द्विभाषी
Bilingual

वार्षिक प्रतिवेदन
Annual Report

2025

भा.कृअनुप-राष्ट्रीय सोयाबीनअनुसन्धानसंस्थान
खंडवा रोड इंदौर-452001
ICAR-National Soybean Research Institute
Khandwa Road, Indore- 452 001

PREFACE

K. H. Singh
Director

Soybean, a crop acknowledged as vehicle of socio-economic transformation of millions of small and marginal farmers of India contributed one third to total oilseeds produced in the country during 2025-26. It is playing a very crucial role in reducing edible oil imports and also supports various soy based industries by providing raw materials. A record 15.27 MT soybean production was achieved during 2024-25 from 12.97 million ha with a productivity of 1179 kg/ha. First advance estimates however indicate a slight decline in production reaching to 14.27 MT during 2025-26. However, it is a matter of concern that the average national productivity is stagnant for the last many years. But it is noteworthy to mention that the yield levels of kharif 2025 has experienced adverse weather conditions. Similarly, the productivity of soybean in Madhya Pradesh which alone contribute (45.8% to the total area of the country) has affected due to disease incidences particularly anthracnose and Rhizoctonia Aerial Blight in addition to Yellow Mosaic Disease.

It is very important that there is a need of increasing the national average production and productivity of soybean to meet out the future demand which are the challenges before the scientists. The task is more difficult considering various biotic and abiotic stresses being frequently experienced now a days. The scientists of ICAR-National Soybean Research Institute (formerly ICAR-Indian Institute of Soybean Research) are actively working to tackle these challenges through their research programmes targeting to develop high-yielding, trait-specific varieties that are resistant/tolerant to biotic and abiotic stresses. The institute has tried to strengthen the seed production and its delivery mechanism for promoting the newly released soybean varieties through formal as well as informal ways. The institute is distributing minikits of seed of new soybean varieties (NRC 150, NRC 142, JS 23-03, JS 22-12 etc.) on the occasion of Rashtriya Kisan Diwas being organized on 23rd December every year since 2023, a platform for soybean farmers of far-off areas to buy a quality seed of recently notified soybean varieties facilitating multiplication of the same during summer for its use during main kharif season.

Biotic and abiotic stresses remained the serious challenges in increasing productivity of soybean. Year 2025 witnessed release of two soybean varieties NRC 197 for Northern Hill Zone and NRC 149 for northern plain zone and NRC 165 for Madhya Pradesh state. Results of seven years of experiments under conservation agriculture were encouraging. Similarly, second year experimentation on soybean cultivation under natural farming were also promising raising hope for successful soybean production under prevalent cropping systems. Efforts were also initiated on standardization of date of sowing and plant geometry for seed multiplication during summer season.1400 germplasm accessions of soybean were evaluated and multiplied during summer season. Few promising microbial strains were also evaluated for their performance.

I express my sincere gratitude to Dr. Mangi Lal Jat, Secretary, DARE, and Director General, ICAR, for consistent support and guidance in soybean research and development. I also feel indebted to Dr. D. K. Yadava, Deputy Director General (Crop Science) for his constant mentoring, support and guidance in planning and execution of various research activities at the institute. I extend my deep appreciation to the Chairman and members of RAC for their guidance in strategic research planning. Special thanks go to Dr Sanjeev Gupta, ADG (Oilseed and Pulses) ICAR, New Delhi, for his valuable contributions to the progress of the Institute. I would also like to acknowledge the editorial committee, scientists and staff for their efforts in making this report comprehensive and informative. I trust that this Annual Report will prove valuable to researchers, policymakers, farmers, industries, and development functionaries involved in promoting soybean research and development.

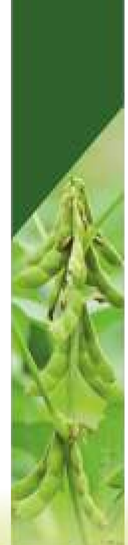
K. H. Singh
Director

अनुक्रमणिका
CONTENTS

कार्यकारी सारांश EXECUTIVE SUMMARY 01

- संस्थान के मिड-टर्म स्टोरेज में कुल 6120 जर्मप्लाज्म, जिसमें 2309 विदेशी कलेक्शन शामिल थे, रखे गए। बेंगलुरु में जर्मप्लाज्म मूल्यांकन के आधार पर 1000 एक्सेस की एक कोर सेट बनाया गया और इसे अलग-अलग एग्रो-क्लाइमेटिक ज़ोन के 5 AICRP केंद्रों को मिनी-कोर सेट बनाने के लिए दिया गया।
- तीन ग्लाइसिन सोजा एक्सेस- EC 116587 और EC 1165820 येलो मोज़ेक वायरस (लुधियाना और जबलपुर में) और फ्रॉग आई लीफ स्पॉट (अल्मोड़ा और पालमपुर) के प्रति प्रतिरोधी पाए गए।
- NRC 164, एक जल्दी पकने वाली किस्म (92 दिन) को MP राज्य के लिए जारी किया गया। इस किस्म की औसत उपज (2068 Kg) सबसे अच्छी चेक किस्म JS 20-34 से 13% बेहतर थी।
- NRC 270, एक अधिक उपज देने वाली किस्म ने AVT I में सबसे अच्छी चेक किस्म JS 21-72 की तुलना में 18.2% अधिक उपज दी और इसे सेंट्रल ज़ोन में AVTII 2025 में प्रमोट किया गया। NRC 268, लिपोक्सीजिनेज 2 मुक्त जीनोटाइप को सेंट्रल और ईस्टर्न ज़ोन में AVT II में प्रमोट किया गया है।
- NRC 290, KTI और लिपोक्सीजिनेज 2 से मुक्त जीनोटाइप को सेंट्रल ज़ोन में AVT I में प्रमोट किया गया है। NRC 291, KTI से मुक्त जीनोटाइप को सेंट्रल और सदर्न ज़ोन में AVT I में प्रमोट किया गया है। NRC 292, अधिक तेल वाला जीनोटाइप, को सेंट्रल ज़ोन में AVT I में प्रमोट किया गया है।
- एक सूखा प्रतिरोधी जीनोटाइप, NRC 295 ने IVT में सबसे अच्छी चेक किस्म JS 21-72 (1986 kg/ha) की तुलना में 20% अधिक उपज के साथ 2380 kg/ha बीज उपज दर्ज की, और इसे सेंट्रल ज़ोन में AVI 1 में प्रमोट किया गया।
- मार्कर-विशेषता संबंध अध्ययनों के माध्यम से, SNP S10_53805585 को प्राथमिक जड़ की लंबाई और कुल जड़ की लंबाई से महत्वपूर्ण रूप से जुड़ा हुआ पाया गया। •
- जीनोटाइप EC 457564 ने तीनों महत्वपूर्ण चरणों, यानी प्री-इमरजेंस, V3, और R2 में जल-जमाव सहनशीलता दिखाई, जो इसकी मजबूत और स्थिर प्रतिक्रिया को उजागर करता है, और इसे भविष्य की जल-जमाव सहनशीलता प्रजनन पहलों के लिए एक आशाजनक दाता के रूप में स्थापित करता है।

- A total of 6120 germplasm including 2309 exotic collections were maintained in the mid-term storage of the institute. A core set of 1000 accessions was formed based on the germplasm evaluation at Bengaluru and was provided to 5 AICRP centers of different agro-climatic zones for mini-core set formation.
- Three *Glycine soja* accessions- EC 116587 and EC 1165820 were found to be resistant against Yellow Mosaic Virus (at Ludhiana & Jabalpur) and Frog eye Leaf Spot (Almora and Palampur).
- NRC 164 an early maturing variety (92 days) was released for MP state. The average yield of the variety (2068 Kg) was 13% superior to the best check JS 20-34.
- One entry-NRC 268 (Lox-2 free) promoted to AVT II in central and eastern zone while another entry NRC 270 promoted to AVTII in Central Zone.
- NRC 290 , genotype free from KTI and Lipoxygenase 2, has been promoted to AVT I in Central Zone. NRC 291, genotype free from KTI , has been promoted to AVT I in Central and Sothern Zones. NRC 292 , high oil genotype , has been promoted to AVT I in Central Zone.
- A drought tolerant genotype, NRC 295 recorded 2380 kg/ha seed yield with 20% superiority over the best check JS 21-72 (1986 kg/ha) in IVT, and was promoted to AVI 1 in central zone.
- Through marker-trait association studies, SNP S10_53805585 was found to be significantly associated with primary root length and total root length.
- Genotype EC 457564 exhibited water-logging tolerance across all three critical stages viz., pre-emergence, V3, and R2, highlighting it's strong and stable response, and positioning it as a promising donor for future waterlogging tolerance breeding initiatives.



- GWAS विश्लेषण ने क्रोमोसोम 16 पर दो महत्वपूर्ण SNPs (S16_36047858 और S16_36087168) की पहचान की जो स्पोडोप्टेरा लिटुरा के खिलाफ प्रतिरोध से जुड़े थे, जो फेनोटाइपिक भिन्नता का 75-77% समझाते हैं।
- 200 सोयाबीन एक्सेशंस और 130 किस्मों के एक पैनल का हॉटस्पॉट स्थितियों में राइजोक्टोनिया एरियल ब्लाइट (RAB) के लिए मूल्यांकन किया गया। जीनोटाइप EC 528623, EC 547464, NRC 2396, Kaeri 651-6, EC456556, EC 528622, TGX984-18E, MAUS 61-2, Hardee, Young, CAT 2797, JS21-71, Lee, MAUS 61-2, Hardee, NRC 142 और NRC150 RAB प्रतिरोध के लिए आशाजनक दाता पाए गए।
- सोयाबीन-आधारित फसल प्रणालियों में, सोयाबीन-चना ने सबसे अधिक सोयाबीन उपज दर्ज की, जबकि सोयाबीन-आलू-गेहूं ने अधिकतम प्रणाली उत्पादकता, उत्पादन दक्षता, सकल रिटर्न और समग्र लाभप्रदता हासिल की।
- अवशेष प्रतिधारण (RR) के साथ स्थायी ब्रॉड बेड फरो (PBBF) को अपनाने से पारंपरिक जुताई बिना अवशेष प्रतिधारण (CTFP No-RR) की तुलना में सोयाबीन की उपज में 20% और रबी फसलों की उपज में 17-32% की वृद्धि हुई, जो स्थायी गहनता के लिए इसकी श्रेष्ठता की पुष्टि करता है।
- तीन वर्षों (2023-2025) में मानकीकृत प्राकृतिक खेती पद्धतियों के परिणामस्वरूप सोयाबीन की उपज 6.57 क्विंटल/हेक्टेयर से बढ़कर 23.3 क्विंटल/हेक्टेयर हो गई, जो सोयाबीन के लिए अनुकूलित प्राकृतिक खेती पैकेजों की प्रभावशीलता को मान्य करता है।
- कंजर्वेशन एग्रीकल्चर (CA) के तहत एलीट सोयाबीन जीनोटाइप के मूल्यांकन में पाँच बेहतर लाइनें (G42, G35, G13, G31, और G18) पहचानी गईं, जिनसे >2000 kg/ha उपज मिली, जो स्थिर उच्च उत्पादकता के लिए CA की क्षमता को उजागर करता है।
- वसंत/गर्मी सोयाबीन उत्पादन तकनीकों को मानकीकृत किया गया, जिसमें इष्टतम बुवाई (25 जनवरी-5 फरवरी), दूरी (30 × 5-10 cm), और पोषक तत्व प्रबंधन (100% RDF + ब्रासिनोस्टेरॉइड स्प्रे) की पहचान की गई, जिससे 16.26 q/ha तक उपज प्राप्त हुई।

- GWAS analysis identified two significant SNPs on chromosome 16 (S16_36047858 and S16_36087168) associated with resistance against *Spodoptera litura*, explaining 75–77% of the phenotypic variation.
- A panel of 200 soybean accessions and 130 varieties were evaluated for Rhizoctonia aerial blight (RAB) under hotspot conditions. Genotypes EC 528623, EC 547464, NRC 2396, Kaeri 651-6, EC 456556, EC 528622, TGX 984-18E, MAUS 61-2, Hardee, Young, CAT 2797, JS 21-71, Lee, MAUS61-2, Hardee, NRC 142 and NRC150 were found to be promising donors for RAB resistance.
- Among soybean-based cropping systems, soybean–chickpea recorded the highest soybean yield, while soybean–potato–wheat achieved the maximum system productivity, production efficiency, gross returns, and overall profitability.
- Adoption of Permanent Broad Bed Furrow (PBBF) with residue retention (RR) enhanced soybean yield by 20% and *rabi* crop yields by 17–32% compared to conventional tillage without residue retention (CTFP No-RR), confirming its superiority for sustainable intensification.
- Natural farming practices standardized over three years (2023–2025) resulted in improvement of soybean yield from 6.57 q/ha to 23.3 q/ha, validating the effectiveness of customized natural farming packages for soybean.
- Evaluation of elite soybean genotypes under conservation agriculture (CA) identified five superior lines (G42, G35, G13, G31, and G18) yielding 2000 kg/ha, highlighting the potential of CA for stable high productivity.
- Spring/summer soybean production technologies were standardized, identifying optimal sowing window (25th January–5th February), spacing (30 × 5–10 cm), and nutrient management (100% RDF + brasinosteroid spray), achieving yields up to 16.26 q/ha.

- गर्मियों में सिंचाई शेड्यूलिंग अध्ययन से पता चला कि V1, R2, और R5 सबसे महत्वपूर्ण विकास चरण हैं; इन चरणों में 40 mm सिंचाई के प्रयोग से नमी की कमी की स्थिति में बीज उपज और पानी के उपयोग की दक्षता अधिकतम हुई।
- एकीकृत फसल प्रबंधन (ICM) रणनीतियों, जिसमें इष्टतम फसल ज्यामिति और लक्षित जैविक/रासायनिक पौध संरक्षण को मिलाकर जैविक तनाव को प्रभावी ढंग से कम किया गया और खरीफ के दौरान 2.98 t/ha की उच्च सोयाबीन उपज प्राप्त की गई।
- माइक्रोबियल बायोप्रोस्पेक्टिंग और बायो-इनोक्यूलेंट अनुप्रयोगों (SOBs, SPBs, ZSBs, PGPBs) ने सोयाबीन और रबी फसलों की उपज में काफी वृद्धि की (26% तक), जो पोषक तत्वों की उपलब्धता और स्थिरता में माइक्रोबियल मध्यस्थता की भूमिका पर जोर देता है।
- डिजिटल और AI-संचालित नवाचारों, जिसमें ई-मार्केटिंग पोर्टल, AI-आधारित रोग और कीट निदान (SmartSoy), और सोयाबीन ज्ञान-AI मोबाइल ऐप शामिल हैं, ने प्रौद्योगिकी प्रसार, किसान निर्णय समर्थन, और बाजार पहुंच को मजबूत किया, जिससे देश भर में बेहतर सोयाबीन उत्पादन तकनीकों को अपनाने में वृद्धि हुई।
- माइक्रोबियल कंसोर्टिया (*Bacillus aryabhattai* + *Bradyrhizobium lioningense*+AMF) ने नियंत्रण की तुलना में मिट्टी में एंजाइम और उपलब्ध पोषक तत्वों की मात्रा में काफी सुधार किया।
- फली झुलसा रोग के प्रबंधन के लिए; थियोफेनेट मिथाइल + एजोक्सिस्ट्रोबिन + थियोमेथोक्साम @ 10ml/kg बीज के साथ ST + फ्लक्सपायरोक्साड 167 g/l + पाइराक्लोस्ट्रोबिन 333 g/l SC @ 300 g/ha के स्प्रे से 46.20% की सबसे कम रोग गंभीरता प्राप्त हुई।
- फर्नेसीन, नेफ्थलीन, मिथाइल सैलिसिलेट और सिस-3-हेक्सिल एसीटेट को आकर्षक पाया गया; जबकि ट्राइडेकेन, 2-हेक्सिल-1-डेकानोल और टेट्राडेकेन तना मक्खी के लिए विकर्षक पाए गए।
- फाइटोहोर्मोन ट्रिया 2ppm के साथ AM इनोक्यूलेशन से नोड्यूल बायोमास, नोड्यूल में लेगहीमोग्लोबिन सामग्री और सोयाबीन की उपज में काफी वृद्धि देखी गई।
- हेटरोट्रॉफिक SOBs (H3) बैसिलस एमाइलोलिक्वेफेशियंस के बीज इनोक्यूलेशन ने नियंत्रण की तुलना में सोयाबीन की उपज में 17% की वृद्धि की।

- Irrigation scheduling study in summer revealed that V1, R2, and R5 are the most critical growth stages; application of 40 mm irrigation at these stages maximized seed yield and water-use efficiency under moisture stress conditions.
- Integrated Crop Management (ICM) strategies combining optimum crop geometry and targeted biological/chemical plant protection effectively reduced biotic stress and achieved high soybean yields of 2.98 t/ha during *kharif*.
- Microbial bioprospecting and bio-inoculant applications (SOBs, SPBs, ZSBs, PGPBs) significantly enhanced soybean and *rabi* crop yields (up to 26%), emphasizing the role of microbial mediation in nutrient availability and sustainability.
- Digital and AI-driven innovations, including e-marketing portals, AI-based disease and pest diagnosis (SmartSoy), and the Soybean Gyan-AI mobile app, strengthened technology dissemination, farmer decision support, and market access, enhancing adoption of improve d soybean production technologies nationwide.
- Microbial consortia (*Bacillus aryabhattai* + *Bradyrhizobium lioningense*+AMF) significantly improved enzymes and available nutrient content in soil over control.
- For the management of pod blight complex disease; ST with Thiophanate methyl + Azoxystrobin + Thiomethoxam @ 10ml/kg seed + spray of Fluxapyroxad 167 g/l + Pyraclostrobin 333 g/l SC @ 300 g/ha produced lowest disease severity of 46.20%.
- Fernesene, Naphthelene, Methyl salicylate and Cis-3-hexyl acetate were found as attractant; while Tridecane, 2-Hexyl-1-decanol and Tetradecane were found as repellant to stem fly.
- The phytohormones Tria 2ppm with AM inoculation found significantly higher nodule biomass, leghemoglobin content in nodules, and soybean yield.
- The seed inoculation of heterotrophic SOBs (H3) Bacillus amyloliquefaciens significantly enhanced soybean yield by 17 % over control.

- सोयाबीन के एरियल ब्लाइट रोग के प्रबंधन के लिए, थियोफेनेट मिथाइल + एज़ोक्सिस्ट्रोबिन + थियोमेथोक्साम @ 10ml/kg बीज के साथ बीज उपचार + फ्लक्सपायरोक्साड 167 g/l + पाइराक्लोस्ट्रोबिन 333 g/l SC @ 300 g/ha 30,45 और 65 DAS के छिड़काव से 48.35% की सबसे कम रोग गंभीरता पाई गई।
- खेत की स्थितियों में जांची गई सोयाबीन की किस्मों में से, RSC 10-46, NRC SL-1, JS 21-72, JS 20-69, PK 308, JS 20-98, PS 1347 सोयाबीन के एरियल ब्लाइट रोग के प्रति अत्यधिक प्रतिरोधी पाए गए।
- सोयाबीन तना मक्खी, M. sojae के लिए काइरोमोन के अलगाव और पहचान के लिए, आठ सोयाबीन जीनोटाइप जैसे, F4P18, F4P21, JS 335, JS 9305, CAT 47, G5P22, JS 9560 और CAT 2503 का मूल्यांकन एयर एंट्रेनमेंट, ओल्फैक्टोमीटर परख, GC EAD (गैस क्रोमैटोग्राफी इलेक्ट्रोएंटेनोडिटेक्शन) और GCMS (गैस क्रोमैटोग्राफी मास स्पेक्ट्रोमेट्री) के माध्यम से किया गया।
- GC-EAD विश्लेषण से पता चला कि कुल 8 यौगिकों की पहचान की गई। आठ यौगिकों में से कुछ तना मक्खी के लिए आकर्षक हैं और कुछ विकर्षक प्रकृति के हैं।
- ICT पहलों के तहत, अलग-अलग प्लेलिस्ट ग्रुप वाले कुल 114 वीडियो बनाए गए हैं, जिनमें 13 शॉर्ट्स शामिल हैं और इवेंट्स के 7 लाइव वेबकास्ट YouTube चैनल पर अपलोड किए गए हैं। इसी तरह, साल के दौरान इंस्टाग्राम रील्स पर 103 रील्स और फेसबुक पेज पर 3 रील्स अपलोड की गईं।
- 10-12 मार्च 2025 के दौरान "मध्य प्रदेश में सोयाबीन-गेहूं फसल प्रणाली की उत्पादकता बढ़ाने के लिए प्रौद्योगिकी" पर तीन दिवसीय राष्ट्रीय प्रशिक्षण कार्यक्रम आयोजित किया गया। साथ ही, इनपुट डीलरों के लिए 3 प्रशिक्षक प्रशिक्षण कार्यक्रम सफलतापूर्वक आयोजित किए गए।
- देश भर में कुल 1112 FLD आयोजित किए गए, जिनमें से 250 FLD मध्य प्रदेश में आयोजित किए गए। इसी तरह, ICAR-NSRI-MP सरकार परियोजना के तहत मध्य प्रदेश के 18 जिलों में सोयाबीन (खरीफ) और गेहूं (रबी) पर 180 प्रदर्शन आयोजित किए गए।
- सोयाबीन की नवीनतम 11 सोयाबीन किस्मों वाले एक प्रदर्शन प्लॉट के उपज डेटा से पता चला कि सबसे अधिक उपज (28.8 क्विंटल/हेक्टेयर) JS 21-72 से प्राप्त हुई, इसके बाद NRC 142 (22.00 क्विंटल/हेक्टेयर) और NRC 150 (17.40 क्विंटल/हेक्टेयर) रही।

- For the management of aerial blight disease of soybean, seed treatment with Thiophanate methyl + Azoxystrobin + Thiomethoxam @ 10ml/kg seed + spray of Fluxapyroxad 167 g/l + Pyraclostrobin 333 g/l SC @ 300 g/ha 30,45 and 65 DAS produced lowest disease severity of 48.35%.
- For isolation and identification of kairomones for soybean stem fly, *M. sojae,* eight soybean genotypes viz., F4P18, F4P21, JS 335, JS 9305, CAT 47, G 5P22, JS 9560 and CAT 2503 were evaluated through air entrainment, olfactometer assays, GC EAD (Gas Chromatography Electroantennodetection) and GCMS (Gas Chromatography Mass Spectrometry).
- The GC-EAD analysis revealed that a total of 8 compounds were identified. Out of the eight compounds, some are attractive and some are repellents in nature for stem fly.
- Under the ICT initiatives, a total of 114 videos comprising different playlist groups has been produced including 13 shorts and 7 live webcast of the events have been uploaded on the YouTube channel. Similarly, 103 reels on instagram reels and 3 on facebook page were uploaded during the year.
- A Three Day's National Training Programme on "Technology for Increasing the Productivity of Soybean-Wheat Cropping System in Madhya Pradesh" during 10-12th March 2025 was organized. Also 3 trainers' training programs for input dealers were successfully organized.
- A total of 1112 FLDs were conducted across the country out of which 250 FLDs were conducted in M.P. Similarly, 180 demonstrations each on Soybean *(kharif)* and Wheat *(rabi)* were conducted in 18 districts of M.P under ICAR-NSRI-MP Govt Project.
- The yield data of a demonstration plot involving newly released 11 soybean varieties revealed the highest yield (28.8q/ha) from JS 21-72 followed by NRC 142 (22.00 q/ha) and NRC 150 (17.40 q/ha).

- कुल 33 एक दिवसीय प्रशिक्षण कार्यक्रम आयोजित किए गए, जिसमें 55 महिला किसानों सहित 972 किसानों ने भाग लिया।
- संस्थान के ABI केंद्र ने महाराष्ट्र के FPO के लिए "सोया खाद्य प्रसंस्करण तकनीक और खाद्य उत्पादों के लिए सोया के उपयोग" पर 3 दिनों की अवधि के 10 प्रशिक्षण कार्यक्रम आयोजित किए हैं। इसके अलावा, आने वाले उद्यमियों के लिए 2 और प्रशिक्षण आयोजित किए गए।
- खरीफ मौसम के दौरान द्विभाषी साप्ताहिक सलाह (20) जारी की गईं, जिसमें सोयाबीन उत्पादकों द्वारा अपनाए जाने वाले कृषि और पौध संरक्षण उपायों पर प्रकाश डाला गया।
- SCSP घटक के तहत, मध्य प्रदेश के इंदौर, सीहोर, बड़वानी, आगर मालवा, उज्जैन और खरगोन जिलों के किसानों के लिए 2218 लाभार्थी किसानों के लिए 15 प्रशिक्षण और 590 प्रदर्शन आयोजित किए गए।
- इसी तरह, अनुसूचित जनजाति (ST) किसानों के लिए 15 प्रशिक्षण ((874 कृषक) आयोजित किए गए और उन्हें जनजातीय उप-योजना (TSP) योजना के तहत कृषि इनपुट वितरित किए गए।

- A total of 33 one-day training programmes of one day duration for the 972 visiting farmers and 27 programmes under SCSP and TSP component, covering 3092 beneficiaries were conducted.
- Similarly, the institute ABI centre has also conducted 10 training programmes of 3 days' duration on "Soy food processing techniques and utilization of soy for food products" for the FPOs of Maharashtra. In addition, 2 more trainings were conducted for upcoming entrepreneurs.
- Bilingual weekly advisories were issued (20 Nos.) during the kharif season highlighting agronomic and plant protection measures to be followed by the soybean growers.
- A total of 590 demonstrations were conducted for the farmers of Indore, Sehore, Badwani, Agar Malwa, Ujjain and Khargone Districts of Madhya Pradesh under FLD Scheme and SCSP.
- Similarly, 15 trainings each under SCSP (652 farmers) and TSP (874 farmers) were organized.

INTRODUCTION 02

Background

The Indian Council of Agricultural Research has initiated All India Coordinated Research Project on Soybean way back in 1967 when there was hardly any area under soybean in the country. However, the varietal development work carried out under AICRPS has led to development of number of soybean varieties suiting to different agro climatic conditions. Consequently, the area under the crop started increasing when more and more AICRPS centres started functioning. Further, to take up the centralized research to support soybean production systems with basic information and breeding material, the ICAR established then National Research Centre for Soybean at Indore in 1987. It was re-designated as Directorate of Soybean Research in 2009 and as Indian Institute of Soybean Research in 2016 Later, it was renamed as National Soybean Research Institute. Coordinating unit of AICRPS, Soybean Breeder Seed Production (SBSP) and National Active Germplasm Site (NAGS) for soybean germplasm are also situated at ICAR-NSRI, Indore. The research plan and policies of ICAR-NSRI are guided by the recommendations of the Research Advisory Committee (RAC), Quinquennial Review Team (QRT) and the Institute Research Council (IRC). The Institute Management Committee (IMC) supports implementation of its plans and programs. Institute had also setup an Agribusiness Incubation Centre (ABI) for training and support of start-ups in the area of soybean food processing and production technologies.

Location

ICAR-NSRI campus is located at Khandwa Road near Crystal IT Park in Indore city of Madhya Pradesh state, which lies in Vidhyanchal range of Malwa Plateau at 22° 4'37"N latitude and 75° 52'7"E longitude. It is positioned at an altitude of 550 meter above the mean sea level. The institute has an area of 55.11 hectares with 42.7 ha cultivable land for research and seed production. ICAR-NSRI is situated at a distance of 12 Km from Devi Ahilya Bai Holkar International Airport, Indore and 6 Km from railway station, Indore.

Soil

The soil of ICAR-NSRI research farm is deep black cotton soil with pH 7.6 to 8.1 (basic / alkaline), low to medium in organic carbon, available phosphorus, and high in potassium. Taxonomically it is classified as fine, montomorillonitic, hyperthermic family of typic chromusterts and fine clay loam, montmorillonitic family of lithic vertic ustochrepts.

Climate

The climate of the Malwa Plateau of Madhya Pradesh is semi arid with a growing period of 90 120 days. As such, the climate of this region is characterized by 3 distinct agricultural seasons. These are: (a) rainy season, also known as monsoon or kharif, usually begins from mid-June and extends up to early October. Generally, duration of monsoon is approximately 98 days with about 1100 mm mean annual rainfall and soybean is grown during this season as a rainfed crop. (b) post-rainy season which runs from mid-October to March, also known as rabi, is dry and cool and, (c) warm and dry season, which begins in February and lasts until April called zaid or summer/spring and any crop grown during this season requires irrigation.

Past Achievements

Major achievements of the institute include maintenance of a vast collection of soybean germplasm comprising exotic, indigenous, breeding lines and wild species. Currently, 6221 germplasm accessions are maintained at ICAR-

NSRI. A number of genetic resources have been identified for various traits like photoperiod insensitivity, long juvenility, extra early maturity, drought and waterlogging tolerance, heat stress tolerance and resistance to diseases such as charcoal rot, anthracnose, rust and yellow mosaic and some insect pests. Twenty-two high yielding varieties having resistance to various biotic and abiotic stresses and food grade characters have been bred by Institute and released for cultivation in different agro-ecological regions of the country.

The institute has done significant efforts in development and release of food grade varieties such as NRC 127, NRC 132, NRC 147, NRC 142, NRC 150, NRC 152, NRC 181, NRC 197 and NRC 188 (Vegetable type). NRC 142, a high yielding variety free from KTI and Lipoxygenase 2, has been released for Central and Southern Zone. First high oleic acid variety NRC 147, has been released for cultivation in Eastern and Southern Zone.

Four germplasm accessions EC 390977, EC 34101, JS 20-34 and MACS 330 having photoperiodic genes and early maturity traits, EC34372 for anthracnose resistance, AGS 25 having long juvenile trait and JS 20-38 having water logging traits have been registered at ICAR-NBPGR, New Delhi. Similarly, two genetic stocks NRCSL-8 having Yellow Mosaic disease resistance, multiple disease resistance genotypes- JS 21-05 and JS 20-20, NRC 252 with extra early maturity traits have also been registered. Molecular markers have been identified for maturity, 100-seed weight and yellow mosaic disease resistance traits. Through GWAS studies, identified significant SNPs associated with drought and water logging tolerance, charcoal rot resistance, anthracnose resistance, Spodoptera litura resistance and root system architecture traits.

In the field of crop production, technology involving permanent broad bed furrow and micro-nutrient management strategies for soybean wheat cropping system in Central India has been endorsed by the ICAR. Also identified six highly suitable states (Uttar Pradesh, Maharashtra, Karnataka, Telangana, Gujarat and Punjab) for horizontal expansion of soybean across India by using GIS-MCDA modelling approach. In situ moisture conservation technology and the associated mechanization for soybean-based cropping system (BBF, FIRBS, R&F, Sub-soiler) have been developed and commercialized. Remunerative soybean based intercropping systems (Soybean + Pigeonpea, Soybean + Maize and Soybean + Sugarcane) with suitable cultivars under soybean + sugarcane intercropping were identified. Integrated nutrient and weed management for soybean based cropping system have been developed. Soil health enhancing microbes including Zn, Fe solubilizing bacteria and native rhizobia have been identified. Foliar application of Thiourea was recommended to alleviate drought stress in soybean. Microbial inoculation (*Bacillus aryabhattai, Burkloderia arboris*) + mycorrhizal fungi increased the productivity of soybean and wheat crop. Microbial consortia (*Bradyrhizobium daqingense + Bacillus aryabhatii*) was identified to save 25% of Nitrogen & Phosphorous fertilizers in soybean.

In the area of plant protection, integrated management schedule for major soybean insect pests have been worked out. Studies on epidemiology of rust occurrence in soybean revealed that the source of rust inoculum for south India lies in the Krishna valley. The economic benefit of adoption of rust resistant varieties in rust prone districts of Maharashtra and Karnataka states were estimated which showed that widespread adoption of rust resistant varieties significantly contributed to farm income and crop stabilization in the region. Among the soybean varieties screened under field conditions, RSC 10-46, NRC SL-1, JS 21-72, JS

20-69, PK 308, JS 20-98, PS 1347 were found to be highly resistant against aerial blight disease of soybean.

For isolation and identification of kairomones for soybean stem fly, *M. sojae*, eight soybean genotypes viz., F4P18, F4P21, JS 335, JS 9305, CAT 47, G 5P22, JS 9560 and CAT 2503 were evaluated through air entrainment, olfactometer assays, GC EAD (Gas Chromatography Electroantennodetection) and GCMS (Gas Chromatography Mass Spectrometry). The GC-EAD analysis revealed that a total of 8 compounds were identified. Out of the eight compounds some are attractive and some are repellants in nature for stem fly.

The expert systems developed by the institute for identification of germplasm, varieties, disease & insects damage, as well as data management systems for AICRPS have made the task easier for the farmers as well as researchers. The institute has recently launched it AI based Mobile App- Soybean Gyan - for soybean farmers, with multilingual and interactive feature provides information on different aspect of cultivation viz., agronomic package of practices, insect and disease management etc. It also gives information about selection of suitable varieties; seed treatment, seed rate and seed storage.

With a major objective of reducing the yield gap, total of 250 frontline demonstrations have been conducted every year in Indore and nearby districts out of which 100 frontline demonstrations have been laid out in the ICAR Model Village (Memdi) in which the recently released soybean varieties and other technologies have been demonstrated since last two years. In addition to the conventional approaches for transfer of technologies, the social media channels of the institute like YouTube, Instagram, and Facebook, X, Telegram and WhatsApp groups are becoming very popular for promotion of among the farmers. All the flagship programmes of GOI/ICAR like Vikasit Krishi Sankalp Abhiyan, PM Dhan Dhanya Yojana, National Mission on Edible Oils, Swachhata Abhiyan, SCSP/TSP, MGMG etc have been implemented in letter and spirit.

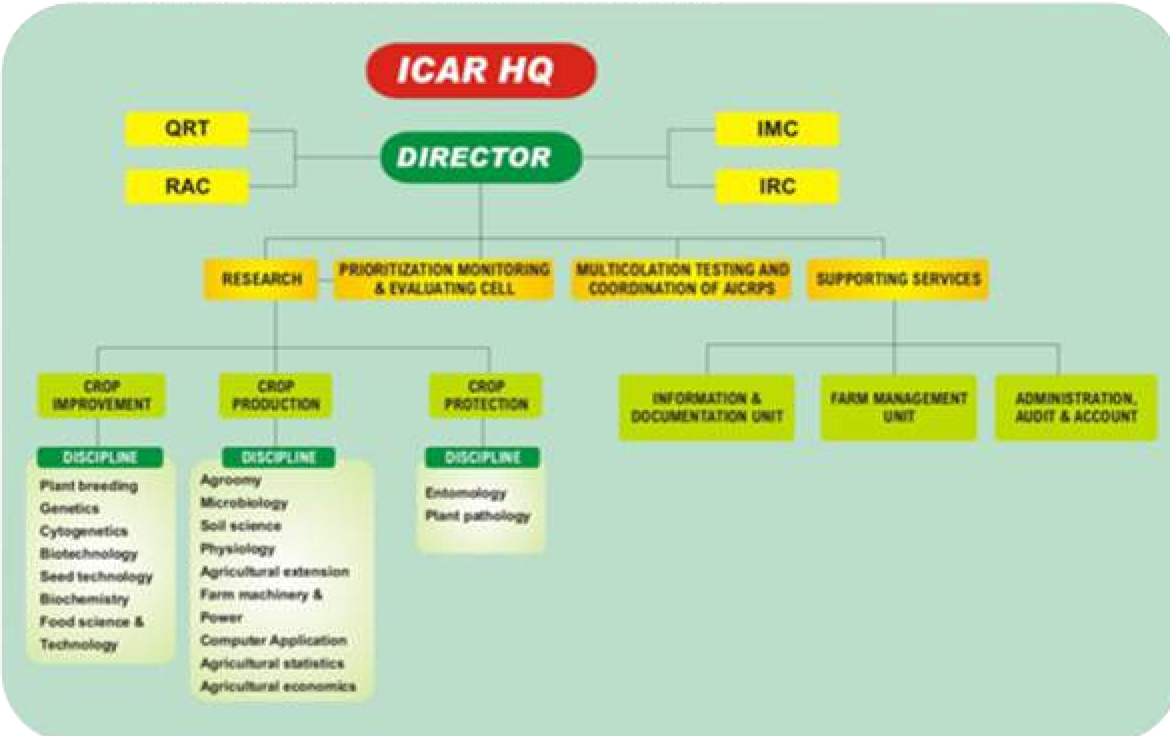
Mandate of ICAR-NSRI

To spearhead the research, give direction and support production systems' research, following mandates have been laid out:

- Basic, strategic and adaptive research on soybean for improving productivity and quality
- Provide access to information, knowledge and genetic material to develop improved technology and enhanced soybean production.
- Coordination of applied research to develop location specific varieties and technologies;
- Dissemination of technology and capacity building

Organizational set-up

For efficient functioning of institute and to achieve the mandate and objectives, the organizational pattern of the Institute has been evolved and depicted below:



Organogram of ICAR-NSRI

FINANCIAL STATEMENT AND BUDGET

Abstract of Expenditure of ICAR-NSRI for 2024-2025 (₹ in lakhs)

Head	R.E.	Actual expenditure
Grant in Aid-Pay & Allowances	1238.41	1238.41
Grant in Aid-Capital	140.00	140.00
Grant in Aid-General	529.00	529.00
Pension & Retirement Benefits	164.90	164.90
NEH (General)	50.00	50.00
NEH (Capital)	00.00	00.00
TSP (General)	16.00	16.00
TSP (Capital)	09.08	09.08
SCSP (General)	43.00	43.00
SCSP (Capital)	37.00	37.00
Total	**2227.39**	**2227.39**
Revenue Generated		55.02

Budget of ICAR-NSRI for 2025-2026 (₹ in lakhs)

Head	R.E.
Grant in Aid-Pay & Allowances	1322.10
Grant in Aid-Capital	451.72
Grant in Aid-General	500.00
Pension & Retirement Benefits	104.29
NEH (General)	50.00
NEH (Capital)	00.00
TSP (General)	17.00
TSP (Capital)	9.80
SCSP (General)	48.00
SCSP (Capital)	37.00
Total	**2539.91**

Staff Position

The total sanctioned staff position of ICAR-NSRI as on 31st December 2025 is 99 comprising 35 scientific including Director, 21 technical, 17 administrative and 26 supporting staff positions. Out of which 68 are in position as on 31st December 2025. The budget and expenditure during 2024-2025, and budget for 2025-26 is given below.

S. No	Designation	Level in Pay Matrix	Sanctioned Strength	In Position	Vacant Post
I	RMP (Director)	Level 14	01	01	-
II	Scientists				
1.	Principal Scientist	Level 14	03	02	01
2.	Senior Scientist	Level 12	06	04	02
3.	Scientist	Level 10	25	20	05
	Total		**34**	**26**	**08**
III	Technical				
4.	T-6	Level 10	02	01	01
5.	T-3	Level 5	10	03	07
6.	T-1	Level 3	09	07	02
	Total		**21**	**11**	**10**
IV	Administration				
7.	Sr. Administrative Officer	Level 10	01	01*	-
8.	Sr. Finance & Accounts Officer	Level 10	01	01*	-
9.	Finance & Accounts Officer	Level 10	00	01	- 01
10.	Assistant Administrative Officer	Level 7	03	01	02
11.	Private Secretary	Level 7	01	-	01
12.	Personal Assistant	Level 6	01	-	01
13.	Assistant	Level 6	07	05	02
14.	UDC	Level 5	02	00	02
15.	LDC	Level 2	01	-	01
	Total		**17**	**08**	**09**
V	Skilled Support Staff	Level 2	26	22	04
	Total		**99**	**68**	**31**

RESEARCH ACHIEVEMENTS

3.1 CROP IMPROVEMENT

3.1 Genetic Resources: Conservation, Procurement, Quarantine clearance, Rejuvenation, Evaluation, Characterization, Distribution and Utilization

NRCS1.1/87: Augmentation, Management and Documentation of Soybean Germplasm

PI: *Dr. Sanjay Gupta*

Co-PIs: *Dr. Vangala Rajesh, Dr. Gyanesh Satpute, Dr. V Nataraj, Dr. M Shivkumar (up to 27.06.2025), Dr. Sanjeev Kumar, Dr. Lokesh Meena, Dr. Giriraj Kumawat, Dr. Prince Choyal, Dr. Punam Kuchlan, Dr. Milind Ratnaparkhe, Dr. Savita Kolhe*

Augmentation and conservation of germplasm

A total of 6120 germplasm including 2309 exotic collections were maintained in the mid-term storage of the institute. This includes trait specific set of 133 accessions, allele specific set of 57 accessions, 361 *Glycine soja* accessions. A core set of 1000 accessions was formed based on the germplasm evaluation at Bengaluru and was provided to 5 AICRP centers of different agro-climatic zones for mini-core set formation. The core set was also sent to disease hot spot centers. Fifty-seven exotic accessions were multiplied in glass house at Indore and then sent to Bengaluru and Dharwad for off season multiplication (Fig. 3.1.1.1). A separate coordinated trial was constituted to evaluate seven of these exotic accessions in Central Zone under AICRP on soybean.

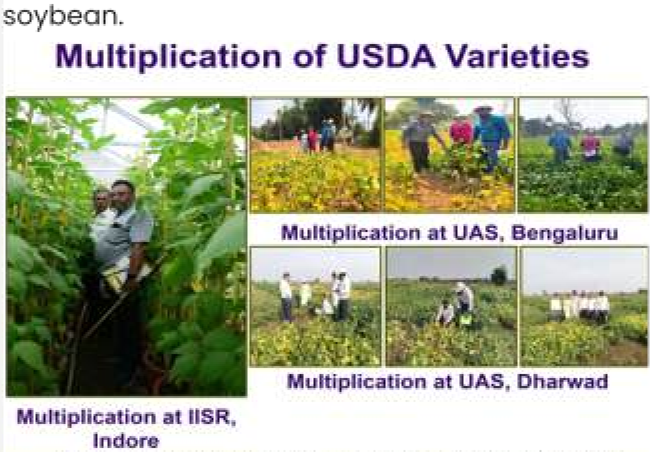


Fig. 3.1.1.1 Multiplication of exotic accessions

Germplasm Rejuvenation and Evaluation

A total of 1435 germplasm accessions were grown at Indore during spring / summer and kharif seasons. Because of severe incidence of Indian bud blight in summer and RAB & Anthracnose in kharif grain yield could be obtained from only 885 accessions in summer and 239 accessions in kharif season. Germplasm accessions resistant to RAB, anthracnose, bacterial pustule were identified (Table 3.1.1.1).

Table 3.1.1.1 Germplasm resistant against different diseases

Disease	No. of Moderately Resistant accessions	Resistant Germplasm
RAB	151	37
Anthracnose	307	59
Bacterial Pustule	172	20
RAB,Anthracnose and Bacterial Pustule	7 (EC 0099556 EC 93605 IC 0118508 IC 0243035 IC 0243568 IC 0243574 IC 0501582)	1 (IC 0243740)
RAB and Anthracnose	43	3 (EC 99545 IC 0243740 IC 0501924)

Under the multi-location germplasm evaluation programme of AICRP on soybean, 205 germplasm accessions were evaluated at 8 centres. At ICAR-NSRI Indore evaluation was conducted in 1 mt row in 2 replications along with 5 checks viz JS 20-94, JS 20-98, JS 21-72, JS 22-12 and JS 335. Data was recorded on 12 traits (Table 3.1.1.2). Grain yield of the checks ranged from 39 g (JS 335) to 185 g (JS 21-72). IC 0241823, EC 0456617, EC 117902, EC 389166, IC 0243577 were the high yielding germplasm accessions with plot yield of 152 g, 135 g, 132 g, 126 g and 125 g. Two very early maturing accessions IC 0117899 (83 days) and EC 117902 (84 days) with plot yield of 116 g and 132 g, as against the early maturing check JS 22-12 (90 days, 149 g) were identified.

Out of 25 *Glycine soja* accessions evaluated and screened at 8 AICRP centres EC 116587 and EC 1165820 were identified as resistant to YMV (Ludhiana & Jabalpurr) and FLS (Almora and Palampur). Along with EC 1165787, EC 116849, EC 1165923 also exhibited resistant reaction to YMV at Ludhiana and these 3 accessions exhibited resistant reaction during previous year also.

Table 3.1.1.2: Mean and range of yield and yield contributing traits in evaluation of 205 germplasm accesions at Indore

S. No	Trait	Mean	Range
1	Days to Flowering	54.2	36.5 – 66.0
2	Days to Maturity	106.8	83.0 – 115.5
3	Plant Height (cm)	66.3	35.5 – 93.1
4	Number of Nodes / Plant	13.5	6.2 – 19.2
5	Number of Pods / Plant	39.4	9.1 – 137.6
6	First Pod Insertion Height (cm)	22.2	7.7 – 40.1
7	Stem Girth (cm)	6.6	3.9 – 11.1
8	Number of Primary Branches	6.0	1.0 – 19.0
9	100-Seed Weight	6.4	3.4 – 10.1
10	Grain yield / plant (g)	5.9	1.3 – 13.8
11	Yield / Plot (g)	38.4	4.8 – 185.1
12	Internodal Length (cm)	5.06	2.6 – 10.5

Distribution of soybean germplasm

A total of 4259 germplasm including 3928 G max and 331 *G soja* were distributed (Table 3.1.1.3).

Development of Soybean Variety NRC 164: NRC 164 an early maturing variety (92 days) was developed from the cross of photo-insensitive soybean variety JS 95-60 and long juvenile parent AGS 25. This variety has been released for MP state. The average yield of the variety (2068 Kg) was 13% superior to the best check JS 20-34.

Table 3.1.1.3: Number of Germplasm accessions distributed to different centres during 2024-25

Organization	*G. max*	*G. soja*	Total
PJTSAU, Adilabad	212	25	237
Agriculture University Kota	200	25	225
ARS Pune	200	25	225
AAU JORHAT	39	-	39
CAU Imphal	402	25	437
CSK-HPKV Palampur	400	25	425
GBPUA&T Pantnagar	400	25	425

Organization	G. max	G. soja	Total
IARI, New Delhi	52	15	68
IGKV Raipur	200	25	225
IIAB, Ranchi	33		33
JNKVV Jabalpur	200	25	225
NSRI Indore	571	35	606
PAU Ludhiana	205	30	235
UAS Dharwad	200	25	225
UAS Bengaluru	12	1	13
VNMKV, Parbhani	400		400
VPKAS, Almora	202	25	227
Grand Total	3928	331	4259

NRCS 1.1/87 Activity: Trait associated KASP marker genotyping in germplasm and marker-traits association analysis

Dr. Giriraj Kumawat, Dr. Sanjay Gupta, Dr. Vangala Rajesh, Dr. Nataraj V., Dr. Shivakumar M., Dr. Gyanesh K. Satpute, Dr. Milind Ratnaparkhe

A total of 28 SNPs associated with nine agronomic traits were utilized for KASP marker design and germplasm characterization. Of these, 19 SNPs were selected from genic region of 15 well-characterized genes, while the remaining nine SNPs were derived from 8 QTLs associated with various traits. The traits associated with these markers are flowering, maturity, seed weight, pod shattering, salt tolerance, root length and growth habit. A set of 336 germplasm accessions were characterized using these 28 KASP markers. Marker traits association analysis in these 336 germplasm identified following prominent markers for Flowering- TOF12SNP5520945, SALTSNP20, and DTSNP1288, Maturity- TOF12SNP5520945 and GmGA3Ox1_251, Reproductive period- DTSNP1181, and 100-seed weight- DTSNP1288. Further rare allele markers E2SNP15056, E3nsSNP3826, also showed high impact on flowering and maturity traits. Combined marker alleles of different genes showed synergistic effect for various traits (Fig. 3.1.1.2 and Fig. 3.1.1.3).

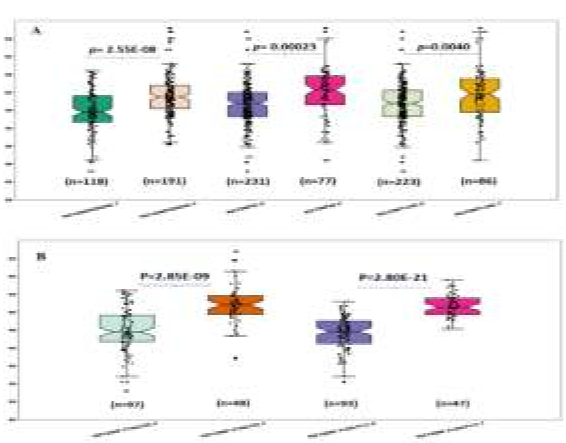


Fig. 3.1.1.2: Allelic effect of different KASP markers on days to flowering (DTF) trait. (A) Single allele effect, (B) Combined allele effect.

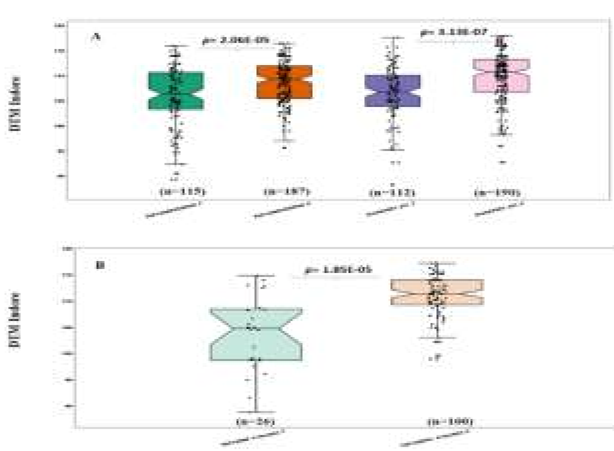


Fig. 3.1.1.3: Allelic effect of different KASP markers on days to maturity (DTM) trait. (A) Single allele effect, (B) Combined allele effect.

IISR 4.6/23: Pre breeding for broadening of genetic base in soybean

PI: *Dr. Vangala Rajesh*

CO-PI: *Dr. Sanjay Gupta, Dr. Shivakumar M. (up to 27.06.2025), Dr. Vennampally Nataraj*

A total of 139 accessions of Glycine soja were characterized at ICAR–National Soybean Research Institute (NSRI), Indore, using standard soybean descriptors. The experiment was conducted in two replications, and quantitative as well as qualitative data were recorded for 112 accessions. Among the important traits studied, days to germination and rapid grain filling were given special attention. Notably, ten accessions viz., EC 1165817, EC 1165818, EC 1165819, EC 1165822, EC 1165832, EC 1165835, EC 1165856, EC 1165862, EC 1165927, and EC 1165946 exhibited 100% germination within just two days, indicating highly vigorous and uniform emergence. Additionally, eighteen accessions including EC 1165787, EC 1165801, EC 1165802, EC 1165803, EC 11 65829, EC 1165842, EC 1165844, EC 1165846, EC 1165848, EC 1165852, EC 1165863, EC 1165868, EC 1165879, EC 1165880, EC 1165887, EC 1165902, EC 1165938, and EC 1165944 showed 100% germination within three days.

Another key trait, rapid grain filling measured as the number of days from scarification to physiological maturity ranged widely from 16 to 65 days across the accessions. The best-performing genotypes with the shortest grain filling duration were EC1165833, EC1165804, EC1165946, EC1165941, EC1165836, EC1165927, EC1165803, EC1165936, EC1165802, and EC1165856, indicating their potential for early maturity and efficient resource use under short growing seasons.

A multi-location trial involving 25 *Glycine soja* accessions was conducted across 11 AICRP soybean centers representing diverse agroclimatic zones, including Indore, Almora, Palampur, Dharwad, Imphal, Jabalpur, Adilabad, Pune, Kota, Ludhiana, Pantnagar, and Raipur. These locations were strategically selected as hotspots for major soybean diseases and insect pests. Among the evaluated accessions, EC1165787 showed broad-spectrum resistance, being resistant to RAB at Indore, yellow mosaic virus (YMV) at Ludhiana and Jabalpur, and rust at Dharwad. Similarly, EC 1165891 demonstrated resistance to YMV at Ludhiana and rust at Dharwad. Accessions EC 1165824 and EC1165790 were highly resistant to powdery mildew at Palampur, while EC 1165820 exhibited high resistance to frog-eye leaf spot (FLS) at the same location. These results highlight the potential of specific *Glycine soja* accessions for incorporating durable resistance against multiple biotic stresses in soybean breeding programs.

