आज़ादी का अमृत महोत्सव

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वार्षिक प्रतिवेदन
Annual Report
2022

भाकृअनुप
ICAR

भा. कृ. अनु. प. – भारतीय सोयाबीन अनुसंधान संस्थान
ICAR-Indian Institute of Soybean Research

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ICAR-Indian Institute of Soybean Research

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Preface

It is a matter of great honor and pride for me to present the annual report 2022 of ICAR-Indian Institute of Soybean Research, Indore. It would give a panoramic scenario of research, development and extension activities undertaken by this institute. The role of ICAR-IISR, is evident from the fact that from negligible area of cultivation in 1960s, the soybean crop occupy to be the most important oilseed crop of India.In India, soybean crop was grown in area of11.44 millionhectares with a total production of 13.9 million tones, in year 2022-23. The contribution of soybean to total oilseeds and edible oil produced in the country is 42 and 22 percent, respectively. In a scenario of meeting edible oil demand by importing almost 60% of country's requirement, soybean plays a significant role in reducing edible oils import requirement of India. Currently, mitigating climate variability related biotic and abiotic stress, and productivity enhancement of soybean crop are major challenges faced by the soybean researchers.

The most significant achievements of 2022 includes identification of six new soybean varieties which includes two varieties of early maturity and improved quality traits NRC 150 and NRC 152, for Central zone, a drought tolerant variety NRC 136, one early maturity variety 131 and a long juvenile variety NRC 157, for Madhya Pradesh state, and a yellow mosaic disease resistant and high oil variety NRC 149, for North plain zone. Genome wide association studies and QTL mapping studies identified important genomic loci associated with various stress tolerance traits, screening of germplasm identified germplasm resistant to various important diseases and pests. Crop establishment with residue retention techniques showed higher seed yield and biological yield, soybean intercropping with sugarcane found remunerative. The institute intensified its efforts in the transfer of technology through use of social media platforms. A mega farmer fair *Soya Mahakumbh* was organized just before start of the crop season to display improved soybean production technologies and to make farmer- scientist interactions. The institute spearheaded various webinars and online trainings for capacity building. I would like to thank the Chairman and members of RAC, who guided and directed the institute for strategic research planning. I take this opportunity to state my deep sense of gratitude to Dr Himanshu Pathak, Secretary, DARE and Director General, ICAR for guidance, and consistent support to soybean research and development. I gratefully acknowledge the help and valuable guidance provided by Dr T.R. Sharma, Deputy Director General (Crop Science) and Dr Sanjeev Gupta, ADG (Oilseed and Pulses) ICAR, New Delhi, for the progress of the Institute. I place as records my sincere thanks to scientists and staff of ICAR-IISR for their contribution in one or another way in bringing this report. Special thanks are also due to the members of editorial committee for making this report crisp, comprehensive and informative. I hope that the Annual Report will be useful for the researchers, policy makers, farmers, farm-women and development functionaries in promoting soybean research and development.

(K. H. Singh)
Director

CONTENTS

कार्यकारी सारांश

❋ सोयाबीन के कुल 5914 जनन्द्रव्य, जिनमे *ग्लाइसिन मैक्स* (5108), *ग्लाइसिन सोजा* (749) और जंगली तृतीयक जीन पूल परिग्रहण (55) शामिल है, आयात किए गए जो अभी संगरोध के अधीन हैं । राष्ट्रीय सक्रिय जर्मप्लाज्म साइट आईसीएआर-आईआईएसआर, इन्दौर से कुल 5239 जनन्द्रव्य पूरे भारत के विभिन्न संस्थानों में वितरित किए गए।

❋ भारत की सोयाबीन किस्मों के आनुवंशिक आधार को व्यापक बनाने के लिए, विविध आनुवंशिक आधार वाले 20 विदेशी परिग्रहणों की पहचान की गई और इनका विभिन्न क्षेत्रों की लोकप्रिय सोयाबीन किस्मों के साथ संकरण कार्यक्रम में उपयोग किया गया । SL 958 (*E1E2E3E4dt1*) की पृष्ठभूमि में प्रकाशअवधि (*e1,e2,e3,e4*) और ग्रोथ हैबिट (*Dt1*) एलील्स के लिए विकसित जेनेटिक स्टॉक का मूल्यांकन मध्य क्षेत्र के चेक के साथ किया गया।

