology), IARI, New Delhi & Member, QRT, ICAR-IIOR	December 19, 2022
Genetically modified (GM) crops: Impact on farmers and consumers	Dr. P. Ananda Kumar, Former Director, ICAR-NIPB, New Delhi and Member, QRT, ICAR-IIOR	December 20, 2022
Attitude and inspiration	Dr. D.M. Hegde, Former Director, ICAR-IIOR and Member, QRT, ICAR-IIOR	December 20, 2022

Education and Training

Details of students working at ICAR-IIOR

Name of the student	Degree	Title of the thesis	Advisor(s)	Discipline	University
G. Vinay Kumar	Ph.D.	Stability and molecular diversity studies in Niger (*Guizotia abyssinica* (L. f.) Cass.)	Dr. M. Sujatha (Chairman) Dr. H.D. Pushpa (Member)	Genetics and Plant Breeding	ANGRAU, Guntur
R. Satish Kumar	Ph.D.	Discovery and validation of QTLs conferring resistance to shoot and capsule borer in castor (*Ricinus communis* L.)	Dr. S. Senthilvel (Co-Chairman)	Genetics and Plant Breeding	UAS, Bengaluru
Kumbha Divya Sravanthi	Ph.D.	Mapping of QTL and discovery of candidate genes for Fusarium wilt resistance in castor (*Ricinus communis* L.)	Dr. S. Senthivel (Co-Chairman)	Molecular Biology and Biotechnology	ANGRAU, Guntur
B.M. Sangeetha	Ph.D.	Fabrication of Trichoderma-biopolymer nano-systems for the management of soil borne and foliar diseases of groundnut and sunflower	Dr. R.D. Prasad (Co-Chairman)	Plant Pathology	PJTSAU, Hyderabad
K. Aravind	Ph.D.	Insights into the host-pathogen interaction and management of Fusarium wilt (*F. oxysporum f. sp. ricini*) in castor	Dr. M. Santha Lakshmi Prasad (Chairman)	Plant Pathology	PJTSAU, Hyderabad
S.S. Monika	Ph.D.	Exploitation, identification and characterization of entomopathogenic fungi and their ability and virulence against insect pests of paddy and maize	Dr. P. Duraimurugan (Co-Chairman)	Entomology	PJTSAU, Hyderabad
K. Naga Latha	Ph.D.	Comparative study of machine learning techniques with time series models in the prediction of India's Agricultural trade (tentative)	Dr. C. Sarada (Co-Chairman)	Agricultural Statistics	ANGRAU, Guntur
B. Venkatesh	Ph.D.	Yield maximization in hybrid pigeon pea through agronomic management	Dr. C. Sarada (Member)	Agronomy	PJTSAU, Hyderabad
O. Vamshi	Ph.D.	Influence of moisture stress and nutrient management on fatty acid composition of oleic and normal groundnut (*Arachis hypogea* L.)	Dr. C. Sarada (Member)	Agronomy	PJTSAU, Hyderabad

Name of the student	Degree	Title of the thesis	Advisor(s)	Discipline	University
Y. Chaithanya	Ph.D.	Performance of redgram (*Cajans cajan* L.) varieties under varied planting densitites and phosphorous levels in rice fallows	Dr. C. Sarada (Member)	Agronomy	PJTSAU, Hyderabad
Bhumireddy Chandana	Ph.D.	Farmers' knowledge and adoption of sunflower crop production technologies disseminated through public and private extension systems	Dr. G.D. Satish Kumar (Co-Chairman)	Agricultural Extension	IGKVV, Raipur
P. Praveen Kumar	Ph.D.	A study on performance and resource use efficiency of major oilseed crops in India	Dr. S.V. Ramana Rao (Co-Chairman)	Agricultural Economics	IGKV, Raipur
Ch. L.N. Manikanta	Ph.D.	Exploitation of the genetic diversity of safflower genotypes for tolerance to deficit soil moisture stress	Dr. P. Ratna Kumar (Co-Chairman)	Plant Physiology	IGKV, Raipur
P. Lora Anusha	Ph.D.	Studies on physiological and biochemical characterization of sesame (*Sesamum indicum* L.) genotypes under moisture stress	Dr. P. Ratna Kumar (Co-Chairman)	Crop Physiology	ANGRAU, Tirupati
N. Sowmya	Ph.D.	Physiological and Genetic characterization of sesame (*Sesamum indicum* L.) under deficit soil moisture stress	Dr. P. Ratna Kumar (Chairman)	Crop Physiology	ANGRAU, Bapatla
Bhukya Rajkumar	M.Sc. (Ag.)	Genetic variability and source-sink relationship studies in multi capsule genotypes of sesame (*Sesamum indicum* L.)	Dr. K.T. Ramya (Chairman)	Genetics and Plant Breeding	PJTSAU, Hyderabad
K. Hari Priya	M.Sc. (Ag.)	Studies on the response of rice fallow sesame to tillage and nutrient management practices	Dr. K. Ramesh (Chairman)	Agronomy	PJTSAU, Hyderabad
Sai Mithra	M.Sc. (Ag.)	Influence of conservation agricultural practices in castor based cropping system under rainfed conditions	Dr. G. Suresh (Chairman), Md. A. Aziz Qureshi (Member)	Agronomy	PJTSAU, Hyderabad
G.V. Suresha	M.Sc. (Ag.)	Development of *Bacillus thuringiensis* microcapsules by complex coacervation and its efficacy against lepidopteran pests	Dr. P. Duraimurugan (Chairman)	Entomology	PJTSAU, Hyderabad
D. Indraja	M.Sc. (Ag.)	Identification of resistant sources and *in vitro* management of *Macrophomina phaseolina*, root rot of castor	Dr. M. Santha Lakshmi Prasad (Chairman)	Plant Pathology	ANGRAU, Guntur

Name of the student	Degree	Title of the thesis	Advisor(s)	Discipline	University
B.L. Sowjanya	M. Sc. (Ag.)	Isolation and characterization of actinomycetes strains from oilseed rhizosphere against major pathogens and nematodes associated with soybean	Dr. K. Sankari Meena (Chairman)	Microbiology	ANGRAU, Bapatla, Andhra Pradesh

Degree awarded

Name of the student	Degree	Title of the thesis	Advisor(s)	Discipline	University
Manmode Darpan Mohanrao	Ph.D.	Studying allelic relationship and identification of SNP markers linked to specific Fusarium wilt resistance genes in castor (*Ricinus communis* L.)	Dr. Senthivel. S (Co-Chairman)	Genetics and Plant Breeding	PJTSAU, Hyderabad
K. Greeshma	Ph.D.	Studies on the role of cuticular wax conferring resistance to gray mold disease of castor	Dr. R.D. Prasad (Co-Chairman) Dr. Senthivel S (Member)	Plant Pathology	PJTSAU, Hyderabad
Navya Matcha	Ph.D.	Studies on chemical and non-chemical approaches for the management of Spodoptera species complex on soybean and castor and its safety to beneficial insects	Dr. P. Duraimurugan (Co-Chairman)	Agricultural Entomology	JNKVV, Jabalpur
Borkar Sundar	Ph.D.	Studies on genetic variability, biology and management of major storage pests of sesame	Dr. P. Duraimurugan (Co-Chairman)	Agricultural Entomology	JNKVV, Jabalpur
K. Divya	Ph.D.	Molecular mapping and validation of QTLs associated with resistance to aphid (*Uroleucon compositae*) in safflower (*Carthamus tinctorius* L.)	Dr. P. Kadirvel (Co-Chairman) Members: Dr. P.S. Srinivas Dr. V. Dinesh Kumar Dr. P. Ratna Kumar	Genetics and Plant Breeding	PJTSAU, Hyderabad
Vishnumolakala Aparna	Ph.D.	Impact of high temperature on physiological traits and yield mechanism of sunflower genotypes	Dr. Lakshmi Prayaga (Co-Chairman)	Plant Physiology	IGKVV, Raipur
M. Kavya	M.Sc. (Ag.)	Transformation of *Trichoderma harizianum* with GUS and GFP genes for studies on Rhizosphere competence and biocontrol activities in oil seed crops	Dr. R.D. Prasad (Co-Chairman)	Plant Pathology	JNKVV, Jabalpur

Name of the student	Degree	Title of the thesis	Advisor(s)	Discipline	University
Falguni. R.	M.Sc. (Ag.)	A comparative study on group dynamics effectiveness among members of Farmer Producer Organizations (FPOs) in Telangana and Chhattisgarh states	Dr. G.D. Satish Kumar (Co-Chairman)	Agricultural Extension	IGKVV, Raipur
G. Asha Latha Sri	M.Sc. (Ag.)	Analysis of impact of frontline demonstrations on oilseeds in Andhra Pradesh and Chhattisgarh	Dr. G.D. Satish Kumar (Co-Chairman)	Agricultural Extension	IGKVV, Raipur
Y. Siri Lakshmi	M.Sc. (Ag.)	Analysis of yield gaps and adoption of pre- and post-harvest technologies of oilseed crops under public and private extension systems in Telangana State	Dr. G.D. Satish Kumar (Chairman)	Agricultural Extension	PJTSAU, Hyderabad
Y. Navya	M.Sc. (Ag.)	Morpho-physiological evaluation of castor inbred lines	Dr. P. Lakshmamma (Chairman) Dr. C. Lavanya (Member)	Plant Physiology	PJTSAU, Hyderabad

Internship programme

Name of the Student	Project title	Discipline	University	Mentor
Hari Niwas S.	Validation of SNP marker linked to Fusarium wilt resistance in RG-1673, a castor monecious line	B. Tech (Biotechnology)	TNAU, Coimbatore	Dr. S. Senthilvel (Supervisor)
P. Tamilarasi	Verification of putative mutants of DPC-9, a castor pistillate line	B. Tech (Biotechnology)	TNAU, Coimbatore	Dr. S. Senthilvel (Supervisor)
M. Sakthivel	Molecular characterization of major sucking pests infesting castor	B. Tech (Biotechnology)	TNAU, Coimbatore	Dr. P. Duraimurugan (Supervisor)
Kodadala Abhiram Reddy	Molecular characterization of insects in sesame	B. Tech (Biotechnology)	Loyola Academy, Secunderabad, Telangana	Dr. T. Boopathi (Supervisor)
A. Sabeetha Anista	Molecular characterization of insects in linseed and niger	B. Tech (Biotechnology)	TNAU, Coimbatore	Dr. T. Boopathi (Supervisor)
S. Priyavarthini	Molecular characterization of chitinolytic bacteria and profiling their volatile compounds exhibiting biocontrol potential against castor pests, diseases and nematodes	B. Tech (Biotechnology)	TNAU, Coimbatore	Dr. K. Sankari Meena (Supervisor)