Interspecific hybridization between Glycine max and *Glycine soja* was undertaken to exploit the genetic diversity and stress tolerance of wild soybean for the improvement of cultivated genotypes. A total of six *Glycine max* lines JS 335, JS 93-05, JS 95-60, KDS 753, MACS 1460, NRC 138, and DSB 34were crossed with three Glycine soja testers EC 1165824, EC 1165891, and PI 549046 using a line × tester mating design. The resulting F_1 hybrids were evaluated to estimate general combining ability (GCA) and specific combining ability (SCA) effects. Significant SCA effects were observed in the crosses JS 93-05 × EC 1165824, JS 95-60 × PI 549046, and JS 93-05 × EC 1165891, indicating strong non-additive gene action and favorable specific parental interactions for desirable traits. Among the parents, PI 549046, EC 1165891, JS 93-05, and JS 95-60 showed high GCA effects, suggesting their suitability as promising donors for improving yield and adaptive traits in interspecific breeding programs. These findings highlight the potential of wild soybean-derived alleles for enhancing the genetic base and resilience of cultivated soybean varieties.

Advancement of generations from the interspecific hybridization program was carried out through pedigree-based selections. Eight BC_2F_2 populations were evaluated along with initial varietal trial (IVT) checks and the respective parental lines of the crosses to identify superior segregants combining desirable traits from both *Glycine max* and *Glycine soja*. Selection was performed based on agronomic performance, phenotypic stability, and expression of target traits (Table 3.1.1.4; Fig. 3.1.1.4).

Table 3.1.1.4: Advancement of generation based on Rapid grain filling trait.

S.No	Cross	No. of Plants Selected (BC_2F_2)	Rapid Grain Filling
1	JS 9560 X PI 407170	10	27-31
2	JS 9560 X PI 593983	7	26-32
3	JS 9560 X PI 549046	13	23-29
4	JS 20-34 X PI 593983	12	23-31
5	JS 20-34 X PI 407170	9	26-33
6	JS 335 X PI 549046	11	24-32
7	JS 20-98 X PI 549046	8	25-30
8	EC 538828 X PI 593983	3	27-29
P	JS 9560	-	46
P	JS 20-34	-	44
P	JS 335	-	50
P	JS 20-98	-	45
P	EC 538828	-	42
CK	NRC 150	-	43
CK	NRC 165	-	44
CK	JS 22-12	-	46
CK	JS 21-72	-	49
CK	NRC 142	-	45

JS 95-60 (Parent)

JS 9560 X PI 593983 (BC_2F_2)

JS 9560 X PI 549046 (BC_2F_2)

Fig 3.1.1.4 Variability for seed size and colour in segregating generation of cross between G.*max* and G.*soja*.

Evaluation of elite soybean entries in

Institute Station Trial (IST)

***In-charge:** Dr Vangala Rajesh and Dr. Sanjay Gupta*

The Institute Station Trial was conducted to evaluate promising entries contributed by scientists of ICAR-NSRI, Indore. The experiment comprised four categories, viz., Early Maturity, Normal Maturity, Clear Hilum, and Vegetable Type, and was laid out in a Randomized Complete Block Design (RCBD) with three replications (Table 3.1.1.5 to 3.1.1.9). The entries promoted to AICRP on soybean trials 2026 viz., IVT (Normal Maturity) includes NRC 309 (SGRJ-3), NRC 310 (AVKS 252), NRC 311 (SGRJ-1), NRC 312 (YP 61), NRC 313 (AVKS 243). In case of IVT (Early Maturity) includes NRC 314 (YP 64), NRC 315 (G-2-3-31), NRC 316 (JSEC 49), NRC 317 (ECJS 95), NRC 318 (YP 67), NRC 319 (AVKS 254), NRC 320 (AVKS 253). In case of IVT (Vegetable Type) includes NRC 285, NRC 321 (CK-14), NRC 322 (CK 6-95), NRC 323 (KVC 109-58), NRC 324 (AVKS 251) were promoted.

Table 3.1.1.5 Details of Institute Station Trials

S. No.	Experimental Trial	Number of Entries including checks
1	IST-Early Maturity	20
2	IST-Normal Maturity	42
3	IST-Clear Hilum	16
4	IST-Vegetable	10

Table 3.1.1.6 Performane of elite soybean entries in Institute Station Trial (Normal Maturity)

Institute Station Trial (Normal Maturity) 2025

Net plot size: 6.75 m2 (5m, 3 rows)						Stem fly	Girdle beetle		Disease Reaction	
S.No	Code	Name of the Entry	Days to Maturity	Yield (Kg/ 6.75m2)	Yield (Kg/ha)	(% stem tunneling)	(% Infestation)	Defoliators (No. of larvae/mrl)	Anthracnose	RBA
1	STN-25-01	SGRJ-4	105	1.13	1673	S	S	LR	R	-
2	STN-25-02	AVKS 246	102	1.15	1701	LR	HS	MR	MR	-
3	STN-25-03	JS 335 (Check 1)	101	0.29	428	LR	MR	LR	MR	-
4	STN-25-04	YP 63	99	1.33	1963	MR	LR	LR	MS	-
5	STN-25-05	NRC 257	99	1.25	1859	LR	LR	MR	MS	-
6	STN-25-06	SGRJ-2	102	1.23	1828	LR	MR	LR	MS	-
7	STN-25-07	SGRJ-10	100	1.34	1984	LR	MR	LR	MR	-
8	STN-25-08	PBS3	103	0.73	1078	HS	S	LR	MS	-
9	STN-25-09	YP 58	99	1.15	1710	LR	MR	MR	MR	-
10	STN-25-10	AVKS 242	98	1.02	1509	LR	LR	MR	R	-
11	STN-25-11	EC HR 95	98	1.24	1837	LR	MR	MR	MR	-
12	STN-25-12	SGRJ-6	100	0.73	1083	LR	LR	MR	MS	-
13	STN-25-13	JS 21-72 (Check 3)	97	1.10	1627	S	LR	LR	MR	-
14	STN-25-14	NRC 142 (Check 4)	97	1.28	1900	LR	LR	LR	MR	-
15	STN-25-15	AVKS 244	99	0.80	1191	S	LR	MR	MR	-
16	STN-25-16	YP 60	97	1.30	1929	LR	MR	LR	HS	-
17	STN-25-17	PBS2	101	1.22	1807	LR	MR	LR	MR	-
18	STN-25-18	AVKS 252 (NRC 310)	100	1.61	2382	LR	MR	MR	MR	-
19	STN-25-19	SGRJ-1 (NRC 311)	101	1.55	2303	R	MR	MR	MS	-
20	STN-25-20	AVKS 260	102	1.37	2023	LR	MR	LR	MR	-

Net plot size: 6.75 m2 (5m, 3 rows)						Stem fly	Girdlebeetle		Disease Reaction	
S.No	Code	Name of the Entry	Days to Maturity	Yield (Kg/ 6.75m2)	Yield (Kg/ha)	(% stem tunneling)	(% Infes-tation)	Defoliators (No. of larvae/mrl)	Anthra-cnose	RBA
21	STN-25-21	SGRJ-13	103	1.07	1585	HS	MR	LR	MS	-
22	STN-25-22	EC HR 24	99	1.25	1854	LR	LR	MR	MR	-
23	STN-25-23	AVKS 240	101	1.17	1735	MR	LR	LR	MR	-
24	STN-25-24	YP 61 (NRC 312)	97	1.52	2256	LR	MR	LR	MS	-
25	STN-25-25	YP 59	97	1.24	1839	LR	MR	MR	MR	-
26	STN-25-26	AVKS 245	104	0.76	1132	LR	MR	MR	MR	-
27	STN-25-27	AVKS 248	102	1.27	1879	LR	MR	MR	MR	-
28	STN-25-28	NRC 256	98	1.37	2035	S	MR	MR	MS	MS
29	STN-25-29	RHN73-15	102	1.31	1933	LR	MR	LR	MR	-
30	STN-25-30	Hardee (Check 2)	104	0.95	1407	LR	S	MR	MR	-
31	STN-25-31	HR JS-42	99	1.12	1663	LR	MR	LR	S	-
32	STN-25-32	AVKS 247	95	1.12	1654	LR	MR	MR	MS	-
33	STN-25-33	SGRJ-14	101	1.39	2063	HS	LR	LR	MR	-
34	STN-25-34	SGRJ-3 (NRC 309)	100	1.70	2515	R	MR	MR	MR	-
35	STN-25-35	PBS1	103	1.09	1610	LR	MR	MR	MS	MS
36	STN-25-36	YP 62	97	1.05	1552	LR	MR	MR	MS	-
37	STN-25-37	SGRJ-5	103	1.00	1488	S	MR	LR	MS	-
38	STN-25-38	AVKS 243 (NRC 313)	102	1.44	2126	MR	MR	MR	R	-
39	STN-25-39	PBS5	97	1.12	1663	LR	MR	LR	MS	-
40	STN-25-40	YP 67 (NRC 318)	94	1.34	1986	LR	MR	LR	S	-
41	STN-25-41	AVKS 241	100	1.05	1550	LR	LR	MR	MR	-
42	STN-25-42	PBS4	104	1.40	2075	LR	LR	MR	MS	MS
	Mean		100	1.18	1748					
	CV (%)		1.09		14					

Table 3.1.1.7 Performane of elite soybean entries in Institute Station Trial (Early Maturity)

Institute Station Trial (Normal Maturity) 2025

Net plot size: 6.75 m2 (5m, 3 rows)						Stem fly	Girdlebeetle		Disease Reaction	
S.No	Code	Name of the Entry	Days to Maturity	Yield (Kg/ 6.75m2)	Yield (Kg/ha)	(% stem tunneling)	(% Infes-tation)	Defoliators (No. of larvae/mrl)	Anthra-cnose	RBA
1	STE -25-01	SGRJ-12	97	0.67	998	S	LR	MR	MS	MS
2	STE -25-02	YP64 (NRC 314)	92	1.56	2313	LR	LR	MR	MS	-
3	STE -25-03	AVKS 250	92	0.67	996	LR	S	MR	S	-
4	STE -25-04	JS EC 19	102	0.81	1207	MR	LR	MR	R	-
5	STE -25-05	JSEC 49 (NRC 316)	94	1.50	2227	LR	LR	LR	R	-
6	STE -25-06	JS 22-12 (Check 2)	95	1.19	1759	LR	MR	MR	MS	-
7	STE -25-07	YP66	90	0.29	433	MR	MR	LR	HS	-
8	STE -25-08	EC JS 69-9	96	0.73	1088	MR	LR	LR	MS	-
9	STE -25-09	G-2-3-31 (NRC 315)	95	1.51	2236	LR	MR	LR	MR	-

Net plot size: 6.75 m2 (5m, 3 rows)						Stem fly	Girdle beetle		Disease Reaction	
S.No	Code	Name of the Entry	Days to Maturity	Yield (Kg/ 6.75m2)	Yield (Kg/ha)	(% stem tunneling)	(% Infestation)	Defoliators (No.of larvae/mrl)	Anthracnose	RBA
10	STE -25-10	SGRJ-8	93	1.05	1551	LR	LR	LR	MR	-
11	STE -25-11	JS 24-33 (Check 4)	96	1.20	1783	LR	MR	LR	MS	-
12	STE -25-12	EC JS 95 (NRC 317)	94	1.31	1934	LR	MR	LR	MS	-
13	STE -25-13	YP65	95	0.64	952	S	LR	MR	S	-
14	STE -25-14	G-5-2-15	100	1.39	2054	MR	LR	LR	MS	-
15	STE -25-15	SGRJ-7	99	0.34	500	LR	MR	MR	S	-
16	STE -25-16	NRC 150 (Check 1)	94	1.16	1716	LR	LR	LR	S	-
17	STE -25-17	SGRJ-11	94	1.02	1507	MR	LR	LR	MS	-
18	STE -25-18	SGRJ-9	98	0.98	1446	LR	LR	LR	MR	-
19	STE -25-19	JS 22-16 (Check 3)	101	0.60	890	LR	MR	LR	HS	HS
20	STE -25-20	AVKS 249	90	0.99	1470	MR	MR	MR	HS	HS
	Mean		95	0.98	1453					
	CV (%)		1.06		11.28					

Table 3.1.1.8 Performane of elite soybean entries in Institute Station Trial (Clear Hilum)

Institute Station Trial (Clear Hilum) 2025

Net plot size: 6.75 m2 (5m, 3 rows)						Stem fly	Girdle beetle		Disease Reaction	
S.No	Code	Name of the Entry	Days to Maturity	Yield (Kg/ 6.75m2)	Yield (Kg/ha)	(% stem tunneling)	(% Infestation)	Defoliators (No.of larvae/mrl)	Anthracnose	RBA
1	STC-25-1	NRC 142 (Check 1)	98	0.934	1384	No	S	HS	LR	R-
2	STC-25-2	CH-14	94	1.247	1847	Yes	LR	MR	MR	S -
3	STC-25-3	CH-11	94	1.462	2166	Doubtful	LR	LR	MR	S -
4	STC-25-4	AVKS 253(NRC 320)	94	1.432	2121	Yes(Best)	LR	S	LR	R -
5	STC-25-5	CH-6	95	0.508	753	Yes	MR	MR	MR	S -
6	STC-25-6	CH-1	90	1.091	1616	No	LR	MR	MR	S -
7	STC-25-7	CH-19	95	1.52	2252	Yes	LR	MR	LR	MR -
8	STC-25-8	NRC 150 (Check 3)	93	1.183	1753	No	LR	MR	MR	MS -
9	STC-25-9	CH-10	93	0.625	926	Yes	MR	LR	LR	S -
10	STC-25-10	CH-18	103	0.452	670	Seg	LR	MR	MR	S -
11	STC-25-11	AVKS 254 (NRC 319)	96	1.612	2388	Yes(Best)	LR	MR	MR	MR -
12	STC-25-12	JS 21-72 (Check 2)	99	1.143	1693	No	MR	LR	MR	R -
13	STC-25-13	CH-13	94	1.251	1853	Doubtful	LR	LR	MR	S -
14	STC-25-14	CH-8	99	0.447	662	Yes	S	LR	LR	S -
15	STC-25-15	CH-12	95	1.419	2102	Yes	MR	MR	LR	S -
16	STC-25-16	CH-3	93	0.354	524	Yes	LR	MR	MR	S -
	Mean		95	1.04	1544					
	C.V. (%)		1.61		19.14					

Table 3.1.1.9 Performane of elite soybean entries in Institute Station Trial (Vegetable Type)

Institute Station Trial (Vegetable Type) 2025
Net plot size: 6.75 m2 (5m, 3 rows)

S. No	Code	Name of the Entry	Days to Picking	GPY (Kg/ 6.75 m2)	GPY (Kg/ ha)	100 FPW (g)	100 FSW (g)	TSS	*Seed Yield (Kg/ 4.5 m2)	Stem fly (% stem tunne-ling)	Girdle beetle (% Infes tation)	Defol-iators (No. of larvae/ mrl)	DR Anth	RAB
1	STV-25-1	KVC 111-28	-	-	-	-	-	-	-	LR	LR	MR	HS	-
2	STV-25-2	AVKS 251												
		(NRC 324)	81	2.30	3410	148	41	33	0.42	MR	LR	MR	S	-
3	STV-25-3	CK 287	81	1.33	1969	105	38	20	0.16	MR	MR	LR	MR	-
4	STV-25-4	KVC 111-167-3	-	-	-	-	-	-	0.69	LR	MR	LR	MR	-
5	STV-25-5	Karune												
		(Check 2)	-	-	-	-	-	-	-	MR	LR	MR	HS	HS
6	STV-25-6	CK 6-95												
		(NRC 322)	81	3.21	4748	106	39	29	0.44	R	LR	MR	MR	-
7	STV-25-7	NRC 285	76	2.78	4117	117	30	33	0.15	LR	MR	MR	MS	-
8	STV-25-8	KVC 109-58												
		(NRC 323)	94	2.90	4293	113	39	34	0.70	MR	LR	MR	MR	-
9	STV-25-9	NRC 188												
		(Check 1)	83	2.28	3375	93	31	25	0.52	LR	MR	LR	MR	-
10	STV-25-10	CK-14												
		(NRC 321)	81	4.41	6530	95	30	29	1.09	LR	MR	MR	MR	-
	Mean		**82**	**2.74**	**4063**	**111**	**35**	**29**	**0.52**					
	C.V.			**13.74**		**12.76**	**9.76**	**5.27**	**27.21**					

*** Seed Yield is of 2 border rows for each replication**
 # STV-25-4 seed yield is of 5 rows for each replication as segregating for disease reaction
GPY-Green Pod Yield at R6, FPW-Fresh Pod Weight, FSW-Fresh Seed Weight

3.1.2 Breeding for early maturity, high yield, wider adaptabillity and food grade characteristic

IISR 4.4/23 Breeding for High Grain and Oil Yield for Different Maturity duration in Soybean

PI: *Dr Shivakumar M (up to 27.06.2025)*

Co-PI's: Dr V. Nataraj, Dr V. Rajesh. Dr N. Raghavendra, Dr Giriraj Kumawat

Significant Achievements:

- NRC 270, a high yielding entry yielded 18.2 % higher yield than the best check variety JS 21-72 in AVT 1and promoted to AVTII 2025 in Central Zone.
- Based on yield and early maturity three entries YP 44, YP 49, and YP 42 were promoted to IVT early 2025 trial. Similarly, two entries viz., YP 50 and YP 42 were promoted to IVT normal maturity trial 2025.

Evaluation early maturing advanced breeding lines under high density planting:

A set of 20 early maturing genotypes including check NRC 150 with erect plant (single culm) type were evaluated under different planting density at two locations viz., Indore and Pune. The salient features of advanced breeding lines used in the present study were presented in Table 3.1.2.1. The location wise yield potential at different crop geometries is given in Table 3.1.2.2

Table 3.1.2.1 List of advanced breeding lines used in high density planting.

Entry Name	Pedigree	Days to maturity	100 Seed weight (g)
Code 1	EC 457254 x JS 95-60	84	15.03
Code 7	EC 457254 x JS 20-34	90	13.67
Code 12	EC 457254 x JS 20-34	79	14.33
Code 14	EC 457254 x JS 20-34	79	13.37
Code 15	EC 457254 x JS 20-34	79	14.83
Code 16	EC 457254 x JS 20-34	88	13.87
Code 21	EC538828 x NRC 155	79	16.81
Code 22	EC538828 x NRC 155	86	20.93
Code 24	EC538828 x NRC 155	86	19.00
Code 25	EC538828 x NRC 155	79	16.87
Code 32	EC 457254 x JS 95-60	79	17.97
Code 35	EC 457254 x JS 95-60	90	14.83
Code 36	EC 457254 x JS 95-60	89	13.23
Code 38	EC 457254 x JS 95-60	90	15.37
Code 40	NRC 128 x JS 20-34	90	14.67
Code 63	EC538828 x JS 95-60	87	19.03
Code 96	EC 457254 x JS 95-60	91	22.93
Code 107	EC 457254 x JS 95-60	90	15.43
Code 38 (YLD)	EC 457254 x JS 95-60	88	15.00

Table 3.1.2.2 : Location wise yield potential at different crop geometries.

Indore		Pune	
Spacing	Yield potential (Kg/ha)	Spacing	Yield potential (Kg/ha)
45 x 5 cm	G12 (2849)	45 x 5 cm	G18 (3033)
30 x 5 cm	NRC 150 (4318)	30 x 5 cm	G18 (3096)
20 x 5 cm	NRC 150 (4417)	20 x 5 cm	G18 (3766)
15 x 5 cm	G11 (3986)	15 x 5 cm	G18 (4003)

1. Multi-location Evaluation of advanced breeding lines

A total of 42 advanced breeding lines were evaluated for agronomic traits at 10 locations viz., Indore, Jabalpur, UAS Dharwad, ARI Pune, Parbhani, Adilabad, Amravathi, Raipur, Lokbharti and Kota for 2023 and 2024 season. Entries viz., NRC 269, G152, G154, G151 and G108 were excelled NRC 270 genotype for seed yield (AVT II entry). These lines were evaluated for RAB, YMD and Charcoal rot diseases at Jabalpur for 2023 and 2024 cropping seasons. Genotypes viz., NRC 269 (3701 Kg/ha), G152 (3409 Kg/ha), G154 (3058 Kg/ha), G151 (2912 Kg/ha) and G108 (2667 Kg/ha) were out performed NRC 270 (2647 Kg/ha) genotype (AVT II entry). At Jabalpur centres these 42 lines were screened for three diseases viz, charcoal rot (sick plot), RAB and YMD. Several entries viz., NRC 269, G4, G323, G34, G32, G 27, G19 and G10 were found highly resistance to charcoal rot for consecutive two years 2023 and 2024. NRC 269 exhibited resistant reaction to RAB and YMD disease both for 2023 and 2024 year.

DBT funded project "Marker assisted introgression of seed weight, early maturity and photoperiod response genes in a multiple stress tolerant climate smart soybean variety JS 97-52 and KTI free variety NRC 127"

PI: *Dr. Shivakumar*

CoPIs: *Dr. Giriraj Kumawat, Dr. V. Nataraj and Dr. Sanjay Gupta*

A total of 39 introgression lines carrying desirable alleles of seed weight (qSW10.1), early maturity (e2) and photoperiod response (e3,e4) were developed. These lines along with two recurrent parents JS 97-52 and NRC 127, were used for multi-location evaluation at 5 centres (Dharwad, Sanosara, Pune, Amerali, Indore) during kharif 2025 to identify best introgression lines with high seed yield, early maturity and high 100 seed weight (Table 3.1.2.3, Fig. 3.1.2.1).

Table 3.1.2.3. Details of introgression lines used for the multi-location evaluation

S.No.	Name of the genetic stock(s)	Genetic constitution
1.	DBT 2025- 34 (R-16-15)	e3
2.	DBT 2025- 2(R-5-2) , 9(R-5-12)	e4
3.	DBT 2025- 1(R-5-1) , 6(R-5-7), 27(R-29-28)	e2
4.	DBT 2025- 11(R-5-17), 14(R-5-25), 20(R-29-1), 26(R-29-26)	qSW10.1
5.	DBT 2025- 38(R-16-31), 39(R-16-32)	Null KTI
6.	DBT 2025- 5(R-5-5), 8(R-5-11), 28(R-29-36)	e4, e2
7.	DBT 2025- 10(R-5-13), 17(R-5-29)	e4, qSW10.1
8.	DBT 2025- 12(R-5-20)	e3, e4
9.	DBT 2025- 13(R-5-21)	e3, e2
10.	DBT 2025-16(R-5-27)	e4, e2, qSW10.1
11.	DBT 2025- 17 (R-5-29)	e4, qSW10.1
12.	DBT 2025- 18(R-5-32), 21(R-29-4), 22(R-29-6)	e3, qSW10.1
13.	DBT 2025- 25(R-29-14)	e3, e4 , qSW10.1
14.	DBT 2025- 29(R-16-2)	e4, e2, null KTI
15.	DBT 2025- 30(R-16-4)	e4, null KTI, qSW10.1
16.	DBT 2025-31(R-16-9), 32(R-16-10), 37(R-16-20)	e3, null KTI
17.	DBT 2025- 33(R-16-13), 36(R-16-19)	e4, null KTI
18.	DBT 2025- 3(R-5-3), 4(R-5-4), 7(R-5-9), 15(R-5-26), 19(R-5-34) 23(R-29-12), 24(R-29-13), 35(R-16-16), 40(R-26-4)	e2, e3, e4, qSW10.1, null KTI

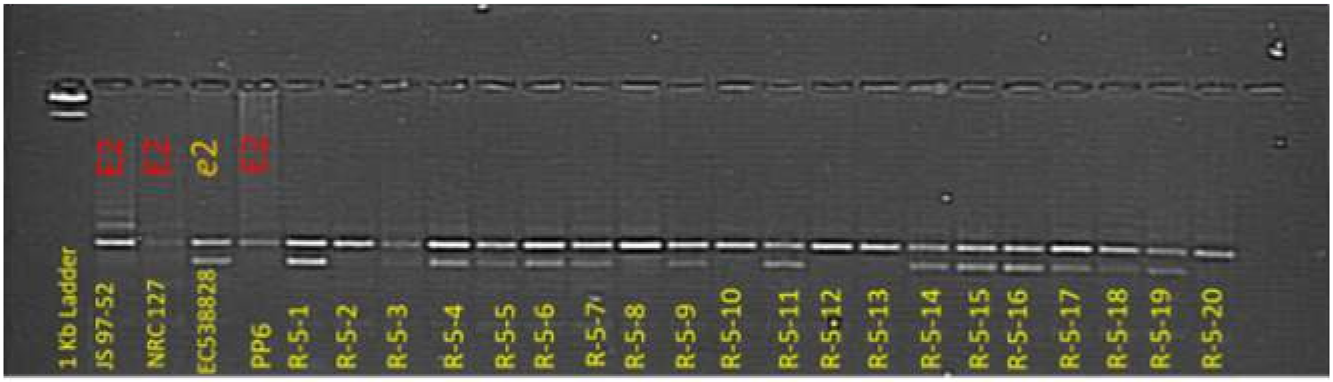


Fig. 3.1.2.1 Detection of e2 allele in introgression lines using CAPS marker.JS 97-52 and NRC 127 are recurrent parents, EC538828 is donor for e2, R-5-1 to R-5-20 are different introgression lines.

NRCS1.12/02: Breeding for food grade characters and high oil content

PI: *Dr Anita Rani,*

CoPI: *Dr Vineet Kumar*

- Three hundreds and fifty (350) individual plants of segregating populations developed for KTI free genotypes were tested for presence/absence of kunitz trypsin inhibitor peptide using PAGE and PCR amplification of gene specific primers. Out of 350 plants , 125 plants were observed to be homozygous for null allele of KTI gene
- Four hundred individual plants of segregating populations developed for Lox 2 free genotypes for presence/absence of lipoxygenase activity using PCR amplification of gene specific primers and rapid bleaching test. Out of 400 plants , 180 plants were observed to be homozygous for null allele of Lox2 gene.
- Seeds of one hundred and twenty (120) advance breeding lines were tested for oil content . A range of 17 to 23 % oil content was observed in these lines.
- NRC 268, lipoxygenase 2 free genotype has been promoted to AVT II in Central and Eastern Zones (Fig. 3.1.2.2.).
- NRC 290 , genotype free from KTI and Lipoxygenase 2, has been promoted to AVT I in Central Zone
- NRC 291 , genotype free from KTI , has been promoted to AVT I in Central and Sothern Zones
- NRC 292 , high oil genotype , has been promoted to AVT I in Central Zone
- NRC 301, genotype free from Lipoxygenase 2, has been entered in IVT,2025
- NRC 302 , genotype free from KTI and Lipoxygenase 2, has been entered in IVT,2025 .

Fig. 3.1.2.2 : NRC 268 promoted to AVT II in central & eastern zone

NRC 268 Lipoxygenase 2 free genotype developed from **NRC 142x NRC SL2** has been promoted to AVT II in Central and Eastern Zone

	Central Zone	Eastern Zone
Yield / ha	26.08	23.53
Days-to maturity	100	95
100-SW (g)	9.7	9.7

DBT funded Project: Developing food-grade soybean using CRISPR/Cas9 mediated multiplex genome editing

PI: *Dr Vineet Kumar*
Co-PI: *Dr. Anita Rani*

CRISPR/Cas9 constructs carrying gRNAs to knock out off-flavor generating genes Lox1, Lox2 and Lox3 individually were developed. The constructs were mobilized in Agrobacterium tumefaciens and Agrobacterium rhizogens and provided to ICAR-IISR, Indore. The Agrobacterium strains were grown on LB Agar supplemented with 50mg/L kanamycin at 280C for 2 days. Single colony was picked up from the plate and grown in Luria broth containing 50mg/L kanamycin and kept in an incubator shaker at 28o C and 200rpm until OD600 reached 0.6.The Agrobacterium cultures harboring different CRISPR/Cas9 constructs were used in in vitro transformation of soybean cultivar JS 20-98. Agrobacterium tumefaciens-mediated transformation was performed by sterilizing 50 sets of 100 seeds of JS 20-98 and incubating them for 5 days. Cotyledons were isolated and infected with Agrobacterium tumefaciens, which was then transferred to co-cultivation media and incubated for 4 days. After 15 days, shoot induction was performed, and the resulting shoots were transferred to different shoot elongation media and rooting induction media followed by primary and secondary hardening. Survived T0 plants were screened for Cas9 and BLPR and seeds were harvested. Subsequently, T1 and T2 generation plants were obtained and screened using the PCR assay. T2 plants having trans genes (Cas 9 and guide RNA) are in the pots in the culture room.

RKVY Project: Vegetable and Food grade soybean as a profitable option for farmers of Madhya Pradesh

PI : *Dr. Ramakrishnan Madhavan Nair*
CC-PI : *Dr. Vineet Kumar*
CC-CoPI : *Dr. Anita Rani, Dr. B.U. Dupare and Dr Rakesh Verma*

The project was sanctioned in Collaboration with World Vegetable Centre for a duration of 3 years (2025-2028) for ICAR-NSRI an amount of Rs. 50 lakhs.Demonstrations were conducted in 0.1 ha area at 124 farmers' field in the villages blocks Mhow, Indore and Depalpur and Sabwere of Indore Districts (Fig. 3.1.2.3). At each farmer's field, three broad Technology packages (TPs) were carried out along with farmer's practice (control). TP-1 pertained to varietal intervention food-grade soybean varieties (NRC142/NRC150) plus recommended husbandry and seed treatment), TP-2 was Biocontrol / integrated biological interventions (use of biocontrol agents and biological seed/seedling protection combined with best agronomy) while TP-3 targeted Chemical / integrated chemical management (which included seed treatment, pre-emergent weedicide, insecticide and fungicide per integrated pest management recommendations). Observations of pest and diseases during cropping season and yield data of the crop cutting recorded.

Fig. 3.1.2.3: Demonstration of food grade variety NRC 150 with three technology packages at Betma Khurd in Indore District

DBT funded Project: Characterization of saponin polymorphism in irradiation-induced TILLING population of soybean cultivar NRC-142

PI: *Dr. Vineet Kumar*
Co-PI: *Dr. Anita Rani*

The E-beamed M2:3 seeds from 500 plants were analysed for saponins through thin layer chromatography (TLC). Plants exhibiting putative mutants were raised in field for analysing saponins in the next generation. All food grade varieties & promising advanced breeding lines and dominant varieties were also phenotyped for saponins. Fig. 3.1.2.4 and Fig. 3.1.2.5 show chromatogram depicting saponin profiling as analysed through TLC in some of the food grade varieties/lines while Fig. 3.1.2.6 depicts putative mutant for saponin in M2:3 generation, respectively.

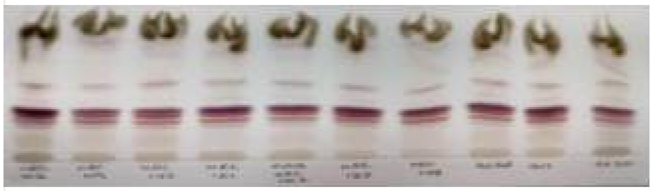


Fig. 3.1.2.4 : TLC Chromatogram depicting saponins for NRC106, NRC105, NRC147, NRC181, MACSNRC1677, NRC132 , NRC149, G688, G11 and G620

Fig. 3.1.2.5 TLC Chromatogram depicting saponins for NRC150, NRC142 and NRC181

Fig. 3.1.2.6: TLC Chromatogram depicting saponin mutants in AGSP 101 (e beam mutated progeny of NRC142)

NSRI 4.7/25: Harnessing Power of Soy: Development of New Age Health Foods from Functional Soy Protein

PI: *Dr. Neha Pandey*

Co-PI: *Prof. Dr. Ashutosh Upadhyay, Dept. of Food Science and Technology, Dr. M.P. Sharma, and Dr. Punam Kuchlan*

Single-factor analysis was done to study the effect of different types of raw materials on the yield of protein. The effect of adding gums at different levels and the impact of various physical treatments, including soaking, germination, defatting, microwave treatment, and ultrasonication, on the protein yield were also studied (Table 3.1.2.4).

Table 3.1.2.4: Effect of changing one factor at a time on soy protein yield.

Raw Material	pH	Time for pH shifting treatment	Additives	Physical treatment type	Yield of protein (%)
Soy flour	pH 8	1h	-	-	23
Defatted soy flour	pH 8.5	3h	-	-	25.4
Defatted soy flour	pH 8.5	3h	-	Fermentation	39.1
Partially defatted soy flour	pH 9	12h	-	Heating at 90°C for 15 min.	30
Germinated soy flour Germinated+	pH 8	12h	-	Heating at 90°C for 15 min.	32.3
Defatted soy flour	pH 9	12h	Pectin (0.1%)	Microwave at 350W for 20 minutes	35.6
Germinated+ dehulled+ defatted soy flour	pH 9	12h	Pectin (0.2%)	Microwave at 350W for 20 minutes	40.7
Dried Okara	pH 9	12h	Pectin (0.1%)	Microwave at 350W for 20 minutes	39.5
Dried Okara	pH 11	12h	Pectin (0.1%)	Microwave at 350W for 20 minutes	42.1
Dried Okara	pH 11	12h	Pectin (0.2%)	Microwave at 350W for 20 minutes+ Ultrasonication at 300 W for 35 minutes	45.5

Application of functional soy protein as a gluten replacer in soy chap:

The primary challenge in creating a gluten-free soy chaap is replacing the vital wheat gluten, which is responsible for the product's unique, elastic, and layered meat-like chewiness. In this experiment, a combination of Modified Soy Protein (MSP) prepared under this project and Pectin was used to replicate this structure (Fig. 3.1.2.7 and Fig. 3.1.2.8).

Fig. 3.1.2.7: Process of extraction of soy protein from soy flour

Fig. 3.1.2.8: Process of developing gluten-free soy chaap

Dough handling properties:

The MSP provided the protein bulk, but on its own, it lacked the elasticity to form a dough. The addition of pectin (a hydrocolloid) was essential. The pectin hydrated and formed a viscous, sticky matrix that effectively **bound the soy protein particles together,** creating a cohesive, pliable mass.

This MSP-pectin dough, while not as elastic as a gluten dough, had sufficient structural integrity and "tackiness" to be sheeted and **successfully wrapped around the wooden chaap sticks** without crumbling or tearing, which is the key processing step.

Final Product Texture (After Cooking)

The wrapped dough was then cooked (typically boiled or steamed) to set the protein.

- Firmness and Bite: During cooking, the MSP and pectin formed a strong, cross-linked gel network. This resulted in a very firm, cohesive, and "bouncy" final product with a resilient bite, successfully preventing the chaap from disintegrating, which a soy-only version would do.
- Textural Difference: The texture was not identical to traditional, gluten-based chaap. Instead of the long, stringy, and separable muscle-like fibers that gluten provides, the MSP-pectin network created a more homogenous, gel-like, and "short" texture (closer to a firm sausage or high-density tofu).
- Moisture Retention: A major positive result was the excellent water-holding capacity of the pectin. It effectively trapped moisture within the protein matrix, preventing the chaap from becoming dry or crumbly after cooking and improving its juiciness when added to a curry.

Conclusion:

The yield of soy protein isolate is lower because the process is more refined, removing most of the carbohydrates and fats, resulting in a product that is over 90% protein. Experimental studies on extracting protein isolate from defatted soy meal report mass yields in the range of 24% to 25%. The results of the single-factor analysis showed a yield of up to 45.5% due to the combination of treatments.

The incorporation of MSP-Pectin blend was highly effective in replacing the binding and structural functions of gluten, allowing for the formation and cooking of a stable, firm soy chaap. However, it created a product with a gel-like, "bouncy" chew rather than the fibrous, layered pull of traditional soy chaap.

Future prospects:

A combination of other treatments and the effect of fermentation and germination on protein yield and protein quality needs to be determined. The effect of a combination of physical (heat, microwave, ultrasonication) and biological (fermentation, germination) treatments on functional properties, in vitro digestibility, and antioxidant properties also needs to be analysed. To mimic a meat-like texture for developing new-age plant-based foods, we may try different combinations of gums to provide fibrous and stringy behaviour lacking when using a single type of hydrocolloid, along with MSP.

3.1.3 Breeding for Abiotic Stress Tolerance

DSR 5.6a/08: Breeding for drought tolerant varieties in soybean

PI: *Dr. Gyanesh Kumar Satpute*

CoPIs: *Dr. Sanjay Gupta, Dr. Milind Ratnaparkhe, Dr. Giriraj Kumawat, Dr. Prince Choyal, Dr. Rakesh Kumar Verma, Dr. Vangala Rajesh and Dr. Sanjeev Kumar*

Hybridization: A total of 42 crosses, including multi-parent crosses (Table 3.1.3.1), were achieved involving parental lines, i.e. M-54-4A-8, M-27-1, 116-136-2, M-23-2, G-5-2-15, G-2-3-31, and high-yielding varieties viz. NRC 150, KDS 992, JS 24-33, JS 22-12, JS 21-72, JS 20-98, and JS 93-05.

Table 3.1.3.1: Multi-parent hybridizations performed in kharif 2025

S.No.	Cross		
1	(JS 22-12 x JS 95-60)	x	(NRC 150 x M-23-2)
2	(JS 22-12 x NRC 295)	x	(NRC 150 x NRC 157)
3	(JS 22-12 x NRC 295)	x	(JS 22-12 x JS 95-60)
4	(JS 22-12 x NRC 295)	x	JS 21-72
5	(JS 22-12 x NRC 295)	x	NRC 150
6	(JS 22-12 x NRC 295)	x	JS 22-12
7	(JS 22-12 x NRC 295)	x	JS 24-33
8	(JS 22-12 x NRC 295)	x	JS 93-05
9	(MACS 1460 x J 732)	x	JS 21-72
10	(MACS 1460 x J 732)	x	NRC 150
11	(MACS 1460 x J 732)	x	JS 22-12
12	[NRC 150 x M-23-2]	x	JS 20-98

Generation advancement: Early generation crosses were advanced to the succeeding generation (Table 3.1.3.2).

Table 3.1.3.2: Sixteen F1 crosses advanced to F2 generation.

$F_{1:2}$	Cross
25F_1-1	NRC 150 x PI 159923
25F_1-2	NRC 150 x JS 95-60
25F_1-3	NRC 150 x NRC 295
25F_1-4	JS 21-72 x PI 159923
25F_1-5	KDS 992 x J 732
25F_1-8	RS 11-42 x J 732
25F_1-10	PS 1670 x J 732
25F_1-11	(JS 20-34 x PI 159923) x (AMS 100-39 x NRC 257)
25F_1-12	(JS 20-34 x PI 159923) x (DSb 34 x EC 107407)
25F_1-13	(JS 20-34 x PI 159923) x PI 159923
25F_1-14	NRC 150 x NRC 157
25F_1-15	NRC 150 x M-23-2
25F_1-16	JS 22-12 x JS 95-60
25F_1-17	JS 22-12 x NRC 295
25F_1-18	KDS 992 x TGX709-50E
25F_1-19	MACS 1460 x J 732

Assessment of F_3–F_4 Derived Single-Plant Selections for Yield-Contributing Traits: Single plant selections were made in 16 F3 and F4 populations, resulting in 90 selections (Table 3.1.3.3).

Table 3.1.3.3: Number of single plant selections in F3 and F4 generation cross

S.No.	Name	Generation	Pedigree	SPS
1	24F2-1	F_3	(AMS-MB-5-18xJS95-60) x (PI159923xJS71-05)/	
			(38-11-265xJS95-60) x (JS71-05xNRC37)	9
2	24F2-2	F_3	(JS71-05xNRC37) x (TGX328-049)/	
			(AMS-MB-5-18xJS95-60) x (PI159923xJS95-60)	3
3	24F2-4	F_3	(AMS-MB-5-18xJS95-60) x (PI159923xJS95-60)/	
			(PI159923xNRC37) x (PI159923xJS95-60)	1
4	24F2-5	F_3	(JS71-05xNRC37) x (TGX328-049)/ (PI159923xNRC37) x	
			(PI159923xJS95-60)	2
5	24F3-1	F_4	(AMSMB 5-18 x JS 95-60) x (PI159923xJS 95-60)	2
6	24F3-2	F_4	(PI159923xNRC 37) x (PI159923xJS 95-60)	4
7	24F3-3	F_4	(JS 71-05xNRC 37) x TGX 328-049	6
8	24F3-4	F_4	(JS 71-05xNRC 37) x (PI159923xNRC 37)	11
9	24F3-5	F_4	JS 71-05 x NRC 37	20
10	24F3-7	F_4	NRC 136 x JS 95-60	3
11	23F2-1	F_3	(AMS-MB-5-18xJS95-60) x (PI159923xJS71-05)	2
12	23F2-7	F_3	(AMS-MB-5-18xJS95-60) x (PI159923xJS95-60)	3
13	23F2-8	F_3	(JS71-05xNRC37) x (AMS-MB-5-18xJS95-60)	3
14	23F2-9	F_3	(JS 71-05 x NRC 37) x EC 602288	2
15	23F2-11	F_3	(JS71-05xNRC37) x TGX328-049)/	
			(AMS-MB-5-18xJS95-60) x (PI159923xJS95-60)	9
16	23F2-13	F_3	(JS71-05xNRC37) x (PI159923xNRC37)	10
			Total SPS	**90**

Out of 90 selections, a total of 52 single-plant selections (SPS) with ≥ 150 pods per plant, derived from 15 F_3–F_4 populations, were evaluated for pods per plant (PDP) and seed yield per plant (SYP) and compared with the high-yielding check JS 21-72. For pods per plant, six SPS G35 (24F3-5-3), G51 (24F3-5-6-1), G21 (24F3-3-5), G26 (24F3-5-D2), G43 (23F2-1-1) and G40 (24F3-5-8) showed superiority over the check. Similarly, for seed yield per plant, six top-ranking selections G35 (24F3-5-3), G44 (24F3-7-1), G23 (24F3-4-1), G39 (24F3-5-7), G9 (24F2-4-2) and G47 (23F2-13-1) expressed superiority *(Fig. 3.1.3.1)*. The strong expression of transgressive segregants across populations indicates effective parental recombination and adequate genetic variance for both traits.

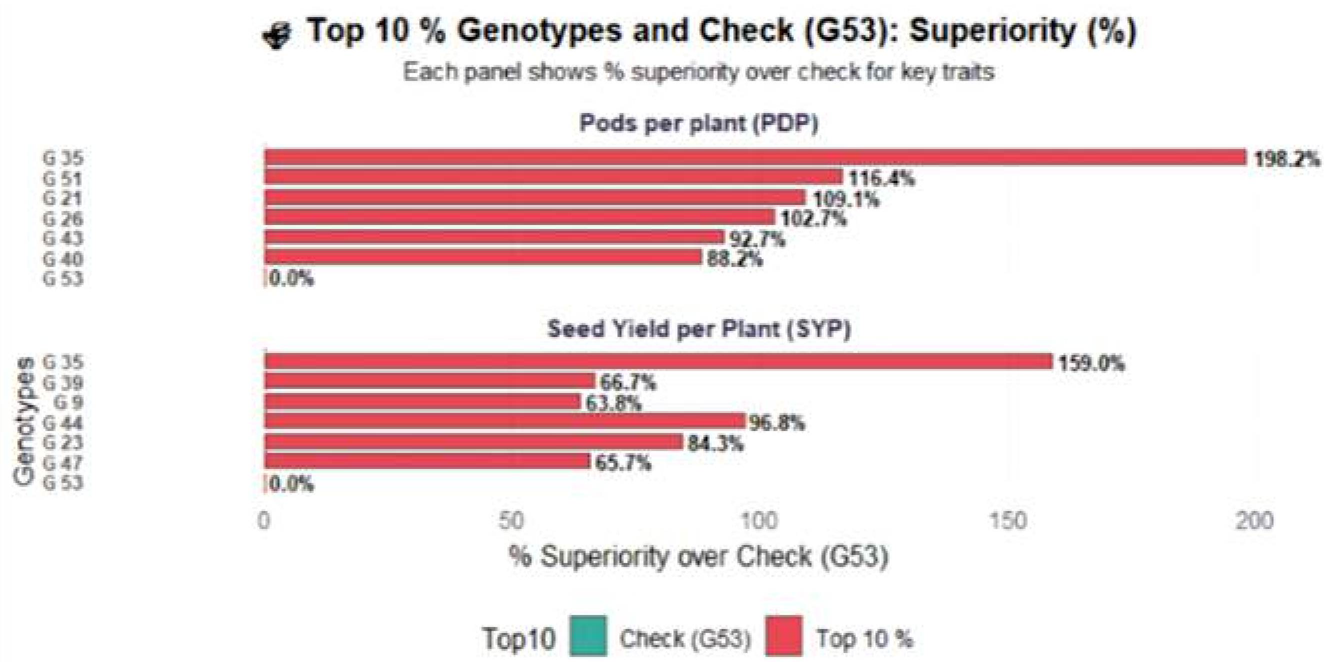


Fig. 3.1.3.1. Percent Superiority of Leading Genotypes for Pods per Plant and Seed Yield

Evaluation of progeny rows for seed yield:

A total of 4 checks, viz. JS 21-72, NRC 142, Hardee and JS 335, and 50 progeny rows were evaluated for seed yield in an augmented block design. Five entries viz. 24F3-4-4 (3160kg/ha; $p < 0.0001$), 24F3-4-3 (3104 kg/ha; $p < 0.0001$), 24F3-5-34 (2816 kg/ha; $p = 0.0007$), 24F3-3-3 (2512 kg/ha; $p = 0.0152$) and 23F2-8-9-2 (2502 kg/ha; $p = 0.0168$) showed significant superiority for seed yield over the best check JS 21-72 (2152 kg/ha). *(Table 3.1.3.4)*.

Evaluation of soybean advanced breeding lines and genotypes for drought tolerance traits under drought stress using multi-trait genotype–ideotype distance index (MGIDI)

Eight advanced breeding lines and seven genotypes were evaluated in a summer field trial in 2024, using a randomized block design (RBD) with three replications. Soil moisture stress was imposed by withholding irrigation at the pod initiation stage for 21 days. Drought tolerance traits—including delayed leaf senescence, canopy temperature depression, and SPAD chlorophyll meter readings—were measured to assess stress response. The strengths and weaknesses view highlighted balanced multi-trait performance in G3 (116-136-2), G7 (23F3-1-14), and G13 (23F3-1-24), which exhibited the lowest MGIDI values and closest alignment to the ideotype *(Fig. 3.1.3.2)*.

Table 3.1.3.4: Top five high yielding progeny row genotypes

S.No.	Progeny Row	Cross	Yield (kg/ha)	100 Seed Wt (g)
1	24F3-4-4	(JS 71-05xNRC 37) x (PI 159923 x NRC 37)	3160	12.9
2	24F3-4-3	(JS 71-05xNRC 37) x (PI 159923 x NRC 37)	3104	13.2
3	24F3-5-34	(JS 71-05xNRC 37)	2816	10.3
4	24F3-3-3	(JS 71-05xNRC 37) x TGX 328-049	2512	10.5
5	23F2-8-9-2	(JS71-05xNRC 37) x (AMS MB5-18xJS95-60)	2502	11.6
6	JS 21-72 (C)		2152	14.1
7	NRC 142 (C)		1834	12.7
8	Hardee (C)		1447	11.6
9	JS 335 (C)		1145	10.2
		Mean	1910	
		CV 5%	7.5	
		R2	0.98	

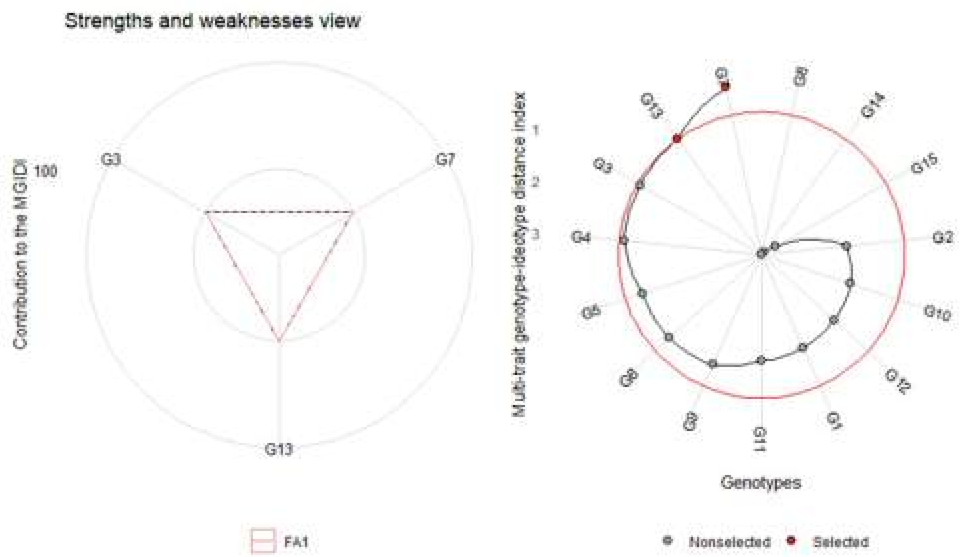


Fig. 3.1.3.2. Strengths and Weaknesses View of Soybean advanced breeding lines and genotypes under Drought Stress (MGIDI Analysis), illustrating the contribution of individual traits to the MGIDI index for each genotype.

Screening of soybean germplasm for drought tolerance under soil-moisture stress:

A total of 41 soybean genotypes comprising 30 introductions (IITA, Nairobi) and 11 Indian cultivars were evaluated in a field trial during summer 2024. The experiment was laid out in a Randomized Block Design (RBD) with two replications. A 21-day soil-moisture stress was imposed by withholding irrigation at the pod initiation stage. Observations were recorded for key drought tolerance traits, i.e. Delayed leaf senescence (DLS), Canopy temperature depression (CTD), and SPAD chlorophyll meter reading (SCMR). Multi-trait selection was carried out using the Multi-trait Genotype–Ideotype Distance Index (MGIDI) approach. The MGIDI biplot and radar chart revealed six genotypes, i.e. G1 (TGX 573209 D), G2 (TGX 30212 D), G3 (TGX 81478 D), G10 (TGX 81314 D), G31 (JS 20-69), and G32 (NRC 190), contributing most effectively to the ideotype for drought tolerance traits *(Fig. 3.1.3.3)*. These genotypes exhibited higher canopy temperature depression, greater chlorophyll retention, and delayed leaf senescence, indicating efficient physiological adaptation to moisture deficit. The analysis demonstrated the application of MGIDI as a multi-trait, integrative selection index for drought resilience in soybean.

Evaluation of elite lines in AICRP Multilocation trials:

NRC 295: The genotype NRC 295 was derived from the cross (JS 93-05 x JS 97-52). In IVT (Normal) CZ 2024, the entry ranked III and recorded 2380 kg/ha seed yield with 20% superiority over the best check JS 21-72 (1986 kg/ha) (Table 3.1.3.4; Fig. 3.1.3.4) It is a drought tolerant genotype with DRI (>1.0, i.e. 1.06) as compared to the tolerant check NRC 136 (DRI 1.04). It was evaluated in AVT-I (Central Zone) during kharif 2025.