❋ बीज की उपज के लिए विभिन्न परिपक्वता अवधि की कुल 189 उन्नत प्रजनन लाइनों का मूल्यांकन किया गया, उनमें से कम परिपक्वता समूह में पांच लाइनें और देर से परिपक्वता समूह में आठ लाइनें संबंधित सर्वश्रेष्ठ चेक से अच्छी प्राप्त हुईं। एनआरसी 150, लिपोक्सीजेनेज 2 से मुक्त एक कम परिपक्वताअवधि और उच्च तेल मात्रा की किस्म मध्य क्षेत्र के लिए जारी की गयी। एनआरी सी 152, KTI और लिपोक्सीजेनेज 2 से मुक्त एक कम परिपकक्वता अवधि की किस्म को मध्यक्षेत्र के लिए जारी किया गया। दो किस्मों , इनआरसी 131 और एनआरसी 157, जल्दी पकने वाली और देरी से बुवाई के लिए उपयुक्त, की मध्य प्रदेश में जारी करने के लिए पहचान की गई।

❋ एनआरसी 142 के गामा विकिरण और इलेक्ट्रॉन बीम विकिरण के बाद प्राप्त M_2 पौधों में ओलिक एसिड की मात्रा अधिक पाई गई, जो एनआरसी 142 के अनुपचारित बीजों की तुलना में लगभग 1.6 गुना अधिक है । काले सोयाबीन की किस्म, VLS65 में कार्बोहाइड्रेट की मात्रा अधिक और प्रोटीन और वसा की मात्रा कम पाई गयी।

❋ एनआरसी 136, जो की हाल ही में पूर्वी क्षेत्र के राज्यों के लिए जारी की गई और सूखा सहिष्णु गुणों वाली एक किस्म हैं, इसकी पहचान मध्य प्रदेश राज्य किस्म विमोचन समिति द्वारा इसके क्षेत्र विस्तार के लिए की गई है।

Executive Summary

□ A total of 5914 accessions incuding *Glycine max* (5108), *Glycine soja* (749) and wild tertiary gene pool accessions (55) of soybean were introduced and are under quarantine. A total of 5239 germplasm accessions were distributed from National Active Germplasm Site ICAR-IISR, Indore to various institutes across India.

□ For broadening the genetic base of Indian soybean varieties, 20 exotic accessions with diverse genetic base were identified and used in hybridization program with popular soybean varieties of different zones. Genetic stocks developed for photoperiodic (*e1, e2, e3, e4*) and growth habit (*Dt1*) alleles in the background of SL 958 (*E1E2E3E4dt1*) were evaluated with checks of Central zone.

□ A total of 189 advanced breeding lines of different maturity duration were evaluated for grain yield, among them five lines in early maturity and eight lines in late maturity group out yielded respective best checks. NRC150, an early maturing line free from *Lipoxygenase 2* and possesing high oil content was released for Cental zone. NRC 152, an early maturing line free from *KTI* and *Lipoxygenase 2* was released for Cental zone. Two varieties, NRC 131 and NRC 157, with early maturity and suitable for delayed sowing, were identified for release in Madhya Pradesh.

□ M_2 plants obtained after gamma irradiation and electron beam irradiation of NRC142 were found to be high in oleic acid content, which is about 1.6 fold higher than the untreated seeds of NRC142. The black soybean variety, VLS 65 had higher carbohydrate content and lower protein and fat content.

□ NRC 136, a variety recently released for Eastern zone states and possessing drought tolerance traits, has also been identified by Madhya Pradesh state variety release committee for its area expansion. Six advanced breeding lines *viz.* A(M/L)-II-92, A(E)-30, B(E)-21, A(M/L)-II-16, 21(Spd) sel105-13 and 49GH130/1-3 were found high yielder than NRC 136 in the third-tier evaluation under drought stress condition.