Awards and Recognitions

Awards

- Dr. Kumaraswamy, H.H. received the Best Oral Presentation award for the paper titled DNA fingerprinting of microsatellite loci in sesame (*Sesamum indicum* L.): Opportunities and Challenges in an International Conference on Biotechnology Trends and Future Prospects organized by the Department of Biotechnology of University of Agricultural Sciences, Bengaluru at GKVK Campus of UAS Bengaluru during September 13-15, 2022.
- Dr. J. Jawahar Lal was awarded second prize for oral paper presentation on Quality seed production of safflower to promote area expansion in non-traditional regions in Maharashtra in the 11th National Seed Congress on Recent advances in research on quality seeds for self-sufficiency in oilseeds and pulses from 21-23 August 2022 at Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, India.
- Dr. H.P. Meena received Distinguished Agriculture Scientist Award-2022 for excellent contribution in the field of Plant Breeding from the Society for Advancement in Agricultural Technology & Development (SAATD), Uttarakhand.
- Dr. H.P. Meena received Best Breeder Award-2021 for outstanding contribution and recognition in the field of Plant Breeding during 5th International Conference organized by ATDS society from March 4-6, 2022 at Jaipur National University, Jaipur, Rajasthan.
- Dr. Mangesh Y. Dudhe received INSA Travel Fellowship for the year 2022 to attend the 20th International Sunflower Conference (ISC) at Novi Sad, Serbia organized by the Institute of Field and Vegetable Crops Novi Sad (IFVCNS), Serbia in collaboration with International Sunflower Association (ISA) during June 20-23, 2022.
- Dr. P. Ratna Kumar, Dr. Mangesh Y. Dudhe, Dr. K. Ramesh, Mrs. B. Usha Kiran received the Best Research Paper Award 2022 for the paper entitled "Identifying traits associated with terminal drought tolerance in sesame (*Sesamum indicum* L.) genotypes published in *Frontiers in Plant Science* during 45th ICAR-IIOR Foundation day celebration on August 1, 2022.
- Dr. Divya Ambati received, Carlotta 2nd edition special mention award during International Conference from Seed to Pasta IV held at bologna, Italy from 26-29th October 2022.
- Dr. A.L. Rathnakumar, received certificate of recognition as a reviewer of the research articles, *Journal of Environmental Biology*, India, July 2022.
- Dr. A.L. Rathnakumar received reviewer excellence Award as a reviewer of *Journal of Legume Research*, July and September, 2022.
- Mrs. B. Usha Kiran and Dr. V. Dinesh Kumar received best oral presentation for the paper entitled, Oleosin gene family of *Carthamus tinctorious*: uncovering of natural allelic variants associated with high oil content through sequence-based allele mining in the International Conference on Advances in Biosciences and Biotechnology on Innovations in Life sciences and Computational Biology (ICABB 2022) organized by Jaypee Institute of Information Technology, Noida during January 20-22, 2022.
- Mrs. B. Usha Kiran received Shining star award for the paper entitled, Identification of candidate genes associated with oil content through allele mining in safflower at *Agri Vision-2022*: International Conference on Agriculture for Sustainable Future Organized by Ravenshaw University, Cuttack, Odisha in association with Department of Botany, Ravenshaw University, Cuttack during March 6-8th, 2022.
- Mrs. K.S.V.P. Chandrika and Dr. R.D. Prasad received best oral presentation award for the paper Evaluation of a novel biopolymer based *Trichoderma harzianum*, Th4d formulations for management of seed and soil borne diseases of oilseed crops under field conditions at the IPS 8th International Conference (Hybrid Mode). Plant Pathology: Retrospect and Prospects organized by SKN Agriculture University, Jobner-Jaipur, Rajasthan, India, during March 23-26, 2022.
- Mrs. K.S.V.P. Chandrika received Young Researcher Award for the work on Evaluation of a novel biopolymer-based *Trichoderma harzianum*, Th4d formulations against seed and soil borne diseases of oilseed crops under field conditions in the Satellite workshop on *Trichoderma* and *Gliocladium* on March 25, 2022 during IPSCONF2022 held at SKNAU, Jobner-Jaipur, Rajasthan, India.

- Dr. T. Boopathi received Prof T. N. Ananthakrishnan Award for the biennium 2020-21 *i.e.*, Senior Scientist Award-First position by Prof. T.N. Ananthakrishnan Foundation, Madanandapuram, Chennai, Tamil Nadu, India during August 6, 2022.
- Dr. K. Sankari Meena received Dr. B. Vasantharaj David Award-2022 from Applied Zoologists Research Association conferred during AZRA International Conference on Advances in Applied Zoological Researches towards Food, Feed & Nutritional Security and Safer Environment held at Odisha, India during 10-11, November, 2022.
- Dr. J. Jawahar Lal received appreciation letter from Sri. M. Venkateshwarlu, IAS, Former VC & MD, APHDC for contribution towards farming society and services of seed section to the farmers.
- Dr. H.H. Kumaraswamy, is a fellow of Indian society of Oilseeds Research (ISOR), Hyderabad, India.

Chairman/ Member of committees/ Panels

- Dr. H.P. Meena co-chaired the technical session and conducted the proceedings in the 5th International Conference on Advances in Smart Agriculture and Biodiversity Conservation for Sustainable Development during March 4-6, 2022.
- Dr. H.P. Meena recognized as a PG teacher for teaching and guidance of M.Sc. and Ph.D. students of Genetics & Plant Breeding, PJTSAU, Hyderabad.
- Dr. Kadirvel Palchamy served as an expert on the selection committee for assessing the promotion cases of ARS scientist for the discipline of Plant Breeding at ICAR-IIRR, Hyderabad on March 01, 2022.
- Dr. Kadirvel Palchamy served as an expert on the selection committee (virtual interview) for selection of JRF at ICAR-IIMR, Hyderabad on April 08, 2022.
- Dr. M. Santha Lakshmi Prasad was nominated as an expert of the selection committee for assessing the promotion cases of ARS scientists (senior scientist and scientists) for the discipline of the Plant Pathology at ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad.
- Dr. M. Santha Lakshmi Prasad was nominated as member of the Institute Management committee (IMC) of ICAR-Indian Institute of Rice Research, Hyderabad for the period of three years with effect from 10-01-2021 to 09-01-2024 and attended the 25th IMC meeting of IIRR.
- Dr. M. Sujatha served as member of IMC of ICAR-DRMR, Bharatpur.
- Dr. M. Sujatha served as Board member of International Sunflower Association, Toulouse, France.
- Dr. M. Sujatha served as member for evaluation of project proposals for award of Sree PVF Agricultural Grants.
- Dr. M. Sujatha was a member of the Scientific Committee of the 20th International Sunflower Conference held at Novisad, Serbia from 20-23 June 2022.
- Dr. M. Sujatha served as a member of the accreditation panel of NCS-TCP, NIPGR and conducted site visits for renewal/recognition of tissue culture facilities.
- Dr. M. Sujatha served as Chairman for review of the progress of the project Shuddhta: Design, Development & Deployment of Electronics Quality Assessment System for Edible Oils being implemented by C-DAC Kolkata jointly with Krishi Vigyan Kendra, Akola, Maharashtra and funded by Ministry of Electronics and Information Technology
- Dr. M. Sujatha was a member of the IBSC of ICAR-Directorate of Poultry Research, Hyderabad.
- Dr. M. Sujatha served as a member of the INSPIRE (DST) selection committee for evaluation of level-2 applications in agriculture.
- Dr. M. Sujatha has been nominated as co-chair of the committee constituted by DBT for reviewing the DBT-UDSC Partnership Centre on Genetic Manipulation of Brassicas-Phase-II proposal.
- Dr. P.S. Srinivas was nominated as member, Research Advisory Group, IFB (ICFRE), Hyderabad
- Dr. P.S. Srinivas was recognized as Member, scrutiny committee for the post of Director (PHM), NIPHM, Hyderabad
- Dr. P. Duraimurugan was recognized as Scientist Expert during the State Level Technical Programme Meetings of Entomology, 19-21 May 2022, ANGRAU, Guntur, Andhra Pradesh.
- Dr. P. Duraimurugan was recognized as DG Nominee on the Selection Committee for promotion under CAS of Scientists (24-25 February 2022) at ICAR-IIMR, Hyderabad, Telangana.
- Dr. P. Duraimurugan was recognized as Expert Member, Selection Committee for promotion of candidates under the Career Advancement Scheme (CAS) of Entomology Discipline (30 December 2022), Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana.
- Dr. P. Duraimurugan was recognized as External Examiner for evaluation of the Ph.D./ M.Sc. Thesis, Tamil Nadu Agricultural University, Coimbatore;

Acharya NG Ranga Agricultural University, Guntur, Andhra Pradesh and Odisha University of Agriculture & Technology, Bhubaneswar, Odisha.

- Dr. P. Duraimurugan was recognized as Member of Scrutiny Committee for scrutiny of applications (December 2022) for the post of Assistant Scientific Officer (Entomology), National Institute of Plant Health Management, Hyderabad, Telangana.
- Dr. T. Boopathi acted as an External Examiner for M.Sc. (Ag.) Dissertation entitled Bio-efficacy of novel insecticides against brinjal shoot and fruit borer *Leucinodes orbonalis* Gueen. (Pyralidae: Lepidoptera) and their residues in brinjal. College of Agriculture, Professor Jayashankar Telagana State Agricultural University, Rajendranagar, Hyderabad-500 030, Telanagana.
- Dr. T. Boopathi acted as an External Examiner for Ph.D. Thesis entitled Management of pulses spotted pod borer, *Maruca vitrata* Fabricius on garden bean, *Lablab purpureus* var. *typicus* (L.). School of Post Graduate Studies, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu.
- Dr. P.S. Srinivas acted as a resource person for the training programme on Promotion of safflower for crop diversification and higher system productivity in Maharashtra organized by ICAR-IIOR on December 6, 2022 and delivered a lecture on "Good Agricultural Practices and Seed production in safflower".
- Dr. K. Sankari Meena served as Adjunct Faculty in PJTSAU, Rajendranagar, Hyderabad for first year M.Sc. (Ag.) plant pathology students to teach PL PATH 504 (Plant Nematology) course during 2022.
- Dr. S.V. Ramana Rao acted as External expert member of ITMC, ICAR-DPR, Hyderabad.
- Dr. S.V. Ramana Rao acted as IMC member, ICAR-Directorate of Floricultural Research, Pune.
- Dr. S.V. Ramana Rao acted as External expert in the field of Agricultural Economics for CAS, PJTSAU, Hyderabad.
- Dr. S.V. Ramana Rao acted as Member, State Level Technical Committee (SLTC)-Scale of Finance, Telangana State Co-operative Axis Bank Ltd, Hyderabad.
- Dr. C. Sarada was appointed as Expert member in selection committee for various awards constituted for faculty members of PJTSAU, Hyderabad during 2022.
- Dr. C. Sarada was appointed as external examiner to conduct oral comprehensive examination for M.Sc (Agricultural Statistics) students, Dept. of Statistics & Computer Applications, Ag. College, Bapatla on April 11, 2022.
- Dr. C. Sarada was nominated as external member for the DPC for Category-III (Lab Technician-Computer Programmer),for ICAR – Indian Institute of Millets, Hyderabad.
- Dr. Mangesh Y. Dudhe Co-chaired the sessions in the 20th International Sunflower Conference (ISC) at Novi Sad, Serbia organized by the Institute of Field and Vegetable Crops Novi Sad (IFVCNS), Serbia in collaboration with International Sunflower Association (ISA) during June 20-23, 2022 in the Section 4: Genetic resources session – Investment for the future Moderators along with Dr. Sreten Terzić, Seriba.
- Dr. Ramya K.T. nominated as external member of the Advisory Committee to conduct qualifying examination (oral) for Doctoral Degree Students of Genetics and Plant Breeding, UAS Raichur on 26.12.2022.
- Mrs. B. Usha Kiran, has been recognized and received accreditation for Teaching or Guiding Post graduate students of PJTSAU, Hyderabad.
- Dr. G. Suresh served as Subject Expert in selection committee for CAS interviews of Professors/Sr. Professors at PJTSAU, Hyderabad.
- Dr. G. Suresh was identified as external examiner for M.Sc. (Ag.)/Ph.D. Tamil Nadu Agricultural University, Coimbatore.
- Dr. G. Suresh served as external examiner for M.Sc. Agronomy, Professor Jayashankar Telangana State Agricultural University, Hyderabad.
- Dr. K. Ramesh served as external examiner for M.Sc. Agronomy, Professor Jayashankar Telangana State Agricultural University, Hyderabad.
- Dr. K. Ramesh served as external examiner for M.Sc. and Ph.D. Agronomy, Tamil Nadu Agricultural University, Coimbatore.
- Dr. V. Dinesh Kumar continued as IMC member of ICAR-National Institute for Plant Biotechnology, IARI Campus New Delhi; ICAR-Indian Institute of Agricultural Biotechnology, Ranchi, Jharkhand and ICAR-Indian Institute of Oil Palm Research, Pedavegi, Andhra Pradesh.
- Dr. V. Dinesh Kumar was nominated as an external expert for the State Level Technical Programme meetings of Genetics and Plant Breeding,

Molecular Biology & Biotechnology and Seed Science & Technology for 2022 conducted by ANGRAU, Guntur through online mode held from 09.05.2022 to 13.05.2022.