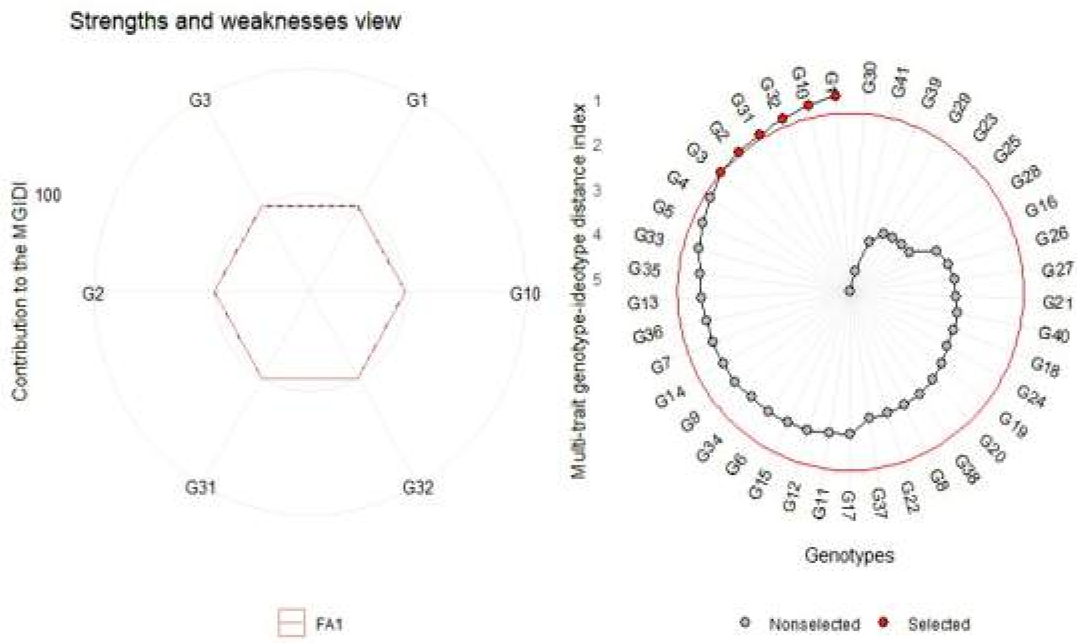


Fig. 3.1.3.3: Strengths and weakness' view and MGIDI-based ranking of soybean genotypes under induced drought stress conditions.

Fig. 3.1.3.4: NRC 295 promoted to AVTI (Normal) Central Zone

NRC 190: It is a high-yielding drought-tolerant entry derived from a cross (JS 97-52 x JS 355). It yielded 2971 kg/ha as compared to the best check KDS 753 (2617 kg/ha) with 13.5% yield increase in IVT 2023 in the North Eastern Zone. The genotype NRC 190 was evaluated in Manipur state multilocation yield evaluation trial 2025 (Fig. 3.1.3.5).

Fig. 3.1.3.5: Field View of NRC 190

Evaluation of soybean advanced breeding lines, varieties and germplasm for desiccation tolerance:

Field experiments were conducted during the Kharif 2025 season to evaluate two soybean trial sets using a randomized block design. The first set consisted of 11 advanced breeding lines along with 4 checks, evaluated in three replications. The second set included 24 germplasm accessions and 13 released varieties, evaluated in two replications. To assess desiccation tolerance, potassium iodide (0.2% w/v) was applied as a chemical desiccant by spraying the whole canopy at the seed-fill stage (R5 plus 8–10 days) for each genotype. Both the sets were also evaluated under rainout shelter-imposed soil moisture stress at seed fill stage.

Pre-evaluation Yield trial:

A set of 11 advanced breeding lines and 4 checks, viz. JS 21-72, NRC 142, JS 97-52 and JS 335 were evaluated for seed yield in a kharif 2025 field trial in RBD, in three replications, and for drought tolerance traits in rainout shelter imposed soil moisture stress at the seed fill stage.

Multilocation evaluation of advanced breeding lines under low rainfall situations: In a multi-location yield evaluation trial conducted in RBD at Kota, Baramati and Indore, 9 genotypes and 5 checks were evaluated in kharif 2024. The mean yield of the genotype G-2-3-31 (2254 kg/ha) was found (15%) higher than the best check JS 20-69 (1960 kg/ha) at Kota and Baramati (Table 3.1.3.5.)

Table 3.1.3.5 : MLT for low moisture stress

Entry	Kota S2 10-7-24	Baramati S1 6-7-24	S2 5-8-24	Mean
G-1-1-18	1604	2536	2004	2048
G-1-3-27	2108	1624	1819	1850
G-2-3-31	2295	2287	2181	2254
G-5-2-15	1835	2024	1299	1719
JS 20-69 (C)	1662	2622	1596	1960
JS 97-52 (C)	1759	1852	1604	1739
NRC 142 (C)	1305	2292	1787	1795
JS 335 (C)	861	2961	1876	1899
JS 93-05 (C)	1379	2354	1480	1738
Mean 1437	2204	1682		
R2 0.97	0.86	0.71		
CV (%) 7.60	8.44	10.37		
RF mm 839.0	400.2	317.0		
Soil-moist %	19.6	11.5	13.1	

In a yield evaluation trial conducted in the same set of genotypes at Indore, two genotypes viz., G2-3-31 (1803kg/ha) and G-5-2-15 (1386kg/ha) were found superior in yield over the best check JS 20-69 (1064kg/ha) under low soil-moisture conditions induced in the rainout shelter (Table 3.1.3.6).

Table 3.1.3.6 : Rainout shelter evaluation for yield & root traits at Indore

Entry	SY kg.ha^{-1}	DRI	TRL cm	SA cm2
G-2-3-31	1803	1.2	7097	2057
G-5-2-15	1386	1.5	4118	11455
JS 20-69	1064	1.8	3066	1028
JS 97-52	1050	1.1	5376	1637
JS 93-05	967	1.0	1734	559
Mean	851			
R^2	0.93			
CV (%)	16.64			
RF mm	1297			
Rainout shelter soil-moist %		19.3		

DST-SERB funded project: Functional characterization of *soil surface rooting (GmSOR)* genes and development of their genic markers in soybean

PI: *Dr Giriraj Kumawat*
CoPI: *Dr. Prince Choyal*

Identification of contrasting root trait genotypes and differential expression analysis of GmSOR1-like genes

Root trait phenotyping identified EC528623, HAL, NRC2396, & Hardee as high rooting-low root angle genotypes and TGX 780-5A, Pusa 37, JS80-21, & PS1024 as low rooting-high root angle genotypes. Primers were designed for the 17 orthologs of GmSOR1 like genes in soybean. 17 genes Glyma04g089851, Glyma06g091651, Glyma01g019300, Glyma09g203400, Glyma14g185600, Glyma02g218200, Glyma01g097900, Glyma08g273400, Glyma11g197001, Glyma12g077333, Glyma10g210051, Glyma13g324534, Glyma20g180551, Glyma12g175351, Glyma07g270000, Glyma15g122900, Glyma09g017200 used for the expression study. Gene expression analysis was performed in root tissue of 3-weeks and 2-weeks grown plants of eight contrasting germplasm accessions. In primary roots of 2-weeks plants, Glyma04g089851 showed significantly high expression in high rooting-low root angle genotypes. Whereas in lateral roots Glyma01g097900, Glyma14g185600, Glyma10g210051, Glyma12g077333, Glyma20g180551, Glyma12g175351, and Glyma13g324534 showed high expression in low rooting-high root angle genotypes. In 3-weeks plants, differential expression analysis revealed distinct transcriptional patterns between primary and lateral root tissues. Notably, Glyma06g091651 exhibited significantly higher expression in the primary roots of high-rooting genotypes, while Glyma13g324534 showed elevated expression in the lateral roots of low rooting-high root angle genotypes (Fig. 3.1.3.6.). The consistent differential expression of Glyma13g324534 at both stages underscores its potential utility in functional characterization and in the development of reliable markers for root traits.

ISSR 3.16/21 Identification of genes/loci for better root system in soybean

PI: *Dr. Giriraj Kumawat*
Co-PIs: *Dr. M. B. Ratnaparkhe, Dr. Gyanesh K. Satpute, Dr. Shivakumar M (up to 27.06.2025)., Dr. Prince Choyal*

1. Phenotyping of 143 soybean varieties for root traits

For validation of a root length QTL, a set of 143 soybean cultivars was phenotyped for Primary Root Length (PRL) and Tertiary Root Lengh (TRL) at three-week stage (V2) under hydroponic culture. Phenotype data of 143 soybean genotypes showed a substantial variation in PRL and TRL at V2 stage (Table 3.1.3.7, Fig. 3.1.3.6).

Table 3.1.3.7 Descriptive statistics for PRL and TRL

Descriptor	PRL (cm)	TRL (cm)
Minimum	38.4	448.34
Maximum	74.7	1551.2
Mean	52.13	864.77
Stand. dev	6.37	213.51
Skewness	0.58	0.87
Kurtosis	0.98	0.78
COV (%)	12.22	24.69

Fig. 3.1.3.6. Soybean cultivars at three-week stage growing under hydroponic culture.

2. Marker association analysis for validation

Two SNPs, S10_53805585 and S10_52786710, from the genomic region of qRoot10.1 (root length QTL) were converted into KASP marker and genotyped in a set of 143 soybean cultivars (Fig. 3.1.3.7). SNP genotyping data and root phenotyping data of 143 soybean cultivars were used for marker trait association analysis. Generalized linear model (GLM) was used for marker trait association in TASSEL v5.0. Marker trait association analysis using GLM detected significant association of S10_53805585 with PRL (P= 0.00017) and TRL (P= 0.00051) (Table 3.1.3.8, Fig. 3.1.3.8).

Table 3.1.3.8. Validation of *qRoot10.1* SNP S10_53805585 for PRL and TRL in 143 soybean cultivars

SNP	Chromosome	Position Wm82.a2	Trait	F- value	P- Value	R^2 (%)
S10_53805585	10	50324088	PRL TRL	14.89 12.64	1.74E-04 5.13E-04	9.67 8.22

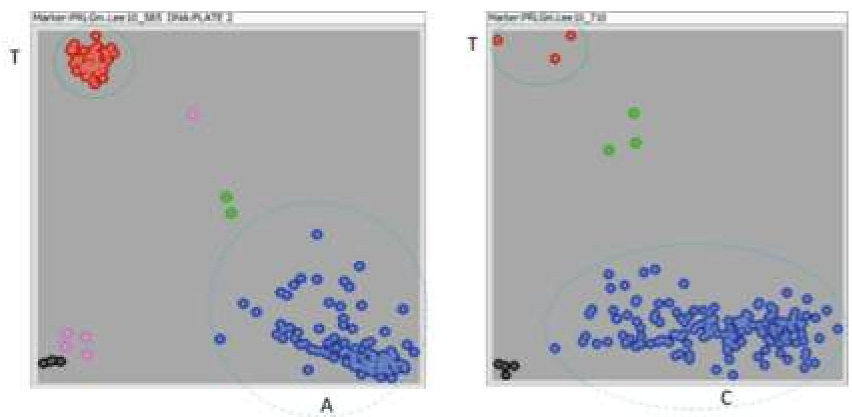


Fig. 3.1.3.7: KASP analysis for SNPs S10_53805585 and S10_52786710, in soybean cultivars.

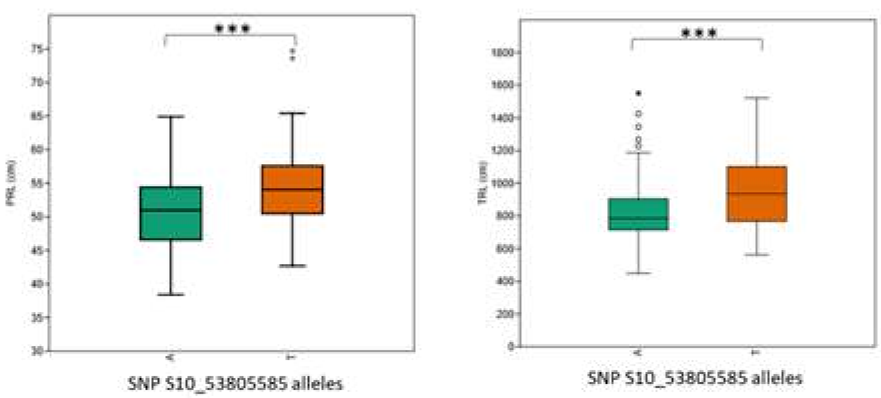


Fig. 3.3.8: Allelic effect of SNP S10_53805585 from the genomic region of qRoot10.1 genotyped in 143 soybean cultivars at V2 stage. A. Primary root length (PRL), B. Total root length (TRL).

3. Genotyping of RILs and BC2F1s for identifying heterozygous lines at QTL *qRoot10.1*

To develop RHL-NILs, 100 F5 RILs developed from cross NRC2 x NRC2396 (long rooting) and 11 BC2F1s of PS1024 x (PS1024 x (PS1024 x NRC2396)) were genotyped with two polymorphic SSR markers BARCSOYSSR_10_1718 and BARCSOYSSR_10_1730. Two heterozygous lines were identified at QTL region for each of the crosses.

IISR7.8/23: Trait identification and physiological breeding for waterlogging tolerance in soybean

PI: *Dr. Prince Choyal*

Co-PIs: *Dr. Gyanesh Kumar Satpute, Dr. Giriraj Kumawat, Dr. Nataraj V. and Dr. Rakesh Kumar Verma*

Evaluation of soybean germplasm for pre-emergence anaerobic stress (waterlogging stress at pre-emergence stage) tolerance

A total of 550 soybean genotypes (500 germplasms, 30 varieties and 20 selected genotypes) were evaluated for waterlogging tolerance at pre-emergence stage in waterlogging structures till Kharif 2024. A period of 72 hours of waterlogging stress was imposed through maintaining the 10 cm of water layer on pots above the soil surface. After completion of the treatment period, the pots were allowed to recover for one week and the germination percentage were recorded (Fig. 3.1.3.9).

Fig. 3.1.3.9: Soybean genotypes under waterlogging stress at pre-emergence stage

टेबल 3.1.3.9: प्री-इमर्जेंस स्टेज में वॉटरलॉगिंग स्ट्रेस के तहत सोयाबीन जीनोटाइप का इवैल्यूएशन

Germplasm	Germination %	Variety	Germination %	Genotypes	Germination %
EC 251413	87	HARDEE	5	WL 02	10
EC 39742	60	JS 20-34	32	WL 04	15
EC 0076754	57	JS 20-38	15	WL 05	10
EC 81822	50	JS 20-69	10	WL 06	5
EC 0093747	47	JS 20-94	10	WL 07	15
EC 457464	47	JS 20-98	10	WL 09	25
EC 57045	47	JS 21-72	10	WL 13	10
EC 113398	45	JS 22-12	10	WL 14	10
EC 291400	45	JS 335	10	WL 16	10
EC 0057039	40	JS 95-60	20	WL 17	15
EC 0251523	40	JS 97-52	10	WL 19	5
EC 0242011	35	KALITUR	20	WL 20	10
EC 294402	35	RVSM 2011-35	10	WL 21	15
EC 100802-A	33	NRC 130	15	WL 23	10
EC 172585	30	NRC 131	15	WL 26	50

Germplasm	Germination%	Variety	Germination %	Genotypes	Germination %
EC 0018646	27	NRC 136	10	WL 27	10
EC 103153	25	NRC 138	10	WL 29	25
EC 294415	20	NRC 142	10	WL 30	10
EC 0241942	15	NRC 147	10	WL 31	15
EC 0242094	15	NRC 150	20	WL33	15
EC 241412	15	NRC 152	25	WL 36	15
EC 0241771	10	NRC 157	10	WL 37	20
EC 0251506	10	NRC 164	15	WL 51	10
EC 251327	10	NRC 165	25	WL57	30
	NRC181	15			

Conclusion: Among the screened materials, EC 251413EC, EC 39742, and EC 0076754 showed the highest germination percentage after 72 hours of waterlogging, suggesting their suitability for use in breeding programs aimed at improving early-stage tolerance (Table 3.1.3.9). Remarkably, WL 26 (EC 457564) also performed well under waterlogging at the germination stage. This genotype exhibited tolerance across all three critical stages—pre-emergence, V3, and R2—highlighting it's strong and stable response, and positioning it as a promising donor for future waterlogging tolerance breeding initiatives.

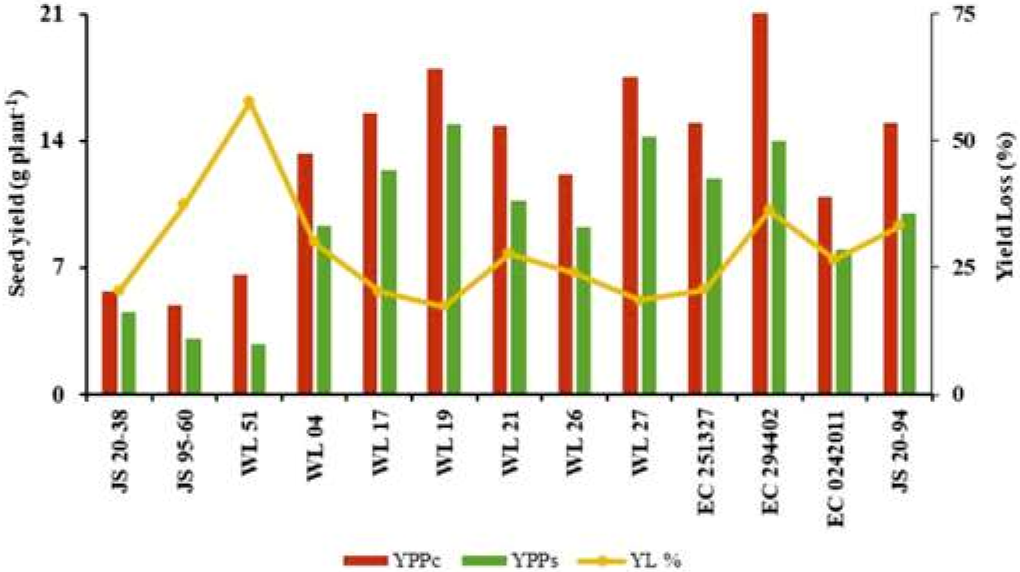
Exp. 2: Screening of soybean genotypes for waterlogging tolerance at seedling stage (V3)

A set of 70 soybean genotypes (Table 3.1.3.10), including released varieties, advanced breeding lines, and soybean germplasm along with six checks, were evaluated for waterlogging tolerance at the vegetative stage (V3) using an augmented block design (Fig. 3.1.3.10). Waterlogging stress was imposed at V3 stage for 15 days in a flooded field, while normal moisture levels were maintained in the control plot. At harvest, plant growth and yield parameters were recorded under both control and waterlogged conditions (Fig. 3.1.3.10), (Fig. 3.1.3.11).

Table 3.1.3.10: List of genotypes for evaluation for waterlogging tolerance at V3 stage

Germplasm		Variety		Selected genotypes	
EC 0018646	EC 0481338	HARDEE	NRC 131	WL 02	WL 04
EC 0057039	EC 1126655	JS 20-34	NRC 136	WL 09	WL 05
EC 0076754	EC 113398	JS 20-69	NRC 138	WL 13	WL 06
EC 0093747	EC 172585	JS 20-94	NRC142	WL 14	WL 16
EC 0107416	EC 241412	JS 21-72	NRC 147	WL 17	WL 19
EC 0241771	EC 251327	JS 22-12	NRC 152	WL 20	WL 26
EC 0241942	EC 251413	JS 335	NRC 157	WL 23	WL 27
EC 0242011	EC 291400	KALITUR	NRC 164	WL 29	WL 31
EC 0242094	EC 294402	RVSM 2011-35	NRC 165	WL 30	WL 33
EC 0251506	EC 294415	NRC 127	NRC 181	WL 57	WL 36
EC 0251523	EC 39742	NRC 130			
EC 045627	EC 457464				
EC 0457261	EC 57045				
EC 100802-A	EC 81822				
EC 103153					

Fig. 3.1.3.10: Evaluation of soybean genotypes for waterlogging stress at V3 stage



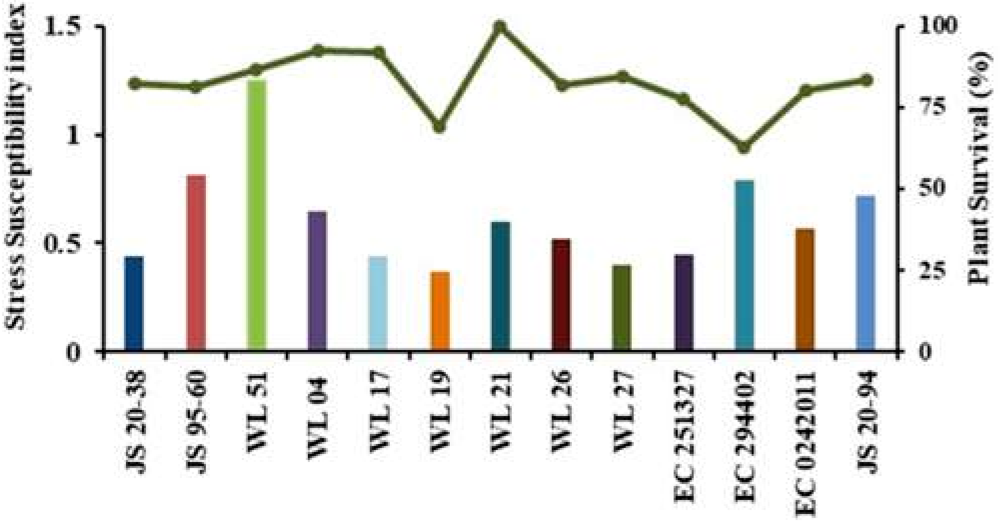


Fig. 3.1.3.11: Performance of waterlogging-tolerant soybean genotypes relative to the check variety under waterlogging stress at the V3 stage: (a) seed yield and yield loss; (b) stress susceptibility index and plant survival rate.

Conclusion : At the V3 stage, genotypes WL 19, WL 17, WL 27, WL 26, WL 21, WL 04, EC 0242011, EC 294402, EC 251327, and JS 20-94 were identified as tolerant to waterlogging stress. Among these, WL 26, WL 04, WL 17, and WL 21 maintained their tolerance even at the R2 stage, indicating stability of response across growth stages.

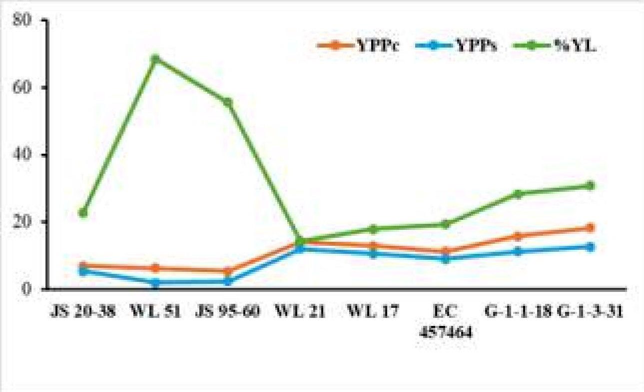
Exp. 3: Screening of soybean genotypes for water logging tolerance at R2 stage

A set of 60 soybean genotypes (Table 3.1.3.11), including released varieties, advanced breeding lines, and soybean germplasm along with six checks, were evaluated for waterlogging tolerance at the reproductive stage using an augmented block design. Waterlogging stress was imposed at full flowering stage (R2) for 15 days in a flooded field, while normal moisture levels were maintained in the control plot. At harvest, plant growth and yield parameters were recorded under both control and waterlogged conditions (Fig. 3.3.12)

Table 3.1.3.11: List of genotypes for evaluation for waterlogging tolerance at R2 stage

Germplasm		Variety		Selected genotypes
EC 0018646	EC 0481338	HARDEE	NRC 131	WL 02
EC 0057039	EC 1126655	JS 20-34	NRC 136	WL 09
EC 0076754	EC 113398	JS 20-69	NRC 138	WL 13
EC 0093747	EC 172585	JS 20-94	NRC142	WL 14
EC 0107416	EC 241412	JS 21-72	NRC 147	WL 17
EC 0241771	EC 251327	JS 22-12	NRC 152	WL 20
EC 0241942	EC 251413	JS 335	NRC 157	WL 23
EC 0242011	EC 291400	KALITUR	NRC 164	WL 29
EC 0242094	EC 294402	RVSM 2011-35	NRC 165	WL 30
EC 0251506	EC 294415	NRC 127	NRC 181	WL 51
EC 0251523	EC 39742	NRC 130		
EC 045627	EC 457464			
EC 0457261	EC 57045			
EC 100802-A	EC 81822			
EC 103153				

Checks: JS 20-34 (T), WL 07 (S), WL 51 (S), JS 97-52 (T), JS 20-38 (T), JS 20-98 (T)



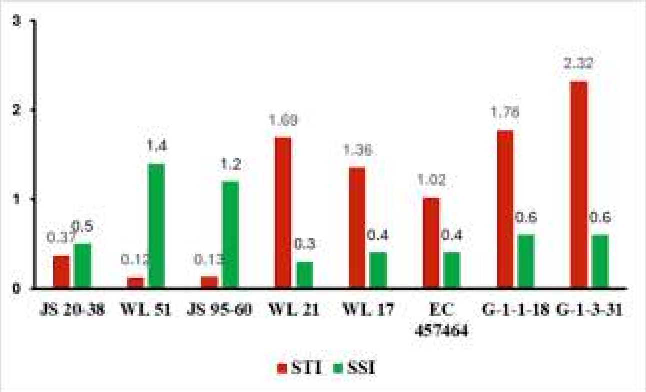


Fig. 3.1.3.12: Performance of waterlogging-tolerant soybean genotypes relative to the check variety under waterlogging stress at the R2 stage: (a) seed yield under control (YPPc) & stress (YPPs) and percent yield loss; (b) Stress susceptibility index and Stress tolerance index.

Conclusion: Based on the minimum yield loss percent under waterlogging stress as compare to control condition, WL 21 (EC528622), WL 17(PI 283327), EC 457464, G-1-1-18, G-2-3-31 genotypes showed reasonably good stress tolerance potential. These genotypes showed minimum yield reduction under stress along with minimum stress susceptibility index and high stress tolerance index.

Experiment 4: Performance evaluation of identified soybean genotypes for waterlogging tolerance at reproductive stage (R2)

A set of 11 identified soybean genotypes (Kharif 2023; Table 3.1.3.10), including advanced breeding lines, RILs, and soybean germplasm along with six check varieties, was evaluated for waterlogging tolerance at the reproductive stage using a randomized block design with three replications. Waterlogging stress was imposed at full flowering stage (R2) for 15 days in a flooded field, while normal moisture levels were maintained in the control plot (Fig. 3.1.3.13 Table 3.1.3.12). At harvest, plant growth and yield parameters were recorded under both control and waterlogged conditions (Fig. 3.1.3.14).

Table 3.1.3.12: List of identified genotypes

Sr. No.	Code	Genotype name
1.	WL 04	NRC 256
2.	WL 05	NRC 257
3.	WL 06	C 20-10-10
4.	WL 16	RIL 104-3
5.	WL 19	RIL 104-5
6.	WL 26	EC 457564
7.	WL 27	EC 250591
8.	WL 31	CAT1258
9.	WL 33	EC 391346
10.	WL 36	F6-1 (JS 97-52× NRC 130)
11.	WL 57	F6-22 (JS 97-52× EC 546882)

Checks: JS 20-34 (T), WL 07 (S), WL 51 (S), JS 97-52 (T), JS 20-38 (T), JS 20-98 (T)

Fig. 3.1.3.13: Soybean genotypes under waterlogging stress at reproductive stage

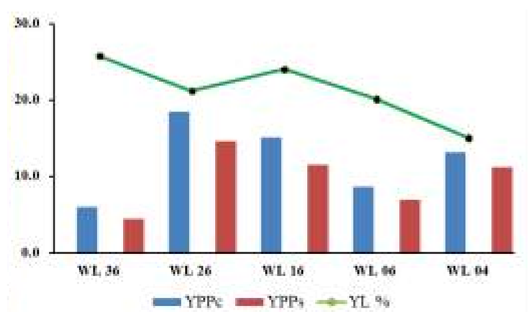


Fig. 3.1.3.14: Yield performance of selected soybean genotypes for waterlogging tolerance at R2 stage.

Conclusion: Based on the plant survival rate, foliar damage score and stress susceptibility index, WL 36, WL 26, WL 16, WL 06 and WL 04 selected as the best genotype for performing under waterlogging stress at R2 stage. These genotypes showed minimum yield reduction under stress along with minimum SSI and high plant survival rate (Table 3.1.3.13).

Table 3.1.3.13: Identified soybean genotypes for waterlogging tolerance at different growth stages

Sr. No.	Stage	Waterlogging tolerant genotypes				
1.	V_3 Stage	NRC 256 (WL 04)	RIL 104-9 (WL 17)	RIL 104-5 (WL 19)	EC 528622 (WL 21)	EC 457464 (WL 26)
		EC 250591 (WL 27)	EC 0242011	EC 294402	EC 251327	JS 20-94
2.	R_2 Stage (2024)	RIL 104-9 (WL 17)	EC 528622 (WL 21)	G-1-1-18	G-2-3-31	EC 457464 (WL 26)
	R_2 Stage (2023 & 2024)	NRC 256 (WL 04)	C 20-10-10 (WL 06)	RIL 104-3 (WL 16)	EC 457464 (WL 26)	WL 36
3.	Both V_3 and R_2	NRC 256 (WL 04)	RIL 104-9 (WL 17)	EC 528622 (WL 21)	EC 457464 (WL 26)	

In this project, several promising advanced soybean breeding lines were identified for high oil content (Table 3.1.3.14). These lines consistently exhibited superior oil content over two to three years of evaluation, indicating their stability and reliability across seasons. The identified stable, high-oil lines can be effectively utilized in future breeding programs targeting enhanced seed oil content, either as potential parental lines or for further multi location evaluation.

Table 3.1.3.14: Advanced breeding lines identified for high oil content

Sr. No.	Code	Pedigree	Oil Content (%)			
			Kharif 2023	Kharif 2024	Kharif 2025	Mean
1	24-F6-20-1	(Hardee × AMS MB 5-18)	23.32	23.08	23.47	**23.29**
2	24-F6-20-4	(Hardee × AMS MB 5-18)	23.32	23.27	23.76	**23.45**
3	24-F6-20-5	(Hardee × AMS MB 5-18)	23.32	24.41	23.29	**23.67**
4	24-F6-21-1	(Hardee × AMS MB 5-18)	23.58	23.83		**23.71**
5	24-F6-22-1	(Hardee × AMS MB 5-18)		23.76	23.45	**23.61**
6	NRC 328	(Hardee × AMS MB 5-18)	23.58	24.52	23.69	**23.93**
7	NRC 329	(Hardee × RSC 10-52)		23.82	23.78	**23.80**

3.4 Breeding for Management of biotic stresses

IISR1.33/16 Marker Assisted Breeding for YMV resistant soybean varieties

PI: *Dr. Anita Rani*

Co-PI: *Dr. Vineet Kumar*

- Following Crosses were attempted to develop MYMIV resistant genotypes :
- NRC196 (YMV resistant) X NRC142 (titilx2lx2)
- NRC196 (YMV resistant) X SW 120 (titilx2lx2 &clear hilum)
- NRC142 (titilx2lx2) x SL955 (YMV resistant)
- NRC149 (YMV resistant) X NRC 150 (lx2lx2 &high oil)
- Advanced generation of NRC142 (double null) x NRCSL2 (YMV resistant) were raised and Selections were made Advanced generation of NRC142 (double null) x BC3 of JS95-60 X(JS95-60XSL525) (YMV resistant) were raised and Selections were made
- F6 of NRC149 (YMV resistant) x AMS100-39 were raised in the field
- F6 of NRC105 (vegetable type) x NRCSL2 (YMV resistant) was raised in Kharif.
- DNA from all the populations was isolated and genotyped for markers linked to MYMIV resistance.
- Advanced Breeding lines developed through MAS were tested at hot spot Ludhiana (Table 3.1.4.1).
- New and closely linked markers were identified for MYMIV resistance (Fig. 3.1.4.1)
- Two Varieties NRC 149 and NRC 197 were released by Honourable Prime Minister of India (Fig. 3.1.4.2)

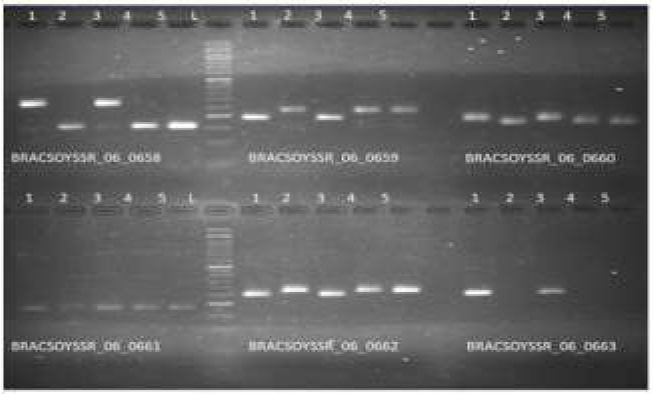


Fig. 3.1.4.1: New and close markers identified for MYMIV resistance.

Fig. 3.1.4.2: Two Varieties NRC 149 and NRC 197 were released by Honourable Prime Minister of India.

Table 3.1.4.1: Advance breeding lines to YMV and RAB

Breeding Line	Pedigree	Yield (Kg/h)	YMV resistance gene	Reaction to other diseases under field condition(RAB)
NRCAM-1	NRC 149 X AMS100-39	2425	Present	Resistant
NRCAM-2	NRC 149 X AMS100-39	2380	Present	Resistant
NRCAM-3	NRC 149 X AMS100-39	2621	Absent	Resistant
NRCAM-4	NRC 149 X AMS100-39	2348	Present	Resistant
NRCAM-5	NRC 149 X AMS100-39	2296	Present	Resistant
NRCAM-6	NRC 149 X AMS100-39	2461	Absent	Resistant
NRCAM-7	NRC 149 X AMS100-39	2628	Present	Resistant
NRNR - 1	NRC105 X NRCSL2	780	Present	Susceptible
NRNR - 2	NRC105 X NRCSL2	870	Present	Susceptible

NASF funded project: Marker assisted stacking of yellow mosaic disease resistance, null Kunitz trypsin inhibitor, null lipoxygenase-2 genes, and broadening the genetic base of soybean.

PI: *Dr. Vineet Kumar*

Co-*PIs: Dr. Anita Rani, Dr. Sanjay Gupta and Dr. Rajesh Vangala*

- Putative BC2F1 seeds for NRC 142 × SL 955 were sown and BC2F1 plants confirmed for hybridity using YMD linked marker BSOYSSR06_0662. Nine true BC2F1 plants which were morphologically similar to RP (NRC142) (Fig. 3.1.4.3). BC2 F2 population was raised in kharif 2025 and DNA was isolated from each for genotyping.
- 9 True BC2F1 plants, also morphologically similar to NRC142 (recurrent parent), were subjected to background selection using 122 Polymorphic SSR markers. Showed Recurrent parent genome content (RPGC) 93.0 -96.67 %.
- Putative BC2F1 seeds for cross combination PS1347 × NRC142 were sown and BC2F1 plants confirmed for hybridity using Lox2 codominant markers. 7 True BC2FI plants and morphologically similar to PS1347 were identified using Lox2 Co dominant marker (Fig. 3.1.4.4). BC2F2 population of the cross combination was raised in Kharif 2025 and DNA was isolated form each plant for genotyping
- F2 seeds of cross AVSB2013× NRC 142 sown in Kharif 2024. F2 plants with null KTI gene & null lox-2 gene confirmed and backcrossed with recipient parent RP to obtain putative BC1F1 seeds. Putative BC1F1 seeds for AVSB2013× NRC 142 were sown in Rabi 2025 and confirmed for hybridity using lox-2 linked SSR marker (Satt522). 8 True BC1F1 plants were morphologically similar to recurrent parent

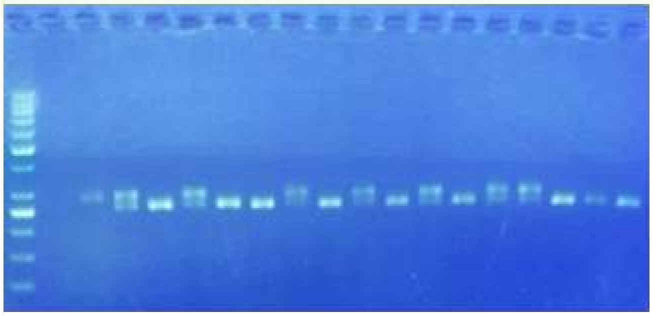


Fig. 3.1.4.3: Confirmation of true BC_2F_1 plants using YMD linked SSR marker (BSOYSSR06_0662) in NRC 142 × SL 955 c. Lane L1 corresponds to size markers. BSOYSSR06_0662)NRC142 : 250 bp SL955 : 270bp

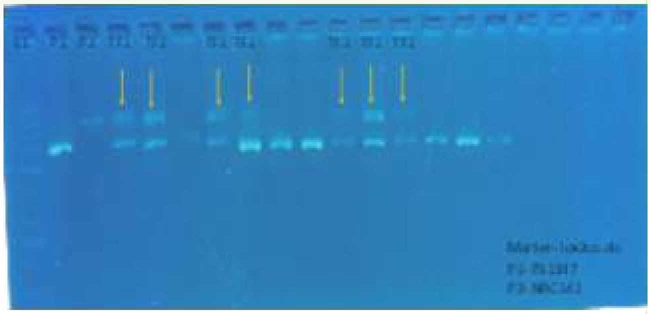


Fig. 3.1.4.4: Confirmation of true BC2F1 plants SSR marker Lox2 codominant marker in PS1347 × NRC142 cross. Lane L1 corresponds to size markers. PS1347:580 bp NRC142:767 bp

IISR 4.5/23: Breeding for resistance against charcoal rot and anthracnose diseases in soybean

PI- *Dr. V. Nataraj*

Co-PIs: *Dr. P.K Amrate, Dr. Shivakumar M (up to 27.06.2025), Dr. Milind B Ratnaparkhe, Dr. Sanjeev Kumar and Dr. V. Rajesh*

Following crosses were attempted aiming at high yield, charcoal rot & anthracnose (Tables 3.1.4.2 to 3.1.4.4).

Table 3.1.4.2: Crosses aiming at higher-yield and charcoal rot resistance (All the F1 made in *Kharif* were advanced to F2 in Off-season)

S.No	Cross	S.No	Cross
1	NRC 166 × JS 22-12	13	JS 21-05 × NRC 186
2	Hardee × AGS 25	14	NRC 252 × NRC 166A
3	NRC 142 × (NRC 128 × JS 9560)	15	JS 335 × AGS 25
4	Hardee × 2023-37	16	2023-37 × AGS 25
5	2023-37 × AGS 25	17	Hardee × NRC 152
6	JS 20-98 × LJ 119	18	2023-37 × K53
7	JS 20-98 × K-53	19	NRC 166 × 16-26
8	Hardee × JS 22-12	20	JS 20-69 × JS 95-60
9	X-67 × Hardee	21	EC 572136 × 2023-37
12	NRC 166 × JS 22-12	22	Hardee × EC 771172

Table 3.1.4.3: Crosses aiming at higher-yield and anthracnose resistance (All the F1 made in Kharif were advanced to F2 in Off-season)

S.No	Cross	S.No	Cross
1	(SKAU-WSB-101× NRC 150) × NRC 150	8	2023-37 × JS 95-60
2	JS 21-05 × POP2	9	EC 34372 × X-67
3	JS 22-12 × POP2	10	JS 90-41 × EC 528623
4	JS 22-18 × POP2	11	EC 34160 × X67
5	AGS 136A × JS 95-60	12	NRC 150 × POP2
6	2023-37 × NRC 150	13	EC 18596 × NRC 150
7	EC 457254 × YP 34	14	POP 2 × NRC 142

Table 3.1.4.4: Crosses aiming at higher-yield, anthracnose and charcoal rot resistance (All the F1 made in *Kharif* were advanced to F2 in Off-season)

S.No	Cross	S.No	Cross
1	NRC 150 × AGS 25	8	JS 20-98 × EC 18596
2	JS 20-98 × EC 390977	9	NRCSL8 × EC 390977
3	JS 20-69 × NRC 150	10	JS 95-60 × (NRC 128 x JS 9560)
4	EC 457254 × NRC 150	11	NRCSL8× POP2
5	NRC 142 × JS 572136	12	JS 94-67 × JS 20-98
6	NRC 181 × NRC 166	13	NRC 181 × AGS 25
7	JS 90-41 × JS 21-05	14	JS 20-20 × JS 90-41

Evaluation of advanced breeding lines for grain yield

Three yield trials were conducted to evaluate resistant breeding lines for grain yield. Experimental design followed was RBD with three replicates. Plot size was 6.75 m2. Plot yield was converted into Kg/ha.

Yield trial 1: A total of 28 advanced breeding lines along with two checks (JS 20-98 and JS 21-72) were evaluated for grain yield. Genotypes superior to the best check will be evaluated for charcoal rot resistance at Jabalpur. Genotype G22 was 9.73% superior to the best check JS 21-72. Genotype G16 was 6.04% superior to the best check JS 21-72 (Fig. 3.1.4.5).

Yield trial 2: A total of 19 advanced breeding lines along with two checks (JS 20-98 and JS 21-72) were evaluated for grain yield. Genotypes superior to the best check will be evaluated for charcoal rot resistance at Jabalpur. Genotype G38 was 17.6% superior to the best check JS 21-72. Genotype G39 was 2.39% superior to the best check JS 21-72 (3.1.4.6).

Yield trial 3: A total of 17 advanced breeding lines along with two checks (JS 20-98 and JS 21-72) were evaluated for grain yield. Genotypes superior to the best check will be evaluated for charcoal rot resistance at Jabalpur. Genotype G53 was 17.19% superior to the best check JS 21-72 (Fig. 3.1.4.7).

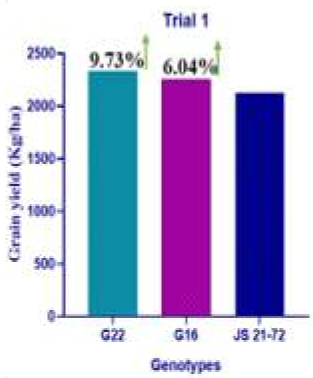


Fig. 3.1.4.5: Graphical depiction of yield superiority in Trial 1

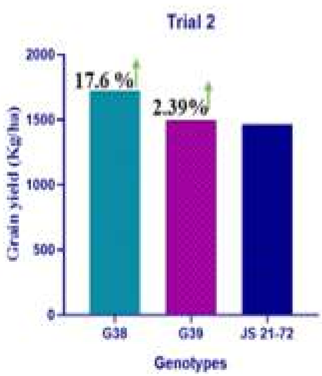


Fig. 3.1.4.6: Graphical depiction of yield superiority in Trial 2

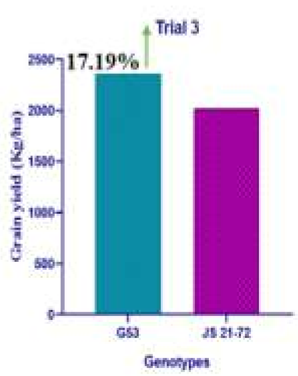


Fig. 3.1.4.7: Graphical depiction of yield superiority in Trial 3

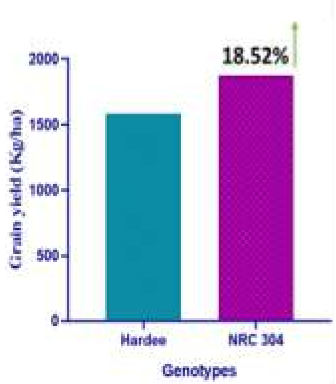


Fig. 3.1.4.8: Graphical depiction of yield superiority in station trial

Station Trial 2024

Entry NRC 304 (NRC 128 x JS 20-69) which is resistant to YMV, anthracnose and RAB was 18.52% superior to the best check Hardee in station trial 2024 (Table 3.1.4.5: Fig. 3.1.4.8)

Table 3.1.4.5: Details of station trial 2024

S.No	Entry	Days to maturity	Hundred seed weight	Grain yield (Kg/ha)	% Superiority
1	NRC 304*	105.00	10.19	1876.54	18.52
2	Hardee	105.33	10.51	1583.21	

Evaluation of promising genotypes for charcoal rot resistance at Jabalpur

A total of forty anthracnose resistant genotypes were evaluated for charcoal rot resistance at Jabalpur. Of them, eight genotypes (G4, NRC 269, G34, G32, G31, G27, G19 and G10) were found to be superior to the resistant check JS 20-34 (Table 3.1.4.6: Fig. 3.1.4.9).

Table 3.1.4.6: Details of genotypes under study. DR-Disease Reaction. HR-Highly Resistant, R-Resistant, MR-Moderately Resistant, MS-Moderately Susceptible, S-Susceptible and HS-Highly Susceptible

Genotype-	Pedigree	PDI	DR
G4	EC 457254 x JS 20-34	0.00a	HR
NRC 269	NRC 128 x JS 95-60	0.00a	HR
G34	EC 457254 x JS 95-60	0.00a	HR
G32	EC 457254 x JS 95-60	0.00a	HR
G31	EC 457254 x JS 95-60	0.00a	HR
G27	CAT 47 x JS 20-69	0.00a	HR
G19	NRC 128 x JS 20-34	0.00a	HR
G10	EC538828 x NRC 155	0.00a	HR
JS 20-34 (RC)	-	0.83a	HR
JS 95-60 (SC)	-	60.83j	HS

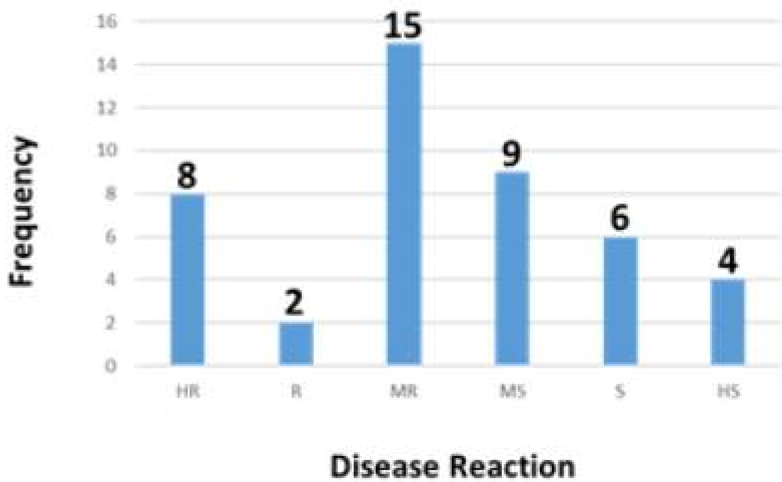


Fig. 3.1.4.9: Histogram showing disease reaction of genotypes under study

Evaluation of a RIL population for anthracnose and charcoal rot resistance

A RIL population (JS 20-98 × JS 95-60) (F2:6) was evaluated for anthracnose and charcoal rot resistance, grain yield and hundred seed weight in augmented design with two checks (JS 20-98 and JS 95-60) (Fig. 3.1.4.10; Fig. 3.1.4.11; Fig. 3.1.4.12). Based on multi-trait selection index- MGIDI genotypes- VN 3-5, VN 10-22, VN 12-27, VN 7-25, VN 5-7, VN 5-18 and VN 6-3 were found to be superior to the better parent JS 20-98

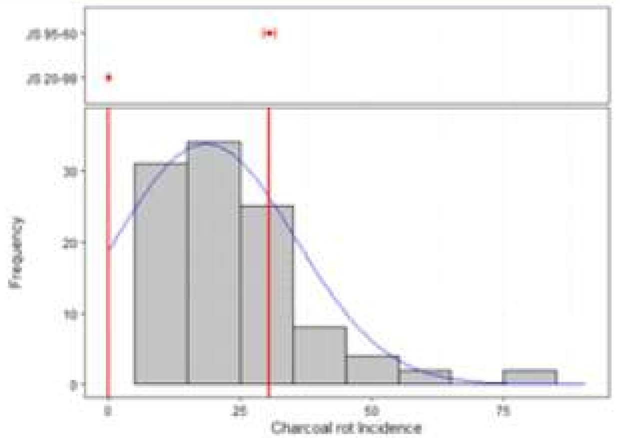


Fig. 3.1.4.11: Frequency distribution of RIL population for charcoal rot incidence

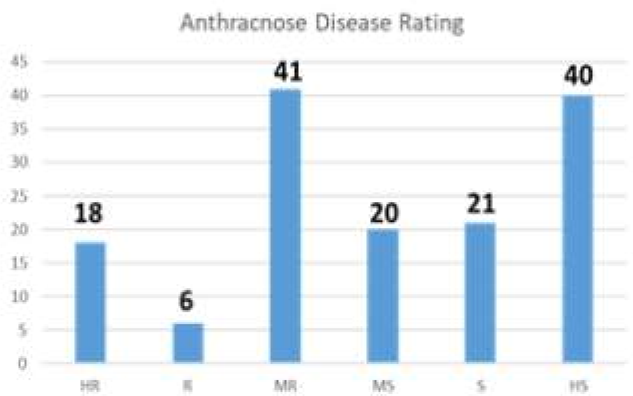


Fig. 3.1.4.10: Frequency distribution of RIL population for anthracnose disease reaction

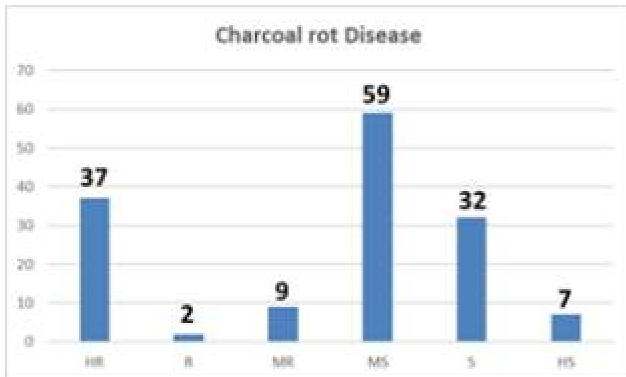


Fig. 3.1.4.12: Frequency distribution of RIL population for charcoal rot disease reaction

NSRI 3.15/25 (Activity): Phenotyping of GWAS panel, RILs and F2s for Rhizoctonia aerial blight disease Dr. Giriraj Kumawat, Dr Sanjeev Kumar, Dr Nataraj, Dr Shivakumar M., Dr Alok Shiv, Dr. Milind B. Ratnaparkhe, Dr Sanjay Gupta

A panel of 200 soybean accessions were evaluated for Rhizoctonia aerial blight (RAB) under hotspot conditions. Genotypes EC528623, EC547464, NRC2396, Kaeri651-6, EC456556, EC528622, TGX984-18E, MAUS61-2, Hardee, Young, and CAT2797 were found having low percent disease intensity (PDI) of <10%. Evaluation of 130 released soybean varieties identified that only six varieties JS21-71, Lee, MAUS61-2, Hardee, NRC 142 and NRC150 have low PDI (<10%) for RAB under hotspot. A RIL population of NRC2 x NRC2396 (N=100) in F5 and F7 was evaluated for RAB. Two F2 populations of LJ140 x NRC 130 (N=373) and LJ140 x NRC138 (351) were evaluated. Molecular marker genotyping for these populations is under progress to identify DNA markers associated with RAB.

IISR 3.12/19: Soybean Improvement against defoliating insects

PI: Dr Vangala Rajesh

CO-PI: Dr. Lokesh Kumar Meena, Dr. Shivakumar M (up to 27.06.2025), Dr. Vennampally Nataraj, Dr Milind Ratnaparkhe

Association mapping of screened data for Spodoptera litura (Field and lab) with GWAS Panel

A genome-wide association study (GWAS) was conducted on 269 soybean accessions using genotyping-by-sequencing (GBS), with 66,300 SNPs across all 20 chromosomes. Phenotypic data for resistance to *Spodoptera litura* was gathered from field screenings and laboratory assays. GWAS analysis identified two highly significant SNPs on chromosome 16 (S16_36047858 and S16_36087168) associated with larval resistance, explaining 75–77% of the phenotypic variation. These SNPs were consistently detected in both the FarmCPU and BLINK models, making them reliable candidates for marker-assisted selection (MAS) in breeding programs. SNP S16_36087168 also exhibited a pleiotropic effect, showing an association with the "C value" trait, suggesting a dual function in insect resistance and other plant traits. On chromosome 7, SNP S7_9277320 was significantly associated with the C value trait ($p < 1E-07$), while two other SNPs (S7_9366205 and S7_9429489) exhibited moderate to strong associations, indicating a potential quantitative trait locus (QTL) influencing this trait. The identified genes Glyma.16g180500, Glyma.16g183300, Glyma.16g182700, and Glyma.16g183400 on chromosome 16, as well as Glyma.07g093900, Glyma.07g094800, Glyma.07g095900, Glyma.07g096100, Glyma.07g096300, Glyma.07g096800, Glyma.07g096900, and Glyma.07g097000 on chromosome 7, were identified as key candidates for resistance to Spodoptera (Fig. 3.1.4.13). These findings provide valuable markers for enhancing pest resistance in soybean through MAS and functional validation.