छह उन्नत प्रजनन लाइनें A(M/L)-II-92, A(E)-30, B(E)-21, A(M/L)-II-16, 21 (Spd) Sel105-13 और 49GH130/1-3, में सूखा तनाव की स्थिति के तहत तीसरे स्तर के मूल्यांकन में चेक एनआरसी 136 की तुलना में अधिक उपज पायी गयी।

❋ लगातार तीन वर्षों के सूखे तनाव के तहत बायोमास और अनाज की उपज के लिए जीनोम वाइड एसोसिएशन विश्लेष्ण (GWAS) से कुछ महत्वपूर्ण और निकट स्थित एसएनपी की पहचान की गयी। वानस्पतिक अवस्था में जड़ लक्षणों के लिए दो, जड़ व्यास के लिए चार, जड़ मात्रा के लिए दो और जड़ युक्तियों के लिए पांच महत्वपूर्ण SNP की पहचान की गयी।

❋ जल भराव सहनशीलता के लक्षणों के लिए GWAS द्वारा चार जल भराव लक्षणों के लिए 29 महत्वपूर्ण SNPs की पहचान की। चार क्यूटीएल यानी *qWLY19, qFDS20, qSER20, qFDS21,* को क्रमशः जल जमाव सहिष्णुता उपज सूचकांक (2019), पर्ण क्षति स्कोर (2020), तना बढ़ाव दर (2020), पर्ण क्षति स्कोर (2021) के लिए पहचाना गया।

❋ एक जल भराव सहिष्णु सोयाबीन जेनेटिक स्टॉक JS20-38 (INGR22169) को ICAR के प्लांट जर्मप्लाज्म पंजीकरण समिति (PGRC) द्वारा पंजीकृत किया गया। सोयाबीन पर AICRP के तहत खरीफ 2022 के दौरान दो जल भराव सहिष्णु जीनोटाइप यानी एनआरसी 192 और एनआरसी 189 का एवीटी 1 (मध्य क्षेत्र) में मूल्यांकन किया गया और दो जल भराव सहिष्णु जीनोटाइप यानी एनआरसी 256 और एनआरसी 257 का आईवीटी में मूल्यांकन किया गया।

❋ YMV प्रतिरोधी और उच्च तेल मात्रावाली जीनोटाइप एनआरसी 149 (एनआरसीएसएल 3) को उत्तरी मैदानी क्षेत्र के लिए जारी किया गया। जीनोटाइप्स ईसी 18596, ईसी 95677, ,एनआरसी 150, ईसी 250586 और एनआरसी 181 एन्थ्रेक्नोज रोग के खिलाफ प्रतिरोधी पाए गए। जीनोटाइप EC-528622, EC-171194, UPSL-50981, UPSL-63, UPSL-390, Cat-2740, IC-073710, EC-572136, EC-456647 और VPSM1096 A को चार स्थानों इन्दौर, पंतनगर, मेदजीफेमा और जबलपुर पर RAB के खिलाफ प्रतिरोधी पाया गया।

❑ Genome wide association analysis (GWAS) for biomass and grain yield under drought stress, of three consecutive years' data revealed a few significant and closely located SNPs for consecutive years. GWAS for root traits at vegetative stage identified two significant loci for total root length, two for surface area, four for root diameter, two for root volume and five for root tips in a panel of 203 soybean accessions.

❑ GWAS for water logging tolerance traits identified 29 significant SNPs for four water logging traits. Four QTLs i.e. *qWLYI9, qFDS20, qSER20, qFDS21,* were identified for the traits i.e. water logging tolerance yield index (2019), foliar damage score (2020), stem elongation rate (2020), foliar damage score (2021), respectively.

❑ Soybean accession (genetic stock) JS 20-38 (INGR22169), a water logging tolerant genotype was registered by Plant Germplasm Registration Committee (PGRC) of ICAR.Two water logging tolerant genotype i.e. NRC 192 and NRC 189, were evaluated in AVT I (Central zone) and two water logging tolerant genotype i.e. NRC 256 and NRC 257 were evaluated in IVT during *Kharif* 2022 under AICRP on Soybean.

❑ YMV resistant and high oil content genotype NRC 149 (NRCSL 3) was released for North plain zone. Genotypes EC 18596, EC 95677, NRC 150, EC 250586 and NRC 181were found to be resistant against anthracnose disease. Genotypes EC-528622, EC-171194, UPSL- 50981, UPSL-63, UPSL-390, Cat-2740, IC-073710, EC-572136, EC-456647 and VPSM 1096 A were found resistant against rhizoctonia aerial blight across four locations viz., Indore, Pantnagar, Medziphema and Jabalpur.

❑ Genotypes IC 24997, EC 113393 , F4P21, CAT 2503, G5P22, F3P18 exhibited strong antixenosis for *Spodoptera litura.* Five wild species of soybean viz., *Glycine tomentolla*, *Glycine canescens* and *Glycine tabacina,* showed antibiosis reaction for *Spodoptera litura.* New insecticides Thiamethoxam 25% WG and Thiamethoxam 75% SG, were found to be effective against white fly.