- Dr. V. Dinesh Kumar was nominated by Director General to be on Career Advancement Scheme meetings to evaluate scientists of Plant Biotechnology of ICAR-IIRR, Hyderabad, ICAR-NIPB, New Delhi and ICAR-CTRI, Rajahmundry.
- Dr. C. Lavanya was nominated as mentor of Dr. K. Sadaiah, Asst. Plant Breeder, RARS, Palem for the Project on "Generation of early, short statured lines with synchronous maturity suitable for mechanical harvesting in castor (*Ricinus communis* L.)" by SERB-DST-Teachers Associateship for Research Excellence (TARE) since March 2022 for a period of three years.
- Dr. P. Ratna Kumar is serving as a Scientific Advisory Member for DBT- BIG scheme of BIRAC

Editor of journals/proceedings

- Dr. S. Senthilvel acted as a member of Editorial Board of the journal 'Scientific Reports'.
- Dr. H.P. Meena acted as a Co-editor of the Proceedings Book of the 4th International Conference on Natural Resource Management for Climate Smart Agriculture.
- Dr. P.S. Srinivas, Principal Scientist (Agricultural Entomology) recognized as Associate Editor of Journal of Allium Research, Indian Society of Alliums, Rajgurunagar, Pune, Maharashtra.
- Dr. P. Duraimurugan was recognized as Editorial Review Board Member, Journal of Food, Agriculture and Environment, WFL Publisher (Science and Technology), Finland.
- Dr. P. Duraimurugan was recognized as Associate Editor, Editorial Board, Journal of Oilseeds Research, Indian Society of Oilseeds Research, ICAR-IIOR, Hyderabad.
- Dr. P. Duraimurugan was recognized as Editorial Board Member, The Journal of Research ANGRAU, ANGRAU, Guntur, Andhra Pradesh.
- Mrs. B. Usha Kiran was recognized as an Editorial Board Member of Journal of Genetics, Genomics and Plant Breeding (JGGBB), India.
- Dr. Kumaraswamy, H.H. was recognized as Editorial Member for International Journal of Agricultural Sciences, Published by Bioinfo Publications, Pune, Maharashtra, India.
- Dr. Kumaraswamy, H.H. was recognized as Editorial Member for ACTA Scientific Agriculture, Published by ACTA Scientific Publications Pvt. Ltd., Hyderabad, Telangana, India.
- Dr. Kumaraswamy, H.H., was recognized as Editorial Member for a monthly e-newsletter "Science for Agriculture and Allied Sectors (AGRIALLIS)", published by Growing Seed (Social Welfare Organization), Dharmanagar, North Tripura, India.
- Dr. J. Jawaharlal was nominated as Editorial board member of Journal of International Academic Research for Multidisciplinary (JIARM).
- Dr. K. Ramesh acted as Review editor of Frontiers in Plant Sciences.
- Dr. P. Ratna Kumar is serving as an Editor for Frontiers of Plant Science journal and Plant Physiology Reports journal and Academic Editor for PeerJ Journal.

Human Resource Development

Annual Training Implementation

Category-wise trainings attended

S. No.	Category	Total No. of Employees	No. of employees attended training
1	Scientific	39	5
2	Technical	25	2
3	Administrative & Finance	17	1
4	SSS	77	0
	Total	**158**	**8**

(As on 31 December, 2022)

a) Scientific staff

Name	Designation	Name of the training Programme	Organiser/ Venue	Date
Dr. K. Sankari Meena	Scientist	Bioprospecting plant microbiome – A novelty to plant health management in organic production	Dept. of Plant Pathology, AAU, Jorhat, Assam	January 19-28, 2022
Dr. N. Mukta	Principal Scientist	Plant taxonomy for plant genetic resources management	ICAR-NBPGR, Kerala	March 21-26, 2022
Dr. P. Ratna Kumar	Principal Scientist	MDP on leadership	ICAR-NAARM, Hyderabad	June 14-25, 2022
Dr. Praduman Yadav	Senior Scientist	Stress management	COD, Hyderabad	October 31 -November 4, 2022
Dr. M.Y. Dudhe	Senior Scientist	Application of bio informatics in agriculture research	ICAR-NAARM, Hyderabad	November 15-24, 2022

b) Technical Staff

Name	Designation	Name of the training Programme	Organizer/ Venue	Date
Shri Y. Venkateswara Rao	Technical Assistant	Automobile maintenance, road safety and behavioural skills	CIAE, Bhopal	November 21-26, 2022
Shri N. Vasanth	Technical officer	Selection, adjustment, operation and maintenance of agricultural implements for field and horticultural crops	ICAR-CIAE, Bhopal	December 29, 2022 - January 07, 2023

c) Administrative Staff

Name	Designation	Name of the training Programme	Organiser/ Venue	Date
Shri B. Giri	UDC	Establishment matters for LDCs and UDCs	IISR, Lucknow, (Virtual mode)	January 17-22, 2022

Other Trainings Attended by ICAR-IIOR Staff

Name	Name of the training Programme	Organizer/ Venue	Date
Scientists			
Dr. S. Senthilvel M.Y. Dudhe	Data visualization using R	ICAR-NAARM, Hyderabad (Virtual mode)	March 09-11, 2022
Dr. Praduman Yadav	Packaging & branding of edible oils	NIFTEM-T, Thanjavur, Tamil Nadu	March 24, 2022
Dr. G.D. Satish Kumar	Recent trends in packaging, labelling, branding of edible oil	NIFTEM-T, Thanjavur, Tamil Nadu (Virtual mode)	March 30, 2022
Dr. Praduman Yadav	GC solutions for speciality chemicals-India	Phenomenex India (Virtual mode)	July 14, 2022
Dr. Ramya K.T	Gender-responsive plant breeding and seed systems in South Asia implemented jointly by Makerere University (Uganda) and Cornell, funded by the CGIAR GENDER Platform	ICRISAT, Hyderabad	September 12-17, 2022
Dr. C. Sarada	TOT programme for CBBOs	CCS National Institute of Agricultural Marketing, Jaipur, Rajasthan	November 9-11, 2022
Dr. Praduman Yadav	Pirates of chromatography: tales of sharp peaks-India	Phenomenex India (Virtual mode)	November 10, 2022
Dr. Divya Ambati	New crop breeding technologies	ICRISAT, Hyderabad	November 21-December 11, 2022
Dr. P. Padmavathi	Training programme on GAP and seed production in safflower	ICAR-IIOR, Hyderabad (Virtual mode)	December 6, 2022
Dr. P. Padmavathi	Training on data entry form	FPO, KISSAN Bazar	December 6, 2022
Dr. Praduman Yadav Dr. K. Sankari Meena Mrs. B. Usha Kiran	NABL laboratory assessors' training course on ISO/IEC 17025:2017	ICAR-NAARM, Hyderabad	December 19–23, 2022,
Dr. K. Alivelu	Data science & big data analytics using R	Andhra University, Visakhapatnam	December 27-28, 2022
Administrative staff			
Sri Vinod Kumar Sahoo	Workshop on financial management in Govt. for DDO/HOD Group A&B Officials dealing with financial management	ISTM, New Delhi (Virtual mode)	February 21-25, 2022

Organisation and Participation in Kisan Mela/ Field Days/ Trainings/ Workshops

Name	Programme	Venue/Place	Date
Dr. G.D. Satish Kumar	Workshop (virtual) on business plan development for the FPOs	ICAR-IIOR, Hyderabad	February 22, 2022
Dr. M. Sujatha	Field Day on sunflower and apiary and development of business plan for FPOs	Siddipet, Telangana	March 5, 2022
Dr. M. Sujatha	Farmers mela on export quality sesame	Malda, West Bengal in collaboration with IOPEPC, Mumbai	March 12, 2022
Dr. M. Sujatha	Field day on safflower seed production	Mariapur, Telangana	March 21, 2022
Dr. M. Sujatha Dr. P. Duraimurugan	Sesame farmers mela	Vriddhachalam, Tamil Nadu	August 11, 2022
Dr. G.D. Satish Kumar	Online meeting on mapping of FLD centres in PFMS (Virtual mode)	ICAR-IIOR, Hyderabad	August 16, 2022; September 29, 2022

Participation in Field Days/Farmers Day

Name	Name of the programme	Organizer/ Venue	Date
Dr. C. Lavanya Dr. P. Lakshmamma	Rabi castor field day cum training program	Venkateswara Bavi village, Amrabad Mandal, Nagarkurnool district	February 24, 2022
Dr. P.S. Srinivas Dr. G.D. Satish Kumar	A field day cum training in safflower seed production technologies at Sherigudem, Nawabpet, Vikarabad Dist, Telangana	ICAR-IIOR, Hyderabad	February 25, 2022
Dr. P.S. Srinivas	A field day cum training on sunflower hybrid	Kopparthi camp, KVK, Rudrur, Nizamabad, ICAR-IIOR, Hyderabad	February 28, 2022
Dr. H.P. Meena	Sunflower field day	Chinnakodur village	March 5, 2022
Dr. K.T. Ramya	Farmer's day	Kendpukur village, Habibpur Mandal, Malda district, West Bengal in association with IOPEPC, Mumbai and ICAR-CISH-KVK	March 12, 2022
Dr. A.L. Rathnakumar Dr. K.T. Ramya	Germplasm field day on sesame	ICAR-NBPGR, New Delhi in collaboration with the RRS, TNAU, Vriddhachalam	April 25, 2022
Dr. A.L. Rathnakumar Dr. T. Boopathi Dr. K.T. Ramya	Sesame germplasm field day	ICRISAT, Patancheru organized by ICRISAT Genebank in collaboration with ICAR-NBPGR, New Delhi	October 28, 2022

Participation in Conferences/ Seminars/ Symposia/ Meetings/ Workshops/ Webinars/ Trainings

Name	Programme	Venue/Place	Date
M.Y. Dudhe Mrs. B. Usha Kiran	International conference on biotechnological initiative for climate resilient agriculture (BICRA-2022)	Dr. Rajendra prasad Central Agricultural University, Pusa, Bihar, India in collaboration with NAHEP	January 7-9, 2022
Dr. H.P. Meena	International webinar on biotechnology for crop tolerance to low and high temperature stresses	Virtual mode	January 15, 2022
Dr. Divya Ambati	1st International symposium on Cereals for Food Security and Climate Resilience	ICAR-IIWBR, Karnal (Virtual mode)	January 18-20, 2022
Dr. K. Sankari Meena	ICAR sponsored 10 days short course on Bioprospecting plant microbiome: A novelty to plant health management in organic production system	Department of Plant Pathology, Assam Agricultural University, Jorhat, Assam	January 19-28, 2022
Mrs. B. Usha Kiran	International conference on Advances in Biosciences and Biotechnology on Innovations in Life sciences and Computational Biology (ICABB 2022)	Jaypee Institute of Information Technology, Noida	January 20-22, 2022
Dr. P.S. Srinivas	National network of plant health experts second biannual sub- committee meeting	NIPHM, Hyderabad (Virtual mode)	January 25, 2022
Dr. G.D. Satish Kumar	Review Meeting of the central sector scheme for formation and promotion of 10,000 FPOs and presented the progress of implementation of FPOs project of ICAR-IIOR	National Cooperative Development Corporation, Hyderabad (Virtual mode)	January 27, 2022
Dr. G.D. Satish Kumar	Meeting on price policy for *Kharif* crops 2022-23 marketing season	CACP (Virtual mode)	February 3, 2022
Dr. N. Mukta	Meeting to review the technical progress of DUS projects-2022	PPV&FRA, New Delhi (Virtual mode)	February 3-4, 2022
Dr G. Suresh	E-conference on promoting new FPOs & raising farmer income in western and central India	Indian Chamber of Commerce (ICC), Kolkata	February 15, 2022
Dr. R.D. Prasad Dr. A.A. Queshi Dr. P. Duraimurugan Dr. Divya Ambati	National workshop on enhancing the production and productivity of maize and oilseeds in NEH region	ICAR RC for NEH Region, Medziphema, Nagaland (Virtual mode)	February 16-18, 2022
Dr. H.P. Meena	National webinar on conservation agriculture in India : Myths, realities and way forward	MPUA&T, Udaipur	February 17, 2022
Dr G. Suresh	National webinar on Status of Farm Mechanization and its progress during 75 years of Independent India.	RARS, Tirupati, ANGRAU	February 17, 2022
Dr. T. Boopathi	1st International conference on recent advances for managing sustainable soil health and crop production	GKV Society, Agra, Uttar Pradesh (Virtual Mode)	February 18-20, 2022
Dr. M. Sujatha Dr. N. Mukta	Webinar on smart agriculture and budget implementations	GoI (Virtual mode)	February 24, 2022