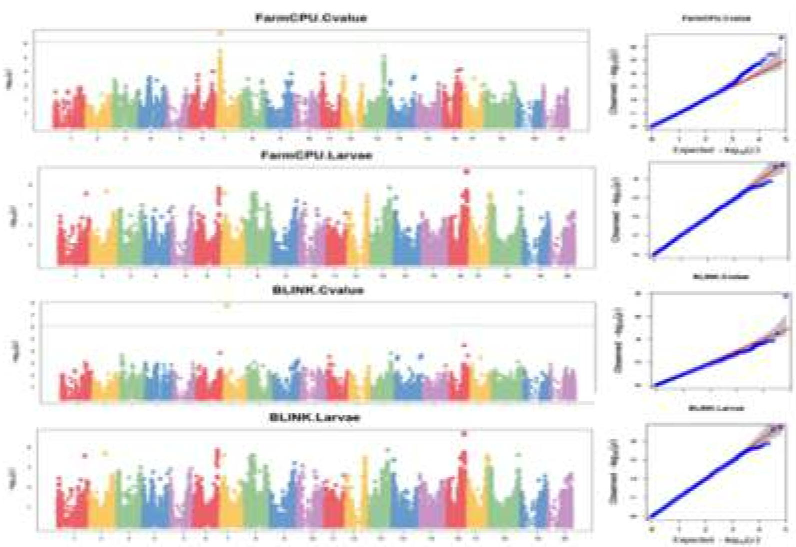


Fig. 3.1.4.13. Manhattan and QQ Plots showing association with field (larvae) and lab (Antixenosis- C value) for *Spodoptera litura*

ICAR EFC SS10 Project: Enhancing climate resilience and ensuring food security with genome editing tools

CCPI: *Dr. Milind Ratnaparkhe*

PIs: *Dr. Milind Ratnaparkhe, Dr. Sanjay Gupta Dr. Giriraj Kumawat, CoPIs: Dr. Shivakumar M., Dr. Prince Choyal, Dr. Lokesh Meena*

Five important traits, Oleic acid (FAD2), Oil yield (GmSDP1), Seed yield (GmGA3ox1), Insect resistance (GmUGT), and Pod shattering resistance (PDh1) have been selected for genome editing in soybean. Full-length gene sequences have been determined through Sanger sequencing of the targeted genes in the selected varieties. A total of 12 gRNAs has been designed and developed to target the chosen gene region. gRNA/Cas9 constructs have been developed with all 12 gRNAs for respective genes and mobilized in Agrobacterium.

The tissue culture protocol for Agrobacterium mediated genetic transformation has been standardized. Additionally, the In-planta method of genetic transformation has also been standardized. The process of plant genetic transformation utilizing gRNA/Cas9 constructs of

Table 3.1.4.9 : Details of gRNA constructs in entry and Cas9 binary vectors developed

Gene	Pblu Vector (Entry)		MDC123/G10 (Binary)	
	gRNA1	gRNA2	gRNA1	gRNA2
GmSDP1/2	√	√	√	√
GmSDP3/4	√	√	√	√
GmUGT	√	√	√	√
GmGA3ox1	√	√	√	√
GmFAD2-1A/1B	√	√	√	√
GmPDH1	√	√	√	√

all five genes has commenced. Putative transgenic plants (T0) have been confirmed by PCR for FAD2 and GmGA3Ox1. (Table 3.4.9)

Genomic Visualization and Assembly Tool for soybean and other oilseed Crops, AgriHub

PI: Dr Milind Ratnaparkhe; Co-PIs: Dr Giriraj Kumawat, Dr Savita Kolhe, Dr Gyanesh Satpute

Single Nucleotide Polymorphisms (SNPs) are crucial markers for genetic studies in crops, providing insights into genetic diversity, trait selection, and breeding strategies. However, efficient visualization and assembly of SNP data remain challenging, particularly for high-throughput genomic datasets. We have developed an advanced computational tool that enables clustering and visualization of SNP datasets for soybean and other oilseed crops. By leveraging machine learning and big data analytics, the tool will help in trait association studies, and breeding programs. The novelty of the approach lies in integrating scalable clustering techniques with interactive visualization to facilitate interpretation and decision-making.

AgriHub MEITY

PI: *Dr. Milind Ratnaparkhe*

Soybean disease dataset was developed and used the pre-trained Deep Learning Models to identify four soybean diseases. This soybean image dataset contains 9786 high-quality soybean leaf images, including healthy and diseased leaves. Further data pre-processing techniques were adopted to enhance the quality of images. In addition, several Deep Learning Models, i.e., fourteen Keras Transfer Learning Models were utilized to determine which model best fits the dataset on SoyLeaf diseases. The experimental results of the proposed fine-tuned models show that only ResNet50V2, ResNet101V2, InceptionV3, InceptionResNetV2, MobileNet, MobileNetV2, DenseNet121, and DenseNet169 have performed better in terms of training, validation, and testing accuracies than other state-of-the-art models.

CRISPR/Cas9-mediated genome editing for the development of climate smart soybean genotype (DST/WISE-PhD/LS/2024/302)

Mentor: Dr. Anita Rani, PI: Ms. Trupti Baburao Tayalkar

- Single sgRNA, sgRNA2, with an efficacy score 0.80 and minimal off-target score, was designed to target GmFT2a gene
- The guide RNA cassette comprising the GmU6 promoter, sgRNA2, and scaffold was cloned into the Cas9_MDC123 vector between the PstI and HindIII restriction sites.
- Cloned GmFT2a_CAS9_MDC123 vector was

mobilized into the Agrobacterium Tumefaciens strain EHA105 and used for the in vitro transformation of popular high yielding soybean variety NRC150.

- Cotyledons from 5-day-old germinated soybean seeds were infected with Agrobacterium tumefaciens culture and co-cultivated for 3 days, followed by shoot induction (glufosinate: 3.5mg/L), shoot elongation I and II (glufosinate: 3.5mg/L) for 15 days each (Fig.3.1.4.14).

- Glufosinate-resistant shoots were transferred to rooting medium (IBA 1 mg/l). Healthy explants were then subjected to hardening.

- A total number of 102 T_0 explants were transferred to primary hardening and screened for Cas9, BLPR and gRNA region using PCR (Fig. 3.1.4.15).

- Screened plants were validated using sanger sequencing. In one of the T0 plant the insertion of adenine at two bases upstream the PAM sequence at the expected target site was observed (Fig. 3.1.4.16)

Fig. 3.1.4.14: Stages of Agrobacterium tumefaciens mediated soybean transformation from co-cultivation to mature T_0 plants

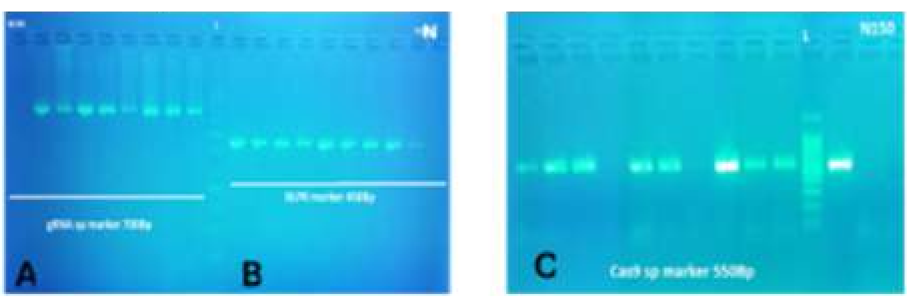


Fig. 3.1.4.15: PCR amplification of T0 plants: A- T0 positive plants for gRNA specific marker; B: T0 positive plants for BLPR specific marker; C: T0 positive plants for Cas9 specific marker; lane L: 50 Bp Ladder

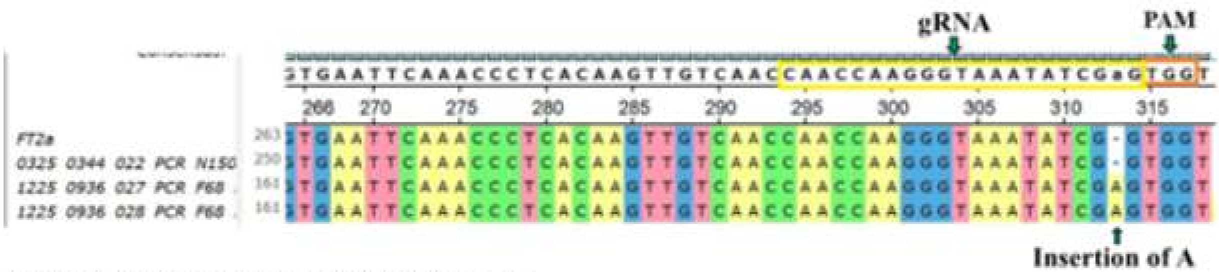


Fig. 3.1.4.16: Sanger sequencing analysis

CRISPR Crop Network: Targeted improvement of stress tolerance, nutritional quality, and yield of crops by using genome editing.

PI: Dr. Anita Rani

Co-PIs: Dr. Vineet Kumar & Dr. Sanjeev Kumar

- Two sgRNAs, sgRNA1 for targeting GmF3H1 and GmF3H2, and sgRNA2 for targeting GmFNSII-1 have been designed, and were cloned in the multiplex vector CAS9_MDC123 with GmU3 and GmU6 promoters and sgRNA scaffolds, respectively (Table 3.1.4.10).

- Cloned multiplex vector CAS9_MDC123 was mobilized into the EHA105 strain of Agrobacterium Tumefaciens. This Agrobacterium Tumefaciens culture was used for in vitro transformation of soybean cultivars.

- Cotyledons of 5 days-old-germinated soybean seeds were separated for infection with Agrobacterium Tumefaciens culture and kept on co-cultivation for 3-4 days followed by shoot induction (glufosinate ammonium- 3.5 mg/l) for 15 days (Fig 3.1.4.17a).

- All the induced shoots were transferred to shoot elongation media I (glufosinate ammonium- 3.5mg/l) (Fig 3.1.4.17b) and shoot elongation media II (glufosinateammonium- 3.5mg/l) for 15 days each.

- Explants survived on shoot elongation media II were further transferred to rooting media (Fig 3.1.4.17c). After root initiation the T0 plants were proceeded for primary hardening (Fig 3.1.4.17d) and secondary hardening (Fig 1e) in soil: Coccopeat (1:0.5 ratio).

- Survived T0 plants were screened for the presence of Cas9 and BLPR using PCR, and seeds were harvested.

- T_1 generation plants were raised and screened for the presence of the Cas9 and BLPR genes using PCR (Fig. 3.1.4.18). T_2 seeds were harvested.

- T_2 seeds were sown, and the resulting plants were further screened for the presence of Cas9. Cas9-free plants were selected (Fig. 3.1.4.19).

- Sanger sequencing analysis of T2 generation plants was performed using the gene specific markers for the targeted region of GmF3H1, GmF3H2, and GmFNSII-1 gene.

- In GmF3H2 gene substitutions of Guanine to Adenine and Adenine to Thymine was observed which resulted in the formation of an early stop codon TAG at the 180 bases downstream of the start codon within the first exon.

Table 3.1.4.10: Transformation efficiency of cotnode explants of soybean cultivar NRC150

Experi-ments	No. of infected explants	No. of glufosinate ammonium Resistant shoots	No. of explants with roots	No. of PCR positive plants	Transfor-mation efficiency
1	153	25	4	1	0.65
2	154	10	2	0	0
3	112	7	0	0	0
4	218	28	3	1	0.45
5	104	8	1	0	0
6	131	7	1	1	0.76
7	115	5	0	0	0
8	188	20	5	3	1.5
9	165	10	2	1	0.60
10	152	10	1	0	0
11	219	25	4	3	1.36
12	126	7	1	1	0.79
13	178	8	0	0	0
14	224	29	14	7	3.1
15	159	5	0	0	0
16	209	27	9	5	2.3

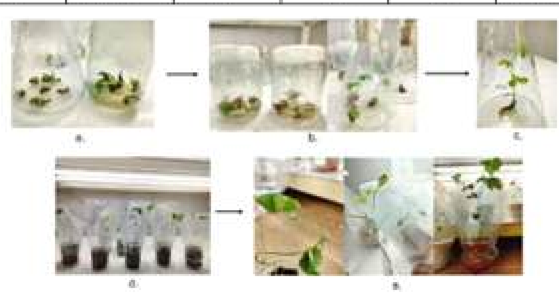


Fig.3.1.4.17 a,b,c,d: Steps in transformation a. Shoot induction [3.5mg/l]; b. Shoot elongation [3.5mg/l]; c. Root induction; d. Primary hardening of plants; e. secondary hardening (T0plants).

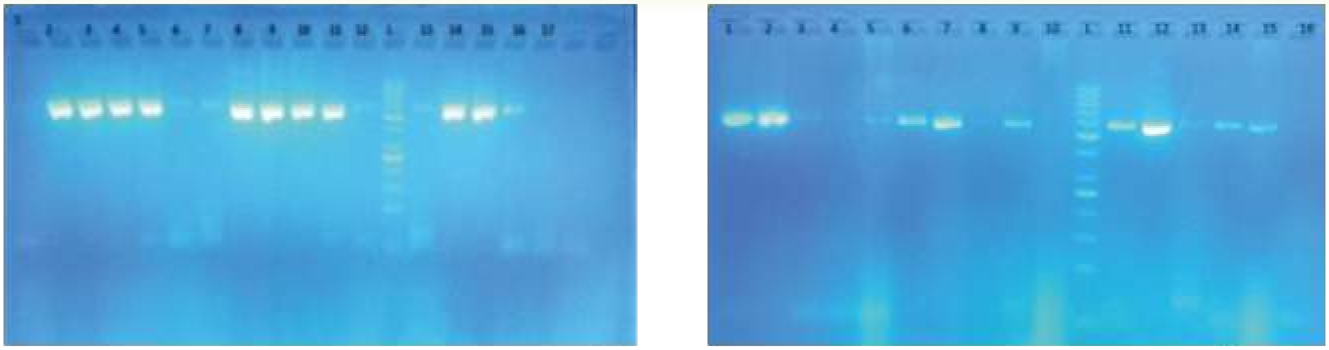


Fig.3.1.4.18: PCR amplification of T0 plants (Cas9: Lane 2, 3, 4, 5 and BLPR: lane 6, 7, 8, 9) and T1 generation plants (Cas9: Lane10,11,12 and 13 and for BLPR: lane14,15,16 and 17), lane L: Ladder 50 Bp in 2% agarose gel.

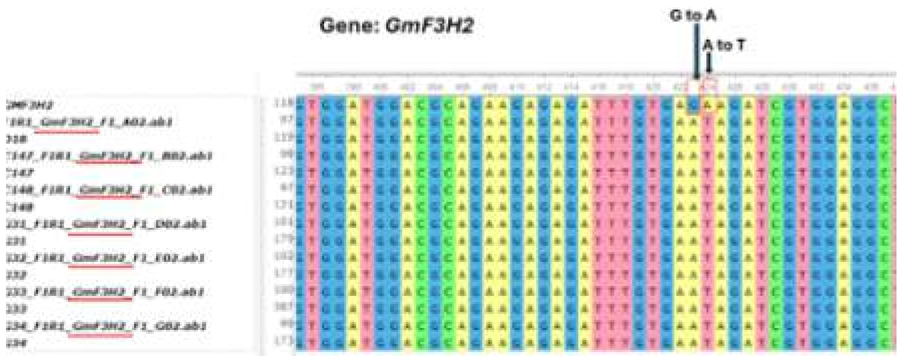


Fig.3.1.4.19. PCR amplification of the Cas9 marker in T_2 plants. Cas9 was absent in plants in lane 4, 8 and 16.

3.5 Seed quality characteristics

IISR4.3/23 Enhancement of seed longevity of vegetable soybean (*Glycine max* L. Merr.) genotypes.

PI: *Dr Punam Kuchlan, Co-PI Dr. Mrinal Kuchlan & Dr. Milind Ratnaparkhe*

To enhance the seed germination potential and adaptability of vegetable soybean (Glycine max L. Merr.), 'Karune' vegetable variety has been crossed with better germination line. Selected lines from the RIL's of were sown for generation advancement (F7) of crosses (Karune x EC 538828), (Karune x VC111) (F6) and Karune X VC109 (F6) in Kharif 2025. Crossing attempted to improve poor germinating sweet taste vegetable line with high germinating lines during kharif 2025. Selected RIL's of vegetable soybean were evaluated during K-25 for Morphological traits as well quality traits like field emergence, hypocotyl pigmentation, Flowering date & colour, Leaf shape , No of pods/ plant, Pod yield (R6 stage), 100 seed weight (R6) stage, pod picking time & duration, disease tolerance, Plant height, TSS content brix %, Sensory taste for sweetness, Storability test through germination test after 6 month of ambient storage and through accelerated aging test Out of 310 RIL's of cross Karune x EC 538828, the single plant yield ranged from 8.0 g to 29.0 g. Days to flowering rage from 33-39 days after sowing. 100 Seed wt. at (R6) stage ranged from 31-55g. TSS ranged from 19.0-33.2% brix. At R6 stage lines were evaluated for protein content at and the range was found 34-40 percent. Moisture content of seed at R6 stage ranged from 59.75 -65.50%. Days to pod picking was ranged from 70-95 days after sowing. Sensory evaluation was done as snacks boiled Edamame at green pod stage (R6) and 2 lines were scored 8.0 by evaluators. Storability of promising lines were evaluated with kharif 24 harvest seed. Lines identified with best seed storability/ longevity is CK 146 CK-303 CK-71, CK-335, CK-289, and KVC 111-22 KVC 111-27. After accelerated aging test with Aging Temperature: 420 C; Relative humidity: 100 % Aging duration: 4 &

7 days. Promising lines were also sown in the Rabi season to see the performance during offseason. The lines are performed well during off season and harvested seed maintained good germination and health. Some of the promising lines were tested in the station trial kharif 2025, three lines namely CK -14, CK- 6-95 and KVC 109-58 promoted for AICRP trial on the basis of superior pod yield as well as seed yield over check.

Soybean seed production under AICRP Seed (Crops) and Seed Hub Project on soybean

PI: *Dr. MK Kuchlan*

Co-PI: *Dr. Punam Kuchlan*

Nucleus and Breeder Seed Production:

Nucleus and breeder seed production of different varieties namely NRC 150, NRC 157, NRC 165, NRC 142, NRC 132 and NRC 127 were undertaken under AICRP Seed (Crop) at our institute, ICARDA and farmers field in an area of around 105 ha during 2024-25.

The variety wise details of nucleus and breeder seed production are as follows (Table 3.1.5.1)

Table 3.1.5.1: variety wise details of nucleus and breeder seed production

S. No.	Variety	Production (quintal)	Sale
Nucleus seed production			
1.	NRC 150	70.0	58.6
2.	NRC 157	4.8	2.8
3.	NRC 165	8.8	6.8
4.	NRC 142	2.0	1.0
	Total	85.6	69.2
Breeder Seed Production			
1.	NRC 150	695.6	668.4
2.	NRC 142	126.6	122.1
3.	NRC 165	27.4	27.4
4.	NRC 157	45.9	45.9
5.	NRC 132	1.2	-
6.	NRC 127	6.3	6.3
	Total	900.0	870.1
	G. Total	985.6	939.3

Foundation and TL seed production

Seed production of Foundation, Certified and TL classes for NRC 150, JS 22-12, JS 22-16 and JS 23-03 was taken up under Seed Hub Project in collaboration with progressive farmers of Indore, Dhar and Ujjain during 2024-25 Table 3.1.52

Table 3.1.5.2: The details of seed production of these varieties

S. No.	Variety	Production (quintal)	Sale
Foundation Seed Production and marketing			
1.	NRC 150	42.3	42.3
	Total	42.3	42.3
TL Seeds Production and marketing			
1.	NRC 150	226.8	215.4
2.	JS 22-12	10.47	10.47
3.	JS 22-16	4.92	4.92
4.	JS 23-03	7.95	7.95
	Total	250.14	238.74
	Grand Total	292.44	281.04

Project: Central Sector Scheme for Protection of Plant Varieties and Farmers Right Authority - Distinctiveness, Uniformity and Stability Testing of Soybean Varieties

PI: *Dr. MK Kuchlan*

Co-PI: *Dr. Punam Kuchlan and Dr. Vineet Kumar*

The maintenance of soybean released and notified varieties as reference collection at NSRI-Nodal Centre of DUS Testing.

164 released and notified soybean varieties were maintained during kharif 2025 at NSRI, Indore. The varieties were characterized for 20 DUS Test characteristics. Due to adverse climatic condition inducing occurrence of diseases affected performance of soybean varieties significantly. The effect of climatic factors is reflected in terms of yield. The yield performance varied from 0.0 q to 30.42 q.

• **Varieties protected:** Four varieties were protected under PPV& FR Act (Table 3.1.5.3). Date of grant of protection start from 6 May 2025 for all the four varieties.

Table 3.1.5.3: Details of varieties protected under PPV&FR Act

Variety	Registration No.
NRC 127	REG/2024/1013
NRC 152	REG/2024/0996
NRC 181	REG/2024/0985
NRC 150	REG/2024/1012

• **DUS Testing of soybean candidate varieties:** Total 21 varieties including 10 candidate and 11 reference varieties were tested. Out of 10 candidate varieties 4 were tested for second season and 6 for first season. 19 morphological and 3 biochemical characteristics namely Peroxidase activity of seed coat, seed protein and oil content have been recorded for study of distinctiveness, uniformity and stability test.

• Identified new traits for DUS testing of soybean e.g. 1. Inflorescence Pattern: (i) Sessile and (ii) Pedunculate; 2. Leaf size : (i) Small (ii) Medium and (iii) Large; 3. Leaf Blistering : (i) Smooth surface and (ii) Rough surface and also to create new categories of existing plant character like hypocotyl anthocyanin pigmentation, leaf shape, pod pubescence, pod colour, seed colour, seed hilum colour for proper identification of varieties which is very critical with development of new varieties in era of plant variety protection and intellectual property right. Following are the few traits which were identified as new traits for DUS testing in soybean (Fig. 3.1.5.1 to Fig. 3.1.5.7)

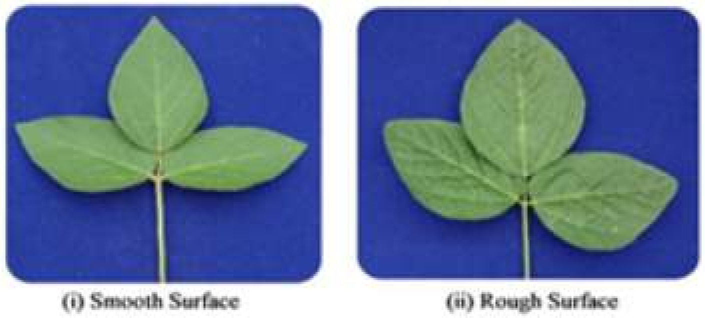


Fig. 3.1.5.1: Leaf: Surface texture :

(I) Weak Pubescence **(ii) Strong Pubescence**

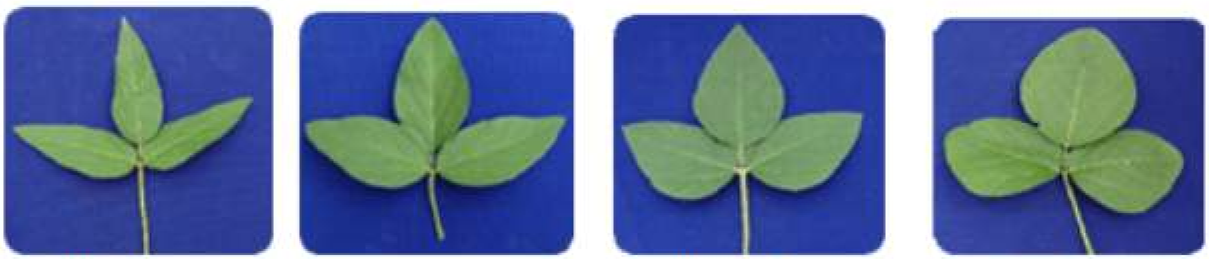
Fig. 3.1.5.2: Pod: Pubescence intensity

(i)Pedunculate Inflorescence **(ii) Sessile Inflorescence**

Fig. 3.1.5.3: Inflorescence Pattern

Low Medium High

Fig. 3.1.5.4: Hypocotyl Anthocyanin Pigmentation



(i) Lanceolate (ii) Elliptical (iii) Pointed ovate (iv) Round ovate

Fig. 3.1.5.5: Leaf Shape

Yellow Brown Dark Brown Black

Fig. 3.1.5.6: Pod Colour

Yellow	Yellow- Green	Green	Brown	Black

Fig. 3.1.5.7: Seed Colour : Seed Coat Colour

3.2 CROP PRODUCTION

3.2.1 AGRONOMY

IISR4.13/17 Evaluation of residue management practices under permanent broad bed furrow as well as conventional tillage practices for sustaining/ improving resource use efficiency, soil quality, and crop productivity in soybean-based cropping systems

PI: *Rakesh K. Verma, Co-PIs: Raghavendra Nargund, A. Ramesh, M. P. Sharma and Prince Choyal*

The field experiment was conducted during the *kharif* and *rabi* seasons of 2024-25 to evaluate the effects of cropping systems, crop establishment methods/land configurations, and residue management practices on the yield of soybean-based cropping systems. The experiment comprised three cropping systems (soybean-potato-wheat, soybean-wheat and soybean-chickpea) in the main plot and four crop establishment methods [Permanent broad bed furrow with residue retention (PBBF with RR), permanent broad bed furrow without residue retention (PBBF with No-RR), conventional tillage as per farmer's practices with residue retention (CTFP with RR) and conventional tillage as per farmer's practices without residue retention (CTFP with No-RR)] in sub plot. The 50% of the soybean crop residue (1.0 t/ha) was left in the field during the subsequent rabi season, followed by 50% of the gram (1.0 t/ha), and 30% of the wheat crop residue (2.5 t /ha) was left in the field during the subsequent *kharif* season. Among cropping systems, the highest soybean yield was found under the soybean-chickpea cropping system, followed by the soybean-potato-wheat system. The highest soybean yield was registered under PBBF with RR, followed by PBBF with No-RR. The yield was increased by 20.0% under PBBF with RR as compared to CTFP with No-RR. The higher yield of rabi season crops (wheat, wheat after potato and chickpea) was registered under PBBF with RR as compared to CTFP with No-RR. However, potato tuber yield was found to be non-significant among the different land configurations and residue retention practices. The wheat, potato, wheat after potato and chickpea yields were increased by 17.8%, 12.3%, 17.4% and 31.8% under PBBF with RR, respectively (Table 3.2.1.1).

Table 3.2.1.1 Effect of cropping systems, land configuration and residue management practices on yields of *kharif* and *rabi* season crops.

Treatment	Soybean seed yield (q/ha)	Rabi season crop yield (q/ha)			
		Potato	Wheat	Wheat yield after potato	Chickpea
Cropping systems					
Soybean-potato-wheat	27.56b	268.13	-	53.15	-
Soybean-chickpea	29.70a	-	-	-	23.45
Soybean-wheat	24.55c	-	63.07	-	-
Crop establishment methods/land configurations (LC)					
PBBF with RR	29.94a	280.86a	68.7a	57.60a	26.5a
PBBF with No- RR	27.40b	253.09a	66.7b	56.66a	26.1a
CTFP with RR	26.85b	288.58a	58.6c	49.32b	21.1b
CTFP with No- RR	24.92c	250.00a	58.3c	49.05b	20.1b

PBBF=Permanent broad bed furrow; CTFP= Conventional tillage as per farmer's practices; RR= Residue retention; WR/No RR=Without residues/ no residue retention

Table 3.2.1.2 Effect of different cropping systems, land configuration and residue management practices on system productivity, production efficiency and economics under soybean based cropping systems.

Cropping system (CS)/ Land configuration (LC)	System productivity (t/ha)	Production efficiency (kg SEY/ha/day)	System cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	B: C ratio
Cropping systems					
Soybean-Potato-Wheat	13.51	49.66	138432	687101	4.97
Soybean-Wheat	5.75	26.63	62654	307179	4.88
Soybean-Chickpea	5.64	27.11	59002	285423	4.86
Sem±	0.21	0.78	-	-	-
CD	0.82	3.07	-	-	-
Crop establishment methods/land configurations (LC)					
PBBF with RR	9.00	37.39	85338	462674	5.41
PBBF with No-RR	8.44	35.14	83408	435056	5.25
CTFP with RR	8.15	33.63	89662	417925	4.50
CTFP with No-RR	7.61	31.71	88375	390615	4.44
Sem±	0.13	0.50	-	-	
CD	0.46	1.73	-	-	

PBBF=Permanent broad bed furrow; CTFP= Conventional tillage as per farmer's practices; RR= Residue retention; WR/No RR=Without residues/ no residue retention

The highest system productivity (SP), production efficiency (PE), gross returns and cost of cultivation were registered under the soybean-potato-wheat system as compared to the remaining cropping systems. Among the different land configurations, the highest SP, PE, gross returns and B:C ratio were found under PBBF with RR. The higher cost of cultivation was associated with the CTFP with RR (Table 3.2.1.2).

IISR6.10/23 Standardization of natural farming practices for soybean-based cropping systems

***PI:** Raghavendra Nargund, Co-PI: R. K. Verma, A. Ramesh, M. P. Sharma, L.K. Meena, Sanjeev Kumar and Hemant S Maheshwari*

ICAR–National Soybean Research Institute (NSRI), Indore, initiated a field experiment on natural farming in soybean-based cropping systems during the Kharif season of 2023. After three years of experimentation (up to *Kharif* 2025), a customized natural farming package of practices specifically tailored for soybean was developed. The package included seed treatment with Beejamritha @ 62–75 L/ha, soil nutrient management through application of Ghanajeevamritha @ 500 kg/ha and Jeevamritha @ 10% spray (50L in 500L of water/ha.); weed management using green manuring, dora operation, and crop residue mulching; insect pest management through Agniastra spray @ 15–20 L/ha along with trap crops; and rhizoctonia aerial blight disease management by using a 15% spray (75L in 500L of water/ha.) of three-day-old buttermilk infused with a copper rod. Implementation of this customized natural farming package resulted in a substantial improvement in soybean productivity, with yields increasing from 6.57 q/ha in 2023 to 23.3 q/ha in 2025 under the natural farming system (Fig. 3.2.1.1).

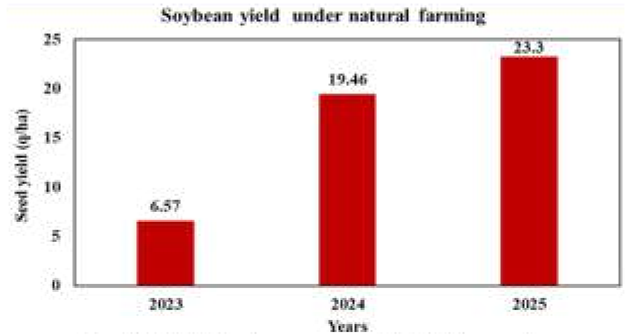


Fig. 3.2.1.1 Soybean seed yield under natural farming practices.

IISR Activity: Evaluation of elite soybean genotypes under a conservation agriculture system

***PI:** Raghavendra Nargund, CoPI: R. K. Verma, Rajpal Meena, M. Shivakumar and V. Nataraj*

A field experiment was conducted during the kharif seasons of 2023–2025 to evaluate 30 advanced soybean breeding lines along with two standard checks under a well-established long-term (>5 years) conservation agriculture (CA) based soybean–wheat cropping system at ICAR–NSRI, Indore. The results revealed that all genotypes, including the checks, performed satisfactorily under the CA system. Notably, five genotypes, such as G42, G35, G13, G31, and G18, exhibited superior performance, recorded grain yield > 2000 kg/ha under a conservation agriculture ecosystem (Fig. 3.2.1.2).

IISR Activity: Development of a standard package of practices for spring/summer soybean Production

***PI:** Raghavendra Nargund, Co-PI: R. K. Verma, Prince Choyal and Rajpal Meena*

The field experiment was initiated during the spring/summer of 2024 to standardization of agronomic practices for seed multiplication of the latest released variety (NRC 150) during the summer season. The experiment was conducted using a split-split plot design. The main plots consisted of three spacing (45 × 5–10 cm, 30 × 5–10 cm and 20 x 5-10cm). The sub-plots included three sowing dates (10th January, 25th January, and 5th February). The sub-sub plots comprised different nutrient management practices (100% RDF (Recommended Dose of Fertilizer), 100% RDF + GA_3 spray at 30–35 days after sowing (DAS) and 60–65 DAS, 100% RDF + Brassinosteroid (Br.) spray at 30–35 DAS and 60–65 DAS, 100% RDF + Thiourea spray at 30–35 DAS and 60–65 DAS and 125% RDF with 100% N and 125% P/K applied as basal + 25% RDN at 60 DAS). The second year (*Kharif* 2025) results indicated that sowing between 25th January and 5th February, under a spacing of 30 × 5–10 cm, combined with 100% RDF + Brassinosteroid spray at 30–35 DAS and 60–65 DAS, reported the highest soybean yield between 14.07-16.26q/ha compared to other treatments (Fig. 3.2.1.3).

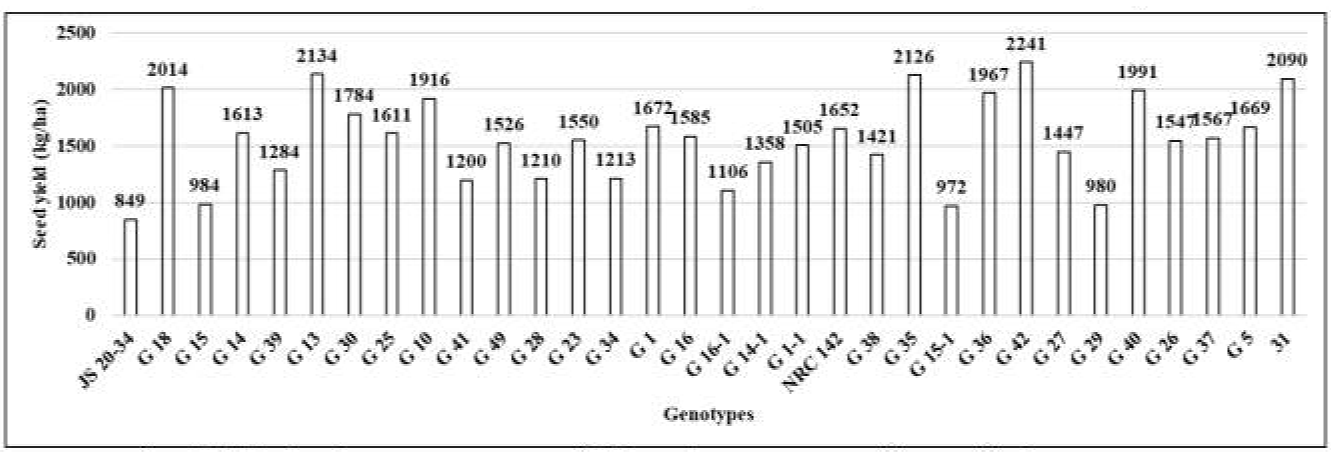


Fig. 3.2.1.2: Soybean genotypes yield under a conservation agriculture system (Pooled mean data of 3 years)

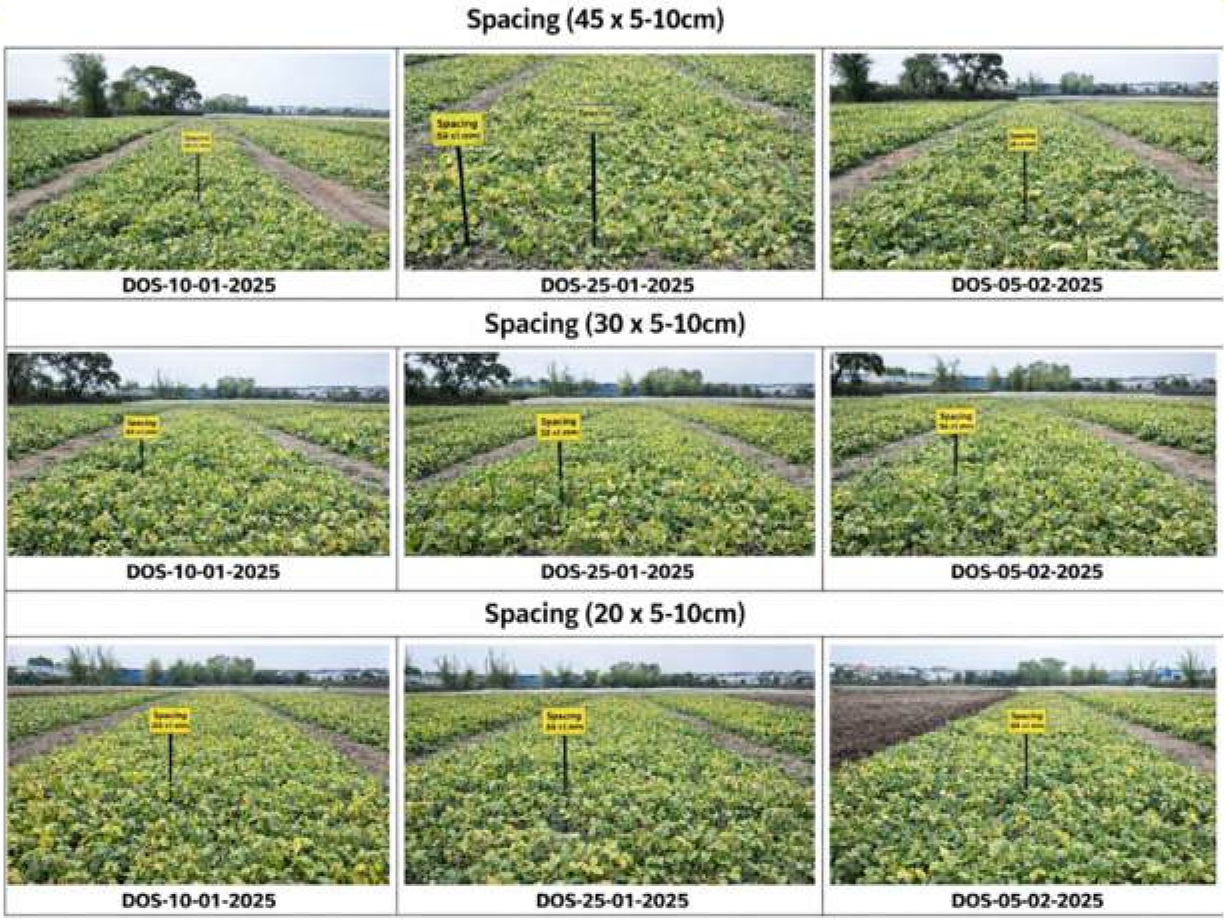


Fig. 3.2.1.3. Overview of spring/summer soybean experimental field

IISR /24 Improving resource use efficiency of soybean in central India

PI: *Rajpal Meena*

Co-PI: *R. K. Verma, Raghavendra Nargund and Prince Choyal*

The study comprised two complementary field experiments conducted during 2025. The first experiment was carried out during the off-season (January–April) to identify the most critical growth stages of soybean *(cv. JS 21-72 & NRC 150)* for moisture stress and to determine optimal irrigation scheduling for maximizing water productivity. The second experiment was conducted during the *kharif* season to develop an ideal integrated crop management (ICM) strategy for minimizing biotic stresses under a changing climatic scenario with two soybean cultivars *(cv. NRC 270 & NRC 157)*. Results from the off-season experiment revealed that seed yield, above-ground biomass (AGBM), and water use efficiency (WUE) were significantly influenced by soil moisture regimes.

The highest seed yield (1,348 kg/ ha) and AGBM (5,293 kg/ ha) were recorded with an irrigation application of 40 mm per event with total of 3 events. Water use efficiency across treatments ranged from 0.56 to 0.84 kg/m³, with reduced irrigation regimes exhibiting comparatively higher WUE. Analysis of irrigation scheduling across growth stages indicated that V1, R2, and R5 were the most critical stages for soil moisture availability. Irrigation applied at these stages resulted in significantly higher seed yield, AGBM, and WUE compared to all other treatments, including the positive control that received nine irrigations. These findings suggest that application of 40 mm irrigation at the V1, R2, and R5 growth stages is crucial for sustaining higher seed yield and WUE during dry spells (Table 3.2.1.3.). In the ICM experiment conducted during the *kharif* season, with 2 cultivars (NRC 270 & NRC 157). first-year results demonstrated that appropriate crop geometry combined with targeted plant protection measures effectively mitigated the adverse effects of biotic stresses on soybean productivity in central India. Among the treatments, a crop geometry of 45 × 5 cm along with a precautionary spray of Thiophanate-methyl at 30 DAS (pre-flowering), followed by *Bacillus amyloliquefaciens* at 45 DAS, proved most effective and resulted in the maximum seed yield of 2,978 kg/ha (Fig. 3.2.1.4.).

Table 3.2.1.3. Performance of soybean genotypes under different moisture levels and irrigation numbers on seed yield, above-ground biomass and water use efficiency during the summer

Treatments	Yield (kg/ha)	AGBM (kg/ha)	WUE (kg/m3)
V1: NRC 150	1351[a]	5323[a]	0.73[a]
V2: JS21-72	1209[b]	4761[b]	0.68[a]
Moisture level			
M1: 30 mm/Irrigation	1153[b]	4636[b]	0.84[a]
M2: 40 mm/Irrigation	1348[a]	5293[a]	0.71[b]
M3: 50 mm/Irrigation	1339[ab]	5197[ab]	0.56[c]
No. of Irrigations @ Critical Growth Stages			
I1: Control (Eight Irrigations)	1380[ab]	6019[a]	0.39[c]
I2: Three Irrigations @V1, R2, R5	1423[a]	5236[ab]	1.24[a]
I3: Four Irrigations @V4, R1, R4, R7	1121[b]	4499[b]	0.73[b]
I4: Five Irrigations @V2, V6, R2, R5, R7	1316[ab]	5135[ab]	0.66[b]
I5: Six Irrigations @ V3, R1, R3, R5, R7, R8	1160[ab]	4322[b]	0.50[ac]

PBBF=Permanent broad bed furrow; CTFP= Conventional tillage as per farmer's practices; RR= Residue retention; WR/No RR=Without residues/ no residue retention

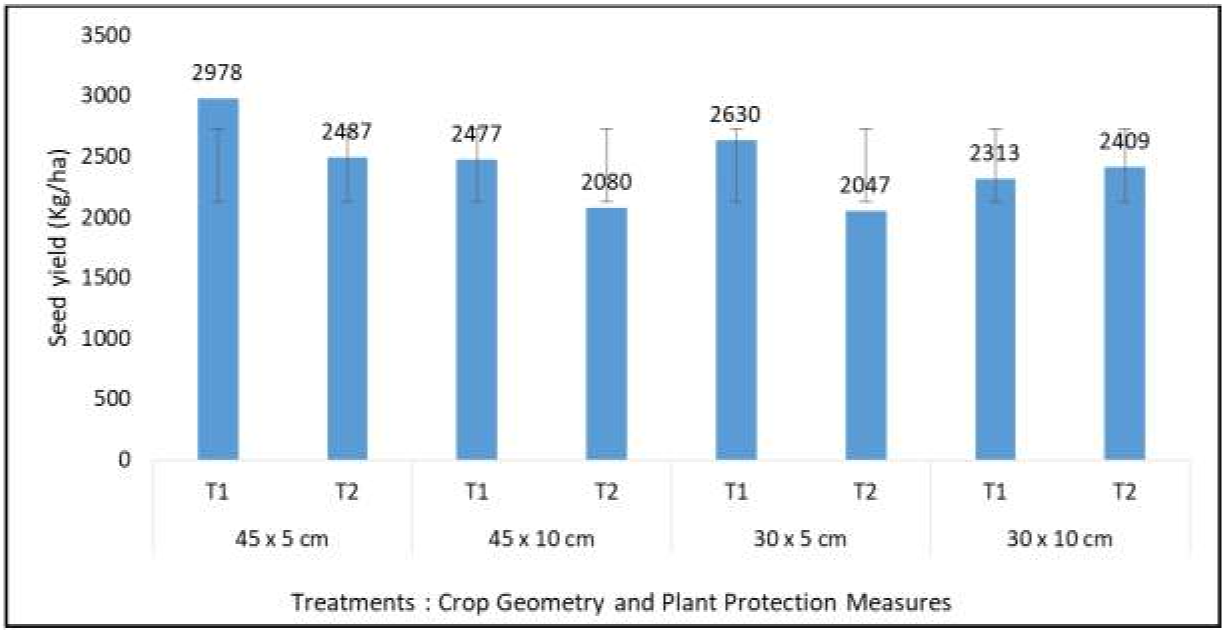


Fig. 3.2.1.4. Effect of integrated crop management practices to minimize biotic stress and improve yield in kharif soybean (T1: Thiophanate methyl (Pre-flowering) fb *Bacillus amyloliquefaciens* at 45 DAS, T2: Need-Based Chemical Spray).

3.2.2 SOIL SCIENCE

IISR9.11/20 Field evaluation of potential plant growth promoting Rhizobacteria (Microbial Consortia) and AM fungi on nutrient dynamics and mineral biofortification under soybean –wheat cropping system

PI: *Dr. A. Ramesh*

Co-PI: *Dr. M.P. Sharma and Dr. Raghavendra Nargund*

A long-term field experiment (2020–2024) was conducted to assess the efficacy of co-inoculation of selected plant growth-promoting rhizobacteria (PGPR) and arbuscular mycorrhizal fungi (AMF) on seed yield of soybean and wheat under a soybean–wheat cropping system. The study was established in a randomized complete block design (RCBD) with 11 treatments and four replications. Results demonstrated that microbial consortia comprising Bacillus aryabhattai + Bradyrhizobium liaoningense + AMF, Burkholderia arboris + Bradyrhizobium liaoningense + AMF, and Bacillus aryabhattai + AMF markedly improved seed yield in both soybean and wheat compared with other treatments (Table 3.2.2.1). Further, study highlighting the synergistic potential of multi-strain microbial inoculation for enhancing productivity under intensified cereal–legume systems.

Table 3.2.2.1 PGPR and AMF on seed yield of soybean and wheat (Pooled data of 5 years)

Tr. No.	Treatment	Soybean Yield (kg/ha)	Wheat Yield (kg/ha)
1	Control	1596^{e}	4865^{e}
2	*Burkholderia arboris*	1743^{d}	5065^{d}
3	*Bacillus aryabhattai*	1787^{cd}	5249^{c}
4	*Bradyrhizobium lioningense*	1549^{e}	4791^{e}
5	*Burkholderia arboris+ Bradyrhizobium lioningense*	1737^{d}	5211^{c}
6	*Bacillus aryabhattai* + Bradyrhizobium lioningense	1831^{bc}	5401^{ab}
7	*Burkholderia arboris* + AMF	$1804^{bcd\ ab}$	5362^{b}
8	*Bacillus aryabhattai* +AMF	1871^{ab}	5483^{a}
9	*Bradyrhizobium lioningense* +AMF	1589^{e}	5084^{d}
10	*Burkholderia arboris* + *Bradyrhizobium lioningense* +AMF	1846^{bc}	5372^{b}
11	Bacillus aryabhattai + *Bradyrhizobium lioningense* +AMF	1928^{ab}	5493^{a}
	LSD (P=0.05)	**68.5**	**101**

Data are means of three replications. LSD: least significant difference at p =0.05 for comparing the treatment means using Duncan's multiple range test, ns (non-significant), T1: Absolute control; T2: TRIA; T3: AMF; T4: TRIA+AMF; T5:75% RDF; T6: TRIA+75% RDF; T7: AMF+75% RDF; T8: TRIA+AMF+75% RDF; T9:100% RDF.

3.2.3 MICROBIOLOGY

ISR6.9/17 Bacterial-mediated sulfur bioavailability in soybean

PI: *Hemant S. Maheshwari, Co-PIs: M.P. Sharma, A. Ramesh, Raghavendra Nargund and Sanjeev Kumar*

Significant achievements include the successful recovery of sulfur-oxidising bacteria from diverse ecological niches, comprising 13 isolates from extreme habitats and five from crop rhizospheres, demonstrating their broad adaptive potential (Fig. 3.2.3.1.). Similarly, a substantial diversity of siderophore-producing bacteria was identified, with 15 isolates from extreme environments and six from the crop rhizosphere and endosphere, underscoring their ecological relevance and plant-associated functional attributes. Furthermore, the development of a serial enrichment incubation technique (SEIT) enabled the rapid and efficient isolation of plant growth-promoting bacteria, substantially reducing researcher time and laboratory resource requirements and providing a robust, scalable methodological advancement for microbial bioprospecting (Fig. 3.2.3.1).

Molecular characterization of bacteria recovered from extreme and crop rhizosphere

Characterized the sulfur-oxidising bacteria (SOBs), sulfur-solubilizing bacteria (SPBs), zinc solubilizing bacteria (ZSBs), multiple plant growth-promoting bacteria (PGPBs), and a unique bacterium through 16s rDNA. Currently, 16 SOBs, 15 SPBs, 8 ZSBs, 2 PGPBs, and two unique bacteria are available at the ICAR-NSRI microbiology lab.

Pot and field evaluation of plant growth-promoting bacteria isolated from extreme habitats. During 2024–25, a total of nine field trials and seven pot trials were conducted across both kharif and rabi seasons. The salient findings from these field and pot experiments in soybean revealed that sulfur-oxidizing bacterial (SOB) isolates enhanced grain yield by 6–17% in soybean. Notably, Bacillus amyloliquefaciens in combination with 20 kg sulfur/ha (Fig. 3.2.3.2.) resulted in a maximum yield increase of 17% in soybean. Among Alliaceae-associated SOBs, Citrobacter freundii with 20 kg/ ha sulfur enhanced grain yield by 8.40%, whereas Enterobacter sp. with sulfur application recorded a 6.69% increase. In contrast, sole application of elemental sulfur without effective sulfur-oxidizing inoculants did not improve soybean grain yield, highlighting the critical role of microbial mediation. Furthermore, bacteria isolated from extreme habitats consistently exhibited a greater magnitude of yield enhancement than those derived from crop rhizospheres. In addition, siderophore-producing bacteria such as Priestia megaterium increased soybean grain yield by 11.41% over the uninoculated control. Zinc-solubilizing Achromobacter sp. significantly enhanced soybean yield by 12.76%, while the plant growth–promoting rhizobacterium Bacillus subtilis resulted in a 10.54% yield increase compared with the uninoculated control (Fig. 3.2.3.3.). Furthermore, the Rabi season trials demonstrated significant yield enhancements across crops due to microbial inoculation in combination with sulfur application. In chickpea, Bacillus amyloliquefaciens supplemented with 15 kg/ha elemental sulfur increased grain yield by 10.40% over the absolute control and by 8.0% compared with the recommended practice. In mustard, sulfur-oxidising Bacillus pumilus combined with 30 kg sulfur/ha resulted in a pronounced grain yield increase of 26.35% over the absolute control and 10.68% over the recommended practice. Additionally, siderophore-producing Pseudomonas sp. enhanced grain yield by 13.44% compared with the absolute control and by 11.72% relative to the recommended practice, confirming its agronomic potential under rabi conditions.

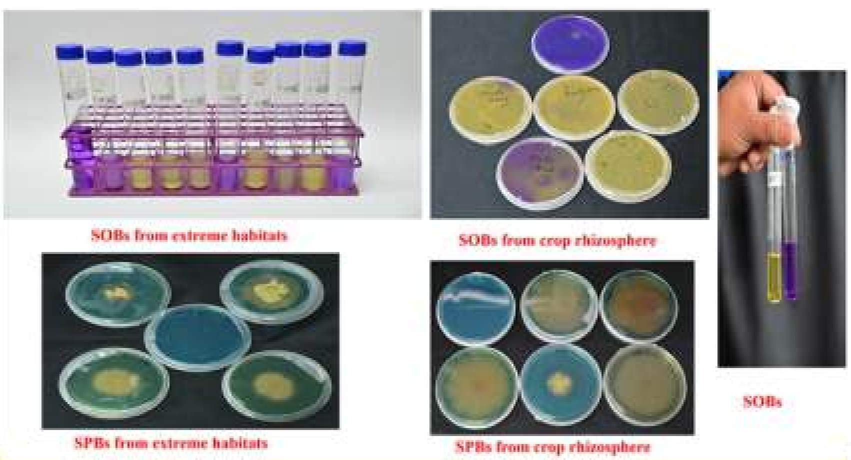


Fig. 3.2.3.1. Sulfur-oxidizing bacteria (SOBs) and siderophore-producing bacteria (SPBs) recovered from extreme (coal & iron mines, and hot water springs) and crop rhizosphere.