जीनोटाइप्स IC 24997, EC113393, F4P21, CAT 2503, G5P22, F3P18 ने *स्पोडोप्टेरा लिटुरा* के लिए अच्छा एंटीक्सेनोसिस प्रदर्शित किया। सोयाबीन की पांच जंगली प्रजातियां, *ग्लाइसिन टोमेंटोला, ग्लाइसीन कैनसेन्स* और *ग्लाइसिन टैबासीना*, ने *स्पोडोप्टेरा लिटुरा* के लिए प्रतिजीवाणु प्रतिक्रिया दिखाई। नए कीटनाशक थियामेथोक्सम 25% डब्ल्यूजी और थियामेथोक्साम 75% एसजी सफेद मक्खी के खिलाफ प्रभावी पाए गए।

❋ तीन फाइटोहोर्मोन अर्थात इंडोल एसिटिक एसिड (IAA), सायटोकायनिन (CK) और ट्राईकॉन्टानॉल (Trai) AM कवक के बड़े पैमाने पर गुणन में प्रभावी पाए गए। खेत की स्थितियों के तहत, उपचार Trai-1ppm, IAA-75ppm और CK-20ppm या तो बीज उपचार के रूप में या AMF के साथ पर्णीय अनुप्रयोग के रूप में लागू करने से अनाज की अधिक उपज देती है।

❋ विभिन्न फसल स्थापना तकनीकों के बीच, पांरपरिक जुताई की तुलना में उल्लेखनीय रूप से उच्चतम सोयाबीन बीज उपज (18.0%) और जैविक उपज स्थायी ब्रॉड बेड फरो (PBBD) + अवशेष प्रतिधारण (R), उसके बाद PBBF + बिना अवशेष प्रतिधारण (WR) में, किसान प्रथाओं के अनुसार (CTFP) + WR के तुलना के तहत दर्ज की गई।

❋ सोयाबीन बीज उपज (7.66%), जैविक उपज (4.67%) और छह लंबी अवधि की किस्मों के फसल सूचकांक का पूलित (3 वर्ष का डेटा) विश्लेषण से बारानी पारिस्थिति की तंत्र की तुलना में ड्रिप सिंचाई प्रणाली के तहत उच्चतम पाया गया। विभिन्न किस्मों के बीच जेएस 20-69 ने ड्रिप और वर्षा आधारित पारिस्थितिकी तंत्र दोनों के तहत अन्य किस्मों की तुलना में काफी अधिक अनाज उपज (82.9%), जैविक उपज (47.8%) और फसल सचकांक की सूचना दी।

❋ सोयाबीन + गन्ना (2.1) इंटरक्रॉपिंग सिस्टम के तहत पांच सोयाबीन जीनोटाइप (YMV-11, NRC130, NRC 131, NRC 136 और JS 20-34) का मूल्यांकन किया गया था। गन्ने की उपज में बाधा डाले बिना गन्ना किसानों को अतिरिक्त लाभ के रूप में सभी सोयाबीन जीनोटाइप ने वसंत ऋतु के दौरान 8.08-15.82 क्विंटल /हे. सोयाबीन बीज उपज के साथ अंतरफसल प्रणाली के तहत अच्छा प्रदर्शन किया।

□ Three phytohormones viz., indole acetic acid (IAA), cytokinin (CK) and Triacontanol (Tria) were found to be effective in mass multiplication of AM fungi. Under field conditions, treatments Tria-1ppm, IAA-75ppm and CK-20ppm either applied as seed treatment or foliar application with AMF showed higher grain yield.

□ Among the different crop establishment techniques, significantly highest soybean seed yield (18.0%) and biological yield was registered under permanent broad bed furrow (PBBF) + residue retention (R) followed by PBBF + without residue retention (WR) as compared to conventional tillage as per farmer practices (CTFP) +WR.

□ The pooled (3 year's data) analysis of soybean seed yield (7.66%), biological yield (4.67%) and harvest index of six long duration cultivars found highest under drip irrigation system compared to rainfed ecosystem. Among different cultivars, JS 20-69 reported significantly higher grain yield (82.9%), biological yield (47.8%) and harvest index compared to other cultivars under both drip and rainfed ecosystem.