Name	Programme	Venue/Place	Date
Dr. P. Duraimurugan Dr. K. Ramesh	Meeting on preparing a video jointly by IOPEPC and ICAR-IIOR for promotion of sesame seed cultivation (Sesame Good Agricultural Practices)	IOPEPC, Mumbai (Virtual mode)	February 25, 2022
Dr. N. Mukta	National science day initiative of I-STEM [Indian Science Technology and Engineering facilities Map]	I-STEM Team, GoI (Virtual mode)	February 28, 2022
Dr. H.P. Meena	5th International conference on advances on smart agril. & biodiversity conservation sustainable development	Ghaziabad	March 4-6, 2022
Mrs. B. Usha Kiran	AGRIVISION 2022-International conference on agriculture for sustainable future	Ravenshaw University, Cuttack, Odisha	March 6-8, 2022.
Dr. N. Mukta	Women in research and extension: Advancing gender equality in innovation in Asia-Pacific	APAARI	March 8, 2022
Dr. C. Sarada	Webinar on use of AI and ICT in agriculture information access and dissemination	Centre for Development of Advanced Computing, Noida in association with CDAC Kolkata, Bihar Animal Science University Patna and Birsa Agriculture University (BAU), Ranchi (Virtual mode)	March 14, 2022
Dr. N. Mukta	Plant taxonomy for plant genetic resources management	ICAR-NBPGR Regional Station, Thrissur (Virtual mode)	March 21-26, 2022
Dr. G. Suresh	Zonal research extension and advisory committee (ZREAC)	Southern Telangana Zone, RARS, Palem, PJTSAU	March 23-24, 2022
Dr. M. Santha Lakshmi Prasad Dr. K. Sakthivel Mrs. K.S.V. Poorna Chandrika	Indian phytopathological society 8th International conference on plant pathology: retrospect and prospects	Indian Phytopathological Society (IPS) and SKN Agriculture University, Jobner-Jaipur, Rajasthan (Hybrid Mode)	March 23-26, 2022
Dr. K. Ramesh	National conference on managing weather & climate risks in agriculture	Sher-e-Kashmir University & Technology of Kashmir (Virtual mode)	March 24-26, 2022
Dr. K. Sankari Meena	National conference on recent innovations, trends & challenges in plant science & research	VHN Senthilkumaranadar College, Tamil Nadu	March 25-26, 2022
Dr. M. Sujatha	XXXXVII PGRC meeting	NBPGR, New Delhi	March 29, 2022
Dr. M. Sujatha	Meeting on framing strategy for revival of sunflower cultivation and to analyse reasons for reduction in area of sunflower	DAC, New Delhi	March 30, April 5 and April 23, 2022
Dr. M. Sujatha	ICAR Director's conference	New Delhi	April 13, 2022
Dr. N. Mukta Dr. A.L. Rathnakumar	National workshop on self-sustainability in edible oils in India	ICAR-NAARM, Hyderabad	April 20, 2022

Name	Programme	Venue/Place	Date
Dr. M. Sujatha Dr. V. Dinesh Kumar Mrs. B. Usha Kiran	Workshop on genome editing for crop improvement: potential and policy	PJTSAU and Bitoech Consortium India Limited (BCIL), New Delhi	May 6, 2022
Dr. N. Mukta	International webinar on prospects of varieties/ crops developed through genome editing (regulatory framework, technologies and experience) under Indo-German cooperation on seed sector development	PPV&FRA, New Delhi, Department of Agriculture, Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare, Govt. of India and Federal Ministry of Food & Agriculture (BMEL) Germany (Virtual mode)	May 24, 2022
Dr. G. Suresh Dr. R.D. Prasad Dr. A.L. Rathnakumar Dr. K. Ramesh Dr. H.P. Meena Dr. P. Duraimurugan Dr. P. S. Srinivas Dr. T. Boopathi	Annual group meeting of AICRP on Oilseeds (Castor, Sunflower) and AICRP on Sesame & Niger-2022	ICAR-IIOR, Hyderabad (Hybrid Mode)	May 25-27, 2022
Dr. G.D. Satish Kumar	CACP meeting with NAFED and ICAR relating to rabi price policy 2023-24 marketing season	The Commission for Agricultural Costs & Prices, New Delhi. (Virtual mode)	June 3, 2022
M.Y. Dudhe	Joint area expansion programme cum workshop of sunflower in four states by ICAR-IIOR and ICRISAT	ICRISAT campus	June 04, 2022
Dr K. Ramesh	Brainstorming Workshop on Organic Farming in India	ICAR-NAARM, Hyderabad	June 10, 2022
Dr. M. Sujatha	CVRC meeting	ICAR-IIOR, Hyderabad (Virtual mode)	June 17, 2022
M.Y. Dudhe	20th International sunflower conference (ISC)	Novi Sad, Serbia organized by the Institute of Field and Vegetable Crops Novi Sad (IFVCNS) Serbia in collaboration with International Sunflower Association (ISA)	June 20-23, 2022
Dr. M. Sujatha	INSPIRE level-2 application selection committee meeting	Amarkantak, Madhya Pradesh	July 6-8, 2022
Dr. N. Mukta	XXXXVIII meeting of plant germplasm registration committee	ICAR-NBPGR (Virtual mode)	July 8, 2022
Dr. C. Lavanya	Symposium on Tending Mendel's Garden for Perpetual and Bountiful Harvest	ICAR-IARI, New Delhi	July 19-21, 2022
Dr. N. Mukta	Stakeholder meeting for consultation on India's position on agenda for 9th governing body meeting of ITPGRFA	ICAR, New Delhi DDG (Education)	August 5, 2022
Dr. A.L. Rathnakumar	Consultation meeting on utilizing plant genetic resources employing traditional and modern tools in their basic or applied studies	ICAR-New Delhi	August 5, 2022

Name	Programme	Venue/Place	Date
Dr. T. Boopathi	4th Prof T N Ananthakrishnan memorial lecture & Prof T N Ananthakrishnan award ceremony	The Prof T N Ananthakrishnan Foundation & Southern Regional Centre, Zoological Survey of India, Chennai, Tamil Nadu.	August 6, 2022
Dr. H.H. Kumaraswamy	A National webinar on the RNA Isoform landscape of cancer	PacBio (virtual mode)	August 17, 2022
Dr. M.Y. Dudhe	National workshop on pathways for the successful implementation of SC sub plan scheme in ICAR	ICAR- NAARM, Hyderabad.	August 18-19, 2022
Dr. C. Manimurugan Dr. J. Jawaharlal	11th National seed congress on recent advances in research on quality seeds for self-sufficiency in oilseeds and pulses	RVSKVV, Gwalior, MP	August 21-23, 2022
Dr. R.D. Prasad Dr. P. Duraimurugan	Annual review workshop of AMAAS projects-2022	ICAR-NBAIM, Mau	August 22-23, 2022
Dr. M. Sujatha Dr. N. Mukta Dr. A.L. Rathnakumar Dr. R.D. Prasad Dr. P.S. Srinivas Dr. G.D. Satish Kumar Dr. P. Kadirvel Dr. P. Padmavathi Dr. K. Ramesh Dr. T. Boopathi Dr. Praduman Yadav Dr. H.D. Pushpa Dr. Divya Ambati	Annual group meeting for AICRP on Oilseeds (Safflower and Linseed)-2022	College of Agriculture, Dr. PDKV, Nagpur	September 1-2, 2022
Dr. M. Sujatha Dr. A.L. Rathnakumar	Technical seminar on crop improvement through Biotechnology	National Seed Association of India (NSAI), New Delhi, in Hyderabad	September 9, 2022
Dr. H.H. Kumaraswamy	International conference on biotechnology trends & future prospects	Department of Biotechnology, University of Agricultural Sciences, Bengaluru	September 13-15, 2022
Dr. M. Sujatha	Brainstorming session on oilseeds research	TNAU, Coimbatore	September 15, 2022
Dr. G. Suresh	International e-ltec program	NIPHM Hyderabad and Ministry of External Affairs, New Delhi,	September 19-23, 2022
Dr. A.L. Rathnakumar	Expert committee meeting for reviewing the achievements of the NASF funded completed projects under the strategic area of abiotic and biotic stresses and quality traits in plants, animals and fisheries	NASF, ICAR, New Delhi (Virtual mode)	September 22, 2022

Name	Programme	Venue/Place	Date
Dr. G. Suresh	National seminar on harnessing the potential of panchabhutas (tatvas) for sustainable climate resilient rainfed agriculture	ICAR-CRIDA, Bharatiya Agro Economic Research Centre (BAERC), New Delhi and Indian Society of Dryland Agriculture, Hyderabad.	September 28-29, 2022
Dr. M. Sujatha	Member of the accreditation panel of the National Certification System of Tissue Cultured Plants (NCS-TCP)	In site visit in Telangana	September 30, 2022
Dr. P. Duraimurugan	Seminar on assessment of post-harvest losses of agri-produce in India	NABARD Consultancy Services (NABCONS) at India Habitat Centre, Lodhi Road, New Delhi	September 30, 2022
Dr. M. Sujatha	ICAR regional committee meeting	Cuttack, Odisha	October 14, 2022
Dr. M. Sujatha	89th CVRC meeting	ICAR-IIOR, Hyderabad (Virtual mode)	October 26, 2022
Dr. Ratna Kumar Pasala Dr. K.T. Ramya	International conference on physiological and molecular mechanisms for abiotic stress tolerance in plants	Calicut University, Kerala	October 26-28, 2022
Dr. M. Sujatha	Release function of book entitled sesame seed on 4th Indian Oilseeds & Produce Export Promotion Council (IOPEPC) global oilseeds conference	Hotel Hyatt Regency, Dubai, UAE	November 4-6, 2022
Dr. A.L. Rathnakumar	QRT Meeting of AICRP-Linseed	ICAR-IIOR, Hyderabad, IGKV, Raipur	November 09-11, 2022
M.Y. Dudhe	DUS review meeting and foundation day celebrations	NASC complex by PPV&FRA, New Delhi	November 10-11, 2022
Dr. K. Sankari Meena	International conference on advances in applied zoological researches towards food, feed & nutritional security and safer environment	Bhubaneshwar, Odisha	November 15-24, 2022
Dr. P. Duraimurugan	Inception workshop on state biodiversity strategy and action plan (SBSAP) 2022-2032 for Telangana state	Plaza Hotel, Begumpet, Hyderabad	November 22, 2022
Dr. M. Sujatha Dr. P. Ratna Kumar Dr. P. Kadirvel	QRT meeting on AICRP-Niger	Araku, Vishakhapatnam	November 24-25, 2022
Dr. J. Jawaharlal	International seminar on strengthening of seed supply systems for food security: from breeders to farmers	Novotel Hotel, Shamshabad by Telangana State Seed Development Corporation (TSSDC), Hyderabad, India	November 26, 2022

Name	Programme	Venue/Place	Date
Dr. R.K. Mathur Dr. S.V. Ramana Rao Dr. R.D. Prasad Dr. G. Suresh Dr. C. Lavanya Dr. P. Lakshmamma Dr. M.A.A. Qureshi Dr. P. Duraimurugan Dr. K.T. Ramya	World soil day and interaction meeting with stakeholders	Rampur, Dharur Mandal, Vikarabad District, Telangana Jakkapur, Siddipet, Telngana State	December 5, 2022
Dr. P. Duraimurugan Dr. T. Boopathi	3rd National symposium entomology 2022: innovation and entrepreneurship	PJTSAU, Entomological Society of India, Plant Protection Association of India, Agri Biotech Foundation, Hyderabad	December 8-10, 2022
Dr. N. Mukta	QRT meeting for AICRP-Safflower	UAS, Dharwad	December 9, 2022
Dr. S.V. Ramana Rao Dr. K. Alivelu	International conference on system of crop intensification (ICSCI 2022) for climate smart livelihood and nutritional security	ICAR-IIRR, Hyderabad	December 12-14, 2022
Dr. P. Padmavathi Dr. G. Suresh	Bee keeping in oilseeds for increasing the productivity and income of farmers	ICAR-IIOR, Hyderabad	December 21-23, 2022
Dr. K. Sankari Meena	Laboratory assessors training course at ICAR-NAARM, Hyderabad	NABL, Gurgaon and ICAR-NAARM, Hyderabad	December 19-23, 2022
Dr. P. Ratnakumar	National conference of plant physiology-west zone	NAU, Navsari, Gujarat	December 22, 2022
Dr. G. Suresh Dr. S.V. Ramana Rao Dr. P. Duraimurugan Dr. K. Ramesh Dr. A. Anil Kumar Dr. P. Duraimurugan Dr. H.D. Pushpa	Participated as representatives from ICAR-IIOR in the exhibition held at International conference on reimaging rainfed agro-ecosystems: challenges & opportunities (ICRA-2022)	ICAR-CRIDA, Hyderabad	December 22-24, 2022
Dr. C. Sarada	Two-day national e-workshop on data science & big data analytics using R (ICON-KSRAO, 2022)	Department of Statistics, Andhra University, Vishakhapatnam (Virtual mode)	December 27-28, 2022
Dr. C. Sarada Dr. K. Alivelu	International conference on knowledge discoveries on satistical innovations & recent advances in optimization (ICON-KSRAO)	Department of Statistics, Andhra University, Vishakhapatnam (Virtual mode)	December 29-30, 2022

Visit Abroad

- Dr. M.Y. Dudhe visited Serbia to participate in the 20th International Sunflower Conference (ISC) at Novi Sad, Serbia organized by the Institute of Field and Vegetable Crops Novi Sad (IFVCNS) Serbia in collaboration with International Sunflower Association (ISA) during June 20-23, 2022.
- Dr. M. Sujatha visited Dubai for participation in the IOPEPC Global Oilseeds Conference (IGOC 2022) from 4-6 November 2022.