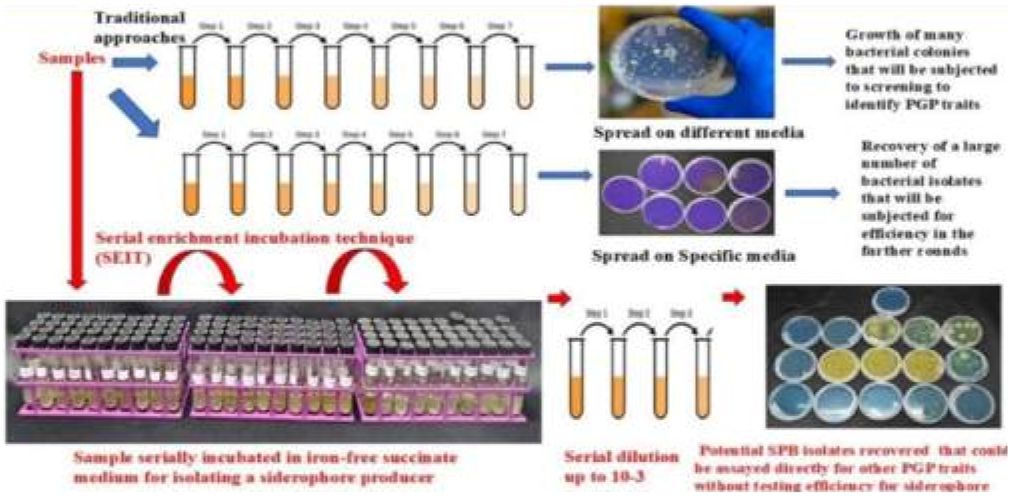


Fig. 3.2.3.2 Serial enrichment incubation technique (SEIT) for rapid isolation of plant growth-promoting bacteria.

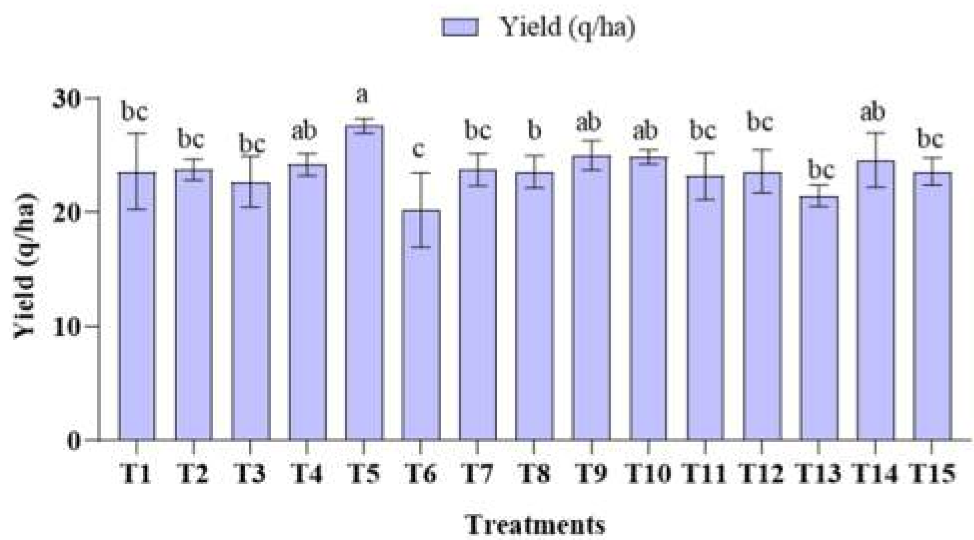


Fig. 3.2.3.3. Evaluation of sulfur-oxidizing bacteria (SOB) isolated from extreme habitats (Coal and iron mines and hot water springs) on soybean yield parameters.

Protocols/Methodology developed

Protocol 1: Serial enrichment incubation technique (SEIT) for rapid isolation of plant growth-promoting bacteria: Saving researcher time and lab resources

Traditional methods of Plant growth-promoting bacteria (PGPB) isolation involve serial dilution and spreading on common or specific media, which result in more than 10 bacteria per sample, and screening for the desired bacterium takes a long time (4-6 months) and requires significant lab resources. The current improved protocol, termed Serial Enrichment Incubation Technique (SEIT), involves incubating the sample in a specific nutrient medium for 5 days, then transferring it into a fresh medium twice for 5 days each, and finally serially diluting the final tube and spreading the suspension onto Petri plates containing specific media. This protocol gives the desired nutrient-transforming bacteria compared to traditional published protocols. Isolation of the siderophore-producing bacteria (SPB) by incubating in an iron-free succinate medium allows the elimination of non-siderophore-producers, and these isolates also potential candidates for biocontrol against phytopathogens. Solubilizers of phosphorus, potassium, zinc, and calcium can be isolated rapidly using SEIT (Fig. 3.2.3.2).

SPB can be isolated by incubating in iron-free succinate media and could be used for iron nutrition and biocontrol against phytopathogens. Nutrient-solubilizing bacteria can be isolated through SEIT in less than 20 days by incubating in media containing an insoluble nutrient source. Slow-growing PGPB can be isolated.

Protocol 2. Serial Coincubation Enrichment Technique (SCET): Rapid isolation of bacterial biocontrol agents

The Serial Coincubation Enrichment Technique (SCET) mimics the rhizomicrobiome interaction between antagonistic bacteria and the target fungal pathogen, and subsequent enrichment allows only the predominant bacteria with antagonistic activity to survive within 20 days or less. Here, three soybean phytopathogens, Rhizoctonia Solani, Colletotrichum truncatum, and Sclerotium rolfsii, were taken. Their discs were placed in a 1:1 ratio of 100 ml nutrient broth and potato dextrose broth, grown for at least 24 h, and then incubated with a 1 g rhizospheric soil sample from healthy, disease-free soybean plants. The enrichment was performed by transferring 1 mL of the previous suspension to freshly prepared media containing the 24 h target pathogen, which had already grown for 5 days, and the process was repeated twice. The final suspension was diluted in a nutrient agar plate containing nystatin (Fig. 3.2.3.4.).

Targeted pathogen co-incubation with rhizospheric sample allows survival of bacteria with biocontrol properties against the target fungal pathogen within 20 days. SCET setup mimics the rhizomicrobiome or classical dual assay, where already existing pathogens interact with the antagonistic bacteria of the rhizosphere. Samples can be screened by comparing sole fungal growth in the medium against the fungal growth in a final enriched co-incubated setup.

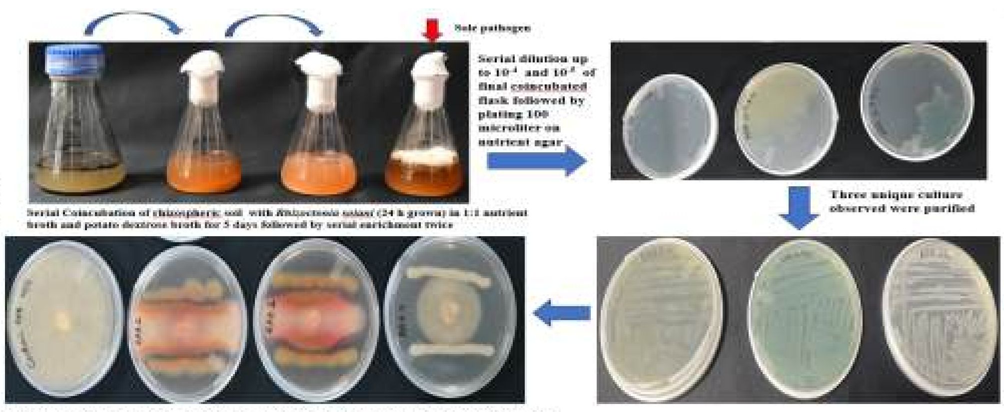


Fig. 3.2.3.4. Serial Coincubation Enrichment Technique (SCET) : Rapid isolation of bacterial biocontrol agents

NSRI 6.10/25: Development of nutrient-transforming microbial consortia for sustaining soybean-based cropping systems".

PI: *Hemant Singh Maheshwari*

Co-PI: *Dr. Mahaveer Prasad Sharma, Dr.Aketi Ramesh, Dr.Raghvendra, Dr. Sanjeev Kumar*

Three Phosphorus-solubilizing bacteria from extreme habitats and 01 soybean endophytes were isolated along with four potassium-solubilizing bacteria. Further, five sulfur-oxidizing bacteria were isolated from the crop rhizosphere and seven zinc-solubilizing bacteria isolated from extreme habitats. Also three calcium solubilizers were isolated from the endosphere of Glycine soja EC1165791, G. tabacina, and G. lentifolia, and one from extreme habitats (Table 3.2.3.1 and Fig. 3.2.3.5). Field experimentation showed 10-18% yield increase over recommended practice and a 25% reduction in fertilizer use.

Table 3.2.3.1: Plant growth-promoting traits characterization of nutrient-transforming bacteria isolated from extreme habitats, crop rhizosphere, and endosphere.

Type of nutrient	Culture Name	N-fixation	Phosp-horus	Potass-ium	Sulfur	Sidero-phore	Zinc	Calcium
Iron	COA1	-	+	-	ND	+	+	-
	COA2	-	+	-	ND	+	+	-
	COA3	-	+	-	ND	+	+	-
	COA4	-	+	-	ND	+	+	-
	COA5	+	+	-	ND	+	+	-
	COA6	-	+	-	ND	+	+	-
	Fe-2 R	+	-	-	ND	+	+	-
	Fe-8 S	+	+	-	ND	+	-	-
Sulfur	1S	+	+	-	+	-	-	-
	2S	-	-	-	+	-	-	-
	3S	-	-	-	+	-	-	-
	5S	+	-	+	+	-	+	-
	6S	-	-	-	+	-	-	-
Phosph-orus	12P BTB	-	+	-	ND	+	+	-
	12P BPB	-	+	-	ND	+	+	-
	9P (BPB)	+	+	+	ND	-	+	-
	P-8 R	+	+	+	ND	+	-	-
Potassium	15K	+	-	+	ND	-	+	-
	13K	-	+	+	ND	-	-	-
	9K	-	+	+	ND	-	+	-
	14K	-	+	+	ND	-	+	-
Calcium	Ca-2 R	+	-	-	-	-	-	+
	Ca-7 S	-	-	-	-	-	-	+
	Ca-4 R	-	+	-	-	-	-	+

Where + means positive for the traits and – means negative, ND indicates not done.

A) Calcium-solubilizing bacteria

B) Phosphorus-solubilizing bacteria

C) Siderophore-producing bacteria

Fig. 3.2.3.5. Isolation of plant growth-promoting bacteria from soybean wild and modern cultivars.

Qualitative nutrient solubilization assay

Among all the recovered nutrient-transforming bacteria, 12 PBTB, followed by 12 PBPB, and COA-4 showed significantly higher phosphorus solubilization indices. For potassium solubilization, 9PBPB followed by 9K showed a higher solubilization index than other recovered cultures. Similarly, zinc solubilization assay, 12PBPB, and 12PBTB showed significantly higher solubilization, followed by COA1 and COA6. Siderophore production showed that COA1, 12PBTB, and 12PBPB produced significantly more siderophores than other recovered isolates.

Among soybean endophytes isolated, the calcium solubilization index was significantly higher in Ca-4R and Ca-2R, and the lowest was observed in Ca-7S. The phosphorus solubilization index was higher in Fe-8S, followed by P-8R and P-1R. Similarly, the siderophore index was significantly higher in the P-8R, followed by Fe-2R and Fe-8S.

Dual assay of nutrient-transforming bacteria against phytopathogens

The dual assay revealed that among all recovered bacteria, COA 1, COA 3, COA 4, and COA 6 exhibited significantly higher antagonistic activity against the *Rhizoctonia solani* phytopathogen. Similarly, COA4 showed activity against Macrophomina phaseolina, COA4 and COA6 against Diaporthe, and COA6 against *Fusarium sojae* pathogen, COA6 and 9PBPB against Fusarium ciceri, COA1 and 9PBPB against *Sclerotium rolfsii* showed significantly higher antagonistic activities. Furthermore, all iron- and phosphorus-solubilizing bacteria exhibited antagonistic action against *Colletotrichum truncatum*. Further, for SOBs, only 1S and 2S showed antagonistic to *Rhizoctonia solani*.

Dual assay of previously isolated sulfur-, iron-, zinc-, and other nutrient-transforming samples showed that H1, H3, H5, H7, and H8. H9, GARLIC, SID+2, SID+3, SID +5, SID+7, SID BHMW, SID JPM, SID BH(AMD), BH(AMD)ZN, BH(AMD)R2, and ZN BIC R1. Similarly, H2, H7, A4, SID+2, SID+BHMW, SID +JPM, and BH(AMD)ZN showed antagonistic activities against Macrophomina phaseolina. These results showed that Achromobacter sp. (H7), Pseudomonas sp. (SID+BHMW), Pseudomonas sp. (SID+JPM) and Agrobacterium tumefaciens (BH(AMD)ZN) exhibited antagonistic activity against both the RAB and charcoal rot pathogens.

Influence of nutrient-transforming bacteria on the growth of soil-borne phytopathogens

Iron: Lesion length was significantly lower in the application of iron in either unavailable or unavailable form against Rhizoctonia solani in soybean plants (JS 93-05). However, lesion length was not significantly decreased in *Macrophomina phaseolina* challenged plants. All SPB inoculations also significantly reduced Rhizoctonia solani lesions. However, in the T5-T8 SPB bacteria treatment along with insoluble iron source, a significant decrease in lesion length was observed against Macrophomina phaseolina in soybean (JS 95-60).

Phosphorus: In both available and unavailable phosphorus nutrient sources, 12PBPB and H9 bacterial-inoculated soybean plants (JS 93-05) significantly decreased lesion length against *Rhizoctonia solani*. Similarly, inoculation with 12 PBTB and 5P significantly decreased lesion length in Macrophomina phaseolina challenged soybean plants (JS 95-60)

Calcium: All three calcium-solubilizing bacteria significantly decreased the RAB lesion length in soybean (JS-335) compared with the uninoculated control and the uninoculated calcium-amended treatment.

Nutrient-transforming bacteria with antagonistic properties.

Adequate nutrition in soybeans, viz calcium, iron, phosphorus, and sulfur through bacteria, decreases the Rhizoctonia solani lesion development in JS-335 and JS-9305. Some microbial cultures showed antagonistic activities against multiple soybean and chickpea phytopathogens such as *Fusarium oxysporum, Colletotrichum trucatum, Macrophomina phaseolina, Rhizoctonia solani, Diaporthe, and Sclerotium rolfsii* due to the production of cell wall-degrading enzymes, siderophore, and HCN production, and enhancing grain yield.

ICAR-NS 2017 Fellowship for pursuing doctorate at the University of Groningen, The Netherlands. Comparative analysis of Bacillus mycoides strains from contrasting habitats: Implications for plant growth promotion under abiotic stress

Dr. Hemant Maheshwari as a part of his Ph.D. Course, carried out the work which highlights the role of the plant's holobiont, particularly the microbiome within plant tissues, in modulating physiological responses to stress. In the present study, *Bacillus mycoides* strains isolated from potato *endospheres* and potato bulk soil were tested for their ability to mitigate the effects of abiotic stresses, including drought, salinity, iron, and heavy metal stress, in Chinese cabbage and *Arabidopsis thaliana.*

IISR 3.12/2020. Interaction effect of phytohormones and AMF for enhanced nodulation, growth, yield of soybean with improved AMF symbiosis in the rhizosphere

PI: *M.P. Sharma, Co-PIs: A. Ramesh, Prince Choyal and Hemant S. Maheshwari*

A field experiment was conducted during the *Kharif* 2025 season on soybean (*cv* NRC 150) using a randomized block design with nine treatments. The treatments comprised combinations of triacontanol (TRIA 2 ppm; 0.1% EW @ 2 mL/ L) applied twice as a foliar spray at 20–25 and 45–50 days after sowing (DAS), and AM fungi applied as a soil inoculation at 150 spores/m². These combinations were evaluated with a reduced fertilizer dose (75% RDF; 20-60-40 kg/ha N, P_2O_5, K_2O) and compared against 100% RDF and an absolute control. The study assessed the effects of TRIA with and without AM fungi on nodulation, nutrient uptake, grain yield, AM root colonization, and spore density. The role of triacontanol with AM fungi for enhanced nodulation, chlorophyll, glomalin and spore density was assessed on soybean plants to further improve the yield. Moreover, the integrated response of triacontanol (2 ppm) and AM fungi (150 spores per sqm) with RDF (75%) on soybean nodulation and yield was assessed in the field trial by using a randomized block design (RBD).

Phytohormones and AMF effect on soybean root nodulation parameters and growth: The combined application of TRIA and AMF (T4) significantly enhanced nodulation, increasing both the number and dry weight of nodules compared to individual applications. When TRIA was applied with 75% RDF (T6), leghaemoglobin content increased markedly, indicating improved symbiotic efficiency (Fig. 3.2.3.6). The highest improvements in nodulation parameters were recorded under TRIA + AMF + 75% RDF (T8), which showed maximum nodule number, nodule dry weight, and leghaemoglobin content, significantly outperforming all other treatments. The chlorophyll content and shoot dry weight increased substantially under treatments integrating TRIA, AMF, and reduced fertilizer levels. The T8 treatment yielded the highest chlorophyll content and shoot dry biomass, followed by TRIA + 75% RDF (T6) and AMF + 75% RDF (T7). These results reveal that integrating TRIA and AMF together supports plant to maintain photosynthetic capacity even under reduced fertilizer application (Table 3.2.3.2). These results indicate that NPK fertilizer inputs can be reduced by 25% without yield loss when TRIA and AMF are applied together, offering a cost-effective and environmentally sustainable soybean production strategy.

Table 3.2.3.2 Evaluation of triacontanol and AM fungi for enhanced mycorrhiza spore density, glomalin and yield under field trial during Kharif 2025.

Treatments	Spore density (no./g soil)	Glomalin (μg/g soil)	Yield (Kg/ha)
T1:Absolute control	5.89h	345.29h	1778.70d
T2:TRIA	10.33e	565.39e	1941.26c
T3:AMF	7.11g	548.18f	1927.97c
T4:TRIA+AMF	12.89bc	602.46b	2070.93b
T5:75% RDF	9.22f	403.69g	2133.89b
T6:TRIA+75% RDF	12cd	576.25d	2271.85a
T7:AMF+75% RDF	13.33b	590.85c	2252.41a
T8:TRIA+AMF+75% RDF	16.33a	640.64a	2338.33a
T9:100% RDF	11.78d	606.58b	2302.04a
LSD (p=0.05)	0.93	7.51	112.95

Data are means of three replications. LSD: least significant difference at p =0.05 for comparing the treatment means using Duncan's multiple range test, ns (non-significant), T1: Absolute control; T2: TRIA; T3: AMF; T4: TRIA+AMF; T5:75% RDF; T6: TRIA+75% RDF; T7: AMF+75% RDF; T8: TRIA+AMF+75% RDF; T9:100% RDF.

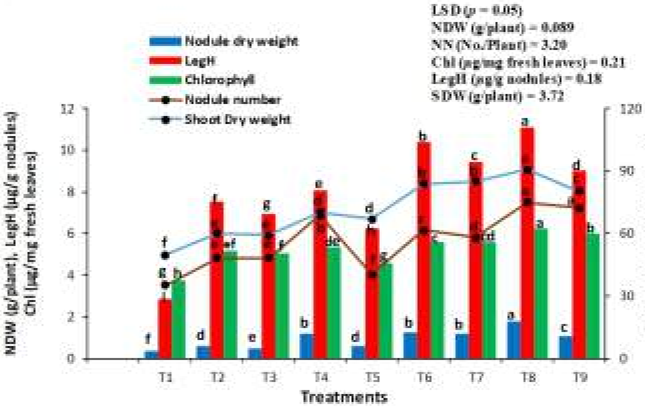


Fig. 3.2.3.6. Effect of different treatments on nodule and soybean growth parameters

Biopolymer coating of soybean seeds with microbial consortia for improved productivity of soybean and soil health (ICAR-NBAIM, Mau AMAAS Network Funded Project)

PI: *Mahaveer P Sharma*

Co-PI: *Aketi Ramesh and Dr Punam Kuchlan*

A compatibility study was conducted during 2024–25 to evaluate the growth response of three soybean-associated bacterial strains, Bradyrhizobium daqingense, Bacillus aryabhattai, and Burkholderia arboris applied individually and in consortia using broth media amended with varying concentrations (0, 0.2, 0.4, 0.6, 0.8, and 1%, w/v) of natural biopolymers, namely xanthan gum, guar gum, and gum acacia. Among the tested biopolymers, xanthan gum followed by guar gum exhibited superior compatibility with the rhizobial strain (B. daqingense), supporting enhanced growth under both liquid and solid culture conditions; however, growth response varied with concentration. Under solid medium (YEMA), significantly higher viable cell counts were recorded with 1% xanthan gum amendment. In liquid culture, media supplemented with xanthan or guar gum at 0.8–1% resulted in significantly greater growth compared with lower concentrations. Although xanthan gum (1%) produced higher growth than guar gum (0.8%), the differences were statistically non-significant. Amendment with gum acacia up to 0.4% improved growth relative to lower doses, but further increases reduced culture proliferation compared with xanthan and guar gums. Overall, the results indicate that B. daqingense is highly compatible with natural gums, with xanthan and guar gum at approximately 0.8% identified as the optimum concentration for maximizing culture population; increasing concentrations beyond this threshold did not significantly enhance growth. (Fig. 3.2.3.7)

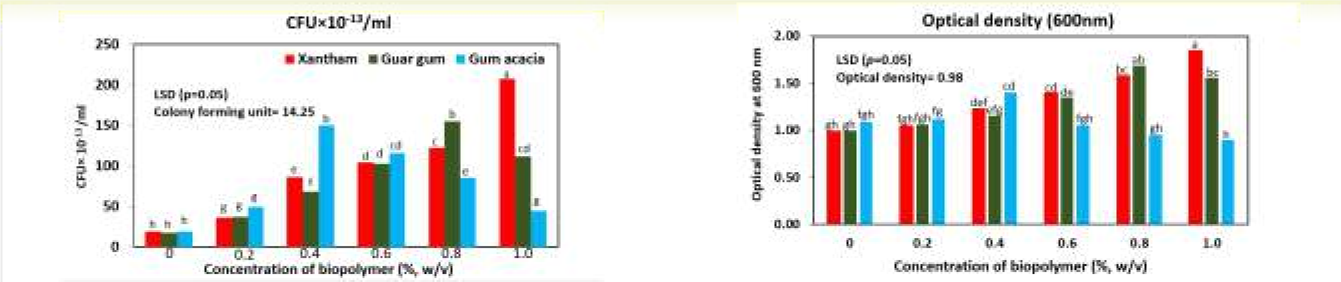


Fig. 3.2.3.7 1 Number of B. daqingense colony forming unit at 10-13 dilution factor in YEMA (topa) and Optical density in YEM broth (bottom) obtained in different concentration of various natural biopolymer under in vitro.

Development of environmentally friendly controlled release P-fertilizer and its evaluation with plant growth promoting microbes on soybean productivity and soil microbial health

(***DBT Project-*** *Collaborating Institutes: IISER, Bhopal, ICAR-NSRI, Indore, and TERI, New Delhi*)

PI: *Dr. M.P. Sharma*

CoPI: *Dr. Aketi Ramesh*

Controlled incubation and microcosm experiments were successfully designed to evaluate phosphorus (P) sorption–desorption behaviour, release kinetics, and transformation among different P pools following application of controlled-release phosphorus fertilizer (CRPF) hydrogels integrated with plant growth-promoting microorganisms (PGPM; AM fungi and soybean rhizobia) under sterilized and unsterilized Vertisol conditions. Results demonstrated that CRPF combined with microbial inoculants (Burkholderia arboris, Bacillus aryabhattai, and AMF) substantially modified soil P adsorption–desorption dynamics compared with conventional DAP and untreated control soils. Significant variability in sorption parameters was observed across treatments, with bonding energy (b) ranging from 0.21 to 5.27 L mg^{-1} and adsorption maxima (Kmax) from 172.41 to 526.32 mg kg^{-1}, indicating strong treatment-dependent regulation of P availability (Tables 1–2). CRPF + *Burkholderia arboris* emerged as the most effective treatment for minimizing P fixation, recording the lowest Kmax values and suggesting greater plant-available P. CRPF + AMF exhibited the highest sorption capacity (502.81 mg kg^{-1}), implying enhanced soil–P interaction and increased adsorption sites under mycorrhizal association. Freundlich isotherms provided a superior fit compared with Langmuir models for most treatments, reflecting heterogeneous sorption surfaces and variable P-binding energies in CRPF- and microbe-amended soils. Pronounced hysteresis between sorption and desorption confirmed partial irreversibility of P retention, whereas CRPF–microbial combinations increased desorption maxima and reduced bonding energy. CRPF-based treatments ensured gradual and sustained P release during incubation (10 and 15 days) relative to conventional DAP application. Comprehensive adsorption–desorption indices (Kmax, b, bKmax, sorption capacity, and desorption maxima) generated in this study provide a strong mechanistic basis for improving phosphorus use efficiency and developing site-specific fertilizer recommendations for Vertisols. Soybean microcosm studies revealed consistently higher nodulation in unsterilized soils than in sterilized soils, emphasizing the critical role of native soil microflora in P nutrition and symbiotic performance. Maximum nodulation was recorded with CRPF (50% DAP) + Burkholderia arboris + AMF under both soil conditions, highlighting synergistic effects of reduced fertilizer input and microbial inoculation. Overall, the integration of CRPF hydrogels with PGPM shows strong potential for regulating soil–plant P dynamics, enhancing nodulation, and reducing reliance on conventional P fertilizers in Vertisols. However, due to poor plant establishment, detailed rhizosphere observations on nodulation and P sorption–desorption could not be completed; therefore, the experiment will be repeated under unsterilized soil conditions (Table 3.2.3.3 and 3.2.3.4).

Table 3.2.3.3: P sorption analysis in soils inoculated with different microbial treatments with DAP and CRPS combinations of inorganic P-fertilizer treatments (at 10 days after incubation)

Treatment	At 10 days						
	Langmuir				Freundlich		
	Sorption Maxima mg kg-1	Bonding capacity mg L-1	maximum buffering capacity	R2	Sorption capacity mg kg-1	Sorption energy	R2
Control	243.90	0.44	107.53	0.949	90.78	1.72	0.995
Burkholderia arboris	243.90	0.51	125.00	0.979	107.15	1.79	0.99
B. aryabhattai	500.00	0.23	113.64	0.778	135.14	1.51	0.999
AMF 588.24	0.12	69.93	0.998	76.95	1.32	0.962	
Consortium 1	526.32	0.16	84.75	0.966	90.2	1.24	0.999
DAP 344.83	0.34	117.65	0.934	129.74	1.47	0.998	
DAP+Blderia arboris	526.32	0.17	89.29	0.978	100.88	1.24	0.999
DAP+B. aryabhattai	149.25	0.60	90.09	0.999	47.9	1.68	0.999
DAP+AMF	263.16	0.33	86.96	0.930	70.6	1.67	0.996
Consortium 2	344.83	0.32	111.11	0.785	122.18	1.48	0.983
CRPF	294.12	0.38	111.11	0.933	76.94	1.32	0.962
CRPF+Burkholderia arboris	588.24	0.15	88.50	0.965	102.83	1.22	0.999
CRPF+B. aryabhattai	263.16	0.37	96.15	0.768	67.45	2.94	0.867
CRPF+AMF	416.67	0.21	85.47	0.849	86.38	1.34	0.995
Consortium 3	294.12	0.37	109.89	0.933	105.24	1.53	0.997

Table 3.2.3.4: Desorption analysis in soils inoculated with different microbial treatments with DAP and CRPS combinations of inorganic P-fertilizer treatments (at 15 days after incubation)

Treatment	At 10 days						
	Langmuir				Freundlich		
	Sorption Maxima mg kg-1	Bonding capacity mg L-1	maximum buffering capacity	R2	Sorption capacity mg kg-1	Sorption energy	R2
Control	270.27	0.27	71.94	0.866	76.31	1.45	0.991
Burkholderia arboris	243.90	0.77	188.68	0.848	232.06	1.84	0.973
B. aryabhattai	222.22	0.94	208.33	0.982	221.51	1.89	0.999
AMF 322.58	3.88	125.00	0.929	214.58	1.47	0.998	
Consortium 1	344.83	0.53	181.82	0.965	302.98	1.67	0.999
DAP 204.08	0.73	149.25	0.928	156.86	1.99	0.983	
DAP+Blderia arboris	434.78	0.17	75.19	0.942	91.45	1.24	0.999
DAP+B. aryabhattai	370.37	0.75	277.78	0.997	378.44	1.39	0.999
DAP+AMF	344.83	0.33	113.64	0.834	159.04	1.41	0.991
Consortium 2	370.37	0.53	196.08	0.985	360.41	1.38	0.999
CRPF	294.12	1.17	344.83	0.999	580.5	1.58	0.987
CRPF+Burkholderia arboris	250.00	0.50	125.00	0.816	152.19	1.7	0.973
CRPF+B. aryabhattai	208.33	2.29	476.19	0.998	409.92	2.18	0.992
CRPF+AMF	232.56	1.19	277.78	0.852	317.32	2.07	0.964
Consortium 3	384.62	0.31	120.48	0.983	182.81	1.31	0.999

3.2.4 COMPUTER APPLICATION IN AGRICULTURE

IISR 7.7/23 Development of seed and product sale portal for e-marketing in soybean

PI: Savita Kolhe, Co-PIs: Mrinal Kuchlan, M.P Sharma, BU Dupare

A Web-based seed and product sale portal for soybean has been developed to promote online marketing using the potential of information technology. The system is developed using ASP.NET at the front end and SQL Server at the back end. The system has provision for selling Breeder Seed, Foundation Seed, Truthfully Labelled (TL) Seed and Certified Seed. It also has a separate facility for selling different soya-based food products, viz., Tofu, Milk, Upma mix, Cookies, Sev, Laddu etc. Google Translate API is integrated into the system for multi-lingual UI. The user can initially book the items to purchase. The booking is then confirmed by the authorized official and after this, he can complete the payment process with the generation of payment receipt. The system is linked to the E-payment gateway implemented at the institute to ease the financial transaction. It has a separate module to enter different products, its packaging size, cost, availability status, etc. Thus, it can be easily customized for any crop. The system is functional and is available at the institute's website https://icar-nsri.res.in/ The user needs to complete the registration process to get login details for using the system. Farmers and different clients are using the system across the country and they are satisfied with the easy-to-use system interface. The development of the system has promoted the use of soya food among different clientele across India which was a bigger challenge earlier. Moreover, the seed sale platform has opened a single window for farmers to get a good quality seed of different popular varieties and thus led to a transparent seed distribution system (Fig. 3.2.4.2 and 3.2.4.2).

IISR 7.9/24: SoyAI: Transforming Soybean Cultivation Through Advanced AI Modelling Development of Transfer-Learning-based AI-Model for Soybean Disease Diagnosis

PI: Savita Kolhe, Co-PIs: Sanjeev Kumar, Lokesh Kr Meena, Raghavendra Nargund, Punam Kuchlan, BU Dupare, Makhan Kumbhkar

Development of Transfer-Learning based AI-Model for Soybean Disease Diagnosis

A total of 24232 images (JPEG) of soybean diseases infected leaves were collected from the fields of ICAR-NSRI, Indore. The soybean image data was pre-processed to develop a soybean disease identification model using Deep Learning techniques. A transfer-learning-based AI model for Soybean Disease Diagnosis was developed for seven soybean diseases, such as Anthracnose, Cercospora Leaf Spot, Charcoal Rot, Purple Seed Stain, RAB, Yellow Mosaic Virus, and Frog Eye Leaf Spot. The performance of the model was evaluated and the results are shown in Fig. 3.2.4.6. An application user interface is developed using Flask to facilitate farmers to diagnose the disease occurrence in their fields using mobile phones or any device connected with Internet (Fig. 3.2.4.1 to 3.2.4.6).

Fig. 3.2.4.1 1 Home page of the Soybean seed and product sale portal with multilingual support

Fig. 3.2.4.2 Home page of the Soybean seed and product sale portal with multilingual support

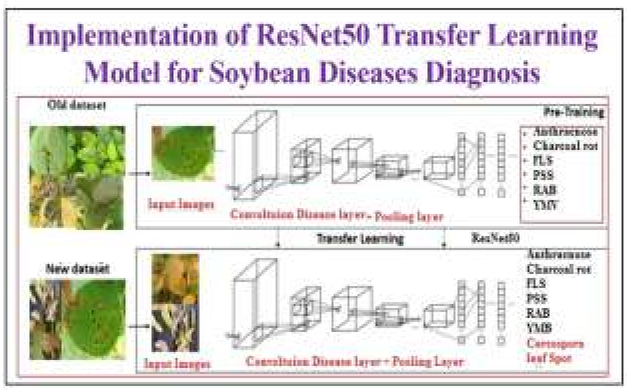


Fig. 3.2.4.3 Multilingual User interface for seed purchase

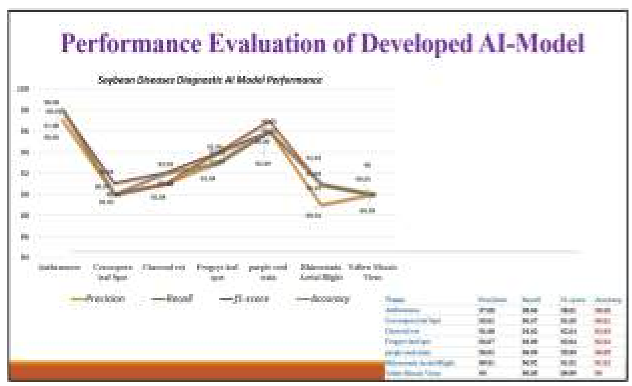


Fig. 3.2.4.4 Performance evaluation of the developed AI model for disease identification

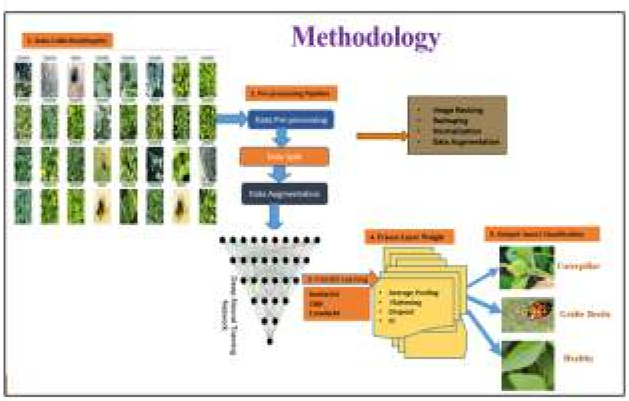


Fig. 3.2.4.5 Methodology used for the development of the soybean insect identification model using Deep Learning techniques

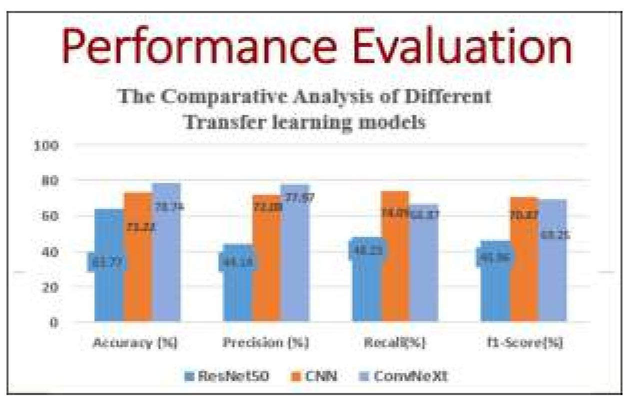


Fig. 3.2.4.6 Performance evaluation of different transfer learning models

Development of Transfer-Learning based AI-Model for Soybean Insect Detection

The total of 1,724 images (JPEG) of soybean insects and damaged leaves were collected from the fields of ICAR-NSRI, Indore and images of Caterpillar – 3309 and Gridle Beetle – 2205 were compiled from online repositories. The soybean image data was pre-processed to develop a soybean insect identification model using Deep Learning techniques as shown in the methodology Fig.. The performance of the different DL models was evaluated and the results are shown in Fig. 3.2.4.5 and 3.2.4.6

Development of User Interface "SmartSoy: AI-Powered Disease and Pest Diagnosis

SmartSoy: AI-Powered Disease and Pest Diagnosis System has been developed that utilizes deep learning to detect soybean diseases and pests with high accuracy. Leveraging the pre-trained ResNet50 model, it diagnoses major soybean diseases and pests. The model is trained with High-resolution images to enhance accuracy, and the custom layers are fine-tuned to the model for this application. The code for model development is written using the Python language. The system is deployed on a GPU-based server at ICAR-NSRI using Flask API. SmartSoy delivers efficient, real-time disease and pest diagnosis and provides real-time control measures for efficient crop management. Its outstanding performance empowers farmers to manage pests and diseases effectively, boosting productivity and crop health. It also has a chatbot facility that helps soybean farmers to get answers to all their farm-related queries about the problems faced by them in real field conditions. The system is highly useful for soybean cultivators to diagnose diseases and pests at the right time and get the right advice for their effective control (Fig. 3.2.4.7).

Development of Soybean Gyan-AI Powered Mobile App

Soybean Gyan-AI Powered Mobile App is developed by ICAR-National Soybean Research Institute for farmer community. It is developed using Flutter Framework and Dart Programming Language and compilation work done on Android Studio. It has user interface for providing information about different aspects of Soybean Farming, production and protection technologies. It is developed to provide a multi-lingual user interface viz. Hindi, English, Marathi, Tamil and Telugu looking to the farmers' understandability. It has menu-options for intelligent features like AI based Disease and Pest diagnosis system and AI-Chatbot. It has navigation to YouTube channel of ICAR-National Soybean Research Institute is provided for better practical experience of soybean technologies through videos. It also has options for farmer advisory system, good agricultural practices, weekly farmer advisories and Mandi-rates. It is very useful for soybean cultivators and other stakeholders (Fig. 3.2.4.8).

Fig. 3.2.4.7 Main Interface of SmartSoy: AI-Powered Disease and Pest Diagnosis System

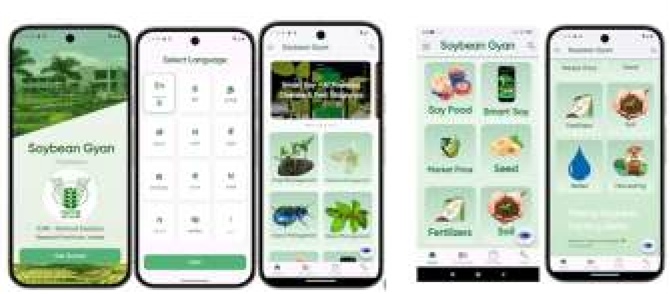


Fig. 3.2.4.8 Soybean Gyan-AI Powered Mobile App.

3.3 CROP PROTECTION

3.3.1 PLANT PATHOLOGY

IISR/3.11/22 Soybean improvement against Rhizoctonia aerial blight disease

PI- *Dr Sanjeev Kumar, Co-PIs: Drs (V. Nataraj, Shivakumar M, M.B. Ratnaparkhe, K.P. Singh, Pezangulie Chakruno, Pawan Amrate)*

Activity 1: Molecular characterization, genetic diversity analysis and AG group identification of *R. solani* isolates

Molecular characterization of *Rhizoctonia* solani isolates was carried out using nuclear ribosomal internal transcribed spacer (nrITS) sequencing and AG group–specific primers. Amplification of the ITS region using universal primers ITS-1 and ITS-4 yielded clear and reproducible PCR products across the isolates. BLAST analysis of the ITS sequences showed high sequence similarity (99–100%) with *R. solani* reference sequences available in GenBank, confirming the identity of the pathogen. Based on ITS sequence homology, the majority of isolates were assigned to anastomosis group AG1, with AG1-IA being the predominant subgroup, while a few isolates clustered with AG1-ID, AG1-IF, and AG4. Further confirmation of AG grouping was achieved using AG1-IA–specific primers (Rs1F/Rs2R and AGC/AG1-IA). Most isolates produced the expected amplification with AG1-IA–specific primers, validating their classification as AG1-IA. Isolates that did not amplify with AG1-IA primers corresponded to AG1-ID or AG1-IF based on ITS sequence analysis, indicating the presence of multiple AG subgroups within the population.

Geographical analysis revealed that AG1-IA was the dominant group across soybean-growing regions of Madhya Pradesh, Uttar Pradesh, Uttarakhand, Delhi, Gujarat, Punjab, Maharashtra, Chhattisgarh, and Nagaland. AG1-ID and AG1-IF occurred at lower frequencies and showed restricted distribution across specific locations. Overall, the results demonstrate considerable genetic diversity within *R. solani* populations infecting soybean in India, with a clear predominance of AG1-IA, supporting its major role in soybean aerial blight across regions (Fig 3.3.1.1).

Activity 2: Integrated management of major diseases of soybean

Integrated management practices significantly influenced pod blight complex severity, Rhizoctonia aerial blight (RAB) incidence, disease progression (AUDPC), and yield of soybean at NSRI, Indore. Treatment T1, comprising fungicidal seed treatment followed by fluxapyroxad + pyraclostrobin spray, was the most effective, recording the lowest pod blight severity at 45 DAS (1.77%) and 70 DAS (46.20%) with the minimum AUDPC value (599.63). This treatment also resulted in lower RAB incidence (20.86%) and

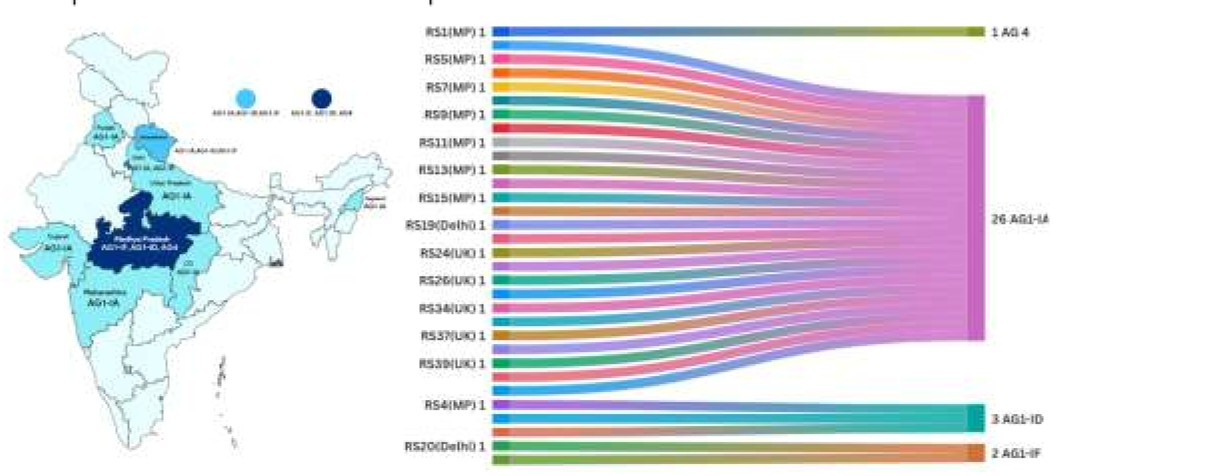


Fig 3.3.1.1 : Frequency and distribution of *R. solani* isolates based on anastomosis groups (AGs)

AUDPC (260.75), and produced the highest grain yield (8.90 q/ha). Treatment T2 (pyraclostrobin + epoxiconazole) also showed effective disease suppression, with moderate pod blight severity at 70 DAS (54.78%), lower RAB incidence (18.11%), the minimum RAB AUDPC (226.38), and a yield of 7.97 q/ha. Treatment T3 (carbendazim + mancozeb) recorded comparable pod blight severity (46.29% at 70 DAS), moderate AUDPC (652.75), and a yield of 7.78 q/ha. Treatment T4 (tebuconazole) resulted in relatively higher disease severity (53.70% at 70 DAS) and AUDPC (696.38), corresponding yield of 7.08 q/ha. Insecticide-based treatment T5 showed poor disease control, with high pod blight severity (68.08%), higher AUDPC (877.13), increased RAB incidence (26.42%), and reduced yield (6.70 q/ha). Seed treatment alone (T6 and T7) was less effective, recording high pod blight severity (>77% at 70 DAS), AUDPC values exceeding 1000, higher RAB incidence (30.41–31.16%), and lower yields (5.73–6.43 q/ha). The untreated control (T8) recorded the highest disease severity and AUDPC values, maximum RAB incidence (33.86%), and the lowest yield (5.12 q/ha) (Fig 3.3.1.2). Overall, integrated disease management combining fungicidal seed treatment with timely fungicide sprays was superior to seed treatment alone and untreated control in reducing disease pressure and improving soybean yield.

Activity 3: Development of sick plot for RAB disease

The sick plot was developed in continuation of the previous year's work on a 20 m² area at the ICAR-NSRI residential colony to prevent the spread of fungal inoculum to the main experimental fields. A pure culture of R. solani was isolated and multiplied on sorghum grains. Approximately 90 kg of inoculum was prepared in batches and applied to the plot, followed by sole cropping of the highly susceptible soybean cultivar NRC 128. At crop maturity, about 35–40 percent of the soybean plants showed symptoms of RAB. Subsequently, the infected plants were chopped and incorporated into the plot to maintain inoculum load.

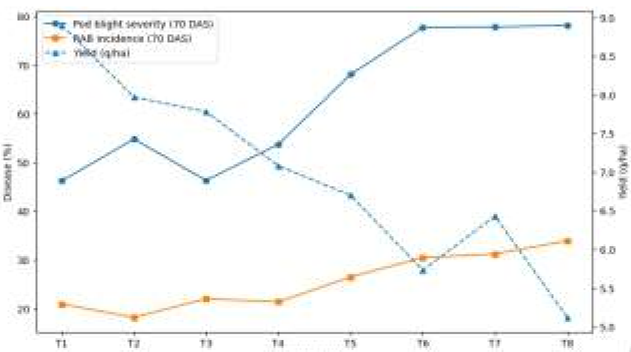


Fig 3.3.1.2: Dual-axis plot showing pod blight disease severity, RAB incidence, and yield

Activity 4: In-vitro evaluation of fungicides against *Rhizoctonia solani* Causing Aerial Blight of Soybean

The *in-vitro* evaluation of six broad-spectrum fungicides agai nst *R. solani* using the poisoned food technique revealed marked differences in their ability to inhibit mycelial growth across concentrations ranging from 100 to 1000 ppm. The experiment was conducted during 2025 at the National Soybean Research Institute, Indore. Overall, inhibition of mycelial growth increased with increasing concentration, indicating a clear dose-dependent response. The pooled mean inhibition values across fungicides increased from 86.78% at 100 ppm to 97.45% at 1000 ppm, confirming that higher doses were generally more effective in suppressing fungal growth. Carbendazim (12%) + Mancozeb (63%) and Pyraclostrobin 133 g/l + Epoxiconazole 50 g/l SE were the most effective, causing complete (100%) inhibition of mycelial growth at all concentrations (Fig 3.3.1.3). Tebuconazole 25.9% EC also showed high efficacy, with inhibition increasing from 93.8% at 100 ppm to 100% at 500 and 1000 ppm. Picoxystrobin 22.52% SC was effective at higher concentrations, reaching complete inhibition at 500 and 1000 ppm but showing slightly lower inhibition at lower doses. Hexaconazole 5% SC exhibited moderate efficacy with gradual increases in inhibition across concentrations, while Tebuconazole 10% + Sulphur 65% was the least effective, particularly at lower doses. Overall, combi fungicides, especially Carbendazim + Mancozeb and Pyraclostrobin + Epoxiconazole, proved most effective against *R. solani* under in-vitro conditions, followed by Tebuconazole 25.9% EC and Picoxystrobin 22.52% SC (Fig 3.3.1.4).

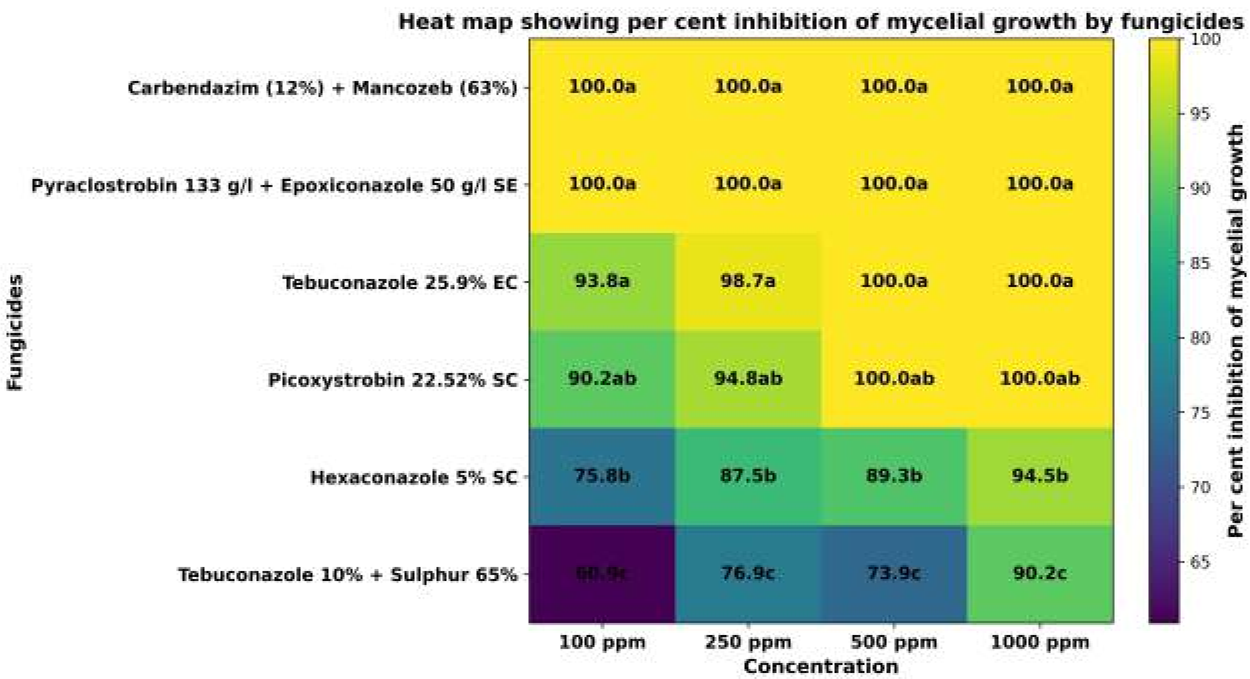


Fig 3.3.1.3. Heat map showing per cent inhibition of mycelial growth by different fungicides at 100, 250, 500, and 1000 ppm under in-vitro conditions

Fig 3.3.1.4: Dose-response relationship of Carbendazim (12%) + Mancozeb (63%) on per cent inhibition of mycelial growth under *in-vitro* conditions.

NRCS 1.1/87 Augmentation, management and documentation of soybean germplasm (Co-PI: Dr Sanjeev Kumar)

Evaluation of 216 USDA soybean varieties under natural conditions during *kharif* 2025 against the pod blight complex indicated that all tested entries expressed a moderately resistant (MR) reaction to pod blight disease. The uniform MR reaction among EC 1205621, EC 1205633, EC 1205700, EC 1205728, EC 1205754, EC 1205762, EC 1205775, EC 1205778, EC 1205779, EC 1205782, EC 1205786, EC 1205793, EC 1205799, EC 1205806, EC 1205810, and EC 1205851 highlights their potential utility as sources of resistance in soybean improvement programmes.