□ Five soybean genotypes (YMV-11, NRC 130, NRC 131, NRC 136 and JS 20-34) were evaluated under soybean + sugarcane (2:1) intercropping system. All the soybean genotypes performed well under intercropping system with 8.08-15.82 q/ha soybean seed yield during spring season as an additional benefit to sugarcane farmers without hampering cane yield.

□ The seed inoculation of PGPR strains such as *Bacillus aryabhattai* + *Bradyrhizobium lioningense* +AMF, *Burkholderia arboris*+ *Bradyrhizobium lioningense* +AMF and *Bacillus aryabhattai* + AMF in both soybean and wheat crops, significantly improved seed yield, macro and micronutrients (N, P, K, Zn and Fe) concentration in soybean seed by enhancing soil enzymatic activities as compared to other treatments under study.

❇ *बेसिलस आर्यभट्टई + ब्रैडीरहिज़ो बियमलियोनिंगेंस + एएमएफ, बुर्कहोल्डरिया आर्बोरिस + ब्रैडीराइज़ो बियमलियोनिंगेंस* + एएमएफ और *बेसिलस आर्यभट्टई* + एएम एफ जैसे सोयाबीन और गेंहू की फसलों में पीजीपीआर उपभेदों का बीज टीकाकरण से अध्ययन के तहत, बीज की उपज, मैक्रो और माइक्रोन्यूट्रिएंट्स (एन, पी, के Zn और Fe) की सोयाबीन के बीज में सांद्रता ज्यादा पायी गयी, एवं अन्य उपचारों की तुलना में मिट्टी की एंजाइमिक गतिविधियों को बढ़ा दिया।

❇ 3S1Y मॉडल देश के विभिन्न हिस्सों में किसानों को पर्याप्त मात्रा में हाल ही में जारी सोयाबीन की किस्मों (केडीएस 726, केडीएस753, एनआरसी 130, एनआरसी 136, एनआरसी 128, एनआरसी 138 एनआरसी 142) की आपूर्ति के लिए विकसित किया गया है। कुल 601 एकड़ को क्रमशः 248q, 1795q, 1135q, 1665q ब्रीडर, फाउंडेशन, प्रमाणित और Truthfully लेबल वाले बीजों के कुल उत्पादन में लाया गया।

❇ मशीन लर्निंग विधि कृत्रिम तंत्रिका नेटवर्क (एएनएन) और सपोर्ट वेक्टर मशीन (एसवीएम) का उपयोग कीट प्रकोप के मॉडल के लिए किया गया है। फसल पैटर्न परिवर्तन विश्लेषण (मार्कोव श्रृंखला विश्लेषण) और प्रमुख वर्षा आधारित फसलों की वृद्धि दर से पता चला है कि मध्य प्रदेश में कपास, ज्वार, मक्का, बाजरा और अन्य छोटी फसलें सोयाबीन की प्रमुख प्रतिस्पर्धी फसलें थीं।

❇ आईसीटी उपकरण और मीडिया का विकास किया गया जो कि प्रौद्योगिकी के हस्तांतरण के लिए सोयाबीन में प्रभावी रूप से कार्यरत हैं। आईसीएआर-मध्य भारत समाचार (सीजन 2) की प्लेलिस्ट में 42 एपिसोड शामिल हैं। इसके अलावा, साप्ताहिक सलाह पर 20 वीडियो, सोया संवाद पर 11 वीडियो, सोयाबीन की उन्नत किस्मों पर 23 वीडियों, जिसमें एआइसीआरपीएस केन्द्रों द्वारा विकसित किस्मों पर 12 वीडियो भी शामिल हैं, का विभिन्न सोशल मीडिया प्लेटफॉर्म पर अपलोड किया गया है।

❇ मध्य प्रदेश के विभिन्न जिलों में आईटीसी के सहयोग से टिकाऊ विकास के लिए ब्रॉड बेड फरा प्रौद्योगिकी के सत्यापन, प्रसार और लोकप्रिय बनाने के लिए एक एकड़ भूखंड में प्रदर्शन भी शुरु किए गए। बीबीएफ के तहत किसानों की प्रथाओं या बिना बीबीएफ की तुलना में जिले की औसत बीज उपज 25.2% अधिक थी।

□ 3S1Y model has developed to supply recently released soybean cultivars (KDS 726, KDS 753, NRC 130, NRC 136, NRC 128, NRC 138, NRC 142) quality seed in adequate quantity to farmers at different parts of the country. A total of 601 acres was brought under the production with a total production of 248q, 1795q, 1135q and 1665q of breeder, foundation, certified and truthfully labelled seeds, respectively.