Presentation in conferences/symposia/workshop/trainings

Name of the presenter	Title	Name of the programme	Organizer/ Venue	Date
Dr. M.Y. Dudhe	A decade of sunflower genetic resources management research activities in India	International Conference on Biotechnological Initiatives for Climate Resilient Agriculture-2022 (BICRA-2022) (In hybrid mode)	Department of Agricultural Biotechnology & Molecular Biology, RPCAU, Pusa, Samastipur, Bihar	January 07-09, 2022
Mrs. B. Usha Kiran	Candidate gene based allele mining for oil content in safflower (*Carthamus tinctorious* L.)	International Conference on Biotechnological Initiatives for Climate Resilient Agriculture-2022 (BICRA-2022) (In hybrid mode)	Department of Agricultural Biotechnology & Molecular Biology Dr. RPCAU, Pusa, Samastipur, Bihar	January 07-09, 2022
Dr. T. Boopathi	Seasonal incidence and sources of resistance for important insect pests of flaxseed	1st International Conference (Virtual Mode) on Recent Advances for Managing Sustainable Soil Health and Crop Production	GKV Society, Agra, Uttar Pradesh	February 18-20, 2022
Dr. Divya Ambati	Biochemical analysis of Indian durum wheat varieties and their suitability for pasta products	1st International Symposium on Cereals for Food Security and Climate resilience	Virtual mode	January 18-20, 2022
Dr. Divya Ambati	Genetic dissection of grain zinc and iron concentration, protein content, test weight and thousand kernel weight in wheat (*Triticum aestivum* L.) through genome wide association study	1st International Symposium on Cereals for Food Security and Climate resilience	Virtual mode	January 18-20, 2022
Dr. P. Duraimurugan	IPM technology for pest management in oil seed crops: novel approaches and future strategies	Awareness Programme on Furtherance in Integrated Pest Management (IPM) Approaches for Important Crops of Delhi, Haryana and Rajasthan	ICAR-NCIPM, New-Delhi and ICAR-ATARI Zone- II Jodhpur, Rajasthan (Virtual mode)	January 19-21, 2022
Mrs. B. Usha Kiran	*Oleosin* gene family of *Carthamus tinctorius*: uncovering of natural allelic variants associated with high oil content through sequence based allele mining	International Conference on Advances in Biosciences and Biotechnology on Innovations in Life sciences and Computational Biology	Jaypee Institute of Information Technology, Noida.	January 20-22 2022
Dr. G.D. Satish Kumar	Progress of Implementation of FPOs project of ICAR-IIOR	Review Meeting of the Central Sector Scheme for Formation and Promotion of 10,000 FPOs	National Cooperative Development Corporation, Hyderabad (Virtual mode)	January 27, 2022

Name of the presenter	Title	Name of the programme	Organizer/ Venue	Date
Dr. C. Sarada	Adoption studies- logit and probit approach	ICAR sponsored winter school entitled advances in agricultural extension research	ICAR-National Dairy Research Institute, Karnal (Virtual mode)	January 28-February 17, 2022
Dr. C. Lavanya	Development of short duration castor varieties	Interaction meeting on development of short duration castor varieties	ICAR-IIOR, Hyderabad	February 14, 2022
Dr. R.D. Prasad	Integrated Management of Oilseed Crops Diseases	Workshop on enhancing the production and productivity of maize and oilseeds in NEH region	ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema, Nagaland	February 16-18, 2022
Dr. P. Duraimurugan	Crop protection measures and strategies for enhancing oilseed production	The workshop on enhancing the production and productivity of maize and oilseeds in NEH region	ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema, Nagaland	February 16-18, 2022
Dr. M. Sujatha	Varietal options for realizing the genetic potential of oilseed crops	The workshop on Enhancing the Production and Productivity of Maize and Oilseeds in NEH Region	ICAR Research Complex for NEH Region, Nagaland Centre, Medziphema, Nagaland	February 17, 2022
Dr. P. Duraimurugan	Insect Pest Management in Organic Farming: Opportunities and Challenges	Training programme on recent advances in organic farming research	ICAR-NAARM, Rajendranagar, Hyderabad (Virtual mode)	February 22-26, 2022
Dr. C. Lavanya	Popularisation of new castor hybrids in non-conventional areas	*Rabi* castor field day cum training program	Venkateswara Bavi village, Amrabad Mandal, Nagarkurnool district	February 24, 2022
Dr. H.P. Meena	Identification, confirmation and application of newly developed downy mildew resistant sunflower inbreds	5th International conference on advances in smart agriculture and biodiversity conservation for sustainable development	ATDS, Ghaziabad (U.P.)	March 4-6, 2022
Mrs. B. Usha Kiran	Identification of candidate genes associated with oil content through allele mining in safflower	Agri Vision-2022: International conference on agriculture for sustainable future	Ravenshaw University, Cuttack, Odisha in association with Department of Botany, Ravenshaw University, Cuttack.	March 06-08, 2022
Mrs. B. Usha Kiran	Association mapping using SSRs	Hands on training program on Biotechnological tools in crop improvement	Institute of Biotechnology, PJTSAU, Hyderabad	March 14-26, 2022
Dr. C. Sarada	Open source software for statistical analysis	One day workshop on application of statistical techniques in agriculture	Agricultural College, Sircilla supported by NCSTC, GOI and TSCOST, EFS&T, Govt. of Telangana.	March 22, 2022

Name of the presenter	Title	Name of the programme	Organizer/ Venue	Date
Dr. M. Santha Lakshmi Prasad	Identification of resistance sources of castor against Fusarium wilt disease	IPS 8th International conference (Hybrid Mode) on plant pathology: retrospect and prospects	SKN Agriculture University, Jobner-Jaipur, Rajasthan, India	March 23-26, 2022
Dr. K. Sankari Meena	Identification and biochemical characterization of chitinolytic bacteria from oilseed rhizosphere	National conference on recent innovations, trends and challenges in plant science and research	Society for Plant Research, Senthilkumar Nadar college, Tamil Nadu.	March 25-26, 2022
Dr. M. Sujatha	Research strategies for enhancing edible oilseed production	The experts meet on self-sufficiency in edible oil production	NAAS, New Delhi	March 28, 2022
Dr. K. Ramesh	Recent advances in oilseeds production	VIT school of agricultural innovations and advanced learning (VAIAL)	Vellore Institute of Technology (VIT), Vellore (TN)	April 12, 2022
Dr. M. Sujatha	Import substitution of edible oils through enhancing production and productivity of oilseeds	AAM lecture series	ICAR-IIOPR, Pedavegi	April 18, 2022
Dr. M. Sujatha	Present growing conditions of various oilseed crops and possible options for area expansion	National workshop on self-sustainability in edible oils in India	ICAR-NAARM, Hyderabad	April 20, 2022
Dr. K. Ramesh	Organic and natural farming in India	Agronomy convention 2022	TNAU, Coimbatore	April 29, 2022
Dr. P. Duraimurugan	IPM in oilseeds	Training programme on integrated pest management for sustainable agriculture	ICAR-NCIPM, New Delhi (Virtual mode)	May 9-13, 2022
Dr. C. Lavanya	Significant achievements of Breeding, AICRP on Oilseeds-Castor	Annual group meeting of AICRP on Oilseeds (castor, sunflower) and AICRP on sesame and niger	ICAR-IIOR, Hyderabad	May 25-27, 2022
Dr. K. Ramesh	Organic farming in India	Brainstorming Workshop on Organic Farming in India	ICAR-NAARM, Hyderabad	June 10, 2022
Dr. M.Y. Dudhe	Current status of sunflower genetic resources in India	20th International sunflower conference (ISC)	Institute of Field and Vegetable Crops Novi Sad (IFVCNS), Serbia in collaboration with International Sunflower Association (ISA)	June 20-23, 2022.
Dr. R.D. Prasad	Production protocol for biocontrol agents (Predators, parasitoids, microbial bio pesticides & bio fertilizers)	Training on production protocol for bio control agents (predators, parasitoids, microbial bio pesticides & bio fertilizers)	NIPHM, Rajendranagar	July 18, 2022

Name of the presenter	Title	Name of the programme	Organizer/ Venue	Date
Dr. C. Lavanya	Efforts on development of novel castor (*Ricinus communis L.*) plant types suitable for machine harvesting in India	Symposium commemorating birth bicentenary of Gregor Johann Mendel	National Agricultural Science Centre (NASC), Pusa, New Delhi	July 19-21, 2022
Dr. T. Boopathi	Economically important insect pests of crops in North Eastern Hill Region of India and their management	4th Prof T N Ananthakrishnan Memorial Lecture & Prof T N Ananthakrishnan Award Ceremony	The Prof T N Ananthakrishnan Foundation & Southern Regional Centre, Zoological Survey of India, Chennai, Tamil Nadu	August 6, 2022
Dr. C. Sarada	Principles and Practices for Modern smart agriculture	ATAL AICTE sponsored FDP titled a holistic approach for sustainable and smart agriculture using AI and deep learning techniques	KLH, Hyderabad (Virtual mode)	September 5-16, 2022
Dr. H.H. Kumaraswamy	DNA fingerprinting of microsatellite loci in sesame (*Sesamum indicum* L.): Opportunities and Challenges	International conference on biotechnology trends and future prospects.	Department of Biotechnology of University of Agricultural Sciences, Bengaluru.	September 13-15, 2022
Dr. G.D. Satish Kumar	Extension strategies for promotion of precision farming	On campus training program on precision farming in agri. and horticulture sectors	Extension Education Institute, Hyderabad	September 26-30, 2022
Dr. G. Suresh	Abiotic stress management for sustainable oilseed production	National seminar on harnessing the potential of panchabhutas (tatvas) for sustainable climate resilient rainfed agriculture	Bharatiya agro economic research centre (BAERC), New Delhi and Indian society of Dryland Agriculture, Hyderabad	September 28-29, 2022,
Dr. P. Duraimurugan	Post-harvest losses in Oilseeds and its management	Seminar on assessment of post-harvest losses of agri-produce in India	NABARD Consultancy Services (NABCONS), India Habitat Centre, Lodhi Road, New Delhi.	September 30, 2022
Dr. G.D. Satish Kumar	Developing and identifying indicators for monitoring and evaluation	Planning, monitoring and evaluation of development programmes and projects for the officers of department of agriculture and allied sectors, south Indian states and UTs	Extension Education Institute, Hyderabad (Virtual mode)	October 11-15, 2022
Dr. C. Sarada	Impact of artificial Intelligence in the field of agriculture	ATAL AICTE sponsored FDP on impact of artificial intelligence in the field of agriculture	Department of Computer Science and Engineering, Malla Reddy Engineering College, Secunderabad	October 17-29, 2022