Based on two years of evaluation (2024–2025) of

80 USDA lines, only a few USDA exotic soybean accessions consistently expressed resistant categories (HR, R, or MR) against the pod blight complex. EC 993943 showed a resistant reaction in both years. CAT 153 A and EC 1037655 recorded highly resistant reactions in 2024 followed by resistant reactions in 2025. EC 993986 maintained a moderately resistant reaction across both years, while EC 993729 showed a resistant reaction in 2024 and a moderately resistant reaction in 2025. These accessions represent stable sources of resistance or partial resistance based on two-year field evaluation.

Evaluation of 550 USDA exotic soybean germplasm lines during kharif 2025 against the pod blight complex revealed a wide range of reactions, with the majority of entries exhibiting moderate resistance. Eight accessions, namely EC 993961, EC 993986, EC 993749, EC 1039082, EC 1039144, EC 892804, EC 0251432, and EC 1126601, showed a resistant reaction with minimal disease expression, indicating their potential as strong and stable sources of resistance. Most of the remaining accessions expressed a moderately resistant reaction, including EC 993927, EC 993929 B, EC 993937, EC 993195, EC 993690, EC 993750, EC 993740, EC 993715, EC 993739, EC 993721, EC 993738, EC 993758, EC 993771, EC 993569, EC 993779, EC 113779, EC 892805, EC 1039107, EC 1039027, EC 1039122, EC 892881, EC 862831, EC 862873, EC 1154370, EC 1154406, EC 39742, EC 113396, EC 0250616, EC 0251415, EC 0287481, EC 55898, EC 0242093, EC 39078, EC 241780, EC 42152, EC 39823, EC 100027, EC 0039047, EC 0241313, EC 0309508, EC 41319, EC 241690, EC 0241842, EC 771200, EC 528626, EC 39685, EC 538802, EC 0039767, EC 0251820, EC 0251439, EC 172670, EC 95289, EC 172662, EC 101082, EC 172612, EC 172620, EC 172599, EC 202038, EC 99551, EC 0241760, EC 309537, EC 0481338, EC 0241770, EC 1154472, EC 0892867, EC 0250591, EC 0456620, EC 0457367, EC 0457371, EC 0685252, EC 1161126, EC 1161127, EC 1126704, EC 1126708, and EC 1154368, indicating restricted disease development under field conditions .

A total of 16 soybean germplasm accessions were screened under hotspot conditions at Indore for aerial blight (RAB) and pod blight disease during 2023–2025. Accessions IC 0243740, IC 0243700, IC 0243713, IC 243708, EC 0456556, and EC 0589402 exhibited HR/MR reactions in one or more years, indicating stable resistance sources. IC 0243591 and EC 389154 maintained consistent MR reaction across years(Table 3.3.1.1).

Table 3.3.1.1: Evaluation of resiatnt germplasms under hotspot conditions at Indore

Germplasm accessions	Disease reaction during 2023		Disease reaction during 2024		Disease reaction during 2025
	RAB	PB(Ct)	RAB	PB(Ct)	PB(Ct)
IC 243584	MR	R	MR	-	-
EC 389154	MR	S	MR	MR	MR
EC 0528623	MR	-	MR	MR	MR
IC 0100324	S	MR	MR	MR	R
IC 0243740	R	R	-	R	R
IC 0243700	MR	-	HR	MR	MR
IC 0243713		MR	HR	MR	-
IC 0243591	MR	MR	MR	MR	MR
IC 243708	MS	MR	HR		-
EC 280149	MS	MR	MR	MR	-
EC 0456556	MR	R	HR	HR	R
IC 243017	S	MR	MR	MR	-
EC 39754	MR		MR	MR	MR
EC 0106991	MR	R	-	-	-
IC 0243708	MR	MR	-	-	-
EC 0589402	MS	MR	HR	HR	R

Screening of advanced photoinsensitive & long juvenile lines for disease resistance.

Screening of advanced photoinsensitive and long juvenile soybean lines identified a distinct set of resistant (R) sources. Resistant reactions were observed in long juvenile lines LJ 1, LJ 3, LJ 6,

LJ 9, LJ 11, LJ 12, LJ 14, LJ 27, LJ 28, LJ 29, LJ 31, LJ 34, LJ 35, LJ 39, LJ 41, LJ 43, LJ 50, LJ 52, LJ 53, LJ 54, and LJ 59, along with LJ 69, LJ 70, LJ 71, LJ 74, LJ 80, LJ 82, LJ 87, LJ 92, LJ 93, LJ 94, and LJ 100.

Among photoinsensitive lines, N 31m, N 32, N 36, N 37m, N 40, N 41, N 42m, N 50m, N 51m, N 56, N 63m, N 64m, N 67m, and N 68 showed resistant reactions. These lines represent promising sources of disease resistance for further breeding and validation.

A total of 260 GWAS lines including checks were screened for the pod blight disease during kharif 2025, out of which 118 entries showed moderately resistant reaction to pod blight disease such as EC 538828, CAT 47, KALITUR, AGS 153, BR 15, EC 291397, TGX 311-101 F, TGX B 1435 E, EC 457050, BRG 1 etc. while 142 entries showed MS to S reaction for the pod blight disease (Table 3.3.1.2.).

IISR 6.9/17 Bacterial mediated Sulphur bioavailability in soybean. (Co-PI: Dr Sanjeev Kumar)

Activity 1: Evaluation of nutrient-transforming bacteria against major soybean phytopathogens.

The nutrient-transforming bacterial isolates showed variable antagonistic activity against major soybean pathogens. Among the tested cultures, COA6 and 9P (BPB) exhibited broad-spectrum activity, showing positive reactions against all seven pathogens including *Rhizoctonia solani, Macrophomina phaseolina, Colletotrichum truncatum, Fusarium ciceri, Fusarium glycines, Diaporthe sojae*, and *Sclerotium rolfsii*. COA1 demonstrated activity against five pathogens but was ineffective against Diaporthe sojae and Sclerotium rolfsii. COA3 and COA4 showed moderate activity with selective inhibition patterns (Table:3.3.1.3). Overall, COA6 and 9P (BPB) emerged as the most promising broad-spectrum bacterial cultures against major soybean phytopathogens.

Table 3.3.1.2: Resistant photoinsensitive & long juvenile lines for anthracnose disease of soybean

Lines	Dis R	Lines	Dis R	Lines	Dis R
LJ 1	R	LJ 62	MR	N 22m	MR
LJ 2	MR	LJ 63	MR	N 31m	R
LJ 3	R	LJ 69	R	N 32	R
LJ 5	MR	LJ 70	R	N 36	R
LJ 6	R	LJ 71	R	N 37m	R
LJ 8	MR	LJ 74	R	N 39m	MR
LJ 9	R	LJ 77	MR	N 40	R
LJ 11	R	LJ 79	MR	N 41	R
LJ 12	R	LJ 80	R	N 42m	R
LJ 13	MR	LJ 82	R	N 50m	R
LJ 14	R	LJ 85	MR	N 51m	R
LJ 16	MR	LJ 87	R	N 54	MR
LJ 27	R	LJ 92	R	N 56	R
LJ 28	R	LJ 93	R	N 57m	MR
LJ 29	R	LJ 94	R	N 63m	R
LJ 30	MR	LJ 95	MR	N 64m	R
LJ 31	R	LJ 96	MR	N 67m	R
LJ 34	R	LJ 97	MR	N 68	R
LJ 35	R	LJ 98	MR	N 68m	R
LJ 36	MR	LJ 99	MR	N 93m	MR
LJ 38	MR	LJ 100	R	N 94m	MR
LJ 39	R	LJ 106	MR	N 100m	MR
LJ 41	R	LJ 108	R	N 123m	MR
LJ 42	MR	LJ 110	MR	N 129m	MR
LJ 43	R	LJ 117	MR	N 138m	MR
LJ 45	MR	LJ 118	MR	N 142m	MR
LJ 48	MR	LJ 125	MR	N 176m	MR
LJ 50	R	LJ 128	MR	N 184m	MR
LJ 51	MR	LJ 141	MR	N 198m	MR
LJ 52	R	LJ 144	MR	N 200	MR
LJ 53	R	LJ 148	MR	N 206	MR
LJ 54	R	LJ 155	MR	N 207	MR
LJ 55	MR	LJ 156	MR	N 210	MR
LJ 57	MR	LJ 158	MR	N 232	MR
LJ 59	R	LJ 161	MR	N 233	MR
LJ 61	MR	LJ 164	MR	N 244	MR

Activity 2: Dual culture assay against major soil-borne soybean phytopathogens

In the dual culture assay, COA1, COA3, COA4, and COA6 showed the highest inhibition against *Rhizoctonia solani* (around 79–81%), with COA4 also recording the maximum inhibition against *Macrophomina phaseolina* (80.83%). COA6 and COA3 also performed strongly against *M. phaseolina* (77–78%). Moderate inhibition was observed with 12PBPB, 12PBTB, 14K, 15K, 9PBPB, 2S, and 3S. Minimal or negligible inhibition was recorded in COA2, COA5, 9K, and 13K against both pathogens. Overall, COA4, COA6, COA3, and COA1 emerged as the most effective antagonists against the tested soil-borne pathogens (Fig 3.3.1.5) (Table:3.3.1.4).

Activity 3: Dual assay of nutrient-transforming bacteria isolated from extreme habitats and crop rhizosphere.

Out of the 43 tested isolates, H1, H3, H5, H8, H9, SID+3, SID+5, SID+7, SID+BH(AMD), BH(AMD)R2, and ZN BIC R1 showed activity only against *Rhizoctonia solani*; H2, A4, and SID+2 were active only against *Macrophomina phaseolina*; H7, SID+BHMW, SID+JPM, and BH(AMD)ZN exhibited activity against both pathogens. The remaining isolates showed no antagonistic activity in the dual assay.

Table:3.3.1.3 Evaluation of nutrient-transforming bacteria against major soybean phytopathogens.

Culture	*R. solani*	*M. phaseolina*	*C. truncatum*	*F. ciceri*	*F. glycines*	*D. sojae*	*S. rolfsii*
COA1	+	+	+	+	+	-	-
COA2	-	-	ND	ND	ND	ND	ND
COA3	+	+	+	-	-	+	-
COA4	+	+	-	+	-	-	-
COA5	-	-	ND	ND	ND	ND	ND
COA6	+	+	+	+	+	+	+
9P (BPB)	+	+	+	+	+	+	+
12P BPB	+	-	+	-	-	-	-
12P BTB	+	+	-	-	-	-	+

Table 3.3.1.4: Percent inhibition against soil-borne soybean phytopathogens in dual assay

Culture name	*R. solani*	*M. phaseolina*
COA1	81.25 ± 1.25a	75.83 ± 0.72c
COA2	2.91 ± 1.44hi	2.08 ± 0.72j
COA3	81.25 ±1.25a	77.08 ± 0.72bc
COA4	79.58±1.91a	80.83 ± 0.72a
COA5	0i	2.91 ± 0.72j
COA6	81.25 ± 1.25a	78.33 ± 0.72b
9PBPB	70 ±1.25c	68.75 ± 1.25d
12PBPB	75 ± 1.25b	67.08 ± 0.72d
12PBTB	75 ± 1.25b	67.91 ± 0.72d

Culture name	*R. solani*	*M. phaseolina*
1S	58.33±2.60e	23.75 ± 1.25h
2S	65.83±1.91d	33.33 ± 0.72g
3S	55 ± 1.25f	63.33 ± 0.72e
5S	5 ± 1.25gh	57.08 ± 0.72f
6S	6.66± 0.72g	58.33 ± 0.72f
9K	0i	1.25 ± 1.25j
13K	0i	17.08 ± 0.72i
14K	76.25 ± 1.25b	67.92 ± 0.72d
15K	65 ± 1.25	67.91 ± 0.72d

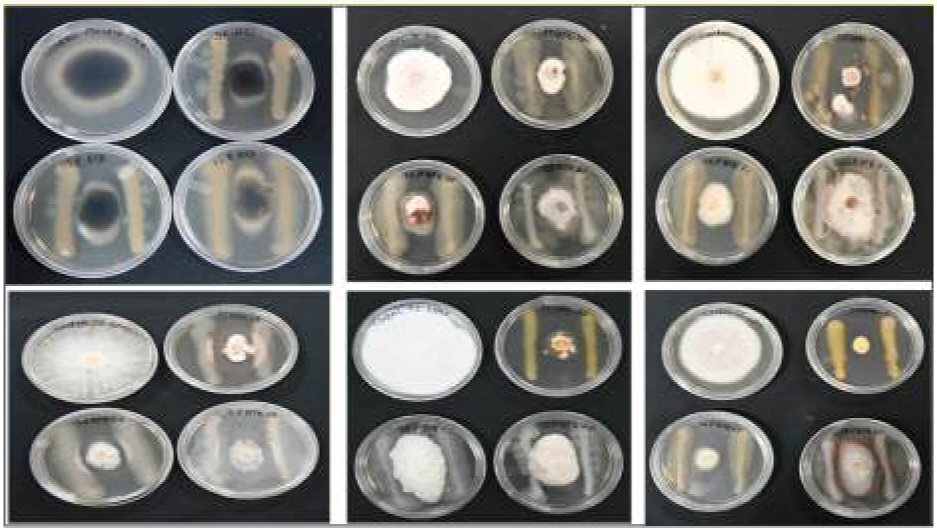


Fig 3.3.1.5: Dual assay for assessing antagonistic activities of phosphorus-solubilizing bacteria against major soybean and chickpea phytopathogens

Activity 4: Influence of siderophore-producing bacteria on disease tolerance against major soil-borne pathogens of soybean.

Under normal soil (T1), higher lesion lengths were recorded against *Rhizoctonia solani* (2.00 cm) and *Macrophomina phaseolina* (3.88 cm). Supplementation with available iron (FE-EDTA) (T2) and unavailable iron ($FeCl_3$) alone (T3) reduced lesions against *R. solani* but resulted in higher lesion development against *M. phaseolina*. Application of siderophore-producing bacteria with $FeCl_3$ significantly reduced disease severity. Normal soil + $FeCl_3$ + COA3 (T5) recorded the lowest lesion length against both *R. solani* (0.24 cm) and **M. phaseolina** (2.46 cm), followed by COA1 (T4), COA6 (T7), and Sid+JPM (T8) (Fig 3.3.1.6). Overall, integration of unavailable iron with efficient bacterial isolates, particularly COA3, markedly enhanced disease tolerance against both pathogens.

IISR 6.10/23 Comparative study on sustainable (Natural/organic farming/conservation agriculture/ICM) management practices to enhance soybean yield under different cropping systems (Co-PI: Dr Sanjeev Kumar)

All the treatments under natural farming experiment reduced pod blight severity compared to the control at both 45 and 70 DAS. At 45 DAS, the lowest severity was recorded in T2 (Buttermilk + Cu-rod) and T3 (Neem + Cow urine) at 10.25%, followed by T6 (10.42%). Control showed the highest severity (15.05%). At 70 DAS, T3 (Neem + Cow urine) was most effective (52.70%), followed by T6 (54.28%) and T2 (53.91%), while control recorded the highest disease (69.38%). Overall, neem-based treatments, particularly T3, and buttermilk + Cu-rod, T2 were most effective under natural farming conditions (Fig 3.3.1.6).

Project: Institute Station Trial (IST); Co-PI: Dr Sanjeev Kumar

In the institute station trial, a total of 20 entries in early maturity, 42 in normal maturity, 16 in clear Hilum, 10 in vegetable type were screened for the disease under hotspot condition for pod blight disease, in which normal maturity entries SGRJ-4, AVKS 242; early maturities entries JS EC 19, JSEC 49; clear hilum entry AVKS 253; vegetable type entry CK 287, CK-14 showed resistant to moderately resistant reaction for pod blight disease.

Fig 3.3.1.6: Experimental view of siderophore-producing bacteria against *Rhizoctonia solani* & *Macrophomina phaseolina*

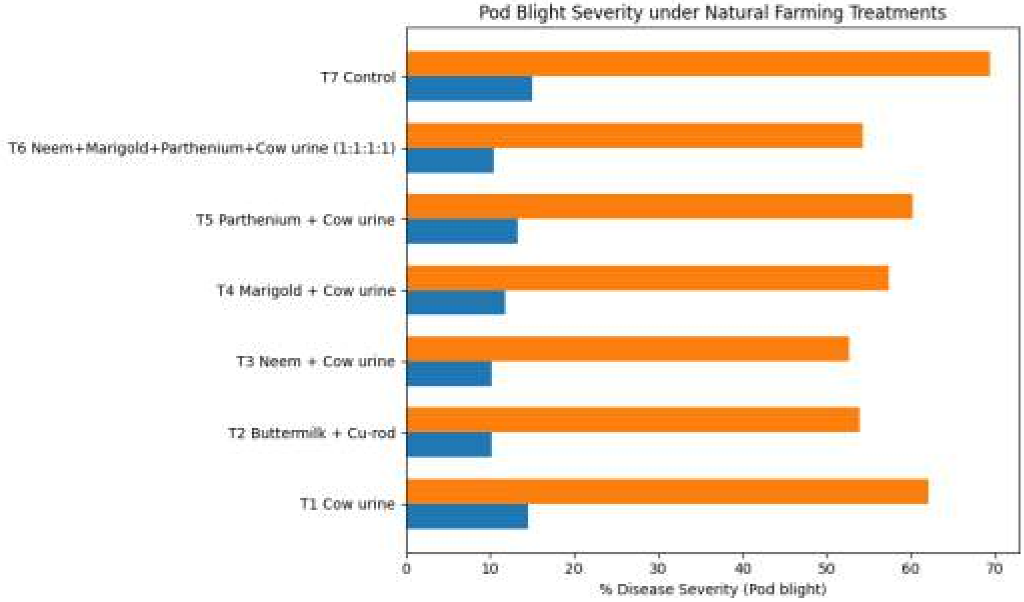


Fig 3.3.1.7: Effect of natural farming treatments on disease severity of pod bligh

Project: Institute Station Trial (IST); Co-PI: Dr Sanjeev Kumar

In the institute station trial, a total of 20 entries in early maturity, 42 in normal maturity, 16 in clear Hilum, 10 in vegetable type were screened for the disease under hotspot condition for pod blight disease, in which normal maturity entries SGRJ-4, AVKS 242; early maturities entries JS EC 19, JSEC 49; clear hilum entry AVKS 253; vegetable type entry CK 287, CK-14 showed resistant to moderately resistant reaction for pod blight disease.

IISR 3.14/24: Standardization of package of practises for soybean production using drone technology (PI: Dr Sanjeev Kumar, Co-PI: Dr Raghvendra Nargund, Dr Savita Kolhe, Dr Lokesh Meena)

During the *Kharif* 2025 season, standardization of practices for soybean production using drone technology was carried out. The study involved growing of soybean on 1400 m^2 area with two treatments: conventional soybean cultivation (T1) and soybean cultivation using drone technology (T2). The spraying schedule included spray of PE herbicide Diclosulam and recommended insecticide Chlorantraniliprol 85.5 SC and fungicide Tebuconazole 25.9% w/w. In both the treatments recommended package of practices for soybean cultivation was adopted. Standard operating procedures were strictly adhered for T2, including a drone flying speed of 4.0 m/s, a height of 2 meters above the crop canopy, and a water volume of 20 L/ha during spraying. Total weed density was comparable between the two spraying methods. Drone spray recorded a mean weed count of 8.0 plants/m^2, while conventional spray recorded 8.1 plants/m^2, while the % disease severity of pod blight was marginally low in drone sprayed plot. It was reduced from 28% in (T1) to 19 % in (T2). Stem fly infestation before spray was 35.60% (drone) and 29.94% (conventional), which declined to 28.98% and 24.68% after spray, showing 18.60% and 17.57% reduction, respectively. Girdle beetle infestation reduced by 51.09% under drone spray compared to 26.57% under knapsack spray. Semilooper and tobacco caterpillar populations also declined more under drone spray (74.91%) than knapsack spray (33.20%). Overall, conventional practise of growing soybean, T1 produced 16 q/ha of soybean, while soybean cultivation using drone technology T2 achieved 18 q/ha, demonstrating slight improvement with drone technology.

IISR 3.1/21 Isolation and identification of kairomones and sex pheromones components for soybean stem fly, Melanoagromyza sojae management

PI: *Dr. Lokesh Kumar Meena*

Co-PIs: *Dr. Vangala Rajesh and Dr. Kamala Jayanthi*

Bio- efficacy/Olfactometer bio-assay tests were for eight (8) no. of identified kairomones. These kairomones were, Tridecane, 2-Hexyl-1-decanol, Naphthelene, Cis-3-hexyl acetate, p-Xylene, Farnesene, Methyl salicylate and Tetradecane. Out of the eight kairomones, 4 kairomones were i.e., Fernesene, Naphthelene, Methyl salicylate and Cis-3-hexyl acetate were found as Attractant to stem fly while 3 Kairomonal compounds viz., Tridecane, 2-Hexyl-1-decanol and Tetradecane were found as Repellant (Fig 3.3.2.1).

NRCS1.1/87: Augmentation, Management and Documentation of Soybean Germplasm (Co-PI-Dr Lokesh Kumar Meena)

Two hundreds ten (210) breeding lines were evaluated for their insect reaction at their respective hot spots (Indore, Parbhani, Dharwad and Imphal). On the basis of insect reaction total eight lines viz., IC0009476, IC0243755, IC0574366, EC0542433, EC0309543, EC241778, EC0242004, EC0550830 etc. were found promising lines.

Evaluation of elite soybean genotype for resistance against major insect-pests

PI- Dr Lokesh Kumar Meena

Forty four (44) normal maturing elite genotypes, twenty two (22) early maturing elite genotypes, twelve (12) vegetable elite genotypes and eighteen (18) clear hilum type elite genotypes of soybean were evaluated against major insect-pests of soybean. The results revealed that in normal maturing genotype group, one genotype, SGRJ-3 (NRC 309) (10.81% stem tunneling) was found Resistant (R) against stem fly. In vegetable type genotype also, one genotype, namely, CK 6-95 (NRC 322) (10.00% stem tunneling) was found Resistant (R) to stem fly.

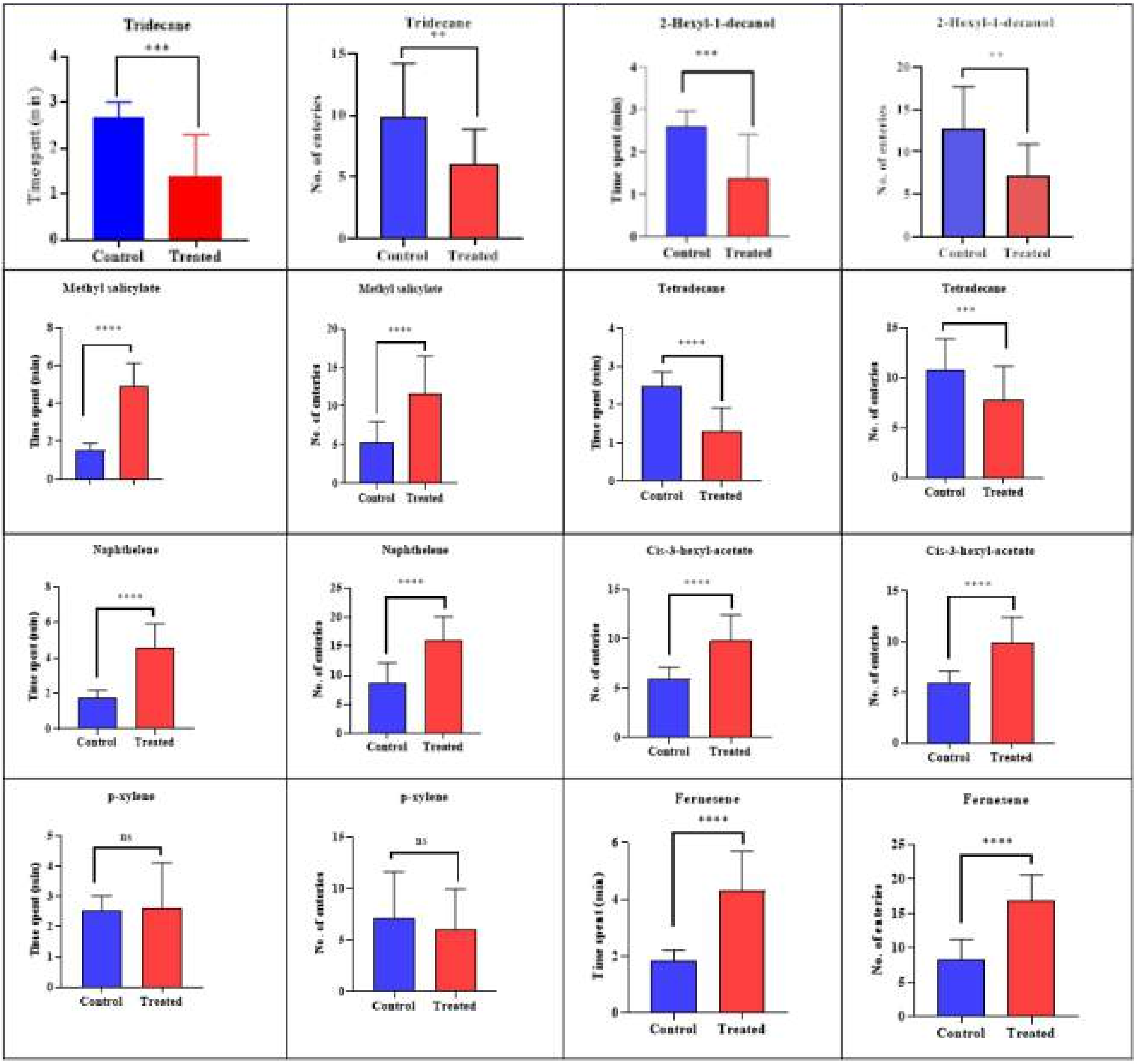


Fig 3.3.2.1: Olfactometer bioassays of volatiles collected from JS 335 genotype against stem fly

IISR6.10/23 Standardization of sustainable (Natural/Organic farming/Conservation agriculture) management practices for soybean yield maximization under soybean-based cropping systems (Co-PI: Dr Lokesh Kumar Meena)

In *Kharif* season on soybean crop, the lowest girdle beetle and stem fly infestation was found in organic farming (2.39%) and (21.00%) while lowest semiloopers (3.22 larva/mrl) and tobacco caterpillar (0.37 larva/mrl) was found in Integrated crop management practices (ICM) while the highest density of natural enemies was found in organic farming practices (1.11 larva/mrl). In Rabi season, in mustard crop the lowest population density of aphid (26.3 nymph and adult) and painted bug (0.11 nymph and adult) was found in conventional agriculture practices (CON) while the lowest population density of pod borer (1.70 larva/mrl) on chickpea in integrated crop management practices (ICM). The highest density of natural enemies was found in Natural farming practices (NF) (9.89 larva/mrl).

Status of AVT I & II entries for antixenosis and antibiosis against S. litura

PI-Dr Lokesh Kumar Meena

Antixenosis and Antibiosis studies have been done on 18 AVT-I & II (Normal) entries at Indore. None of the genotype was exhibited strong/extreme antixenosis and in Antibiosis reaction against S. litura NRC 290 entry showed the lowest Approximate digestibility (AD) (66.15%), Efficiency of conversion of digested food (ECD) (60.13%) and Efficiency of conversion of *ingested food* (ECI) (41.93%) (Table 3.3.2.1.).

Table 3.3.2.1: Status of AVT-I & II entries for antixenosis and antibiosis against S. litura (Indore)

S.No.	Genotypes	'C' Values	Interference	AD (%)	ECI (%)	ECD (%)
1.	JS 25-55	0.89	Slight antixenosis	70.10(56.85)	51.79(46.02)	74.43(59.62)
2.	NRC 291	1.30	Preferred host	72.61(58.44)	57.57(49.36)	79.56(63.12)
3.	NRC 268	1.06	Preferred host	71.80(57.92)	65.13(53.81)	90.53(72.08)
4.	NRC 292	1.28	Preferred host	70.46(57.08)	52.38(46.36)	75.82(60.55)
5.	NRC 290	0.62	Moderate antixenosis	66.15(54.42)	41.93(40.36)	60.13(50.85)
6.	NRC 270	1.05	Preferred host	78.11(62.10)	74.43(59.62)	95.29(77.47)
7.	AUKS 22-10	0.93	Slight antixenosis	74.00(59.34)	61.28(51.52)	83.74(66.22)
8.	CAUMS 4	1.01	Preferred host	70.47(57.09)	58.59(49.95)	84.00(66.42)
9.	NRC 295	0.81	Slight antixenosis	71.07(57.46)	56.86(48.94)	81.39(64.45)
10.	NRC 294	0.81	Slight antixenosis	81.23(64.32)	49.05(44.45)	60.50(51.06)
11.	AUKS 22-1	1.05	Preferred host	71.43(57.69)	66.29(54.51)	92.78(74.41)
12.	NRC142©	0.81	Slight antixenosis	78.44(62.33)	57.45(49.28)	74.17(59.45)
13.	JS 20-98©	1.36	Preferred host	71.27(57.59)	59.91(50.72)	84.50(66.81)
14.	JS 335 ©	1.16	Preferred host	67.36(55.16)	44.71(41.96)	65.90(54.27)
15.	RSC 10-46©	1.24	Preferred host	72.70(58.50)	65.82(54.22)	90.03(71.59)
16.	JS 21-72 ©	1.24	Preferred host	71.28(57.59)	65.33(53.93)	91.69(73.24)
	G5P22 (RC)	0.61	Moderate antixenosis	67.52(55.26)	51.12(45.64)	77.93(61.98)
	JS335 (SC)	1.00	Preferred host	71.84(57.95)	61.74(51.79)	93.28(74.97)
	SEm±			(7.32)	(13.38)	(23.73)
				(3.60)	(6.58)	(11.68)

INFORMATION, COMMUNICATION AND TECHNOLOGY TRANSFER

04

IISR 8.17/20 Development and evaluation of ICT tools and media for TOT of Soybean

PI: *Dupare B U*

Co-PI: *Savita Kolhe*

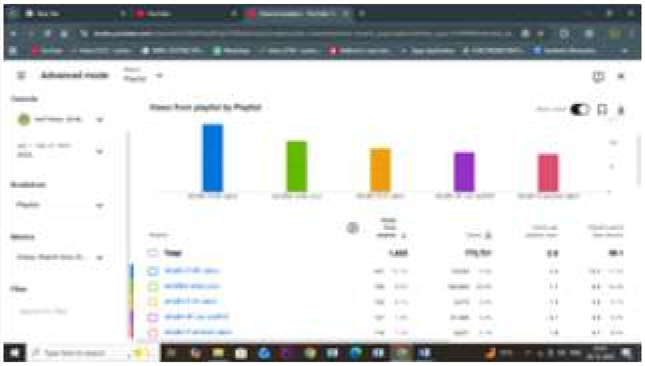
The ICAR-NSRI is using almost all the popular social media such as YouTube Channel (43.6K Subscribers), Facebook Page (25.7K followers), Instagram (10.6K followers), Twitter *1.46K followers), beside farmers group on Telegram channels and WhatsApp (Fig. 1) for dissemination of package of practices and improved soybean production technologies to the soybean stakeholders. They also act as a feedback mechanism about the technologies at the ground level and as an interactive mechanism for further improvement of technologies. During the year 2025, a total of 94 videos ,13 shorts and 3 live steams comprising different themes has been produced and uploaded on the YouTube channel (Table 4.1.1) of the institute and were popularized by sharing on other social media. The playlist includes ICAR-Madhya Bharat Samachar, Weekly Soybean Advisories, Soya Samvad with Progressive Soybean Growers and Soy Scientists, Improved Soybean Varieties developed by ICAR-IISR, Indore as well as by other AICRPS centers. Similarly, 103 reels on Instagram and Facebook page were uploaded during the year. Our viewers/subscribers/followers have given tremendous response to the institute social media as has been reflected in increase of subscribers as well as total views and reach. Among the different playlists, videos on plant protection measures involving control of insect-pests and diseases are viewed by majority of our viewers. Among all the videos, the one about the latest soybean variety ie. NRC 150 has topped the list. (Table 4.1.1).

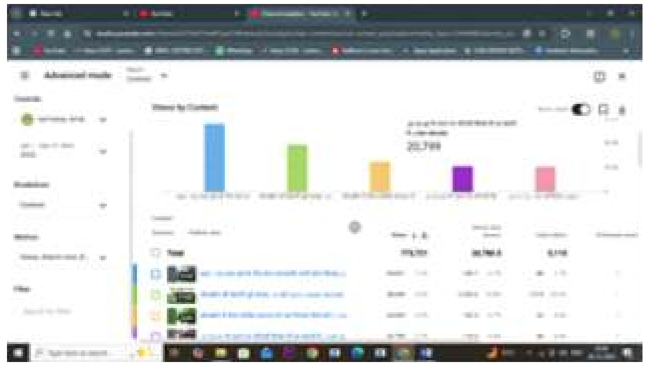
Table 4.1.1: The details of content produced and uploaded on YouTube, Facebook and Telegram channels of the institute

Content	Total Video uploads	YouTube views	Uploads (Nos) and total views during 2025					
			YouTube		Instagram		Facebook	
			Uploads	Views	Uploads	Views	Uploads	Views
Videos	1026	39.36K	94	7.63M	-	-	-	-
Shorts	224	11.77M	13	3.77M	103	19.4M	3	1.8 M
Live stream	94	1.02K	3	4.5K	-	-	-	-
Others	5		0	-	-	-	-	-
Total	1026	77K	110	7.68 M	103	19.4M	18	2.2M

Facebook

Instagram





IISR 8.18/23 Transfer of Improved Soybean Production Technologies for Increasing Soybean Production

PI: *Dupare B.U.*

Co-PI: *R.K. Verma, Raghavendra N., Lokesh K. Meena, Sanjeev Kumar, Mrinal Kuchlan and Savita Kolhe*

The project includes coordination of various extension activities like organization of on and off-campus training programmes, conduct of demonstrations at Institute farm as well as on farmers' fields through various schemes like Mera Gaon Mera Gaurav, Model ICAR-Soybean village, Tribal Sub Plan, Scheduled Caste Sub Plan, publication of literature and use of print/electronic/social media for dissemination of information etc.

Organization of Trainers' Training Programmes

Trainers' Training Programme on "Technology for Increasing the Productivity of Soybean-Wheat Cropping System in Madhya Pradesh" organized during 10-12 March was also concluded toady. The programme was conducted under the project financed by the MP Govt which is implemented in 18 districts (Indore, Khargone, Burhanpur, Khandwa, Dhar, Badwani, Dewas, Ujjain, Shajapur, Rajgarh, Agar Malwa, Ratlam, Sehore, Bhopal, Jhabua, Alirajpur, Mandsaur and Neemuch) of Madhya Pradesh and attended by 34 agricultural extension officers belonging to 18 districts and 11 scientists belonging to KVKs of Madhya Pradesh. In this training, the scientists of National Soybean Research Institute and Regional Wheat Research Centre Indore gave information to the trainees through their lectures on topics like different varieties of soybean and wheat, production and processing technology, different methods for pest disease and weed management. In this context, the course director of this training, Dr. B.U. Dupare suggested to grow medium duration soybean varieties in case the farmers are growing two crops (soybean followed by Wheat/Chickpea). Whereas, soybean farmers who take three consecutive crops should adopt the varieties that mature in a short duration facilitating its sowing time.

Organization of Trainers' Training Programmes:

The institute has conducted one day trainers' training programme on "Improved Soybean Production Technologies' imparting knowledge to 250 participants (newly recruited Rural Agricultural Extension Officers) and Input Dealers registered under DAESI Scheme implemented by the State Agricultural Department of Madhya Pradesh (Table 4.2.1).

Table 4.2.2 : One Day Trainers' training programmes on Improved Soybean Production Technology

No.	Date	Type of Participants	No. of Participants	Scheme
1	28.07.2025	Input Dealers	40	Ujjain
2	27.08.2025	Input Dealers	40	Ujjain
3	29.08.2025	Input Dealers	38	Indore
	Total		**118**	

Frontline Demonstrations under National Mission on Edible Oil

In order to demonstrate the productivity potential of research emanated technologies, frontline demonstrations involving different component i.e. full package, IPNS, IPM, Intercropping, BBF etc. are conducted on 4000 sqm area in real farm situations. During the year 2025, a total of 1180 frontline demonstration were allotted across the country out of which 1112 were successfully conducted, This included 250 frontline demonstrations conducted in villages selected under Mera Gaon Mera Gaurav programme of the ICAR-NSRI as well as ICAR-Model Village Memdi.

Demonstration on short and medium duration soybean varieties under ICAR-NSRI MP Govt. Project

During 2025, the institute has initiated a project funded by Department of Agriculture, Madhya Pradesh which is executed in 18 districts of viz. Indore, Ujjain, Devas, Shajapur, Dhar, Sehore, Rajgarh, Bhopal, Jhabua, Mandsaur, Khandwa, Khargone, Alirajpur, Burhanpur, Neemuch, Ratlam, Agrar Malwa and Barwani. Farmers of Madhya Pradesh particularly Central India prefer to grow short duration (<90 days) soybean varieties as it fit in soybean-wheat cropping system. Short duration varieties of soybean are more prone to aberrant weather conditions, pest and diseases whereas medium duration (95-105 days) soybean cultivars are more suitable to enhance soybean productivity in Malwa region. Therefore, medium duration soybean variety RVS-2020-24 was demonstrated to those who grows only two crops in succession (Soybean-Wheat/chickpea) and recently notified short duration variety NRC 150, was demonstrated to the farmers who grow three crops in a year (soybean-potato/onion/garlic-wheat/chickpea). During kharif 2025, a total of 180 demonstrations were laid out in the project locations.

Demonstration of Improved soybean varieties and new agronomic practices at Institute Experimental Farm: In order to show the worth of new soybean varieties and practices to the visiting farmers, a demonstration plot containing Eleven Soybean varieties was conducted during kharif 2025. The sowing was completed on 24th June whiel the maturity duration ranged from 100-115 days. Out of these, the highest yield (28.8q/ha) was obtained from JS 21-72 followed by NRC 142 (22.00 q/ha) and NRC 150 (17.40 q/ha)

Organization of One Day Farmers' Training Programmes

Normally, the farmers keep visiting the institute throughout the year to seed the information and to visit the institute demonstration plot. Their visits are conducted by the state agriculture Departments, NGOs, Nationalized banks and other agencies through their ongoing schemes The institute scientists make these visitors aware about the technologies developed and recommended for their area, control of biotic and abiotic factors followed by an interaction on pertinent issues. The institute has successfully conducted 28 one-day training programmes thereby updating the technical know-how of 917 farmers including 17 women farmers who visited the institute during the year 2025 (Table 4.2.1).

Trainings conducted through Agri Business Incubation Centre of ICAR-NSRI

With a vision to promote soybean productivity, utilization, value addition, skill enhancement, and employment generation, the ABI Centre aims to build entrepreneurs in microbial bioinoculants, soybean food products, and soy-related technology ventures.

Organization of Five Days Entrepreneurship Development Program on Soy Food Processing and Allied Sector (Course convener: Dr M. P. Sharma, Course co-convenor: Neha Pandey)

The institute ABI centre has organized two programmes involving 22 upcoming entrepreneurs from different states who desired to undergo Five Days Entrepreneurship Development Program on Soy Food Processing and Allied Sector. The programs were conducted in two batches during 21-25 July, 2025 and 8-12 September, 2025.

Organization of Three Day Farmers' Training Programmes

A total of 10 training programmes of 3 days

duration each were conducted with the total participation of 466 farmers of different FPOs of Maharashtra state during 2025 as requested by different districts of Maharashtra state Department of Agriculture, the institute through the Agri-Business Incubation Centre of the institute. This training entitled "Soy Food Processing Techniques and Utilization of soy for Food Products" is specially organized involving members/office bearers of Farmer Producer Organizations constituted under the SMART project.

Table 4.2.3: Details of Training programmes organized by ABI during 2025

S. No	S. No.Name of trainee/ institution / FPOs	Date	Numbers of participant
1	Five Days enterpreureship development (EDP) on Soy food processing and allied sector	21-25 July 2025	10
2	Five Days enterpreureship development (EDP) on Soy food processing and allied sector	8-12 Sept 2025	12
		Total entrepreneurs	**22**

Table 4.2.5: Details of Online programmes and Seminars organized during 2025

S. No	Title	Date	No. of participants
1	Role of PPV&FR Authority in protection of plant varieties among the farming communities	10.01.2025	321
2	माननीय श्री शिवराज सिंह चौहान जी का सोयाबीन हितग्राहियों के साथ संवाद - दिनांक 26 जून 2025	26.06.2025	2867
		Total participants	**3188**

Weekly advisory for soybean farmers

Institute also circulated weekly advisory (हिंदी and English) for soybean farmers through various media platforms and email. The list of weekly advisory for soybean farmers is given below:

Issue of Soybean advisories started with Pre-Sowing Soybean Advisory (May 2024)		
Soya Advisory (May 2025)	Weekly Soya Advisory 2nd -8th June 2025	Weekly Soya Advisory 9th -15th June 2025
Weekly Soya Advisory 16th -22rd June 2025	Weekly Soya Advisory 23th -29th June 2025	Weekly Soya Advisory 30th June -6th July 2025
Weekly Soya Advisory 7th -13th July 2025	Weekly Soya Advisory 14th -20st July 2025	Weekly Soya Advisory 21st-27th July 2025
Weekly Soya Advisory 28th July 3rd August 2025	Weekly Soya Advisory 4th-10th August 2025	Weekly Soya Advisory 11th-17th August 2025
Weekly Soya Advisory 18th-24th August 2025	Weekly Soya Advisory 25th August-31st September 2025	Weekly Soya Advisory 1st -7th September 2025
Weekly Soya Advisory 8th-14th September 2025	Weekly Soya Advisory 15th-21st September 2025	Weekly Soya Advisory 22nd -28th September 2025
Weekly Soya Advisory 29th September-5th October 2025	Weekly Soya Advisory 6th September-12th October 2025	***Total Views 154K on Institute YouTube Channel.**

Organization of Field Days:

1. Training of farmers under Frontline Demonstrations under NMEO on 16.09.2025 at ICAR-NSRI .
2. Soybean Diwas at Rajoda, District Indore on 25th September 2025.

Farmers training and input distribution under schedule caste sub-plan

Nodal officer: Rakesh Kumar Verma,

Co-Nodal officers: B.U. Dupare, Prince Choyal and Raghavendra Nargund

The ICAR- National Soybean Research Institute, Indore organized farmers training and input distribution programmes under Schedule Caste Sub Plan (SCSP) scheme. Under this scheme distribution of soybean seed, NPK fertilizer, plant growth promoting Rhizobacteria(PGPR), hole digger machine, brush cutter machine, wheat seed and Tarpaulins etc., inputs were distributed among the eligible beneficiaries. The total number of 652 farmers from the Sehore, Khargone, Ujjain, Indore, Agar Malwa, Khandwa and Barwani districts of the Madhya Pradesh were benefited from the scheme.

Under the training programs scientist addressed the farmers and urged them to use the new technologies, diversified crops and value addition for improving the farm productivity. Emphasis was also laid on use of climate smart technologies. Interaction was held with the farmers' wherein, experts from the institute attended to their queries.

A total of 48 quintals of soybean seeds were distributed to 160 beneficiaries, 560 bags of fertilizer were distributed to 240 beneficiaries, and 220 packets of Plant Growth Promoting Rhizobacteria (PGPR) were distributed to 220 beneficiaries. A total number of 160 demonstrations were conducted on soybean crop during Kharif, 2025. During the Rabi -2025-26 season, 100 quintals of wheat seed were distributed to 250 farmers for demonstrations across the districts of Sehore, Ujjain, Indore, Agar Malwa, Khandwa, and Barwani in Madhya Pradesh.

External Funded Project: -Expansion Activities of Biotech-KISAN Hub in Eight Aspirational Districts in Madhya Pradesh Phase – II

DBT funded project entitled "DBT-Expansion Activities of Biotech-KISAN Hub in Eight Aspirational Districts in Madhya Pradesh Phase – II" under this project total number of 03 trainings were conducted Online. Under this project 10 demonstrations on soybean were conducted at Khandwa and Badwani District. The significantly higher yield was registered under demonstrations as compared to farmer's field.

Distribution (Soybean Seed, fertilizer and PPGPR to eligible farmers under SCSP

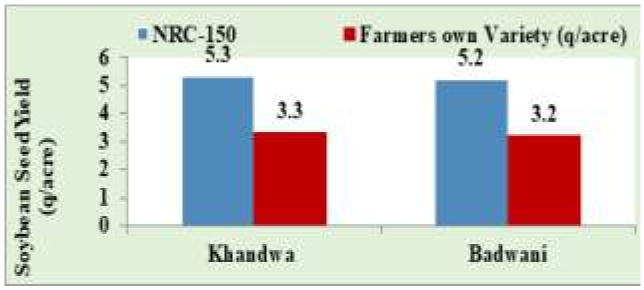
Farmers training programme under SCSP at ICAR-NSRI, Indore

Distributed Post hole digger machine

Distributed Brush Cutter Machine

Distributed (wheat seed, fertilizer and PPGPR to eligible farmers under SCSP

Farmers trainings and Input distribution under DBT- Biotech-KISAN Hub project



Farmers' Training Programmes organized under Tribe sub-plan

There were total 15 trainings organized for Schedule tribe (ST) farmers and distributed different agricultural inputs to them under Tribal sub-plan (TSP) scheme. During these programmes, soybean seed (variety- NRC-150), Maize Seed (variety- ADV-756), Wheat seed (variety- HI-1650, NPK (12:32:16) fertilizer, insecticide (Emamectin Benzoate), Electron pesticide which was pre mix of fungicide and insecticide for soybean seed treatment, Battery operated sprayer pump, Hasiya, Irrigation Pipes and Paddy seeder for planting of maize, ground nut and soybean were distributed among the eligible beneficiary farmers. The total 874 number of farmers belonging to Dhar, Khargone, Khandwa and Indore districts of the Madhya Pradesh were benefited from the scheme. Similarly, trainings were also conducted for the farmers and trained them to use the new production technologies of different crops, diversified crops and value addition for improving the farm productivity. Emphasis was also laid on use of climate smart technologies.

4.2.5 Participation in Agricultural Exhibitions

S. No	Event	Venue	Dates
1	ICAR-IISR Research-Industry Interface Meet	ICAR-NSRI Interface Meet interface meet	12.03.2025
2	Farm Tech: Agricultural Exhibition	Labhganga Complex, Indore	8-10 November 2025
3	Krishi Pradarshani on the occasion of release of amount for CM Bhawantar Yojana	Gautampura, Depalpur, Dist Indore	26.11.2025
4	Krishi Pradarshani on the occasion of Hon'ble Governor of M.P.	College of Agriculture, Indore	26.11.2025
5	Rashtriy Kisan Diwas evam Soya Krishak Mela	ICAR-National Soybean Research Institute, Indore	23.12.2025

4.2.6 Radio / TV Talk

दिनांक	चैनल	विशेषज्ञ	कार्यक्रम का प्रकार	शीर्षक
03.07.2025	डीडी किसान चैनल	डॉ. बी.यू. दुपारे	लाइव फोन इन	सोयाबीन की खेती
04.09.2025	डीडी किसान चैनल	डॉ. बी.यू. दुपारे	लाइव फोन इन	सोयाबीन फसल में समसामयिक कार्य
26.08.2025	डीडी किसान चैनल	डॉ. के.एच. सिंह	लाइव फोन इन	सोयाबीन की आधुनिक उत्पाद तकनीक
07.08.2025	आकाशवाणी इंदौर	डॉ. राघवेंद्र एन	लाइव फोन इन	सोयाबीन की उन्नत खेती, सस्य क्रियाएँ
21.08.2025	आकाशवाणी इंदौर	डॉ. लोकेश मीना	लाइव फोन इन	सोयाबीन में कीट प्रबन्धन, फसल संरक्षण
28.08.2025	आकाशवाणी इंदौर	डॉ. संजीव कुमार	लाइव फोन इन	सोयाबीन में रोग व्याधि प्रबन्धन
11.09.2025	आकाशवाणी इंदौर	डॉ. राकेश वर्मा	लाइव फोन इन	सोयाबीन फसल की कटाई गहाई, भंडारण









EDUCATION

05

5.1 Education

Table 5.1: List of registered Ph.D / M.Sc. Scholars undergoing dissertation programme at ICAR-NSRI

S.No.	Name of the Scholar	Guide	Title of the dissertation
			A. Ph.D. Program
1.	Ms Purva Dubey	Dr M.P. Sharma	Evaluation of ACC deaminase producing bacterial endophytes and their integration with AM fungi and Bradyrhizobium sp to enhance drought tolerance in soybean
2	Mr Prem Ranjan	Dr M.P. Sharma	Unravelling the rhizosphere soil microbiome and enzyme activities in soybean based cropping system cultivated under different crop and soil management practices
3	Ms Aashima Mukati	Dr Sanjay Gupta	Combining photoperiod and long juvenile alleles for wider adaptation
4	Ms Charu Jamnotia	Dr. Gyanesh Satpute	Breeding for genetic improvement of yield potential under water-limited condition in soybean (*Glycine max* L. Merill
5	Ms Meenal Baghel	Dr Vangala Rajesh	Characterization, Evaluation And Utilization Of Primary And Tertiary Gene Pools For Genetic Improvement Of Soybean
6	Ms Nandini Kashyap	Dr Vineet Kumar	CRISPR/Cas9 -mediated gene editing of phytic acid pathway genes to improve soybean quality.
7	Mr Vivek Gupta	Dr Savita Kolhe	Enhancing artificial intelligence based model for soybean crop germination and production
8	Mr Murlidhar Iyer	Dr Raj Pal Meena	Assessment of Agronomic Interventions for Biotic Stress Mitigation in Soybean (*Glycine max* L.) in Malwa Region of Madhya Pradesh
9	Mr Pradeep Chauhan	Dr Rakesh Kumar Verma	Impact of cropping systems, residue management and land configurations on productivity, profitability and soil health under soybean-based cropping systems.
			B. M.Sc. Program
10	Mr Shivam Patel	Dr Gilriraj Kumawa	Introgression of long juvenile and root length loci in soybean to study their effect on root architecture and yield
11	Ms Meenakshi Patidar	Dr M.P. Sharma	Evaluation of soybean core germplasm for enhanced nodulation and arbuscular mycorrhiza association in the rhizosphere
12	Ms Nandini Patel	Dr Giriraj Kumawat	Screening of soybean germplasm for Rhizoctonia aerial blight resistance and marker trait association analysis
13	Mr Jayesh Longre	Dr Giriraj Kumawat	Screening of breeding populations of soybean for Rhizoctonia Aerial Blight and DNA marker tagging.
14	Ms Deepali Tomar	Dr Lokesh K Meena	Screening, identification and biochemical analysis of different soybean genotypes against bruchid insect-pests.
15	Mr Yash Dubey	Dr Lokesh K Meena	Biophysical and biochemical bases of host plant resistance on some selected soybean (G. max) genotypes against Spodoptera litura Fabricius.

S.No.	Name of the Scholar	Guide	Title of the dissertation
16	Ms Tisha Gonde	Dr V Nataraj	Evaluation of advanced early maturing soybean (Glycine max (L.) Merr.) genotypes for yield and attributing traits
17	Ms Bharti Tanwar	Dr V Nataraj	Studies on soybean improvement for grain yield, agronomic traits
18	Mr. P.K. Sanjeev Prasad	Dr. Vangala Rajesh	Studies on genetic diversity,multitrait ideotype selection and character association for yield and yield attributing traits in USDA soybean varieties [Glycine max (L.) Merrill]" under Indian conditions.
19	Ms. Manasi Chaudhary	Dr. Vangala Rajesh	Genetic evaluation of BC3F2 interspecific population for pre- breeding introgression of rapid grain filling and disease resistance along with yield traits in Soybean (Glycine max (L.) Merril)
20	Mr. Neeraj Kushwah	Dr. Sanjay Gupta	Harnessing exotic soybean [*Glycine max* (L.) Merrill] germplasm to elucidate genetic variability and trait interrelationship for seed yield and yield component characters.
21	Mr. Monish Vaghmore	Dr Gyanesh Kumar Satpute	Evaluation of soybean (*Glycine max* L. Merill) genotypes for seed yield and drought tolerance traits under low soil-moisture condition
22	Ms. Megha Katare	Dr. Sanjeev Kumar	Phenotypic screening and validation of soybean germplasm resistance against anthracnose disease
23	Mr Mukesh Yadav	Dr. Sanjeev Kumar	Virulence profiling of Rhizoctonia solani isolates and identification of resistant sources for aerial blight disease of soybean.
24	Mr Mahesh Kumar Khaped	Dr Rakesh Kumar Verma	Effect of Improved Nutrient Management Strategies on Soil Health and Productivity of Soybean in Vertisols.
25	Mr Vedant Bhaidiya	Dr Raghvendra Nargund	Evaluation of Soybean Genotypes under Conservation Agriculture System
26	Mr Aakash Gour	Dr Hemant Maheswari	Harnessing extremophile nutrients transforming bacteria strengthen Soybean (Glycine max L. Merrill) against Rhizoctonia aerial blight caused by *Rhizoctonia solani Kühn.*
27	Ms Akanksha Patel	Dr Hemant Maheswari	Nutrient-transforming soybean bacterial endophytes against Rhizoctonia Aerial Blight (RAB)

Table 5.2: Details of student visit conducted during 2025

S.No.	Name of school/institution	Date of visit	No. of Students
1.	College of Agriculture, Nagaur, Agriculture University, Jodhpur	25.04.2025	35
2	School of Agricultural Science, Renaissance University, Indore	15.8.2025	55
3.	Symbiosis University of Applied Sciences Indore, School of Data Science	30.9.2025	60
4.	Dept of Botany, Mata Jijabai Govt PG Girls College, Indore, MP	20.10.2025	10
5.	Government higher secondary school bhagirathpura Indore	15.12.2025	40
6.	Govt. Higher Sec. School, Dharampuri,Sanwer,Indore	4.12.2025	45
7.	Prime minister College of Excellence,Government Degree College, Dhar	25.11.2025	50
8.	Government Higher Secondary School, Gawlipalasia, Mhow, Indore	23.9.2025	65
9.	Agriculture Sciences, SAGE University, Indore	25.9.2025	40
10.	College of Food Technology, Pravara Institute of Agricultural Sciences, Khadkewake, Ahilyanagar, Maharashtra	13.11.2025	50
11.	Rabindra Nath Tagore Agriculture College, Baijandih, Mohanpur,-814107, Deoghar	6.11.2025	43
12	School of Life Science, Devi Ahilya Vishwavidyalaya,	19.7.2025	50
13	Softvision College, Indore	11.10.2025	40
14	Mata Jijabai Govt PG Girls College Indore, MP	12.10.2025	10
15	Chameli Devi Institute of Pharmacy, Indore	1.12.2025	10

All India Coordinated Research Project on Soybean

06

The 55th Annual Group Meeting of the All India Coordinated Research Project (AICRP) on Soybean was organized from 19 to 21 February 2025 at CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (HP) under the chairmanship of Dr. Sanjeev Gupta, ADG (Oilseeds & Pulses), ICAR, New Delhi. The programme was inaugurated by Prof. Naveen Kumar, Vice Chancellor, CSKHPKV, Palampur, and coordinated by ICAR-National Soybean Research Institute (ICAR-NSRI), Indore. More than 140 scientists from AICRP centres, State Agricultural Universities and ICAR institutes participated in the three-day meeting. Dr. K. H. Singh, Director, ICAR-NSRI, presented the Project Coordinator's report highlighting the national research progress and GIS-based identification of potential areas for soybean expansion in Uttar Pradesh, Karnataka, Gujarat and Telangana. During the meeting, the Varietal Identification Committee identified a promising new variety JS 24-33 for release in central zone. Entries with superior performance in different trials were identified (Table 1).

The house also endorsed rezonalization of testing centres and designation of disease hot-spot locations for major pathogens. Key recommendations included multiplication of Glycine soja accessions resistant to yellow mosaic virus and charcoal rot for use in pre-breeding, development of long-juvenile and widely adaptable crosses, and establishment of breeding hubs for targeted hybridization combining high yield and disease resistance. Dr. Sanjeev Gupta (ADG) emphasized the need to develop soybean varieties with yield potential above 2 t ha^{-1}, diversify seed-chain varieties, and apply functional markers and genome editing for traits such as high oleic acid (> 70 %) and resistance to anthracnose, YMV and RAB. A special session demonstrated the use of the "Field Book" mobile application for digital recording and real-time data compilation across AICRP centres. The meeting finalized the technical programme for Kharif 2025 covering breeding, agronomy, pathology, entomology, microbiology and transfer-of-technology components, thereby strengthening coordination and national priorities for soybean research and development in India,

Table1: Entries superior to the best check in AICRP 2024 trials

Zone and Trial	Name of the Superior Enteries	Range of grain/oil yield superiority
CZ, IVT	NRC 292, NRC 295, NRC 291, AUKS 22-1, JS 25-55, NRC 294, NRC 290, CAUMS 4, AUKS 22-10. Best check JS 21-72 (1986 Kg/ha)	11-36%
CZ, AVT I	NRC 268, NRC 270. Best Check JS 21-72 (2165 Kg/ha)	21 and 18%
SZ, IVT	NRC 291 (Food grade), Best Check JS 335 (3071 Kg/ha)	Equivalent to best
EZ, AVT I	NRC 268 (Food grade), Best check RSC 10-46	check, 2.5%



Events, Meetings and Media Coverage 07

Republic Day: The institute has celebrated country's 76th republic day on 26th January 2025 to commemorate the day on which the Constitution of India came into effect. Dr. K.H Singh, Director, ICAR-NSRI addressed about the importance of the constitution of India and how Indian turned from a dominion country to a republic country.

Research-Industry-Interface Meet

The Agri-Business Incubation Centre of ICAR-National Soybean Research Institute, Indore organized "Research-Industry Interface Meet" with the involvement of about 90 participants including 40 incubates and scientists of the institute. At the outset the participants visited the exhibition of the products launched by the trained incubatees who got training and skills for their products.

The Chief Guest of the function Dr D.K. Yadav, Hon'ble Deputy Director General (Crop Science), ICAR joined virtually and appreciated various programs organized by ICAR-NSRI for technology commercialization and transfer of technology among various stakeholders associated with soybean production chain. He appreciated the soybean breeding work and genome editing programme going on at NSRI but emphasized to work on crop protection. He mentioned about trait specific 92 soya varieties developed by the institute through AICRPS network. During the occasion, the institute Director Dr. Kunwar Harendra Singh presented the scenario of soybean cultivation in the country and said that by gradually India is reducing the export dependence of soybean economy and increasing the consumption of soybean food products or soya cake in the country itself, essential for bringing the stability in the market to farmers. During the panel discussion, Dr. Dinesh Bhosale of B Vista South Asia Office, Pune; Dr. Ratan Sharma, Director, Soya Food Program, Soya Cow Center, Ghaziabad; Dr. Deepak Kumar, Executive Director, Next Node India Private Limited, Kadi, Gujarat; Dr. J. Stanley, Agri Business In-charge, Indian Millet Research Institute, Hyderabad; Dr. Nilesh Trivedi, Assistant Director, MSME, Indore along with Dr. Mrinal Kuchlan of the Institute delivered key lectures on the occasion. In addition, Mycorrhiza fungal formulation developed by M/s Biome Technology, Ahmednagar, Maharashtra, a trained firm from the Institute's incubation centre, has released its formulation.

Germplasm Day: During the off-season, the institute organized "Germplasm Day" on 1st May 2025 to showcase the rich diversity of soybean germplasm conserved, characterized, evaluated, and maintained at the institute. The event was attended by the scientists of ICAR–NSRI; and scientists from AICRP on Soybean centres at Amravati, Kota, and Kasbe Digraj. The event was jointly coordinated by Dr. Sanjay Gupta and Dr. Vangala Rajesh.

39th Institute Research Council: The meeting of the Institute Research Council (IRC) of ICAR-NSRI was held on April 21-23, 2025 under the chairmanship of Hon'ble Director ICAR-NSRI, Dr K.H. Singh. The Member Secretary, Dr Punam Kuchlan presented the action taken report of 38th IRC followed by the presentations on research achievements of various research projects. The chairman appreciated the efforts of scientist in developing a valuable breeding materials expressed from evaluation reports of coordinated trials. He interpreted that share of institute's varieties may reach up to 50 percent on next five years. He emphasized that continuous disease pressure necessitates intensive research on biotic stresses to insulate soybean varieties against multiple diseases.

Celebration of World Intellectual Property Day: Under the aegis of ICAR, IP&TM Division, the ITMU of ICAR-NSRI, Indore has organized a seminar on Intellectual Property Rights (IPR) to celebrate World IP Day in the forenoon on 1st May 2025. On this occasion, Dr. D.K. Agarwal, Registrar General, PPV&FR Authority, Govt. of India, New Delhi, was the chief guest and delivered a talk on "Protection of Plant Varieties. He emphasized the importance of protecting and conserving plant varieties in Indian agriculture. He highlighted the milestone discoveries and their relevance with music and modern day science inventions citing various examples. He clarified how indigenous plant varieties performing better than high-yielding varieties could be granted protection rights for farmers. In the interactive session, he explained how PPVFRA creating awareness among the farmers by organising visits to their fields. He also mentioned that currently PPVFRA is striving hard to increase the registration of varieties. The Guest of Honor Shri Nilesh Trivedi, Assistant Director, MSME, Govt. of India, Indore, also spoke on "Trademarks, Copyrights, and Government Initiatives on IPR." The program was chaired by Dr K.H. Singh, Director, ICAR-NSRI, Indore. Dr M.P. Sharma, Pr. Scientist and Nodal Officer, ITMU, NSRI, Indore served as convener of the program while Dr. Giriraj Kumawat, Sr. Scientist, ICAR-NSRI, Indore was the co-convener.

International Yoga Day: The institute celebrated the International Yoga Day on June 21, 2025. The day is aimed to raise awareness worldwide of the many benefits of practicing yoga.

Vikasit Krishi Sankalp Abhiyan : The institute scientists actively participated in the mission to make the farmers aware about the technologies and know-how before the start of kharif season under "Vikasit Krishi Sankalp Abhiyan" conducted across the country from 29 May to 12 June 2025 under the leadership of Union Agriculture Minister Hon'ble Shri Shivraj Singhji Chauhan. The campaign was conducted across the country, including Indore district which were jointly organized by the National Soybean Research Institute, Krishi Vigyan Kendra and Department of Agriculture. The ICAR-NSRI scientists were also deputed in nearby districts like Indore, Dhar, Ujjain, Dewas, Ratlam, Badwani, Khargone who delivered relevant information and also assessed their issues of concerns. Under the VKSA campaign, an awareness drive for promotion of production technology of kharif crops was also conducted in "ICAR Model Village Memdi" adopted by ICAR-NSRI, in which the institute's director Dr. K.H. Singh, Principal scientist Dr. B.U. Dupare, Scientists of Krishi Vigyan Kendra Indore and Deputy Director Agriculture of Indore Shri C.L. Kevada have graced the programme at Memdi along with public representatives, Mr. Dinesh Chauhan (member of District Panchayat Indore and chairman of District Agriculture Standing Committee), Mr. Rupesh Waghmore (Mandal President) and Mrs. Lalita Balram Kelwa (Deputy Sarpanch of Gram Panchayat Memdi) attended and participated in the program.

Address of Hon'ble Agricultural Minister Shri Shivraj Singh Chauhan during Soybean Stakeholder's Meet (26th June 2025) at the institute

Hon'ble Agricultural Minister laid the foundation stone of Farm Resource Lab in August presence of Hon'ble Secretary DARE & DG, ICAR and other officials

Hon'ble DDG (Crop Science) ICAR, Dr. D.K. Yadava addressing the Soybean Stakeholder's Meet

Inspection of Official Language Implementation of ICAR-NSRI by parliamentary standing committee.

Stakeholder consultation meeting on soybean and a "Review Meeting of the National Edible Oil Mission" and launch of Oil Seed Mission : Stakeholder consultation meeting on soybean and a "Review Meeting of the National Edible Oil Mission" were organized at the ICAR-National Institute of Soybean Research, under the chairmanship of the Hon'ble Union Minister of Agriculture and Farmers Welfare, Shri Shivraj Singh Chouhan.

Inspection of Rajbhasha Activity

The institution was inspected by the second sub-committee of the Parliamentary Committee on Official Language headed by Shri Ujjwal Raman Singh, Hon'ble Member of Parliament on 04.07.2025. The Director of the institute Dr K. H. Singh, Dr Punam Kuchlan (In-Charge, Official Language), Dr B. U. Dupare, Dr Sanjiv Gupta (ADG, O&P), ICAR Headquarter represented the from the institute side.

Webcasting of Pradham Mantri Dhan Dhanya Krishi Yojana: The ICAR-NSRI organized webcast of Hon'ble Prime Minister of India, Shri Narendra Modi, launching Pradhan Mantri Dhan Dhanya Krishi Yojana and Mission of Aatmanirbharta in Pulses' on 11th October 2025 from the National Agricultural Science Complex (NASC), New Delhi. The webcast programme was attended by 360 farmers from Indore, Dewas and Ujjain district along with institute staff wherein Hon'ble Member of Parliament Mr. Shankar Lalwani graced the event as Chief Guest along with Dr. K. H. Singh, Director, ICAR–NSRI.

21st PM kisan Samman Nidhi programme

Prime Minister Narendra Modi today transferred ₹18,000 crore directly to the bank accounts of 9 crore eligible farmers by pressing the button as 21st instalment of the Pradhan Mantri Kisan Samman Nidhi Yojana. The main event was held at the Agricultural University campus in Coimbatore, Tamil Nadu, and was live webcast from the National Soybean Research Institute's pavilion complex. A total of 334 people, including 217 farmers and staff, participated. wOn this occasion, Dr. Kunwar Harendra Singh, Director of the ICAR-National Soybean Research Institute, stated in his address that agriculture contributes 17-18% to India's economy and employs more than half the population. He warned that the land fragmentation among family members would drastically reduce cultivated acreage, making food security a challenge. In his brief address, Dr. Singh emphasized the need to integrate small and medium-sized enterprises into agriculture to make farming economically viable. He informed them about the Institute's Agribusiness Incubation Center's facilities available to young people interested in starting soybean farming and marketing nutritious dishes.

During the occasion, an input distribution programme was also organized under the "Tribal Sub-Plan" through which battery-operated sprayer pumps were distributed to 74 eligible beneficiaries belonging to Dhar and Khargone districts of Madhya Pradesh by the Hon'ble MLA, Rau, Indore Shri Madhu Verma. Shri Verma also visited the "natural farming" experiments being conducted at the Institute's research field and discussed with the scientists.

Monitoring of field experiments during Kharif season

A committee under the leadership of Honble Director Dr K. H. Singh visited the experimental field of institute scientists and monitored field experiments during 22nd July 2025. Committee interacted with all scientists at their field experiment site and suggested measures for improvement. Objective of this internal monitoring was to enhance interaction among scientists and increase the precision in research experiments.

Crop Cutting Experiment

In order to explore the potential of technology/package of practice/genotype, a new activity "Crop Cutting Experiment" has been initiated this year as directed by Institute Director Dr K. H. Singh. A committee was constituted which visited the experimental plots of all the scientists and harvested a sample measuring 5X5 m area which the concerned scientist feels a best one among all the treatments. The harvested sample was threshed and kept under the custody till the samples from all the scientists are collected. The samples were weighted and the data were communicated to concerned scientists along with the sample. The highest yield was worked out as 3.03t/ha in an agronomical evaluation conducted by Dr Rakesh Kumar Verma.

Independence Day

Institute has celebrated country's 79th Independence Day on 15th August 2025. On this occasion, Dr. K.H. Singh, Director, ICAR-IISR, addressed about the importance of the day to the nation and remembered the sacrifices of the freedom fighters in getting the India free from the colonization. He also urged the institute's staff to serve the nation through enhancing the soybean production and to make India self-sufficient in edible oil.

29th Research Advisory Committee meeting

The meeting of the 29th Research Advisory Committee of ICAR- National Soybean Research Institute, Indore was held on 25- 26th August, 2025 under chairmanship of Dr. Swapan Kumar Datta, Former Dy. Director General (CS) ICAR, New Delhi.

Dr. K. H. Singh, Director delivered a brief presentation on the current status of the soybean crop, highlighting both emerging opportunities and prevailing constraints. He outlined key achievements, innovative breeding strategies, advancements in crop production and protection technologies, and new initiatives.

Dr. Milind Ratnaparkhe, Member Secretary, presented the action taken report of the previous RAC. This was followed by the presentation of salient research achievements made during 2024-25 by Section In charges under various projects. During interaction session, all the esteemed members appreciated the efforts made by the Institute during 2024-25 in addressing major issues.

Dr. V. K. Baranwal suggested that several viruses infect soybean and new technologies should be explored for detection of viruses. Dr. S. R. Bhat stated that genomics data are accumulating at a very fast pace, and crop-based institutes like NSRI with limited human and computation resources may not be able to efficiently harness it for crop improvement. Dr. Masood Ali opined that plant geometry, tillage irrigation and population management are important aspects for biotic stress management and higher productivity. Dr. Ashutosh Upadhyay suggested research on industrial uses of soybean while addressing the industry expectations for soybean products. Dr. Sanjeev Gupta, ADG (O&P), ICAR emphasized that new traits should be identified and utilized for soybean improvement. He suggested that benchmark should be developed for soybean variety release and seed longevity data should be included in proposals. The committee also visited frontline demonstrations laid out in village-Raikonda and interacted with farmers on various pertinent issues.





Vigilance awareness week

On the directives of Central Vigilance Commission - Government of India, institute observed Vigilance Awareness Week-2025 from 30th October 2025 to 5th November 2025. All the scientific, administrative, and technical staff led by the Director of the institute, Dr K.H. Singh, took oath in this regard. Director called upon the employees to follow the office ethics, protocol, guidelines as well as the conduct rules and to work for the institute with full integrity and honesty. On 2nd November, all the staff members led by the Director, performed the walkathon within the institute. The program was concluded on 6th October with the valedictory-cum-prize distribution.

39th Foundation day of ICAR-NSRI

The Institute celebrated its 39th Foundation Day on December 11, 2025 . The program was attended by Dr. A.K. Vyas, former Vice-Chancellor of Agriculture University, Kota (Rajasthan), Dr. V.S. Bhatia, former Director of the institute, Mr. D.N. Pathak, Executive Director of SOPA, and Dr. Jagdish Kumar of Hi-Rich Soy Seed Company. The special Guest Dr. Sanjeev Gupta, Assistant Director General (Oilseeds and Pulses), Indian Council of Agricultural Research, New Delhi, and Director General (Crop Science), Hon'ble Dr. D.K. Yadav, addressed as Chief Guest of the function through online mode while Dr S.P. Tiwari, former DDG (Education and Crop Science, ICAR) presided over the function.

On the occasion of the institute's foundation day, Artificial Intelligence-based mobile app "Soybean Gyan" developed by the institute's scientists, was launched beside release of five publications which include "Monthly Agricultural Calendar for Soybeans (2026)," the official language magazine "Soy Vritika," the extension bulletin "Soybean: Improved varieties, agronomic practices, methods for insects and disease control and Technical Recommendations," the technical bulletin "Weekly Advisory for Soybean Farmers - Kharif 2025," and "Success Stories of Progressive Farmers under the Scheduled Caste Sub-Plan."

During the programme the employees who did excellent work during 2025 were honoured which include Dr. Raghavendra Nargund (Scientist category), Mr. Rakesh Chandra Shakya (Technical category) and Mrs. Mangi Bai (SSS category). Dr Rakesh Kumar Verma was also felicitated on the occasion for harvesting highest soybean yield in the crop cutting experiment category initiated this year. The best team work award was given to Purchase Advisory committee while a team led by Dr Mrinal Kuchlan was awarded for excellence in soybean seed production programme. At the end, Sh Sanjeev Kumar, Smt Antar Bai, Smt Sagri Bai, Smt Fulki Bai, Smt Raida Bai & Smt Chunki Bai from skilled supporting staff and Shri Raghu Nath Singh, Shri Shyam Kishor Verma and Shri Om Prakash Vishwakarma who are superannuating soon were felicitated for their contribution in institute development.

The Institute honored seven farmers associated with the Institute with the highest production in various districts of Madhya Pradesh with the "Outstanding Soybean Farmer" award. These include Mr. Gangadhar Gora (village-Memdi "ICAR Model Village Project"; Mr. Chetan Holkar (village Memdi under the FLD Program); Mr. Banveer Chauhan (village Ratlipura, district-Khargone under (TSP); Mr. Jagdish Mangilal of (village Mugli, district-Sehore) SCSP; two beneficiaries of the project on "Evaluation of Early and Medium Duration Varieties" program funded by the M,P. Government Mr. Seemant Gehlot village-Kotha, district Khandwa & Mr. Azad Singh village Rajoda, district-Indore and Mr. Rohit Anjana, District-Ujjain (under seed production category) was honoured with the Best Soybean Farmer Award along with a certificate.

The program was conducted by Ms. Priyanka Sawan, and the vote of thanks was delivered by the organizing secretary of the program, Dr. B.U. Dupare.

Rashtriya Kisan Diwas-cum-Soya Krishak Mela

The institute celebrated the birth anniversary of late Prime Minister Shri Chaudhary Charan Singh on 23rd December 2025 by organizing "Rashtriya Kisan Diwas cum-Soya Krishak Mela" at the institute campus. The programme was organized under the aegis of various TOT programmes being executed at the institute like "Frontline Demonstrations on Soybean under National Mission on Vegetable Oil", Mera Gaon Mera Gaurav, Seed Hub and Model ICAR village programme etc. A Farmer-Scientist Interaction was also conducted immediately after the brief talk by the institute scientists on the major issues of farmers' significance like improved soybean varieties, their characteristics, new agronomic practices, insect-pest and disease management etc.

This year, four soybean seed producer farmers from Madhya Pradesh who achieved the highest soybean production under the Institute's soybean seed production program were honoured:

Janjatiya Gaurav Varsh Pakhwada: In compliance to the instructions commomorating the 150th Birth Anniversary of Bhagwan Birsa Munda, various educational and skill development activities, Janjatiya Gaurav Tribal Market, Seed Bank, digital inclusion to highlight the legacy of tribal freedom fighters have been highlighted.

Cleanliness Activities during 'Swachhata hi Sewa' and 'Swachta pakhwada 2025'

Cleanliness Activities during 'Swachhata hi Sewa' and 'Swachta pakhwada 2025'

The institute celebrated "स्वच्छोत्सव Swachhotsav" during 14th September-2nd October 2025 by conducting various activities like Essay Competition for Shriram Convent School, Indore, Cleanliness at Regional Park, Indore, Gram Sanwad at village Katkatkhedi in addition to cleanliness drive at the Office building as well as residential campus.

Similarly, 'Swachhta Pakhwada 2025' was conducted during December 16-31, 2024, which began with the Swachhata Pledge administered by the Institute Director Dr K. H. Singh to the staff of the institute. During this fortnight, appropriate action was taken on review & weeding out of old records, disposal of scrap items, as well as conduct of various competitions and activities like signature campaign, recycling of waste water, Shramadan, Walkathon etc along with cleaning of institute premises as well as Residential Campus, cleaning of compost pits, drainage chambers etc. carried out by all the staff of the institute. The programme was






concluded with the prize and certificate distribution to the winners during the valedictory programme organized. Shri Shyam Kishore Verma, the Member Secretary of Swacch Bharat Abhiyaan organized various activities meticulously.

Other important meetings/activities

- Re-zoning of AICRP on soybean and identification of disease hotspots was done on 23.01.2025.
- A meeting on vegetable and food grade soybean as a profitable option for farmers in Madhya Pradesh was held on 16.06.2025.
- Rashtriya Ekta Diwas was celebrated on 31st October 2025 by administering Integration Pledge
- The institute staff recited National Song "Vande Mataram" on the occasion of its 150th year of composing.
- Janjaatiya Gaurav Varsh Pakhwada – 2025 was Celebrated on the occasion of Birth Centenary of Bhagwan Birsa Munda by organizing various programmes and activites. Health & Wellness Camp was conducted on 01.11.2025 in which Dr Nitin Modi, Senior Heart Surgeon, CHL-CARE Hospital, Indore delivered talk on "Healthy heart & healthy lifestyle".

Media Coverage


लैब-टू-लैंड से खेती में उपलब्धियां

अब हो रहा लैब में बैठे कृषि वैज्ञानिक और लैंड पर काम कर रहे किसान का सीधा संवाद

इससे हो रहा किसानों को फायदा, केंद्रीय कृषि मंत्री शिवराज सिंह चौहान ने बताई सरकारी योजनाएं


कृषि मंत्री शिवराज ने की ट्रैक्टर की ड्राइविंग


सोयाबीन किसानों के लिए उपयोगी सलाह जानें बुवाई का सही समय और उन्नत किस्म


विकसित भारत के लिए कृषि और समृद्ध किसान जरूरी - शिवराज

11 साल में 44 प्रतिशत खाद्यान्न उत्पादन बढ़ा


दूसरे देश में उत्पादकता ज्यादा है तो हमारे यहां क्यों नहीं : शिवराज


बीज और तकनीकी प्रशिक्षण से किसानों को मिली राष्ट्रीय औसत से दोगुनी उपज

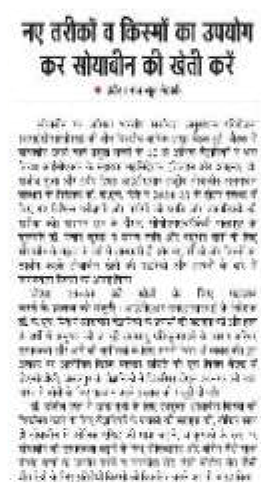

आज तक

"खेती का नया युग: शिवराज सिंह चौहान के नेतृत्व में इंदौर से सोयाबीन क्रांति की शुरुआत"


इंदौर

ग्राम मेमदी में गेंदे की खेती पर प्रशिक्षण एवं पौध वितरण कार्यक्रम


सोयाबीन की उत्पादकता बढ़ाने उन्नत बीज-सही डाम-फूड यूज पर होगा काम : शिवराज


नए तरीकों व किस्मों का उपयोग कर सोयाबीन की खेती करें


सोयाबीन में प्रमुख रोगों के प्रबंधन हेतु बीज उपचार विधि एवं अनुशंसित फफूंदनाशक


बड़वानी के किसानों को कीटनाशक दवाई वितरित


प्रदेश में सोयाबीन-गेहूं फसल प्रणाली की वृद्धि हेतु प्रशिक्षण कार्यक्रम का आयोजन


'प्रधानमंत्री धन-धान्य कृषि योजना' और 'दलहन आत्मनिर्भरता मिशन' का शुभारंभ


11 साल में अनाज का 40 प्रतिशत अधिक उत्पादन सोयाबीन में अग्रणी


नई किस्म के एक क्विंटल बीज से एक सीजन में 25 क्विंटल हो रही पैदावार


नृत्य नाटिका से बताया अच्छी खेती करने का तरीका

Distinguished Visitors 08

- **Dr. S.K. Rao**, Former Vice Chancellor, RVSKVV, Gwalior visited on 23.1.2025
- **Shri Shivraj Singh Chauhan**, Hon'ble Union Agriculture Minister, Govt. of India, New Delhi visited on 26.6.2025.
- **Honble Dr. M.L. Jat**, Secretary DARE % DG, ICAR visited on 26.6.2025.
- **Prof. Indra Mani**, Vice Chancellor, VNMKVVV, Parbhani (Maharashtra) visited on 26.6.2025.
- **Dr. D.K. Yadava**, Deputy Director General (CS), ICAR, New Delhi visited on 26.6.2025.
- **Mr. Devesh Chaturvedi**, Union Agriculture Secretary, DA&FW, Govt. of India visited on 26.6.2025
- **Dr. Ch. Srinivasa Rao**, Director, ICAR-IARI, New Delhi visited on 3.10.2025.
- **Dr. S.K. Pradhan**, ADG (FFC), ICAR, New Delhi visited on 17.10.2025.
- **Dr. C.D. Mayee**, Ex Chairman, ASRB, New Delhi visited on 28th August, 2025
- **Dr. Dhiraj Kumar**, Ex Director, ICAR-DRMR visited on 1st September 2025.
- **Dr. R.K. Mathur**, Director, ICAR-IIOR, Hyderabad visited on 11.10.2025.
- **Dr. D.K. Agarwal**, Registrar General, PPV&FR Authority, Govt. of India, visited on 1st May 2025

Honble MoA&FW
Shri Shivraj Singh Chauhan

Honble Secretary DARE &
DG ICAR and DDG (CS)

Honble Dr. Ch. Shrinivasa Rao,
Director, ICAR-IARI

Dr. Ravi Mathur
Director ICAR-IIOR, Hyderabad

Honble Shri Madhu Verma
MLA, Rau-Indore

Honble Shri Shankar Lalwani
MP-Indore

Dr. Dinesh Kumar Agrawal
Registrar General PPV & FRA

Dr. C.D.Mayee
Ex-Chairman, ASRB

Dr. Dhiraj Singh
Ex-Director, ICAR-IIRMR

Ongoing Project List-2025

Project No.	Years	Project Title	PI
NRCS 1.1/87	1987-LT	Augmentation, management and documentation of soybean germplasm	Dr. Sanjay Gupta
IISR4.6/23	2023 LT	Pre-breeding for broadening of genetic base in soybean	Dr. Vangala Rajesh
IISR 1.33/16	2016-LT	Development of YMV resistant soybean varieties using marker assisted selection	Dr. Anita Rani
IISR4.5/23	2023-31	Breeding for resistance against charcoal rot and anthracnose diseases in soybean	Dr. Nataraj V
IISR 3.12/19	2019-2024	Soybean Improvement against defoliating insects	Dr. Vangala Rajesh
IISR4.4/23	2023-31	Breeding for high seed and oil yield for different maturity duration in soybean	Dr. Shivakumar M.
IISR4.3/23	2023-2028	Enhancement of Seed Longevity of Vegetable Soybean (Glycine max l. Merr.) Genotype.	Dr. Punam Kuchlan
NRCS 1.12/02	2002-LT	Breeding for food grade characters and high oil content	Dr. Anita Rani
DSR 5.6a/08	2009-LT	Breeding for drought resistance / tolerance varieties in soybean	Dr. G. K. Satpute
ISSR 3.16/21	2021-2026	Identification of genes/loci for better root system in soybean	Dr. Giriraj Kumawat
IISR 3.15/2020	2020-2024	Development of genome edited soybean lines with improved oil quality	Dr. Milind B. Ratnaparkhe
NEW PROJECT	2025-2029	Harnessing power of soy: Development of new age health foods from highly soluble soy protein	Mrs.Neha Pandey
		CROP PRODUCTION	
IISR 7.10/24	2024-2028	"Irrigation scheduling in soybean to enhance yield and water use efficiency at central India".	Dr. Rajpal Meena
IISR4.13/17	2022-27	Evaluation of residue management practices under permanent broad bed furrow as well as conventional tillage practices for sustaining/ improving resources use efficiency, soil quality and crop productivity in soybean-based cropping systems	Dr. Rakesh Kumar Verma
IISR6.10/23	2023-2028	Standardization of sustainable (Natural/Organic farming/Conservation agriculture) management practices for soybean yield maximization under soybean-based cropping systems	Dr. Raghvendra Nargund
IISR 7.8/23	2023-2028	Trait identification and physiological breeding for water logging tolerance in soybean	Dr. Prince Choyal

Project No.	Years	Project Title	PI
IISR 8.17/2020	2020-2025	Development and evaluation of ICT tools and medias for ToT of soybean	Dr. B.U. Dupare
IISR 8.18/23	2023LT	Transfer of Improved Soybean Production Technologies for Increasing Soybean Production	Dr. B.U. Dupare
IISR/7.9/24	2024-2029	Transforming Soybean Cultivation Through Advanced AI Modeling	Dr. Savita Kolhe
IISR 7.7/23	2023-2025	Development of Seed and Product Sale Portal for Online marketing in Soybean	Dr. Savita Kolhe
DSR4.11/20	2020-2024	Field evaluation of potential plant growth promoting rhizobacteria (microbial consortia) and AM fungi on nutrient dynamics and mineral biofortification under soybean-wheat cropping system (enquire from Dr. Ramesh whether it is completed?)	Dr. A. Ramesh
CROP PROTECTION			
IISR3.11/22	2022-2027	Soybean Improvement against Rhizoctonia aerial blight disease	Dr. Sanjeev Kumar
IISR 3.13/21	2021-2024	Isolation and identification of kairomones and sex pheromones components for soybean stem fly, Melanoagromyza sojae management	Dr. Lokesh Kumar Meena
NEW PROJECT	2025-2028	Population dynamics of major insect-pests of soybean and their natural enemies	Lokesh Kumar Meena
IISR 6.9/17	2017-2020	Bacterial mediated Sulphur bioavailability in soybean	Mr. Hemant S. Maheshwari
IISR 3.12/2020	2020-2024	Interaction effect of phytohormones and AMF for enhanced nodulation, growth, yield of soybean with improved AMF symbiosis in the rhizosphere	Dr. M. P. Sharma
IISR 6.9/17	2017-2020	Bacterial mediated Sulphur bioavailability in soybean	Mr Hemant S. Maheshwari
IISR/3.14/24	2024-2026	Standardization of package of practices for soybean production by using drone technology	Dr. Sanjeev Kumar
NEW PROJECT	2025-2029	Development of nutrient transforming microbial consortia for sustaining soybean based cropping system". Duration of the project 4 years.	Mr. Hemant S. Maheshwari
EXTERNAL FUNDED PROJECTS			
Meity	2025-	Genomic Visualization and Assembly Tool for Soybean and other oil seed crops:	Dr. Milind B. Ratnaparkhe
ICAR	2022-2025	Enhancing climate resilience and ensuring food security with genome editing tools Rs 565.43 Lakhs	Dr. Milind B. Ratnaparkhe

Project No.	Years	Project Title	PI
DBT, Govt. of India	2024	Development of Environmentally Friendly Controlled-Release P-fertilizer and its Evaluation with Plant Growth Promoting Microbes on Soybean Productivity and Soil Microbial Health (collaborative project with IISER-Bhopal and TERI New Delhi) ICAR-IISR Centre	Dr. Mahaveer P Sharma
ICAR-NBAIM, Mau	2023-2025	Biopolymer coating of soybean seeds with microbial consortia for improved productivity of soybean and soil health: AMAAS Network project.	Dr. Mahaveer P Sharma
SERB, DST, Govt. Of India	2021-2024	Genome-wide association mapping of charcoal rot resistance in soybean (Glycine max L.)	Dr. Nataraj V.
BRNS, BARC Mumbai	2022-2025	Development of high oleic acid mutants of KTI and lox2 free soybean gamma and electron beam	Dr. Vineet Kumar
DBT Govt. of India	2021-2024	Developing food-grade soybean using CRISPR/Cas9 mediated multiplex genome editing	Dr. Vineet Kumar
NASF, ICAR	2022-2025	Marker assisted stacking of yellow mosaic disease resistance, null Kunitz trypsin inhibitor, null lipoxygenase-2 genes, and broadening the genetic base of soybean	Dr. Vineet Kumar
DBT Govt. of India	2022-2025	Marker assisted introgression of seed weight, early maturity and photoperiod response genes in multiple stress tolerant climate smart soybean variety JS97-52 and KTI free variety NRC 127	Dr. Shivakumar M.
DST-ANRF	2025-2027	Functional characterization of soil surface rooting (GmSOR) genes and development of their genic markers in soybean.	Dr. Giriraj Kumawat
NASF, ICAR	2023-2026	Targeted improvement of stress tolerance, nutritional quality and yield of crops by using genome editing	Dr. Anita Rani
PVPFRA India	2005-LT	DUS testing of soybean-Central sector scheme for protection of plant varieties and farmers right.	Dr. Mrinal K. Kuchlan
ICAR	2006-LT	ICAR – Seed Project: Seed Production in Agricultural Crops.	Dr. Mrinal K. Kuchlan
DAC, Minister of Agriculture	2018-Till Date	Creation of Seed Hubs for enhancing quality seeds availability of major oil seed crops under NFSM-Oil Seeds	Dr. Mrinal K. Kuchlan
DAC, MoA&FW	2023	Frontline Demonstrations under National Mission on Edible Oilseeds	Dr. B.U. Dupare
DOA, M.P.	2024	Demonstration of early and medium duration soy cultivars under soy-wheat cropping system in Madhya Pradesh	Dr. B.U. Dupare
DBT, Govt. of India	2022-2025	Expansion of Activities of Biotech-KISAN Hub in Eight Aspirational Districts in M.P.–Phase II	Dr. Rakesh Kumar Verma

Publications, Patents, Awards and Recognition 10

Publications

1. Amrate, P.K., Nataraj, V., Shivakumar, M., Shrivastava, M.K., Rajput, L.S., Mohare, S., Agrawal, N., Mandloi, S., Anand, K.J., Ratnaparkhe, M.B., Naik, K.B., Gupta, S and Singh, K.H. 2024. Best linear unbiased prediction (BLUP)-based models aided in selection of high yielding charcoal rot and yellow mosaic resistant soybean genotypes. Genetic Resources and Crop Evolution. https://doi.org/10.1007/s10722-024-02289-5

2. Amrutha Lakshmi M, Kulshreshtha A, Mondal K K, Dasgupta I, Tyagi A, Kumar S, Kalaivanan N S, Mrutyunjaya S, Sreenayana B, Rashmi E R, Ghoshal T, Jagram N, Challa G K, and Mani C. 2025. Functional validation of OsRPM1 as a positive regulator of bacterial blight resistance in rice via virus-induced gene silencing. Folia Microbiologica (Praha). https://doi.org/10.1007/s12223-025-01280-6

3. Amrutha Lakshmi M, Kulshreshtha A, Mondal K K, Kalaivanan N S, Handique P J, Borbora D, Rajrana Y, Verma G, Bhattacharya A, Reddy K, Soni M, Ghoshal T, Mrutyunjaya S, Rashmi E R, Kumar S, Sreenayana B, and Mani C. 2025. Rice transcriptomic analysis provides novel insights into T3SS-mediated modulation of plant defense responses by the most virulent Indian race 4 of Xanthomonas oryzae pv. oryzae. Journal of Plant Diseases and Protection. 132, Article 132. https://doi.org/10.1007/s41348-025-01122-0

4. Asiamah, J.Y., Mahdi, S.H., Christian, T., Carson, B., Koirala, P., Anne, ER., Aaron, E., Asare, T., Augustine, A., Ratnaparkhe, M.B. et al. 2025. Gene Editing in Grain Legumes for Food Security (2025) Frontiers in Genome Editing 7, 1572292

5. Bright, J.P., Chinnasamy, K., Maheshwari, H.S., Perveen, K., Khan, F., Barasarathi, J., Balachandar, D. and Rebouh, N.Y. (2025). Multi-potent rhizobacteria enhance banana growth and reduce chemical fertilizer input. Frontiers in Microbiology, 16: 1659278.

6. Bright, J.P., Maheshwari, H.S., Thangappan, S., Perveen, K., Bukhari, N.A., Mitra, D. and Mastinu, A. (2025). Biofilmed-PGPR: next-generation bioinoculant for plant growth promotion in rice under changing climate. Rice Science, 32(1): 94–106.

7. Chauhan, I.P., Verma, P., Bhattacharya, A., Narayan, S., Sharma, M.P., Choure, K. and Mishra, A. (2025). Intervention of Bacillus subtilis enhances defence activity in soybean as compared to chemical fungicide during charcoal rot disease. Journal of Plant Growth Regulation, 44: 2734–2749. https://doi.org/10.1007/s00344-024-11572-9

8. Dwivedi, R., Tiwari, A., Bharill, N., Ratnaparkhe, M.B., Singh, S.K., Tripathi, A. 2025. A novel chemical property-based, alignment-free scalable feature extraction method for genomic data clustering. Computers & Electrical Engineering, 123 (C): 110175

9. Gowdra, G.V.M., Lalitha, B.S., Halli, H.M., Senthamil, E., Negi, P., Jayadeva, H.M., Basavaraj, P.S., Harisha, C.B., Boraiah, K.M., Adavi, S.B., Suresha, P.G., Nargund, R., Mohit, G. and Reddy, K.S. (2025). Root growth, yield and stress tolerance of soybean to transient waterlogging under different climatic regimes. Scientific Reports, 15(1): 6968.

10. Gudge, S., Tiwari, A., Ratnaparkhe, M.B., Jha, P. 2025. On construction of data preprocessing for real-life SoyLeaf dataset & disease identification using Deep Learning Models. Computational Biology and Chemistry 117, 108417,

11. Jha, P., Tiwari, A., Bharill, N., Ratnaparkhe, M.B., Patel, O.P. 2025. Gpu-enhanced scalable methods for genome sequence feature extraction and clustering. International Journal of System Assurance Engineering and Management, 1-16

12. Kesawat, M.S., Manohar, S., Anand, A. Alamery, S.F., Badu, M., Kabi, M., Mohanty, A., Naik I.S., Kumar, S., Kherawat, B.S., Kumar, V., Lenka, S.K., Verma, S., Shrivastava, H., Kumawat, G., Masika, F.B. 2025. Genome-wide investigation of

peptides containing tyrosine sulfation (PSY) gene family: identification, evolutionary and expression analysis in soybean (Glycine max L.). BMC Plant Biology. 25, 1136. https://doi.org/10.1186/s12870-025-07052-1

13. Kolhe Savita, Kumar Sanjeev, Dupare B.U., Kumbhkar Makhan and Saxena Anand. 2024. Transfer learning approaches to soybean diseases classification. Soybean Research 22(2): 65-73

14. Kumar S, Rajput L S, Bhati H, Akhtar J, Kumar P and Dubey S C. 2025. Morpho-molecular diversity analysis of Macrophomina phaseolina infecting different hosts. Indian Phytopathology, 78, 49–59. https://doi.org/10.1007/s42360-024-00796-0

15. M.K. Kuchlan, P. Kuchlan, D. Parte, S. Hote, and K.H. Singh (2025). Reclassifying Indian soybean [Glycine max (L.) Merr.] varieties on the basis of new and improved DUS characteristics and categories. Agricultural Science Digest. https://doi.org/10.18805/ag.D-6249

16. Maheshwari H S, Parmar D, Gour A, Patel A, Kumar S, Rajput L S, Vennampally N, Bright J P, Singh R K, Sharma M P, and Singh K H. 2025. Serial enrichment incubation technique (SEIT) for rapid isolation of plant growth-promoting bacteria: Saving researcher time and lab resources. MethodsX. 15, Article 103677. https://doi.org/10.1016/j.mex.2025.103677

17. Maheshwari, H.S., Parmar, D., Gour, A., Patel, A., Kumar, S., Rajput, L.S. and Singh, K.H. (2025). Serial enrichment incubation technique (SEIT) for rapid isolation of plant growth-promoting bacteria: saving researcher time and lab resources. MethodsX, 12: 103677.

18. Mandahal, K.S., Kaur, H., Sirari, A., Kaur, S., Kumar, V and Gill, B.S. 2025. KASP assisted pyramiding null Kti and null Lox2 with YMD resistance in Indian soybean. Crop Breeding and Applied Biotechnology 25 (1)

19. Mandloi S, Dhaka P, Nataraj V, Pandey V, Kumar S, Rajput L S, Kumawat G, Shivakumar M, Solanki P, Nagar S K, Maheshwari H S, Rajesh V, Ratnaparkhe M B, Gupta S, and Singh K H. 2025. Virulence patterns of Colletotrichum truncatum isolates causing soybean anthracnose disease and identification of resistance sources. BMC Plant Biology. 25, Article 1559. https://doi.org/10.1186/s12870-025-07680-7

20. Mandloi, S., Dhaka, P., Nataraj, V. et al. 2025. Virulence patterns of Colletotrichum truncatum isolates causing soybean anthracnose disease and identification of resistance sources. BMC Plant Biology. 25, 1559. https://doi.org/10.1186/s12870-025-07680-7

21. Mandloi, S., Dhaka, P., Nataraj, V., Pandey, V., Kumar, S., Rajput, L.S. and Singh, K.H. (2025). Virulence patterns of Colletotrichum truncatum isolates causing soybean anthracnose disease and identification of resistance sources. BMC Plant Biology, 25(1): 1559.

22. Meena L K and Rajesh V. 2024. Effects of different soybean genotypes on the biology and food consumption and nutritional indices of Spodoptera litura (Fabricius) (Noctuidae:Lepidoptera). AMA, Agricultural Mechanization in Asia, Africa and Latin America. 55(10): 19015-19024.

23. Meena L K, Rajesh V, and Sharma A N. 2024. Effects of genotypic diversity on population density of natural enemies of soybean. AMA, Agricultural Mechanization in Asia, Africa and Latin America. 55(10): 19083-19090.

24. Meena L K, Rajesh V, Patel R M, and Sharma A N. 2024. Impact of genotypic mixture on soybean (Glycine max) pest population. Indian Journal of Agricultural Sciences. 94 (8): 822–826

25. Meena, R.P., Kumar, V., Venkatesh, K., Sujatha, H.T., Tripathi, S.C., Nargund, R. and Nataraj, V. (2025). Multi-trait-based identification of water use efficient genotypes in bread wheat (Triticum aestivum L.). Indian Journal of Genetics and Plant Breeding, 85(3): 418–425. https://doi.org/10.31742/ISGPB.85.3.7

26. Nargund, R., Rautela, K.S., Goyal, M.K., Sinha, N.K., Mohanty, M. and Bhatia, V.S. (2025). Assessing soybean yield in Madhya Pradesh by using a multi-model approach. Field Crops Research, 322: 109716.

27. Nataraj V, Amrate, P.K., Ratnaparkhe, M.B., Maranna, S., Rajput, L.S., Agrawal, N., Raghuvanshi, R., Pathak, K., Mandloi, S., Mohare, S., Naik, B., Shrivastava, M.K., Kumawat, G., Rajesh, V., Gupta, S., Chitikineni, A., Varshney, R.K and Singh, K.H. 2025. Unveiling key genetic determinants of charcoal rot resistance in soybean via genome-wide association studies. Frontiers in Plant Science. 16:1649397. doi: 10.3389/fpls.2025.1649397

28. Nataraj, V., Maranna, S., Kumawat, G., Nagar, S.K., Megwal, P., Gupta, S., Singh, H.S. 2025. Multiple selection indices based identification of soybean (Glycine max L.) in early segregating generations. Indian Journal of Genetics and Plant Breeding. 85(03): https://doi.org/10.31742/ISGPB.85.3.11

29. Pandey, N., Kumar, N. and Upadhyay, A. 2025. Soy protein modification strategies, functional interplay and industrial relevance: a review. Food Measure 19, 785–805. https://doi.org/10.1007/s11694-024-02989-7

30. Prashnani M, Dupare B, Vadrevu KP, Justice C (2024) Towards food security: Exploring the spatio-temporal dynamics of soybean in India. PLoS ONE 19(5): e0292005. https://doi.org/10.1371/journal.pone.0292005

31. R. Raghuvanshi, G. Kumawat, R. Kavishwar, S. Gupta, A. Chitikineni, S. Chandra, G. K Satpute, V. Nataraj, R.K. Varshney, H. Nguyen, V. Rajesh, S. Maranna, M.K. Kuchlan, P. Kuchlan, A.K. Singh, K.H. Singh, M.B. Ratnaparkhe (2025). Dissecting genetic architecture of flowering and maturity traits in soybean using GWAS in Indian environment. BMC Plant Biology, 25(1): 1426 https://doi.org/10.1186/s12870-025-06669-6

32. Raghuvanshi, R., Kumawat, G., Kavishwar, R., Gupta, S., Chitikineni, A., Chandra, S., Satpute, G.K., Nataraj, V., Varshney, R.K., Nguyen, H., Rajesh, V., Maranna, S., Kuchlan, M.K., Kuchlan, P., Ratnaparkhe, M.B. 2025.Dissecting genetic architecture of flowering and maturity traits in soybean using GWAS in Indian environment. BMC Plant biology 25 (1), 1426,

33. Raghuvanshi, R., Gautam, Y., Soni, P., Yadav, N., Shende, R.T., Kavishwar, R., Nishtha, S., Nataraj, V., Kumawat, G., Kumar, S., Shivakumar, M., Gupta, S and Ratnaparkhe, M.B. 2024. In Silico Analysis of Rpp1 Locus-Derived NB-ARC-LRR Domains Reveals Insights into Rust Resistance in Soybean. Journal of Advances in Biology & Biotechnology, Volume 27, Issue 9, Page 586-596,

34. Rajput L S, Kumar S, Pathak K, Acharya P, Goswami D, Nataraj V, Shivakumar M, Maheshwari H S, Mandloi S, Jaiswal S, Yadav A, and Vishwakarma R. 2025. Morpho-cultural, pathogenic, and genetic characterization of Indian isolates of Macrophomina phaseolina causing charcoal rot in soybean. Heliyon, 11(2), e42035. https://doi.org/10.1016/j.heliyon.2025.e42035

35. Rajput L S, Shaikh M S, Borah M, Kumar S, Nataraj V, Shivakumar M, Maheshwari H S, Pathak K, Gupta A, Goswami D, Pinnamwar K, Kumar S, and Jadon K S. 2025. Evaluation of combination fungicides for charcoal rot and collar rot management in soybean. Agronomy, 15, 528. https://doi.org/10.3390/agronomy15030528

36. Rajput, L.S., Kumar, S., Pathak, K., Acharya, P., Goswami, D., Nataraj, V. and Vishwakarma, R. (2025). Morpho-cultural, pathogenic and genetic characterization of Indian isolates of Macrophomina phaseolina causing charcoal rot in soybean. Heliyon, 11(2).

37. Rajput, L.S., Shaikh, M.S., Borah, M., Kumar, S., Nataraj, V., Shivakumar, M. and Jadon, K.S. (2025). Evaluation of combination fungicides for charcoal rot and collar rot management in soybean. Agronomy, 15(3): 528.

38. Sinha, S.S., Upadhyay, A., Singh, A., Mishra, S and Pandey, N. 2024. Bigels a versatile gel composite for tailored application in food industries: A review, Food Structure, Volume 41, 100380, ISSN 2213-3291, https://doi.org/10.1016/j.foostr.2024.100380.

39. Thakur, R., Kumari, V., Gupta, S., Chahota, R.K., Isobe, S., Shirasawa, K., Vangala, R., Bisht, A and Kumar, N. 2025. Elucidating Morpho-Molecular Diversity in Soybean Germplasm Using SSR Markers. Plant Molecular Biology Reports 43, 1551–1565 (2025). https://doi.org/10.1007/s11105-025-01569-3.

40. Thorat Vishal S., Dupare B.U., Garde Y.A.,

Nargund R. and Verma, R. K. 2024. Economic positioning of soybean: A study of growth trends and cost comparisions with kharif crops in major soy states of India. Soybean Research 22(2): 95-106

41. Tripathi, S.C., Kumar, N., Venkatesh, K. and Meena, R.P. (2025). Enhancing energetics, system productivity, profitability and soil fertility in maize-based cropping system by conservation vis-à-vis conventional agriculture in North-West India. International Journal of Plant Production. https://doi.org/10.1007/s42106-024-00323-1

42. Tripathi, S.C., Kumar, N., Venkatesh, K., Samota, S.R., Shivani, Meena, R.P., Mamrutha, H.M., Kumar, N., Khippal, A.K., Chhokar, R.S. and Chander, S. (2025). Optimizing nitrogen use efficiency and yield in wheat: insights from a comparative study of varieties under variable nitrogen inputs. Journal of Plant Nutrition.

43. Yadav A, Shaikh M S, Saini P, Dhaka P, Kumar S, Jaiswal S, and Rajput L S. 2025. In vitro evaluation of fungicidal efficacy against Sclerotium rolfsii in soybean. Journal of Experimental Agriculture International. 47(3), 367–374. https://doi.org /10.9734/ jeai/2025/v47i33343

Books and book chapters

1. Soyvritika Volume-6 (2025) special edition on secondary agriculture and value addition (Eds. Kuchlan, P. Kuchlan M K, Dupare B U and Khan I R.) ICAR-National Soybean Research Institute Publication Pp 84

2. दुपारे, बी.यू., राकेश कुमार वर्मा, राघवेन्द्र नर्गुंद, लोकेश मीना, संजीव कुमार, मृणाल कुचलान, पूनम कुचलान एवं के.एच. सिंह. 2025. मध्य प्रदेश में सोयाबीन-गेहूं फसल प्रणाली की उत्पादकता हेतु उन्नत उत्पादन तकनिकी. ISBN: 978-93-342-5915-5 भा.कृ.अनु.प.-राष्ट्रीय सोयाबीन अनुसन्धान संस्थान का प्रकाशन. कुल पृष्ठ 110.