Name of the presenter	Title	Name of the programme	Organizer/ Venue	Date
Dr. C. Lavanya	Status of oilseed genetic resources in a multi-stakeholders	Workshop to develop a plan towards mainstreaming the landraces / traditional varieties – particularly NUS crops.	collaborative event between CROPS4HD (Consumption of Resilient Orphan Crops & Products for Healthier Diets), SWISSAID, FiBL (Research Institute of Organic Agriculture), and AFSA (Alliance for Food Sovereignty in Africa), at IMAGE, Bhubaneshwar	November 7, 2022
Dr. K. Sankari Meena	Screening of NRRI rice varieties against rice root knot nematode, *Meloidogyne graminicola*	XVIII AZRA International conference on advances in applied zoological researches towards food, feed & nutritional security and safer environment	Hotel Suryansh, Bhubaneswar, Odisha	November 10-12, 2022
Dr. G.D. Satish Kumar	Building high performance teams	Training on behavioral skills for Extension Professionals for the officers of department of agriculture and allied sectors, South Indian states and UTs	Extension Education Institute, Hyderabad (Virtual mode)	November 15-19, 2022
Dr. G.D. Satish Kumar	Analytical and goal setting skills	Training on MDP for women officers in agri. and allied sectors	Extension Education Institute, Hyderabad (Virtual mode)	November 21-25, 2022
Dr. V. Dinesh Kumar	RNA seq and its applications in agriculture	Training on recent bioinformatics tools for genome and proteome analysis	ICAR-NAARM, Hyderabad (Virtual mode)	November 23, 2022
Dr. G.D. Satish Kumar	Developing and identifying indicators for impact assessment	Training on Planning, Monitoring and Evaluation for Impact Assessment to the officers of Department of Agriculture and Allied Sectors of Southern States	Extension Education Institute, Hyderabad.	November 24, 2022
Dr. T. Boopathi	Emerging insect pests of sesame under changing climate scenario	3rd National Symposium on Entomology 2022: Innovation and Entrepreneurship	Entomology-Hyderabad, PJTSAU, Hyderabad, Telangana	December 8-10, 2022
Dr. P.S. Srinivas	Management of insect pests of oilseed crops	Training programme on Skill development on 'Bee keeping in oilseeds for increasing the productivity and income of farmers'	ICAR-IIOR, Hyderabad	December 21-23, 2022

Publications

Research Papers

Ajith Kumar, K., Savitha, A.S., Mahadevakumar, S., Sujatha, M., Maharachchikumbura, S.S.N., Sreenivasa, M.Y., Renuka, M., and Yenjerappa, S.T. 2022. First report of molecular detection of *Leveillula taurica* associated with powdery mildew of linseed (*Linum usitatissimum*) from India. *Plant Disease*, **106**(5):1529. doi: 10.1094/PDIS-09-21-1937-PDN. Epub 2022 Apr 8.

Anjani, K. and Yadav, P. 2022**.** Enhancing oleic acid and oil content in low oil and oleic type Indian safflower (*Carthamus tinctorius* L.)**.** *Industrial Crops & Products*, **175**: 114254.

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Asha Latha Sri, G., Kumar, G.D.S. and Khan, M.A. 2022. Farmers' characteristics effecting the yield gap in oilseed crops. *Indian Research Journal of Extension Education*, **22**(5): 59-62. http://krishi.icar.gov.in/jspui/handle/123456789/76203.

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Chandana, M., Qureshi, A.A., Sharma, S.H.K. and Triveni, S. 2022. Influence of different doses and methods of phosphorous solubilizing bacteria and phosphorus levels on the phosphorus solubilizing bacteria population and phosphorous use efficiency in sunflower and chickpea. *International Journal of Environment and Climate Change*, **12**(11): 953-959.

Chandhana, B., Kumar, G.D.S. and Sengar, R.S. 2022. Development of scale to measure sunflower farmers' perception on public and private extension systems. *Indian Journal of Extension Education*, **58**(3): 197-200. http://krishi.icar.gov.in/jspui/handle/123456789/76210.

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On-going Research Projects

A. INSTITUTE FUNDED PROJECTS

S. No.	Project No.	Project title	Investigators	Start date	End date (proposed)
1.	101-6	Identification, characterization, evaluation and multiplication of the trait specific germplasm and pre-bred lines for the development of superior populations in sunflower	**M.Y. Dudhe** H.P. Meena M. Sujatha K. Sakthivel P. S. Srinivas	2021	2024
2.	101-7	Diversification of parental base for development of superior hybrids in sunflower (*Helianthus annuus* L.)	**H.P. Meena** M. Sujatha M.Y. Dudhe K. Saktivel P.S. Srinivas Lakshmi Prayaga P. Ratna Kumar Praduman Yadav K. Ramesh	2021	2026
3.	102-10	Diversification of safflower germplasm through exploitations of wild species	**N. Mukta** H.P. Meena Praduman Yadav R.D. Prasad P.S. Srinivas A. Anil Kumar (Since September 2022)	2020	2025
4.	102-11	Improvement of safflower for high oil content, biotic and abiotic stress resistance coupled with high seed yield through recombination and heterosis breeding.	H.D. Pushpa Praduman Yadav R.D. Prasad P.S. Srinivas B. Usha Kiran Ratna Kumar Pasala	2020	2025
5.	103-14	Development of genomic resources and tools for applications in castor breeding	**S. Senthilvel** R.D. Prasad M. Santha Lakshmi Prasad	2017	2022
6.	103-15	Optimization of regeneration and transformation protocols to realize gray mold resistant transgenic castor (*Ricinus communis* L.)	**V. Dinesh Kumar** M. Sujatha B. Usha Kiran H.H. Kumaraswamy R.D. Prasad Rohini Sreevathsa, (NRCPB,IARI, New Delhi)	2017	2022
7.	103-16	Exploitation of plant genetic resources for identification of trait specific accessions with resistance/tolerance to biotic/abiotic stresses in castor	**J. Jawahar Lal** T. Manjunatha Praduman Yadav P. Lakshmamma	2020	2025
8.	103-17	Designing new plant types in castor suitable for mechanical harvesting	**C. Lavanya** P. Lakshmamma G. Suresh T. Manjunatha	2021	2026

S. No.	Project No.	Project title	Investigators	Start date	End date (proposed)
9.	103-18	Development of diverse parents and early to medium maturing castor hybrids with high oil yield, resistance to major pests, diseases and drought	**T. Manjunatha** C. Lavanya S. Senthilvel P. Lakshmamma	2021	2026
10.	103-19	Breeding for resistance to gray mold and capsule borer in castor	**S. Senthilvel** R.D. Prasad P. Duraimurugan	2021	2026
11.	103-20	Optimization of transformation protocol and developing transgenic castor (*Ricinus communis* L.) with gray mold resistance and plants expressing cas9 to exploit genome editing using viral vectors	**B. Usha Kiran** V. Dinesh Kumar M. Sujatha	2022	2027
12.	104-12	Agronomic interventions for increasing productivity and resource use efficiency (nutrient and moisture) of emerging cropping systems involving oilseeds	**S.N. Sudhakara Babu** M.A.A. Qureshi K. Alivelu	2015	2022
13.	104-16	Developing best management practices for organic soybean-sesame cropping system	**K. Ramesh** M.A.A. Qureshi P. Duraimurugan Praduman Yadav T. Boopathi K. Sankari Meena C. Manimurugan	2018	2023
14.	104-17	Fabrication of Fe and Zn nanosystems as efficient nutrient sources	**K.S.V.P. Chandrika** M.A.A. Qureshi Praduman Yadav Balaji Gopalan (BITS, Hyderabad) Anupama Singh (ICAR-IARI, New Delhi)	2018	2023
15.	104-18	Agronomic interventions for enhancing resource use efficiency in castor based cropping systems	**G. Suresh** M.A.A. Qureshi Ratna Kumar Pasala K. Sankari Meena	2018	2023
16.	104-19	Developing best management practices for sesame under rice-sesame cropping system	**K. Ramesh** M.A.A. Qureshi Praduman Yadav Harisudan (Agronomy), TNAU, Vriddhachalam KV Ramanamurty (Agronomy), ANGRAU, Ragolu BS Dhir (Agrl. Entomology), OUAT, Mahisapet Mangal Tuti (Agronomy), ICAR-IIRR	2019	2022
17.	104-22	Approaches to improve nutrient use efficiency in oilseed crops	**M. A.A. Qureshi** K. Ramesh P. Ratna Kumar	2021	2024
18.	104-23	Lignin extraction from agricultural waste and its applications in agriculture and industry	**K.S.V.P. Chandrika** C. Manimurugan K. Ramesh G. Suresh M. A.A. Qureshi	2021	2025

S. No.	Project No.	Project title	Investigators	Start date	End date (proposed)
19.	105-14	Screening and identification of dependable sources of resistance to insect pests of castor and deciphering the associated mechanisms	**P. Duraimurugan** J. Jawahar Lal	2017	2023
20.	105-15	Screening and identification of dependable/durable sources of resistance to biotic stresses of sesame and deciphering the associated mechanisms	**K. Sakthivel** M. Santha Lakshmi Prasad P. Duraimurugan H. H. Kumaraswamy Ramya, K.T.	2017	2022
21.	105-17	Screening and identification of durable sources of resistance to castor diseases and race identification of wilt pathogen	**M. Santha Lakshmi Prasad** T. Manjunatha	2020	2024
22.	105-18	Identification of sources of resistance to leaf webber/capsule borer and leafhopper and understanding the mechanisms of resistance in sesame	**T. Boopathi** K. Sakthivel	2020	2024
23.	105-19	Exploitation of chitinolytic bacteria and development of effective formulation against major insect pests, diseases and plant parasitic nematodes of oilseed crops	**K. Sankari Meena** R.D. Prasad P. Duraimurugan K.S.V.P. Chandrika K. Sakthivel	2021	2025
24.	106-3	Development of high throughput protocol to detect adulteration in oils and formulation of oil blends for enhanced nutritional quality and stability	**Praduman Yadav** K.S.V.P. Chandrika K. Alivelu	2021	2025
25.	107-18	Impact assessment of hybrids/varieties of IIOR mandated crops in varied agro ecological regions of India	**S.V. Ramana Rao** C. Sarada K.P. Thakar, Professor and Head, Dept. of Ag.Econ, (C.P. College of Agriculture, SDAU, Sardarkrushinagar)	2018	2023
26.	107-20	Development of ICT tools for technology dissemination in oilseed crops	**P. Madhuri** C. Lavanya N. Mukta H.P. Meena K.T. Ramya H.D. Pushpa J. Jawahar Lal S.V. Ramana Rao G.D. Satish Kumar	2020	2025
27.	107-22	A cross platform application for Identification and advisory for managing diseases and insects in oilseed crops through Image Analysis and Artificial Intelligence	**C. Sarada** R.D. Prasad M. Santha Lakshmi Prasad K. Sakthivel P.S. Srinivas P. Duraimurugan T. Boopathi S.V. Ramana Rao G.D. Sathish Kumar G. Rekha, KLEF-Hyderabad	2021	2023
28.	107-23	Analysis of yield gaps and developing suitable extension strategies for reducing yield gaps in oilseeds	**G.D. Sathish Kumar** K. Alivelu	2021	2025

S. No.	Project No.	Project title	Investigators	Start date	End date (proposed)
29.	107-24	Development of statistical methodology for selection of drought tolerant genotypes based on multiple traits for oilseed crops	**K. Alivelu** P. Lakshmamma, Lakshmi Prayaga P. Ratna Kumar	2022	2024
30.	108-2	Exploitation of inter & intra specific genetic resources for development of elite breeding lines in sesame	**K.T. Ramya** J. Jawahar Lal A.L. Rathna Kumar P. Ratna Kumar K. Sakthivel	2017	2023
31.	108-3	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	2017	2022
32.	108-4	Molecular characterization of water logging tolerance in sesame (*Sesamum indicum* L.)	**H. H. Kumaraswamy** K.T. Ramya P. Ratna Kumar K. Ramesh	2022	2024
33.	109-1	Exploitation of plant genetic resources for development of improved breeding populations in niger (*Guizotia abyssinica* Cass.)	**H.D. Pushpa** M. Sujatha	2017	2023
34.	110-1	Development of seed production and seed quality maintenance technologies for oilseed crops	**C. Manimurugan** S.N. Sudhakara Babu M.Y. Dudhe J. Jawahar Lal H.D. Pushpa T. Boopathi	2020	2025
35.	111-1	Exploitation of linseed genetic resources for development of elite breeding lines with high seed yield, oil and quality	**A.L. Rathnakumar** Divya Ambati Praduman Yadav T. Boopathi M.A.A. Qureshi	2020	2025