3. दुपारे, बी.यू., राकेश कुमार वर्मा, राघवेन्द्र नर्गुंद, लोकेश कुमार मीणा, संजीव कुमार, मृणाल कुचलान, डॉ पुनम कुचलान एवं के.एच.सिंह. सोयाबीन : उन्नत किस्में, खेती की पद्धतियाँ एवं सस्य क्रियाएं, कीट व रोग नियंत्रण तथा तकनीकी अनुशंसाएं (2026). विस्तार बुलेटिन क्रमांक 21. भा.कृ.अनु.प.-राष्ट्रीय सोयाबीन अनुसंधान संस्थान, इंदौर (म.प्र.) प्रकाशन. पृष्ठ: 64

4. Dupare, B. U., Punam Kuchlan, M. Shivakumar, Raghavendra Nargund and Sanjeev Kumar. 2025. ICAR-National Soybean Research Institute Annual Report 2024. Annual Report: ICAR-NSRI, Indore. Pp: 112

5. दुपारे बी. यु. , राघवेन्द्र नर्गुंद, राकेश कुमार वर्मा, लोकेश कुमार मीणा, संजीव कुमार, पूनम कुचलान, मृणाल कुचलान एवं सविता कोल्हे. 2025. मध्य प्रदेश में सोयाबीन-गेहूं फसल प्रणाली की उत्पादकता हेतु उन्नत उत्पादन तकनिकी. भा.कृ.अनु.प.-राष्ट्रीय सोयाबीन अनुसन्धान संस्थान का प्रकाशन. कुल पृष्ठ 110.

6. Bhartiya, A., Aditya, J.P., Pandey, N., Shrivastava, M.K., Arya, M., Dev, R., Joshi, H., Hedau, N.K and Kant, L. 2025. Black Soybean in India: Enhancement, Processing, Utilization, and Way Forward. In: Singh, K.P., Singh, N.K., T, A. (eds) Soybean Production Technology. Springer, Singapore. https://doi.org/10.1007/978-981-97-8677-0_4

7. Halli, H.M., Prabhu, G., Nargund, R., Senthamil, E., Vinay, M.G. and Rudresh, K. (2025). Descriptive Agronomy: A Comprehensive Guide for ARS Mains, Ph.D. Courses and Other Competitive Examinations as per New Syllabus. Kushal Publication, Varanasi, India, Book, pp. 1–286. ISBN: 978-93-93704-65-8.

8. भारत में सोयाबीन की उन्नत प्रजाद्धतयों का पररदश्य डॉ. एम.के . कु चलान, डॉ. पूनम कु चलान एवां डॉ बी.यू. दुपारे training manual

9. सोयाबीन उत्पादन की सस्य कक्रयाएां डॉ. राघवेन्द्र नगु्ुंद, डॉ राकेश कु मार वमातएवांडॉ बी. यु. दुपारे

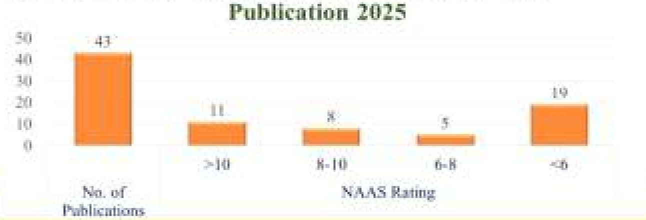
10. सोयाबीन मेंखरपतवार प्रबांधन डॉ राके श कु मार वमात, डॉ. राघवेन्द्र नगु्ुंद, डॉ राज पाल मीणा एवां डॉ बी. यु. दुपारे

11. सोयाबीन मेंरोग प्रबांधन डॉ. साांजीव कु मार, डॉ लोके श कु मार मीणा, डॉ वी. नटराज, डॉ हेमांत माहेिरी एवां डॉ बी. यु. दुपारे

12. सोयाबीन के पौद्धिक गुण, खाद्य पदार्थत एवां प्रसांस्करण तकद्धनकी डॉ . बी. यु. दुपारे एवां डॉ के . एच. चसांह

Research Publications (2025)

Research Publications: The institute scientists have published 43 research publications in national and international journals.



Publication of abstract in seminar/symposia

- Sharma, MP (2025). Promoting soy among Indian farmers: Research directions. Presentation made at the National Stakeholder Consultation on Soy White Paper: Improving Food and Nutrition Security by Mainstreaming Soybean-Based Food Products, organized by SFPWA, IHCL Sujan Singh Park, Khan Market, New Delhi, India, July 12, 2025.
- Sharma, MP, Agnihotri R, and Ramesh A. (2025) Arbuscular Mycorrhizal Fungi: Drivers of Soil Carbon Sequestration and Biomass Assessment via Signature Lipid Biomarkers." Paper presented at Session 4: Microbial Consortia and Their Role in Soil Health and Plant Growth, Agri-Inputs for Sustainable Agriculture and Climate (AISAC-2025), The Energy and Resources Institute (TERI), TERI Gram, Gurugram, Haryana, November 12–14.

Popular articles

1. https://nuffoodsspectrum.in/2025/11/ 06/how-Internal-and-external-drivers-are-propelling-indias-soya-market.html
2. राकेश कुमार वर्मा, बी.यू. दुपारे, राघवेन्द्र नर्गुंद, राज पाल मीना, प्रिंस चोयल एवं के. एच. सिंह. 2026 अनुसूचित जाति उप-योजना के अंतर्गत लाभार्थीयों की प्रेरणादायक सफलता की गाथाएँ: सफलता की कहानियाँ (एस .सी. एस. पी.) -1. भा.कृ.अनु.प.-राष्ट्रीय सोयाबीन अनुसंधान संस्थान द्वारा प्रकाशित। पृष्ठ: 43
3. बी. यु. दुपारे, मृणाल कुचलान, पूनम कुचलान, राघवेन्द्र नर्गुंद, राकेश कुमार वर्मा एवं के,एच. सिंह. 2024. सोयाबीन की उन्नत किस्मे, बीज गुणवत्ता परिक्षण एवं बोवनी की विधियां. किसान की गाथा 1-31 जुलाई 2024. पृष्ठ 16-17
4. बी. यु. दुपारे, राकेश कुमार वर्मा, राघवेन्द्र नर्गुंद, मृणाल कुचलान, पूनम कुचलान, एवं के,एच. सिंह. 2025. सोयाबीन की आधुनिक खेती हर किसान के लिए जरुरी जानकारी. कृषक जगत 21 जुलाई 202. पृष्ठ 7-8

Technical/Extension bulletins/Folders

1. BU Dupare, Rakesh Kumar Verma, Raghavendra Nargud, Lokesh Meena, Sanjeev Kumar, Mrinal Kuchlan and KH Singh. (2025). Improved soybean production technologies and technical recommendation. Extension Bulletin No. 20. ICAR-Indian Institute of Soybean research Indore, MP, and India. Pp 69

6. Lectures Delivered:

- **Presented Exper talk title-** AI in Agriculture-Transforming Indian Agriculture through cutting-edge Technology" in the Round Table Conference on "AgriTech and HealthTech - The Twin Pillars of a Self- Reliant Bharat", 8th November 2025 organized by Acropolis Innovation & Incubation Hub Foundation {AIIH} at Acropolis Institute of Technology & Research, Manglia Square, Indore (M.P.)
- **Presented Expert Lecture title-** 'AI in Agriculture-Transforming Indian Agriculture through cutting-edge Technology" Brainstorming Session on " Artificial Intelligence in Agriculture", at Medicaps university on September 30, 2025 from 02:00 - 05:00 PM.
- Dr Raghavendra Nargund: Delivered lectures on natural farming practices for soybean-based cropping systems during the training programme on "Natural Farming" under the National Mission on Natural Farming at the College of Agriculture, Indore, and at the ICAR–National Soybean Research Institute (ICAR-NSRI), Indore, natural farming experimental field on 21st and 22nd August 2025.
- **Dr Raghavendra Nargund:** Participated as an expert member in the panel discussion of a multi-stakeholder conference on regenerative agriculture and sustainable vegetable oil supply chains, organized by SOLIDARIDAD at Bhopal, Madhya Pradesh, on 23.08.2025.
- **Dr Raghavendra Nargund:** Delivered a lecture on regenerative agriculture practices in soybean in Soya for Sustainability: Soy Farmers' Conclave 2025, organized by SOLIDARIDAD at Village Siradi, Sehore, Madhya Pradesh, on 06.06.2025.
- **Dr. Raghavendra Nargund:** Attended the multi-stakeholder event "Promotion of Regenerative Agricultural Practices for a Food Secure and Climate-Resilient Future in the EU–India Partnership" and delivered a lecture on soybean cultivation through organic and natural farming practices at SOPA, Indore, on 30.07.2025.

Awards/Peer recognitions/member of expert panel/journal editorial board

1. Dr Hemant Maheshwari, Scientist (Microbiology) of the institute has been awarded a doctoral degree from university of Groningen, Netherland.
2. Dr Sanjay Gupta received Best team award of the institute for development of NRC 165 soybean variety
3. Dr Vineet Kumar was conferred with the "Special Award for Excellence in Soybean Breeding" in recognition of Outstanding contribution to soybean breeding ,development of high value specialty varieties and advancing quality traits for farmers and industry in International Soy Conclave (held from 8-9 Oct 2025)
4. Dr M.P. Sharma selected as Associate Editor in Frontiers in Microbiology: Section Microbial Symbioses (Sept 2021 onwards).
5. Dr M.P. Sharma was nominated as Member, Editorial board, Indian Journal of Agricultural Research.
6. Dr M.P. Sharma National Scientific Advisory Board of the Long-term farming systems comparison (SysCom) project hosted by FiBL, Frick, Switzerland at Bio Re India, Kasrawad, Khargone, MP, India (Nov 2020 onwards).
7. Dr M.P. Sharma Elected as Fellow, Mycological Society of India, Chennai (2020).
8. Dr M.P. Sharma Member, Institute management committee (2023-2026), ICAR-NBAIM, Mau.
9. Dr M.P. Sharma Keynote speaker during International conference on Agri-Inputs for Sustainable Agriculture and Climate (AISAC-2025), Organised by The Energy and Resources Institute (TERI) at TERI Gram, Gurugram, Haryana, India from November 12–14, 2025.
10. Dr M. P. Sharma: Associate Editor in Frontiers in Microbiology: Section Microbial Symbioses (Sept 2021 onwards).
11. Dr M. P. Sharma: Member, Editorial Board, Indian Journal of Agricultural Research.
12. Dr M. P. Sharma: National Scientific Advisory Board of the Long-term farming systems comparison (SysCom) project hosted by FiBL, Frick, Switzerland at Bio Re India, Kasrawad, Khargone, MP, India (Nov 2020 onwards).
13. Dr M. P. Sharma: Member, Institute management committee (2023-2026), ICAR-NBAIM, Mau.
14. Dr M. P. Sharma: Keynote speaker during the International Conference on Agri-Inputs for Sustainable Agriculture and Climate (AISAC-2025), organised by The Energy and Resources Institute (TERI) at TERI Gram, Gurugram, Haryana, India, from November 12–14, 2025.
15. Dr Raghavendra Nargund: Attended the Scientific Advisory Committee (SAC) meetings of Krishi Vigyan Kendras (KVKs) at Mandsaur, Neemuch, and Ratlam as an expert, conducted virtually on 05.06.2025, 05.05.2025, and 07.05.2025, respectively.
16. ICAR-NSRI Team (Dr Rakesh Kumar Verma, Dr Raghavendra Nargund and Dr K. H. Singh) received the Professor Rattan Lal Award for excellence in Regenerative Agriculture under the category of Regenerative Innovator Award (Organisation) on the occasion of World Soil Health Day, 5th December 2025, organised by ICAR-Indian Institute of Soil Science and SOLIDARIDAD, Bhopal.
17. Dr. Raghavendra Nargund received the ICAR–NSRI, Indore Best Scientist Award (2024–25) on the occasion of the 39th ICAR–NSRI Foundation Day, held on 11 December 2025.
18. Dr. Mrinal Kuchlan and team (Dr. Punam Kuchlam, Mr. Rakesh Sakya, Samiksha hote) received excellence in soybean seed production award during (2024–25) on the occasion of the 39th ICAR–NSRI Foundation Day, held on 11 December 2025.

ICAR-NSRI Received Prof. Ratan Lal Award

ICAR-NSRI, received Professor Rattan Lal Award for excellence in Regenerative Agriculture under the category of Regenerative Innovator Award (Organization) on the occasion of world soil health day 5th December 2025, organized by ICAR-Indian Institute of Soil Science and SOLIDARIDAD, Bhopal

Conference presentations / exhibitions / trainings attended

- Giriraj Kumawat, Nisha Agrawal, Rishiraj Raghuvanshi, Harsha Shrivastava, Shreya Verma, Rucha Kavishwar, Subhash Chandra, Prince Choyal, Shivakumar Maranna, Vennampally Nataraj, Mrinal K. Kuchlan, Punam Kuchlan, Gyanesh Kumar Satpute, Milind B. Ratnaparkhe, Vangala Rajesh, Sanjay Gupta, Ajay Kumar Singh, Kunwar Harendra Singh (2025) Oral Presentation in the 11th International Conference on "Recent Advances in Agricultural, Biological & Applied Sciences for Eco-Friendly Development (RAABASED-2025)" held on July 25-27, 2025 at School of Agriculture and Technology, Maya Devi University, Dehradun, Uttarakhand, India.
- Oral presentation in 8th International Goa Conference on Cutting-edge Research Innovation in Sustainable Education, Environment, and Agriculture (CRISEA) on the topic of Exploring the Effect of Pulse Electric Field Pretreatment on Microwave Glycation of Soy Protein Isolate-Pectin Conjugates; presented on 25th February, 2025
- Oral presentation in 7th International Conference held on entitle "Global Approaches in Agricultural, Biological, Environment and Life Sciences for Sustainable Future (GABELS- 2024)" on June, 08-10, 2024 at Buddha Hall, D.A.V. College, Kathmandu, Nepal on the topic of "Soy Protein Modification through Microwave Glycation with Sodium Alginate"
- Sharma, MP (2025). Promoting soy among Indian farmers: Research directions. Presentation made at the National Stakeholder Consultation on Soy White Paper: Improving Food and Nutrition Security by Mainstreaming Soybean-Based Food Products, organized by SFPWA, IHCL Sujan Singh Park, Khan Market, New Delhi, India, July 12, 2025.
- Sharma, MP, Agnihotri R, and Ramesh A. (2025) Arbuscular Mycorrhizal Fungi: Drivers of Soil Carbon Sequestration and Biomass Assessment via Signature Lipid Biomarkers." Paper presented at Session 4: Microbial Consortia and Their Role in Soil Health and Plant Growth, Agri-Inputs for Sustainable Agriculture and Climate (AISAC-2025), The Energy and Resources Institute (TERI), TERI Gram, Gurugram, Haryana, November 12–14.
- Organised nine (09), three-day training programme on "soy products processing and byproduct utilisation" conducted through ABI Centre, ICAR-NSRI, Indore for various farmers producing organisations (FPOs) from 8different districts of Maharashtra State and 32 entrepreneurs of different States during March 2024 to March 2025.
- Organised research industry-interface meet on "Opportunities for Agri-Startups and entrepreneurs in soy food processing, value addition and soybean production technologies during 12th March 2025.
- Sh. Viraj Gangadhar Kamble participated in the 7th International Conference on Plant Genetics and Genomics, which was held during February 16–17, 2024 at the A.P. Shinde Symposium Hall, NASC Complex, Pusa, New Delhi.
- Sh. Viraj Gangadhar Kamble participated in the M.S. Swaminathan Centenary International Conference 2025 on "Evergreen Revolution: The Pathway to Biohappiness", jointly organized by the M.S. Swaminathan Research Foundation (MSSRF), Indian Council of Agricultural Research (ICAR), National Academy of Agricultural Sciences (NAAS), ICAR–Indian Agricultural Research Institute (ICAR-IARI), and the Ministry of Agriculture & Farmers Welfare, Government of India, held during August 7–9, 2025 at the NASC Complex, New Delhi.

Radio/Television Talk

- Dr Raghavendra Nargund: Delivered a radio talk on improved soybean production technologies, including a farmer interaction and question–answer session, at Akashwani Kendra, Indore, on 07.08.2025.

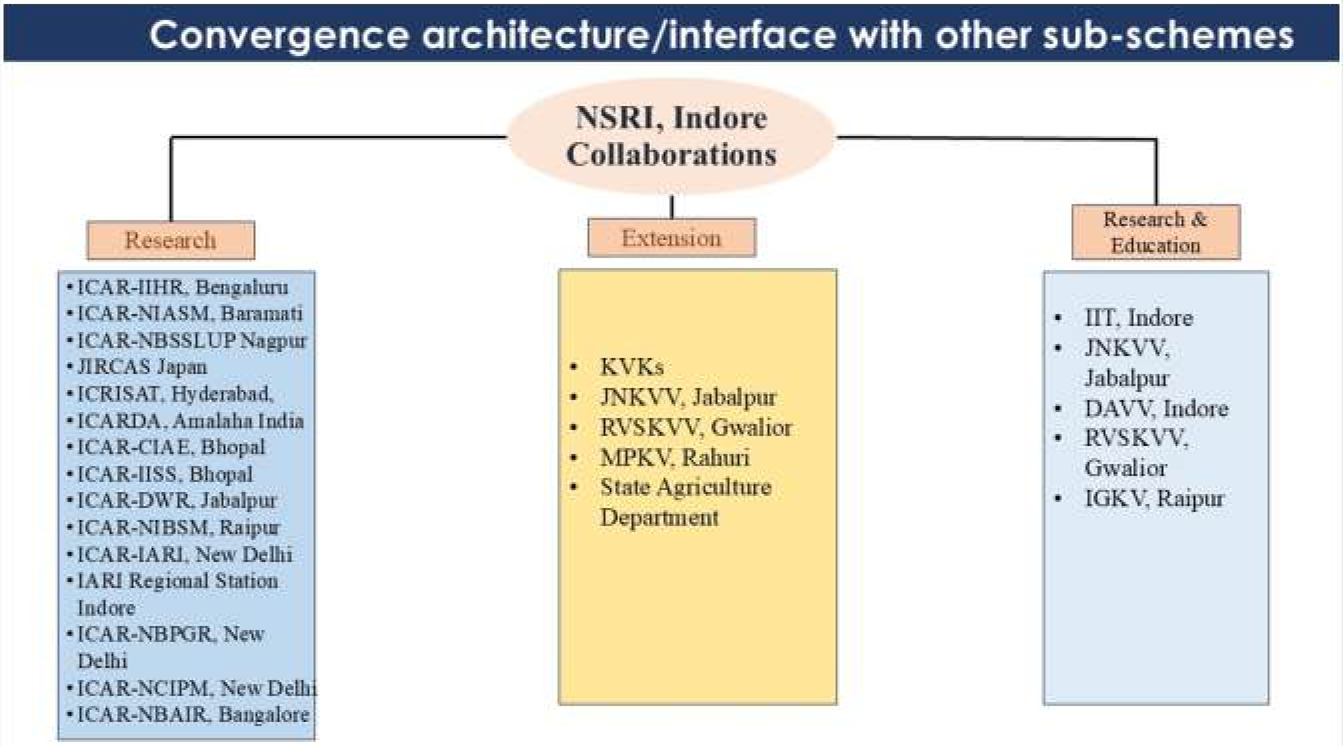
Participation in Meetings by Dr. Kunwar Harendra Singh Director, ICAR-NSRI, Indore during 2025

Dr. K.H. Singh, Director, ICAR-NSRI, Indore

- Attended online Inaugural Session of the National Symposium on Hybrid Technology" on 8.1.2025.
- Lecture delivered on 30.01.2025 through online mode in the 5 days training program on "Technologies for improving production and productivity of oilseeds in North Eastern Hill Region" organized by IIOR, Hyderabad during January 27-31, 2025.
- Attended and organized 55th Annual Group Meeting of AICRP on Soybean at CSKHPKVV, Palampur during 19-21 February, 2025.
- Attended online zoom meeting regarding Inaugural programme of Global Conference (Hybrid Mode) on 'Innovations to Impact: Gender Transformative Approach for Sustainable Agri-food System' to be held at ICAR-CIWA, Bhubaneswar.
- Attended Rural Innovators Conclave II at Centre for Rural Development and Technology (CRDT), at IIT, Simrol, Indore on 21.3.2025.
- Chair the Session entitled "Sustainable Production of Soybean for Manufacturing High-Quality Soy Foods" in International Conference on Farm to Fork: Bridging the Protein Gap in India through Sustainable Soy Foods 2025 during 4-5 April, 2025 at Indore Marriott organized by Soy Food Promotion & Welfare Association, New Delhi.
- Attended 40th Annual Group Meet of AICRP on Seed (Crops) along with 28th ABSRM scheduled through virtual mode (Zoom) on 15th May, 2025
- Participated DD Kisan Live Phone-in Programme of "Hello Kisan Programme, Topic सोयाबीन की खेती" through Google Meet on 27th June, 2025
- Attended Stakeholder Consultation on Strengthening the Seed Supply Chain on 10th July, 2025 at Brilliant Convention Centre, Indore organized by Solidaridad, Bhopal
- Attended Stakeholder consultation on Soy White Paper and "Year of Soy 2026" on 12th July, 2025 at New Delhi organized by Soy Food Promotion & Welfare Association, New Delhi.
- Attended M.S. Swaminathan Centenary International Conference 2025: Evergreen Revolution – The Pathway to Biohappiness scheduled to be held on 7-9 August, 2025 at Bharat Ratna Dr. C. Subramanian Auditorium, NASC Complex, New Delhi.
- Organized 29th Research Advisory Committee Meeting (RAC) on 25-26 August, 2025.
- Participated DD Kisan Live Phone-in Programme of "Hello Kisan Programme" through Google Meet on 10th September, 2025.
- Organized Institute Management Committee (IMC) on 15th September, 2025.
- Attended Two Day workshop entitled "AgriConnect: Building Bridges between Tech developers, Agri Industries, FPOs, NGOs and Agri Stakeholders" on 15th September, 2025 at IIT, Simrol, Indore.
- Chief Guest during 74th Foundation Day Programme and delivered the Foundation Day Lecture at ICAR-IARI Regional Station, Indore on 3rd October, 2025.
- Delivered a talk on "Enhancing Soybean Yield in India" during International Soy Conclave 2025 on 8-9 October, 2025 at Brilliant Convention Centre, Indore Organized by SOPA, Indore.

LINKAGES AND COLLABORATIONS 11

The institute has established linkages with various ICAR institutes as well as SAUs under All India Coordinated Research Project on Soybean in addition to other national & international organizations like DBT, DST/GOI, BARC, Department of Agriculture of GOI as well as Madhya Pradesh for strengthening the implementation of various activities for soybean research and development.



In addition to above, the institute has structural linkages with following international agencies

- Asian Vegetable Research and Development Centre, Taiwan
- Japan International Research Centre for Agricultural Sciences, Tsukuba, Japan
- International Crop Research Institute for Semi-Arid Tropics, Hyderabad
- Borlaug Institute for South Asia (BISA), Jabalpur, India

Functional Linkages at Regional Level

- Department of Agriculture of Madhya Pradesh, Chhattisgarh, Maharashtra, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Rajasthan, Punjab, Haryana, Jharkhand, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, North-Eastern States
- NGOs like SOPA, OILFED
- State Cooperative Development Banks of respective States.
- State Seed Corporation
- Department of Seed Certification

Consultancy services, Intellectual Property

12

DETAILS OF THE CONTRACT RESEARCH TRIALS DURING kharif /Rabi 2025-2026

[Ref: ICAR Rules and Guidelines for Professional Service Function (Training, Consultancy, Contract Research and Contract Service)-2014

S.No.	Company/Product Name	Name of PI	Name of Co-PI proposed	Project cost Excluding GST
1	**Coromandel International Limited, Secunderabad** **Title:** Validate the bio-efficacy results of CIX-4116 (Premix) in pre-emergence application timing of Soybean	**Dr. Raghavendra Nargund**, Scientist (Agronomy)	Dr.R.K.Verma Scientist (Agronomy) Dr.Rajpal Meena, PS(Agronomy)	Rs. 16,11,0,54 (For two seasons fee i.e., soybean-wheat) **(Previous year project)**
2	**PI Industries Ltd, Gurugram** **Title:** To evaluate the bio efficacy of PIX-20042 50% WG against insect-pest of soybean, phytotoxicity on crop and effect on natural enemies and yield	**Dr. Lokesh Kumar Meena**, Scientist (Entomology)	Dr.Punam Kuchlan, PS (Seed technology) Dr.Rajesh Vangala, Scientist (Plant Breeding) Dr.Sanjiv Kumar Scientist (Plant Pathology)	Rs. 12,08,280 (For two years i.e., kharif 2025 & kharif 2026)
3	**Insecticide India Ltd Delhi** **Title:** Bio-efficacy field Trial for evaluation of IIL 355 against Grasses' sedges and broadleaved weeds in Soybean for two seasons (Kharif 2025 & 26) at ICAR-NSRI, Indore	**Dr. Rajpal Meena**, PS (Agronomy)	Dr.A.Ramesh Dr.Prince Choyal Mr.Hemant Maheshwari	Rs. 9,10,200 (For two years i.e., kharif 2025 & kharif 2026)
4	**Bayer Crop Science Limited, Indore** **Title:** Bio-efficacy studies of Ambition on Soybean	**Dr. Prince Choyal** Scientist (Plant Physiology)	Dr.Gyanesh Satpute Pr.Scientist(Plant Breeding & Genetics) Dr.V.Natraj, Scientist (Plant Breeding & Genetics) Mr.Hemant Maheshwari, Scientist(Agri. Microbiology)	Rs 5,37018 (For one season kharif season 2025)

Technology management & Commercialization

A. The institute ABI centre signed MoUs with following Farmer Producer Organizations of Maharashtra

DETAILS OF THE CONTRACT RESEARCH TRIALS DURING kharif /Rabi 2025-2026

[Ref: ICAR Rules and Guidelines for Professional Service Function (Training, Consultancy, Contract Research and Contract Service)-2014]

Official Language Implementation 13

Various Official Language Implementation Activities at the Institute during the Year 2025

The Indian Constitution establishes Hindi as the official language of the Union, and Part 17, Article 351 of the Constitution mandates that the official language, Hindi, be developed in such a way that it is capable of expressing India's diverse culture. Therefore, Hindi's role as an official language is extremely important and fraught with responsibility. Toward this objective, the ICAR-National Soybean Research Institute, Indore, is implementing numerous programs to promote the official language, Hindi. These programs are evident in the progressive progress in the field of official language implementation at the National Soybean Research Institute, which is proving highly beneficial in the progressive use of the official language. A brief description of the activities being undertaken in this area is as follows:

(a) Compliance with the Official Language Rules, 1976: The officers and employees of the Institute write notes and perform other official functions in Hindi as per sub-rules (1) and (4) of the Official Language Rules, 1976.

(b) Quarterly Meetings of the Official Language Implementation Committee:

• First Meeting: April 7, 2025

• Second Meeting: July 7, 2025

• Third Meeting: October 8, 2025

(c) Hindi Workshops: Hindi workshops are organized in the Institute to address the problems faced by the officers and employees of the Institute while working in Hindi. Furthermore, the main objective of organizing these workshops is to develop the use of Hindi from the simplest to the simplest. Therefore, at least one Hindi workshop is organized every quarter to promote the practice of working in Hindi among all cadres of the Institute. For this purpose, workshops are organized according to the relevant subject.

(d) Training: To promote the official language, all training materials are provided in Hindi to farmers and trainees at the Institute.

(e) Weekly Advisory: The Institute issues weekly advisories to farmers and other soybean producers on various soybean production techniques, which are issued bilingually.

(f) Bilingual Form Translation: The Institute is also in progress translating various letters and forms used in official work. This includes bilingual printed versions of all types of letters and forms, including daily and frequently used letters and forms. This work is a permanent and fundamental achievement towards the implementation of the official language.

(g) Submission of Quarterly Official Language Reports: The Institute reports details all work related to the official language Hindi through quarterly Hindi reports, sent online and via dual postal service to the concerned departments. All relevant sections of the Institute make an active and commendable contribution in implementing this work.

(h) Section 3(3) of the Official Languages Act, 1963: Documents covered under Section 3(3) of the Official Languages Act, 1963, such as general orders, notifications, press releases, contracts, licenses, permits, tender forms and notices, resolutions, rules, etc., are published bilingually (in Hindi and English) in the Institute, ensuring consistent adherence to the Official Language Guidelines.

(i) Unicode Facility: To encourage the interest of the Institute's officers and employees in working in Hindi, Hindi Unicode has been provided on all computers, enabling the entire Institute to progress in the same direction through a common font.

(j) Emergence of Original Writing: Along with various activities related to the Official Language, the Institute has a unique interest in providing a two-pronged dimension to original writing. They contribute their writings to the magazine "Soyvritika" published by the Institute.

S.No.	Date	Topic	Guest Speaker
1.	March 20, 2025	Scientific approach to Devanagari script and its impact	Shri Girendra Singh Bhadoria "Pran"
2.	July 09, 2025	kanthasth 0.2	Mr. Anurag Shakargae, Senior Translation Officer, Central Goods and Services Tax Commissionerate, Indore
3.	September 10, 2025	Official Language Act and Implementation	Shri Tripurari Lal Sharma, Retired Chief Manager, State Bank of India, Indore
4.	December 4, 2025	Official Language Policy and Implementation of Government of India	Mrs. Suparn Dasgupta Director of Official Language Indian Council of Agricultural Research, New Delhi

The institute was inspected by the Second Sub-Committe of the Parliamentary Official Language Committee on 04.07.2025

Guest speaker Mr. Girendra Singh Bhadoria "Pran". Delivered lecture during the Hindi workshop organized on March 20, 2025

Chief guest Mr. Anurag Shakargae was Gust Speaker for the Hindi workshop organized on 09 July 2025

ICAR-National Soybean Research Institute, Indore

Hindi Pakhwada 2025 Report: September 1-17, 2025

The Hindi Pakhwadawas organized at the ICAR-National Soybean Research Institute, Indore, from September 1-17, 2025. The Hindi Pakhwada program was presided over by the Institute's Director, Dr. Kunwar Harendra Singh. Through the Hindi Pakhwada, our endeavor has been to continuously increase the interest of the Institute's scientists, officers, and employees in working in Hindi, and to ensure the progressive development and promotion of the official language, Hindi. Following the Council's guidance and maintaining the prestige achieved by the Institute in the field of Hindi, "Hindi Pakhwada 2025" was organized with great enthusiasm from September 1-17, 2025. Various competitions were organized during the Hindi Pakhwada.

The inaugural ceremony of Hindi Pakhwada-2025 was held on 1st September 2025 in the Director's Committee Room of ICAR-National

Soybean Research Institute, in the presence of Chief Guest Dr. Dheeraj Singh, Former Director, ICAR-Indian Mustard Research Institute, Bharatpur (Rajasthan) and Director and Chairman, Official Language Implementation Committee of the Institute Dr. Kunwar Harendra Singh, Dr. Poonam Kuchlan, Principal Scientist and Officer-in-Charge (Official Language); Section In-Charge - Crop Production; Dr. B.U. Dupare, Principal Scientist and Section In-Charge - Crop Protection; Dr. M.P. Sharma and Section In-Charge - Crop Improvement Dr. Anita Rani. First of all, the Director of the Institute, Dr. Kunwar Harendra Singh welcomed the Chief Guest Dr. Dheeraj Singh, Former Director, ICAR-Indian Mustard Research Institute, Bharatpur (Rajasthan) with a bouquet of flowers. Dr. Poonam Kuchlan, Officer-in-Charge, Official Language, provided detailed information about the various competitions scheduled during Hindi Pakhwada 2025. Chief Guest Dr. Dheeraj Singh briefed the staff and officers on the importance of Hindi and its role in daily work. During the event, the Institute's Director, Dr. Kunwar Harendra Singh, encouraged the staff and officers to dedicate themselves to the progressive use of the official language, as well as to research, dissemination, communication, and original writing, including research papers and technical writing, 100% in Hindi. He emphasized the need to enrich Hindi through continued use and dedication to it within the Institute, and to utilize it in daily work. A Hindi workshop was also organized as part of Hindi Pakhwada 2025, with the chief guest being Mr. Tripurari Lal Sharma, retired Chief Manager, State Bank of India, Indore. He delivered a lecture on "Hindi Official Language Act and Implementation."

Various Competitions to be Held During Hindi Pakhwada 2025|

On September 3, 2025, at 3:00 PM, a Hindi Shruti Lekhan Competition was organized for the Institute's skilled Assistant Grade employees. It was conducted and judged by Mrs. Jyoti Meena, Technical Officer, and Mrs. Priyanka Sawan, Assistant Administrative Officer.

On September 4, 2025, at 4:00 PM, an Original Hindi Slogan Competition (Topic: "The Potential of Soybean in the Indian Circular Economy and its Role in Food Use for Improving Human Health") was organized. The judges for this competition were Dr. M.P. Sharma, Principal Scientist, and Dr. G.K. Satpute, Principal Scientist.

On September 8, 2024, at 4:00 PM, a Hindi Essay Writing Competition (Topic: "The Role of Official Language Hindi in the Changing Digital Era") was organized for all the Institute employees. The judges for this competition were Dr. Poonam Kuchlan, Principal Scientist, and Dr. B. U. Dupare, Principal Scientist.

On September 10, 2025, a Hindi workshop was organized at the Institute. The chief guest was Mr. Tripurari Lal Sharma, retired Chief Manager, State Bank of India, Indore. He provided detailed information on the topic "Hindi Official Language Act and its Implementation."

On September 12, 2024, a note-writing competition in Hindi was organized for all the Institute's employees. The judges for this competition were Mr. Ganesh Meena, Administrative Officer, and Mr. Avinash Kalnke, Assistant.

On September 17, 2025, the closing and prize distribution ceremony of the Hindi Pakhwada program was held. All eligible participants were honored with prizes. On the successful conduct and completion of the program, the Institute's Director, Dr. Kunwar Harendra Singh, congratulated and wished all the participants and urged them to work more in Hindi.

The Hindi Pakhwada-2025 Prize Distribution and Closing Ceremony was held with great enthusiasm on September 17, 2025. The program was presided over by the Institute's Director, Dr. Kunwar Harendra Singh. The welcome address and a brief report on Hindi Pakhwada 2025 were presented by Dr. Poonam Kuchlan, Principal Scientist and Officer-in-Charge, Official Language. The Institute's Director presented prizes and certificates to all the winning participants. He encouraged the winning participants and praised the officers and employees for their work and progressive development of Hindi. The Prize Distribution and Closing Ceremony was conducted by Mr. Shyam Kishore Verma.

GLIMPSES OF HINDI PAKHWADA 2025


Inauguration of Hindi Pakhwada 2025 by
Chief Guest Dr. Dheeraj Singh
Ex. Director, ICAR-IIRMR


Organization of Hindi workshop :
Chief Guest Mr. Tripurarai Lal Sharma
Retired Chief Manager, SBI, Indore on 10.09.2025


The institute staff attended the
Hindi Workshop programme organized during
Hindi Fortnight Programme.


on 03.09.2025 a "Shrutilekhan Competition"
in Hindi was organized for skilled
assistant grade employees of the institute.


Essay writting competition
(Topic : The nature of the official language
Hindi in the changing digital era.)


Organising a Note-Writting competition
in Hindi on 12.09.2025.


The valedicgtory and Prize Distribution
function of Hindi Pakhwada - 2025
was held on 17.09.2025


Distribution of awards to the winners of
Hindi Pakhwada - 2025 during valedictory
function on 17.09.2025

Infrastructure Facilities created and upgraded 14

HPLC

FTNIR

COMBINE HARVESTER

TRACTOR

Important committees

16

Institute Management Committee

Rule	Name & Designation
66 (a) 1	The Director, ICAR-NSRI, Indore
66 (a) 2	**Shri M Selvendran,** Commissioner & Director, Department of Agriculture, Bhopal Representative - Dr. Rajendra Prasad Parmar, Assistant Director Directorate of Farmer Welfare and Agricultural Development, Madhya Pradesh
66 (a) 3	**Commissioner & Director,** Office of Commissioner of Agriculture, Pune, Maharashtra.
66 (a) 4	**Vice Chancellor,** Rajmata Vijay Raje Sindhiya Krushi Vishwavidhyalya, Race Course Road, Gwalior- 474002
66 (a) 5	Representative - Dr. Bharat Singh, Dean, College of Agriculture, Indore **1. Shri Rajkumar Patel(Virendra)** Add: Village Suratlai Janpad Panchayat, District: Jabalpur (MP) **2. Shri Chanbasappa (Ajit) Baburao Nadagadalli** Add: Kasaba Nool, Taluka- Gadniglaj,Dist-Kolhapur–416551 (Maharashtra)
66(a) 6	**1. Dr. O.P.Premi,** Principal Scientist (Agronomy) ICAR-Indian Institute of Soil and Water Conservation Research Centre, 3-A Madhya Marg 27 a Sect-227 Chandigarh-160019.
	1. Dr. S. K. Jha, Principal Scientist (Oilseed & Pulses), Crop Science Division, Room no. 422, ICAR, Krishi Bhawan, , New Delhi-110001
	2. Dr. Naveen Singh, Principal Scientist (Plant Breeding), Division of Genetics, ICAR-IARI, New Delhi-110 012
	3. Dr. Yashvir Singh Shivay, Principal Scientist, Agronomy, Division of Agronomy, ICAR-IARI, New Delhi-110 012
	4. Dr. K. C. Sharma, Principal Scientist & Head, ICAR-IARI, RS, Indore
66 (a) 7	The Assistant Director General (O&P) Krishi Bhawan ICAR, New Delhi
66 (a) 8	Senior.Finance and Accounts Officer, ICAR-IISS, Nabibagh, Berasia Road, Bhopal(M.P.)
66 (a) 9	The Administrative Officer, ICAR-IISR, Indore,
	Senior Finance and Accounts Officer, ICAR-IISS, Nabibagh, Berasia Road, Bhopal(M.P.)
	The Administrative Officer, ICAR-IISR, Indore

Research Advisory Committee (w. e. f. 07.06.2023)

Rule	Name & Designation
Chairman	**Dr. S.K. Datta,** Former DDG (CS), ICAR & Former VC, Visva-Bharti University, Santiniketan, West Bengal
Member	**Dr. S.R. Bhat,** Retired Principal Scientist & Professor, ICAR-National Institute for Plant Biotechnology, New Delhi
Member	**Dr. Masood Ali,** Former Director, Indian Institute of Pulse Research (ICAR-IIPR), Kanpur, UP
Member	**Dr.V.K.Baranwal,** National Professor (Virology), Division of Plant Pathology, IARI, New Delhi
Member	**Dr.Ashutosh Upadhyay,** Professor, Department of Food Science & Technology, NIFTM Industrial Estate, Kundli, Sonipat, Haryana
Member	**Dr. K.H.Singh, Director,** ICAR-National Soybean Research Institute, Khandwa Road, Indore
Member	**Dr. Sanjeev Gupta,** ADG. (Oil Seeds & Pulses), ICAR, Krishi Bhawan, New Delhi
Member Secretary	**Dr. Milind Ratnaparkhe,** Principal Scientist (Plant Biotechnology), ICAR-National Soybean Research Institute, Khandwa Road, Indore

Other Committees of Institute

1. Official Language Implementation Committee

Director, ICAR-IISR (Ex-officio Chairman)
Dr. Punam Kuchlan
Shri I. R. Khan
Administrative Officer
Finance & Accounts Officer

2. Institute Technology Management Committee (ITMC)

Director, ICAR-IISR (Chairman)
Dr. J.B. Singh, IARI RS, Indore
Dr. Anita Rani
Dr. Savita Kolhe
Dr. Punam Kuchlan, I/c PME
Dr. Giriraj Kumawat
Dr. M.P. Sharma, Member secretary (I/c ITMU)

3. Priority Setting Monitoring and Evaluation (PME) Cell

Dr. Punam Kuchlan (Chairperson)
Dr. Raghvendra Nargund
Dr. Sanjeev Kumar
Dr. Vishal S. Thorat (W.E.F. 4-12-2025)
Mr. R.M. Patel (W.E.F. 4-12-2025)
Shri I. R. Khan
Dr. V. Nataraj (Member Secretary)

4. Purchase Advisory Committee (PAC)

Dr. A Ramesh (Chairman)
Dr. Rajpal Meena
Dr. Prince Choyal
Dr. V. Nataraj
Finance & Accounts Officer
Administrative Officer (Member Secretary)

5. Human Resource Development Committee

Dr. Milind Ratnaparkhe (Chairman)
Dr. Savita Kolhe
Dr. Hemant Maheshwari

6. Consultancy Processing Cell (CPC)

Dr. M.P. Sharma (Chairman)
Dr. Mrinal Kuchlan
Dr. Savita Kolhe
Finance & Accts. Officer
Administrative Officer
Dr. Raghvendra Nargund (Member Secretary)

7. Student Affairs Committee & Higher Study Committee

Dr. Sanjay Gupta (Chairman)
Dr. Gyanesh Kumar Satpute
Mrs. Jyoti meena

8. Technology Transfer and Extension Activities Committee

Dr. B.U. Dupare (Chairman)
Dr. Rakesh Kumar Verma
Dr. Lokesh Meena
Dr. Sanjeev Kumar
Mr. S.K. Verma (Member Secretary)

9. Estate and Guest House Management Committee

Dr. Gyanesh Kumar Satpute (Chairman)
Mr. S. K. Verma
Sh. R.C. Shakya
Sh. O.P.Vishwakarma
Ms. Jyoti Meena
Ms. Priyanka Sawan, (Member Secretary)

10. Publication Committee (Annual Report / Newsletter)

Dr. B. U. Dupare (Chairman)
Dr. Punam Kuchlan
Dr. V. Nataraj
Dr. Raghavendra Nargund
Dr. Sanjeev Kumar

11. Library Advisory Committee

Dr. Anita Rani (Chairperson)
Dr. Punam Kuchlan
Dr. V. Nataraj
Administrative Officer
Finance & Accounts Officer
Shri R. N. Singh, (Member Secretary)

12. Foreign Deputation and Higher Study Committee

Dr. Milind B. Ratnaparkhe (Chairman)
Dr. Savita Kolhe
Dr. Raghavendra Nargund
Administrative Officer, (Member Secretary)

13. Works Committee

Dr. G. K. Satpute (Chairman)
Dr. Raghvendra Nargund (Co-Chairman)
Dr. Vangala Rajesh
Finance & Accounts Officer
Administrative Officer
Mr. S.K. Verma, Estate Officer (Member Secretary)

14. Agriculture Knowledge Management Unit

Dr. Savita Kolhe (Chairperson)
Dr. B.U. Dupare
Mr. I. R. Khan

15. Women's Complaint Committee on Sexual Harassment

Dr. Punam Kuchlan (Chairperson)
Ms. Priyanka Sawan
Ms Jyoti Meena
Third Party Representative (To be nominated as &when required)
Administrative Officer

16. House Allotment Committee

Dr. Gyanesh K. Satpute (Chairman)
Dr. Giriraj Kumawat
Dr. Rakesh Kumar Verma
Shri S.K. Verma, Estate officer
Finance & Accounts Officer
Administrative Officer (Member Secretary)

17. Centralized Public Grievance Cell and Monitoring Systems (CPGCMS)

Dr. Vineet Kumar, Chairman

18. Store Management Committee

Dr. Nikhlesh Pandya, Chairman
Ms. Seema Chauhan

19. Liaison Officer (SC/ST/OBC)

Dr. Punam Kuchlan (SC/ST)
Dr. Savita Kohle (OBC)

20. Security Cell

Mr. Ganesh Kumar Meena (Chairman, wef. 04.08.2025)
Mr. Rishap Kumar
Shri R. C. Shakya, (Member Secretary)

21. Farm Management, Price Fixation , Farm item Disposal Committee

Dr. M.K. Kuchlan (Chairman)
Dr. Rakesh Kumar Verma
Store Officer
Finance & Accts. Officer
S Administrative Officer
Dr. V.P.S. Bundela, (Member Secretary)

22. Sport and Staff Welfare Committee

Dr. Rakesh Kumar Verma (Chairman)
Sh. S. K. Verma
Shri. R. C. Shakya
Ms. Seema Chauhan
Ms. Priyanka Sawan, (Member Secretary)

23. Swachh Bharat Abhiyaan Committee

Administrative Officer (Chairman)
Mrs. Jyoti Meena
Dr. D.N. Baraskar
Shri R. C. Shakaya
Finance & Account Officer
Shri S.K. Verma, Estate Officer (Member Secretary)

24. Press & Media Committee

Dr. B.U. Dupare (Chairman)
Dr. Savita Kohle
Dr. Rajpal Meena
Shri S.K. Verma (Member Secretary)

25. Vehicle Management Committee

Dr. G. K. Satpute (Chairman)
Dr. Lokesh Meena
Shri R. N. Singh (Member Secretary)

26. Physical Verification and Condemnation Committee

Dr. M. P. Sharma (Chairman)
Dr. Raghavendra Nargund
Mr. S. K. Verma
Mr. O.P. Vishwakarma (Store Officer)
Ms. Priyanka Sawan, AAO (Member Secretary)

27. Tender Committee

Dr. Savita Kolhe (Chairperson)
Dr. Prince Choyal
Dr. Hemant Maheshwari

28 Local Purchase Committee

Dr. Rajpal Meena (Chairman)
Dr. Rakesh Kumar Verma
Mr. R. C. Shakya, Indenter
Administrative Officer (Member Secretary)

PERSONNEL 16

S.No.	Name	Designation
Director and Scientific staff		
1.	Dr. Kunwar Harendra Singh	Director
2.	Dr. Anita Rani	Principal Scientist
3.	Dr. Sanjay Gupta	Principal Scientist
4.	Dr. Mahaveer Pd. Sharma	Principal Scientist
5.	Dr. Vineet Kumar	Principal Scientist
6.	Dr. Ramesh Aketi	Principal Scientist
7.	Dr. Buddheswar U. Dupare	Principal Scientist
8.	Dr. Savita Kolhe	Principal Scientist
9.	Dr. Milind. B. Ratanparkhe	Principal Scientist
10.	Dr. Raj Pal Meena	Principal Scientist
11.	Dr. Gyanesh K. Satpute	Principal Scientist
12.	Dr. Punam Kuchlan	Principal Scientist
13.	Dr. Mrinal Kanti Kuchlan	Senior Scientist
14.	Dr. Giriraj Kumawat	Senior Scientist
15.	Dr. Vishal Shankar Thorat	Senior Scientist
16.	Shri Ram Manohar Patel	Scientist (SG)
17.	Smt. Neha Pandey	Scientist (SS)
18.	Dr. Lokesh Kumar Meena	Scientist (SS)
19.	Shri Hemant S Maheswari	Scientist (SS)
20.	Dr. Rakesh Kumar Verma	Scientist (SS)
21.	Dr. Prince Choyal	Scientist (SS)
22.	Dr. Sanjeev Kumar	Scientist
23.	Dr.Vennampally Nataraj	Scientist (SS)
24.	Dr. Vangala Rajesh	Scientist (SS)
25.	Sh Kamble Viraj Gangadhar	Scientist
26.	Dr. Raghavendra Nargund	Scientist (SS)
27.	Dr. Aalok Shiv	Scientist
Administrative Staff		
28.	Sh Ganesh Kumar Meena	Administrative Officer
29.	Sh Ashutosh	Finance and Account Officer
30.	Smt. Priyanka Sawan	Assistant Administrative Officer
31.	Sh Ravi Shanker Kumar	Assistant
32.	Sh Avinash Kalanke	Assistant
33.	Sh Anil K. Carrasco	Assistant
34.	Ms Diksha	Assistant
35.	Ms Anupama Kumari	Assistant
Technical Staff		
36.	Sh. Raghu Nath Singh	Chief Technical Officer
37.	Dr. Nikhilesh Pandya	Chief Technical Officer
38.	Dr. V.P.S. Bundela	Farm Manager
39.	Sh Shyam Kishor Verma	Assistant Chief Technical Officer

S.No.	Name	Designation
40.	Sh Omprakash Vishwakarma	Technical Officer
41.	Sh Rakesh Chandra Shakaya	Technical Officer
42.	Sh Irfanur Rehman Khan	Sr Technical Officer
43.	Smt. Jyoti Meena	Sr Technical Assistant
44.	Miss. Seema Chouhan	Sr Technician
45.	Mr Anurodh Jain	Technician
46.	Mr Rishap Kumar	Technician
Skilled Supporting Staff		
47.	Smt. Naki Bai	Skilled Supporting Staff
48.	Sh. Jalam Singh	Skilled Supporting Staff
49.	Sh. Balvir Singh	Skilled Supporting Staff
50.	Sh. Sanjeev Kumar	Skilled Supporting Staff
51.	Smt. Raida Bai	Skilled Supporting Staff
52.	Smt. Kamli Bai	Skilled Supporting Staff
53.	Smt. Fulki Bai	Skilled Supporting Staff
54.	Shri Mangi lal	Skilled Supporting Staff
55.	Shri Deepak	Skilled Supporting Staff
56.	Smt. Sagari Bai	Skilled Supporting Staff
57.	Smt. Rumli Bai	Skilled Supporting Staff
58.	Smt. Meera Bai	Skilled Supporting Staff
59.	Smt. Romu Bai	Skilled Supporting Staff
60.	Smt. Teju Bai	Skilled Supporting Staff
61.	Smt. Sarita Bai	Skilled Supporting Staff
62.	Smt. Parvati Bai	Skilled Supporting Staff
63.	Smt. Sangeeta Bai	Skilled Supporting Staff
64.	Smt. Surja Bai	Skilled Supporting Staff
65.	Smt. Sagar Bai	Skilled Supporting Staff
66.	Smt. Rekha Bai	Skilled Supporting Staff
67.	Smt. Antar Bai	Skilled Supporting Staff
68.	Smt. Mangi Bai	Skilled Supporting Staff

Joining, Promotions, Transfer, Superannuation

S. No.	Name	Post	Date of Joining
1.	Ms Anupama Kumari	Assistant	05.03.2025.
2.	Dr. Vishal Shankar Thorat	Sr Scientist (Agricultural Economics)	26.06.2025
3.	Dr. Aalok Shiv	Scientist (Genetics & Plant Breeding)	07.07.2025
4.	Shri Ganesh Kumar Meena	Administrative Officer	04.08.2025

Promotion :

1. Shri I R Khan, Technical Officer (T-5) promoted to the post of Sr Technical Officer (T-6) w.e.f. 31.10.2023
2. Dr. Giriraj Kumawat, Sr Scientist (Level 12) promoted to the post of Sr Scientist (Level 13 A) w.e.f. 01.09.2022
3. Sh Hemant Singh Maheshwari, Scientist promoted to the post of Scientist (SS) w.e.f. 01.01.2022

Transfer

S.No.	Name of the employee	Post	Transferred to	Date of Transfer
1	Dr. Shiva Kumar M.	Sr. Scientist	ICAR-IIHR, Bangaluru	13.06.2025
2	Shri Saurabh Meena	Senior Administrative Officer	ICAR-IISS, Bhopal	04.08.2025





Superannuation

S.No.	Name of the employee	Post	Date of Retirement
1.	Shri Sanjay Kumar Pandey	Chief Technical Officer	31.01.2025
2.	Shri Bilber Singh	Senior Technician	31.01.2025
3.	Shri Francis Damasus	Technical Officer	30.04.2025
4.	Smt Chunki Bai	Skilled Supporting Staff	30.04.2025


(f) Following Staff members were granted financial upgradation under the MACP Scheme during the period since last IMC:3rd MACP Shri Avinash Kalanke Assistant Level 7