B. EXTERNALLY FUNDED PROJECTS

S. No.	Project title	Investigators	Period	Sponsoring organization	Budget (Rs. In lakhs)
1.	Molecular characterization and development of biopolymer based formulations of potential *Bacillus thuringiensis* and *Metarhizium (Nomuraea) rileyi* stains for the management of lepidoteran pests.	**P. Duraimurugan** K.S.V.P. Chandrika K. Sankari Meena V. Dinesh Kumar Balaji Gopalan	2021-2026	ICAR Network-AMAAS	6.98 (2022-23)
2.	A novel biopolymer based multilayer seed coating with *Trichoderma* and other microbial inputs and their tracking on applied surfaces in oilseed crops for integrated disease and nutrient management	**R.D. Prasad** K.S.V.P. Chandrika V. Dinesh Kumar K. Sakthivel K. Sankari Meena K Ramesh M.A.A. Qureshi	2021-2026	ICAR Network-AMAAS	7.80 (2022-23)

S. No.	Project title	Investigators	Period	Sponsoring organization	Budget (Rs. In lakhs)
3.	Seed production in agricultural crops	**J. Jawahar Lal** C. Manimurugan T. Manjunatha H.P. Meena H.D. Pushpa	2022-23	DA&FW, Govt. of India	11.50 (2022-23)
4.	Central sector scheme for protection of plant varieties and farmers rights authority (Annual)	**N. Mukta** C. Lavanya M.Y. Dudhe	2008-2022	PPV&FR Authority	8.50 (Annual)
5.	Development of distinctiveness, uniformity and stability (DUS) testing guidelines for niger [*Guizotia abyssinica* (L.f.) Cass.]	**N. Mukta** H.P. Meena Divya Ambati	2020-2023	PPV&FR Authority	27.00 (3 years)
6.	Delineating the effector biology of phytoplasma affecting selected crop taxa in India with special emphasis on sesame (*Sesamum indicum* L.)	**V. Dinesh Kumar** Suman Lakhapaul, Department of Botany, Delhi University	2019-2023	NASF, ICAR	9.4459 (2022-23)
7.	Exploitation of genetic & genomic resources for improvement of niger (*Guizotia abyssinica* L.F. Cass) through breeding and biotechnological tools	**M. Sujatha** H.D. Pushpa Praduman Yadav	2020-2024	DBT	215.0196 (Allocation)
8.	Exploiting genetic diversity for improvement of safflower through genomics-assisted discovery of QTLs/genes associated with agronomic traits	**P. Kadirvel** N. Mukta R.D. Prasad P.S. Srinivas PradumanYadav Lakshmi Prayaga P. Ratna Kumar P. Padmavathi M.A.A. Qureshi C. Sarada	2020-2025	DBT	-
9.	Frontline demonstrations (FLDs) on oilseeds and other extension activities	**G.D. Satish Kumar** J. Jawahar Lal K. Ramesh R.D. Prasad G. Suresh P.S. Srinivas P. Duraimurugan	2022-2023	National Food Security Mission-Oilseeds (NFSM-Oilseeds) under DA & FW	1163.66 (Allocation)
10.	Revival of sunflower cultivation	**H.P. Meena** C. Manimurugan J. Jawaharlal M.Y. Dudhe	2022-2025	DA & FW	444.00 (2022-23)

S. No.	Project title	Investigators	Period	Sponsoring organization	Budget (Rs. In lakhs)
11.	Formation and development of Farmer Producer Organizations (FPOs)	**G.D. Satish Kumar** R.D. Prasad G. Suresh M.A.A. Qureshi S.V. Ramana Rao P. Padmavathi Ch. Sarada T. Manjunatha	2021-2026	National Cooperative Development Council (NCDC)	10.00 (2022-23)
12.	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** P. Lakshmamma P. Padmavathi G.D. Satish Kumar K. Alivelu M.A.A. Qureshi P. Duraimurugan Ramya K.T. T. Manjunatha P. Madhuri S.T. Viroji Rao Gnan Prakash Sarat Chandra Venkata Ramana G. Vidyasagar Reddy	2017-2023	DoE, ICAR	15.05 (2022-23)
13.	Unravelling the genetics of shoot and capsule borer (*Conogethes punctiferalis*) resistance in castor (*Ricinus communis* L.)	**Dr. S. Senthilvel** Dr. P. Duraimurugan	2022-2025	SERB, DST	37.67428 (Total) 13.69142 (Per year)
14.	National Agriculture Innovation Fund (Component I): Innovation Fund (the XI Plan Scheme of Intellectual Property Management and Transfer/ Commercialization of Agricultural Technologies)	**Dr. S.V. Ramana Rao** Dr. T. Boopathi	2007-till date	ICAR	6.45 (2022-23)
15.	National Agriculture Innovation Fund (Component II): Incubation Fund (Supporting Agri-business Incubation Centres in Institutions Developing Agricultural Technologies)	**Dr. S.V. Ramana Rao** Dr. R.D. Prasad Dr. P. Duraimurugan	2015-till date	ICAR	3.50 (2022-23)
16.	Contract research: Studies on bioefficacy of Trichoderma against castor root rot and groundnut stem rot	**Dr. R.D. Prasad**	2022-23	M/s Valagro India Pvt. Ltd., Hyderabad	7.198
17.	Promoting inclusive seed production systems for accelerating cropping systems diversification	**Dr. K. Ramesh** Dr. A. Anil Kumar	2022 (Annual renewal basis)	IRRI	20.63

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.10.3 lakhs was spent during the period under report to acquire 30 books and for subscription to 52 Indian, 6 foreign periodicals and 2 databases. A total of 30 books and 48 publications were received on gratis besides newsletter and annual reports from different organizations. New records of books were added to the computerized library catalogue database. A total of 300 articles have been delivered to indenters through e-mails. Four issues of ICAR-IIOR Newsletter were published and were circulated to all scientists working in AICRP on Oilseeds centres. Literature searches were carried out in the mandate crops using in-house database, CROP CD, AGRIS on CD, AGRICOLA. The online database Indiagristat.com (Agriculture) was subscribed for the year 2022.

Civil Works

Repairs, minor works and maintenance works carried out during 2022 are listed below

S.No.	Name of the work
1.	Renovation & Maintenance of Main Office-cum-Laboratory Building
2.	Deeping and Lining of Farm Pond at Narkhoda Research Farm
3.	Repair and Renovation of Toilets and painting/white washing in IIOR Guest House
4.	Re Carpeting of Roads at Rajendranagar and Narkhoda Farm
5.	Fixing of False ceiling work, Removing of Old tiles, windows, Fixing of LED Lights etc at SFAO's Room
6.	Construction of Seed and Production Sale Counter (SC Enterpreneur Development Cell) at IIOR
7.	False ceiling of office building in front of Gents Toilets

Re-carpeting of Roads at Rajendranagar Farm

Inauguration of seed processing lab

Hindi Activities

राजभाषा संसदीय समिति का निरीक्षण

संसदीय राजभाषा समिति के सदस्य सांसद सुशील कुमार गुप्ता, सांसद रंजनबेन भट्ट एवं सांसद श्रीमती संगीता यादव ने दूसरी उपसमिति की संयोजिका सांसद प्रो. रीता बहुगुणा जोशी के नेतृत्व में अन्य कार्योलयों के साथ-साथ भाकृअनुप – भारतीय तिलहन अनुसंधान संस्थान का 25 अगस्त, 2022 को संस्थान में राजभाषा हिन्दी को आगे बढाने व राजभाषा हिन्दी अनुपालन के लिए किए जा रहे कार्यो का निरीक्षण किया।

समिति ने संस्थान के राजभाषा कार्यान्वयन पर संतोष प्रकट किया। विशेषतः सभी तिमाही बैठक निदेशक महोदय की अध्यक्षता में संपन्न हुई तथा वे नगर राजभाषा कार्यान्वयन समिति की बैठक में भी नियमित रुप से भाग लेते है। इससे यह ज्ञात होता है कि कार्यालय प्रधान राजभाषा कार्यान्वयन को लेकर सजग है। कार्यालय ने वार्षिक कार्यक्रम के अन्य मुद्दों के साथ-साथ पत्राचार, धारा 3 (3) जैसे प्रमुख मुद्दों का अच्छे से अनुपालन किया है। समिति ने संस्थान के राजभाषा कार्यान्वयन पर प्रसन्नता व्यक्त करने के साथ-साथ समिति की संयोजिका सांसद प्रो. रीता बहुगुणा जोशी ने अकादमी को प्रशंसा पत्र भी प्रदान किया।

अकादमी की ओर से इस बैठक में संस्थान की ओर से डॉ. एम. सुजाता, निदेशक (का.), भारतीय तिलहन अनुसंधान संस्थान, डॉ. संजीव गुप्ता, सहायक महानिदेशक, भाकृअनुप, नई दिल्ली, श्री. ओमप्रकाश जोशी, सहायक मुख्य तकनीकी अधिकारी, भाकृअनुप, नई दिल्ली, डॉ. प्रद्युम्न यादव,वरिष्ठ वैज्ञानिक, भारतीय तिलहन अनुसंधान संस्थान, डॉ. हरिप्रकाश मीणा, वरिष्ठ वैज्ञानिक, भारतीय तिलहन अनुसंधान संस्थान, श्री. मुकुल राजसिंह, प्रभारी वरिष्ठ प्रशासनिक अधिकारी, श्री. विनोद कुमार साहु, वरिष्ठ वित्त एवं लेखा अधिकारी श्री. प्रदीप सिंह, सहायक निदेशक (रा.भा), भारतीय तिलहन अनुसंधान संस्थान ने भाग लिया।

Promotions/ Transfers/ Superannuations

Promotions

Name	Position/Grade	Effective Date
Scientific		
Dr. Boopathi, T	Promoted to the next higher grade of 13A and designated as Sr. Scientist	January 8, 2020
Dr. M.Y. Dudhe	Promoted to the next higher grade of 13A and designated as Sr. Scientist	June 26, 2020
Dr. T. Manjunatha	Promoted to the next higher grade of 13A and designated as Sr. Scientist	April 12, 2021
Dr. Jawaharlal, J	Promoted to the next higher grade of 13A and designated as Sr. Scientist	December 15, 2021
Dr. H.P. Meena	Promoted to the next higher grade of 12 and designated as Sr. Scientist	May 10, 2019
	Promoted to the next higher grade of 13A and designated as Sr. Scientist	May 10, 2022
Dr. Praduman Yadav	Promoted to the next higher grade of 12 and designated as Sr. Scientist	May 10, 2019
	Promoted to the next higher grade of 13A and designated as Sr. Scientist	May 10, 2022
Dr. Ramya, K T	Promoted to the next higher grade of 12 and designated as Sr. Scientist	April 21, 2019
	Promoted to the next higher grade of 13A and designated as Sr. Scientist	April 21, 2022
Smt. Usha Kiran, B	Promoted to the next higher grade of 13A and designated as Scientist	February 10, 2020
Smt. Chandrika, KSVP	Promoted to the next higher grade of 11	January 1, 2020
Technical		
Smt. Mary, P	Promoted to the next higher grade Sr. Technician (T-2)	April 25, 2020
Shri Narasimha, J	Promoted to the next higher grade of Sr. Technician (T-2)	April 25, 2020

Transfers/ Joining

Name	Post	From	To	Date
Dr. A. Anil Kumar	Senior Scientist (Genetics and Plant Breeding)	ICAR-CRIJAF, Kolkata	ICAR-IIOR, Hyderabad	September 5, 2022
Shri Shitanshu Kumar	Senior Administrative Officer (SAO)	ICAR-IIOR, Hyderabad	ICAR-IIRR, Hyderabad	March 30, 2022

Superannuations

Name	Post	Date
Smt. A. Lalitha,	Skilled Support Staff	March 31, 2022
Smt. S. Padmamma	Skilled Support Staff	March 31, 2022
Smt. Y. Yadamma	Skilled Support Staff	March 31, 2022
Dr. S.N. Sudhakara Babu	Principal Scientist	April 30, 2022
Shri G. Srinivasa Rao	Technical Officer	April 30, 2022
Shri G.B. Nagendra Prasad	Assistant	May 31, 2022

Personnel

Dr. R.K. Mathur	Director (From November 28, 2022)
Dr. M. Sujatha	Director (A) (up to November 27, 2022)

Director's Cell

Smt. C. Lalitha	Private Secretary
Shri. P. Srinivasa Rao	Private Secretary

Crop Improvement

Name	Position	Discipline
Dr. M. Sujatha	Principal Scientist & Head (from November 28, 2022)	Genetics & Cytogenetics
Dr. V. Dinesh Kumar	Principal Scientist & Head (upto November 27, 2022)	Biotechnology
Dr. N. Mukta	Principal Scientist	Economic Botany
Dr. C. Lavanya	Principal Scientist	Plant Breeding
Dr. Senthilvel Senapathy	Principal Scientist	Plant Breeding
Dr. Kadirvel Palchamy	Principal Scientist	Genetics
Dr. A.L. Rathnakumar	Principal Scientist	Plant Breeding
Dr. T. Manjunatha	Senior Scientist	Plant Breeding
Dr. J. Jawahar Lal	Senior Scientist	Plant Breeding
Dr. Mangesh Y. Dudhe	Senior Scientist	Plant Breeding
Smt. B. Usha Kiran	Scientist	Biotechnology
Dr. H.P. Meena	Senior Scientist	Plant Breeding
Dr. C. Manimurugan	Scientist	Seed Science & Technology
Dr. H.H. Kumaraswamy	Scientist	Biotechnology
Dr. K.T. Ramya	Senior Scientist	Genetics & Plant Breeding
Dr. H.D. Pushpa	Scientist	Genetics & Plant Breeding
Dr. Divya Ambati	Scientist	Plant Breeding
Dr. A. Anil Kumar	Senior Scientist	Plant Breeding
Shri P. Gopinadhen	Technical Officer (F/F) (T-5)	-
Smt. P. Mary	Senior Technician (T-2)	-
Shri J. Narasimha	Senior Technician (T-2)	-
Shri Narasimha	Technician (T-1)	-
Smt G. Sailaja	Technician (T-1)	-

Crop Production

Name	Position	Discipline
Dr. S.N. Sudhakara Babu	Principal Scientist & Head (up to April 30, 2022)	Agronomy
Dr. G. Suresh	Principal Scientist & Head (from May 1, 2022)	Agronomy
Dr. P. Padmavathi	Principal Scientist	Agronomy
Dr. P. Lakshmamma	Principal Scientist	Plant Physiology
Dr. Lakshmi Prayaga	Principal Scientist	Plant Physiology
Dr. Md. A. Aziz Qureshi	Principal Scientist	Soil Science
Dr. K. Ramesh	Principal Scientist	Agronomy
Dr. Ratna Kumar Pasala	Principal Scientist	Plant Physiology
Dr. Praduman Yadav	Senior Scientist	Biochemistry
Smt. K.S.V.P. Chandrika	Scientist	Agricultural Chemicals
Smt. Ch.V. Haripriya	Chief Technical Officer (F/F) (T-9)	-
Shri S. Narsimha	Technical Officer (F/F) (T-5)	-

Crop Protection

Name	Position	Discipline
Dr. R.D. Prasad	Principal Scientist & Head	Plant Pathology
Dr. M. Santha Lakshmi Prasad	Principal Scientist	Plant Pathology
Dr. P. Satya Srinivas	Principal Scientist	Agricultural Entomology
Dr. P. Duraimurugan	Principal Scientist	Agricultural Entomology
Dr. T. Boopathi	Senior Scientist	Agricultural Entomology
Dr. K. Sakthivel	Scientist	Plant Pathology
Dr. K. Sankari Meena	Scientist	Nematology
Shri Ch. Anjaiah	Senior Technician (F/F) (T-2)	-
Shri S. Saida Reddy	Technical Assistant (F/F) (T-3)	-

Social Sciences

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

Support Services

Technical Information Cell

Name	Position
Dr. T. Boopathi	Officer-in-charge, TIC
Smt. J. Gnana Prasuna	Senior Technical Assistant (T-4)

Library & Documentation

Name	Position
Dr. P. Lakshamma	Officer-in-charge, Librory
Shri G. Raghunath	CTO (T-9)
Shri V. Sambasiva Rao	ACTO (T-7-8)

Farm Section

Name	Position
Shri M. Bhaskar Reddy	Chief Technical Officer (F/F) (T-9)
Shri C. Prabhudas	DMO (LDC)
Shri A. Srinivasa Raju	Technical Officer (Workshop) (T5)
Shri N. Vasanth	Technical Officer (Workshop) (T5)
Shri K. Srinivas	Technical Officer (Workshop) (T5)
Shri M. Indrasena Reddy	Senior Technical Assistant (Tractor Driver) (T4)
Shri Y. Venkateshwar Rao	Technical Officer (Tractor Driver) (T5)
Shri P. Demudu Naidu	Technical Assistant (T-3)
Shri J. Ashok	Technician (T-1)
Shri S. Venu	Technician (T-1)

Seed Section

Name	Position
Dr. J. Jawahar Lal	Officer-in-charge, Seed Section
Shri T. Veeraiah	Senior Technical Assistant (F/F) (T4)

Administration

Name	Position
Shri Pradeep Singh	i/c SAO, Assistant Director (OL)
Shri Shitanshu Kumar	SAO (up to March 30, 2022)
Smt. R.A. Nalini	Assistant Administrative Officer
Shri G. Srinivas Yadav	Personal Assistant
Shri P.R. Varaprasada Rao	Assistant
Shri E.V.R.K. Nagendra Prasad	Assistant
Shri T. Bichanna	Assistant
Smt. P. Gyaneshwari	UDC
Shri B. Giri	UDC
Smt. P. Swapna	LDC
Shri P. Srinivas	LDC

Stores

Name	Position
Shri Rakesh Geeda	Assistant Administrative Officer
Smt G. Maheshwari	LDC

Audit & Accounts

Name	Position
Shri Vinod Kumar Sahoo	Senior Finance & Accounts Officer
Smt S. Swarupa Rani	Assistant Administrative Officer
Shri G. Raghava Kiran Kumar	Stenographer

Drivers

Name	Position
Shri G. Ramulu	Technical Officer, Driver, T-5
Shri G. Pardhasaradhi	Technical Officer, Driver, T-5
Shri E. Ravi Kumar	Senior Technical Assistant, Driver, T-4

Skilled Supporting Staff

Name	Name	
Shri M. Venkatesh	Shri B. Sankaraiah	Smt. P. Lakshmi
Shri A. Rambabu	Shri N. Mallesh	Smt. P. Bharathamma
Shri M. Ramulu	Shri K. Yadagiri	Smt. T. Jangamma
Smt. B. Kistamma	Smt. N. Ratnamma	Smt. P. Suseela
Shri K. Sanjeeva	Smt. P. Venkatamma	Smt. P. Amrutha
Shri B. Vishnu	Smt. P. Balamani	Smt. M. Sukkamma
Shri B. Gyaneshwar	Smt. Y. Shanthamma	Smt. M. Lakshmi
Smt. K. Kalavathi	Shri N. Ramulu	Shri B. Venkataswamy
Smt. K. Suseela	Smt. N. Venkatamma	Shri C. Kumar
Shri N. Buchaiah	Smt. B. Lakshmamma	Shri P. Siddeshwar
Shri R. Venkatesh	Smt. M. Venkatamma	Shri P. Nagesh
Shri M. Krishna	Smt. Y. Lakshmi	Shri G. Mallesh
Smt. K. Krishnaveni	Smt. B. Kamalamma	Shri G. Mallesh
Smt. G. Pentamma	Smt. P. Satyamma	Shri M. Venkatesh
Smt. C. Chandrakala	Smt. K. Balamani	Smt. C. Bhagya
Shri R. Ramulu	Smt. B. Suvarna	Smt. P. Karunamma
Smt. Ch. Satyamma	Smt. Y. Balamani	Smt. E. Parvathamma
Smt. E. Sujatha	Smt. P. Santhamma	Shri S. Venkatesh
Smt. G. Sobha rani	Smt. B. Andallu	Shri M. Komaraiah
Smt. G. Anasuya	Shri M. Narasimha	Smt. D. Balamani
Shri B. Anjaiah	Shri M. Jangaiah	Shri A. Aagulu
Shri P. Narasimha	Shri M. Kistaiah	Smt. R. Kalyani
Shri B. Ramesh	Shri M. Gopal	Smt. E. Devamma
Smt. K. Bhagyamma	Smt. K. Bhagyamma	Smt. K. Kistamma
Shri D. Mallesh	Smt. P. Yellamma	

Press Coverage

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PRABHATHA SAMACHARAM
TELANGANA TELUGU DAILY

నూనె గింజల పంటల సాగుతో అధిక లాభాలు

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ఈనాడు, హైదరాబాద్: తాము విడుదల చేసిన కొత్త వంగడాలను సాగు చేస్తే అధిక దిగుబడి వస్తుందని రైతులకు 'భారత నూనెగింజల పరిశోధనా కేంద్రం'(ఐఐఓఆర్) సోమవారం ఒక ప్రకటనలో సూచించింది. పొద్దుతిరుగుడు పంట సాగుకు కొత్తగా 'తిలహాన్‌టెక్-ఎస్‌యూఎస్‌హెచ్-1' అనే పేరుతో కొత్త వంగడాన్ని విడుదల చేసినట్లు తెలిపింది. తెలుగు రాష్ట్రాలతో పాటు కర్ణాటక, గుజరాత్, కశ్మీర్, మహారాష్ట్ర, తమిళనాడు రాష్ట్రాల్లో సాగుకు ఇది అనుకూలమని పేర్కొంది. అలాగే కర్ణాటకకు ఆర్‌ఎస్‌ఎఫ్‌హెచ్-700, పంజాబ్‌కు 'పీఎస్‌హెచ్-2080' అనే వంగడాలను ప్రత్యేకంగా సిద్ధం చేసింది. ఆముదం పంటలో 'ఐసీహెచ్-5' అనే సంకరజాతి రకాన్ని విడుదల చేసింది. కొత్త వంగడాల పరిశోధనలపై ఈ నెల 25 నుంచి సదస్సు నిర్వహిస్తున్నట్లు ఐఐఓఆర్ ప్రకటించింది.

Date : 24/05/2022 EditionName : TELANGANA PageNo :

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నూనెగింజల ఉత్పత్తిలో ప్రగతిని సాధించాలి

బ్రోచర్‌ను విడుదల చేస్తున్న డాక్టర్ సంజీవ్ గుప్తా, డాక్టర్ సుజాత

Date : 26/05/2022 EditionName : Hyderabad PageNo : 7

Safflower ryots in A'bad get tips from experts

S RAJA REDDY @ Adilabad

WITH Telangana geared up for the cultivation of oilseeds, farmers in Keslapur village of Indervelli mandal, Adilabad district, are growing safflower for the first time. Experts often attribute the failure of crops to the communication gap between agricultural scientists and farmers.

To address this, the Indian Institute of Oilseeds Research, Hyderabad, (IIOR) and the Vikasit Rythu Sankshema Samstha, Rangagreddy, (VRSS) are conducting several awareness programmes, under the Tribal Sub-Plan.

The ongoing conflict between Russia and Ukraine has already caused edible oil prices to soar. On multiple occasions, Prime Minister Narendra Modi and several other Central Ministers have underlined the need to cut down on edible oil imports and be self-reliant on this front. Even Ministers from the State government, including Chief Minister K Chandrasekhar Rao, have stressed its importance.

In an issue that cuts across party lines, ensuring that farmers get the best yield remains of utmost importance, especially because they are growing it for the first time.

Executive Director of VRSS and former scientist M Padmaiah says after two years of efforts, they have been able to help the farmers grow oilseeds.

He informs that three types of oilseeds — safflower, sesame and castor — are being cultivated on 125 acres of land across Indervalli, Gudihathnoor and Ichoda mandals.

Attram Seetharam, a Keslapur resident, says he would usually grow soybean, but is cultivating safflower now. He informs that it's a short duration crop with a harvest period of 125 days.

Another tribal farmer Kinaka Shaku says he cultivated safflower in his one-acre piece of agricultural land with sparse investment. He mentions that the yield of his cotton crop was affected owing to attacks by pink bollworm and other such pests. While the price of cotton is high in the market, it didn't translate in profits for the grower, he comments.

Speaking to *Express*, Dr G Suresh, Principal Scientist (Agronomy), IIOR, informs the erstwhile district of Adilabad was selected since 70 per cent of the population belongs to tribals.

Explaining the thought behind urging ryots to grow safflower, Suresh says farmers get six to quintals of yield by cultivating it in one acre of land. It will fetch them ₹6,000 per quintal and in the range of ₹300 and ₹600 per kg at the open market.

"In the country, the cultivation of oilseeds is very limited, one needs to be aware and direct the farmers carefully so that they good returns in less investment," he comments.

Indian Express

Quinquennial Review Team visit to niger field at Araku, Andhra Pradesh

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किसानों का हमसफर
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