□ The machine learning method Artificial Neural Network (ANN) and Support Vector Machine (SVM) have been used to model the insect incidence. Cropping pattern change analysis (Markov Chain analysis) and growth rate of major *rainfed* crops, revealed that cotton, sorghum, maize, pearl millet, and other minor crops were the major competing crops to soybean in Madhya Pradesh.

□ ICT tools and media developed and effectively employed in soybean for transfer of technology. The playlist of ICAR-Madhya Bharat Samachar (Season 2) includes 42 episodes. Inaddition, 20 videos on weekly advisories, 11 videos on Soya Samvad, 23 videos on improved soybean varieties, which also includes 12 videos on varieties developed by AICRPS centres, uploaded on various social media platforms.

□ Demonstrations were also initiated in one acre plots for validation, dissemination and popularization of the broad bed furrow technology for sustainable development, in collaboration with ITC support at different districts of Madhya Pradesh. Irrespective of the district's the average seed yield of soybean was 25.2% higher under BBF as compared to farmer's practices or without BBF.

2. Introduction

Indian Council of Agricultural Research (ICAR) has established the ICAR-Indian Institute of Soybean Research (IISR) in the year 1987 at Indore in the State of Madhya Pradesh to take up the centralized research to support soybean production systems with basic information and breeding material. Coordinating unit of All India Coordinated Research Project on Soybean (AICRPS), Soybean Breeder Seed Production (BSPS) and National Active Germplasm Site (NAGS) for soybean germplasm are also situated at ICAR-IISR, Indore.The research plan and policies of ICAR-IISR 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.

Physiography

ICAR-IISR campus is located in the village Piplyarao of district Indore in 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 with an area of 58.05hectares, 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-IISR 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 typicchromusterts and fine clay loam, montmorillonitic family of lithic verticustochrepts.

Climate

The climate of the *Malwa* plateau of Madhya Pradesh is semi-arid with a growing period of 150-180 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 800 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 achievement of the institute includes a vast collection of soybean germplasm comprising exotic, indigenous, breeding lines and wild species. Currently, 5946 germplasm accessions are maintained at ICAR-IISR. Further, for better management of genetic resources and to enhance germplasm utilization, core-collection of germplasm has been developed successfully. A number of genetic resources have been identified for various traits like photoperiod insensitivity, long juvenility, drought and waterlogging tolerance, heat stress tolerance and resistance to diseases such as charcoal rot, anthracnose, rust and yellow mosaic and some insects. Genotypes with high oleic acid (NRC 106, IC 210), low linolenic acid (VLS 59) and vegetable soybean genotypes (NRC 105), have been developed at this institute. High yielding varieties having resistance to various biotic and abiotic stresses (NRC 7, NRC 37, NRC 86, JS 97-52, NRC 128, NRC 130, NRC 136, NRC 138) have been bred and released for cultivation in different agro-ecological regions of the country. First KTI free genotype in the country, NRC 127, has been released for cultivation in the Central Zone. NRC 142, an early maturing variety free from KTI and *Lipoxygenase 2*, has been released for Central and Southern Zone. First high oleic acid variety in the country, NRC 147, has been released for cultivation in Eastern and Southern Zone. Three germplasm accessions EC 390977, EC 34101 and MACS 330 having photoperiodic genes and early maturity traits, EC34372 for anthracnose resistanceand AGS 25 having long juvenile trait have been registered at ICAR-NBPGR, New Delhi.

Molecular markers have been identified for maturity, 100-seed weight and yellow mosaic disease resistance traits.

In the field of crop production, *in situ* moisture conservation technology and the associated mechanization for soybean-based cropping system (BBF, FIRBS R&F) have been developed and commercialized. Integrated management for soybean-wheat and soybean-chickpea, and integrated weed management for soybean cropping system have been developed. Soil health enhancing microbes including Zn, Fe solubilizing bacteria and rhizobia have been identified.

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.

Web-based expert systems for varietal and disease identification and data management systems for AICRPS have been developed. Soybean Gyan- a mobile app for soybean farmers, developed by the institute, 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.

Consequently, the institute has emerged as a catalyzing force to facilitate rapid increase in acreage and production of soybean since 35 years. It has also been instrumental in providing sustainability to soybean cultivation in different regions of the country.

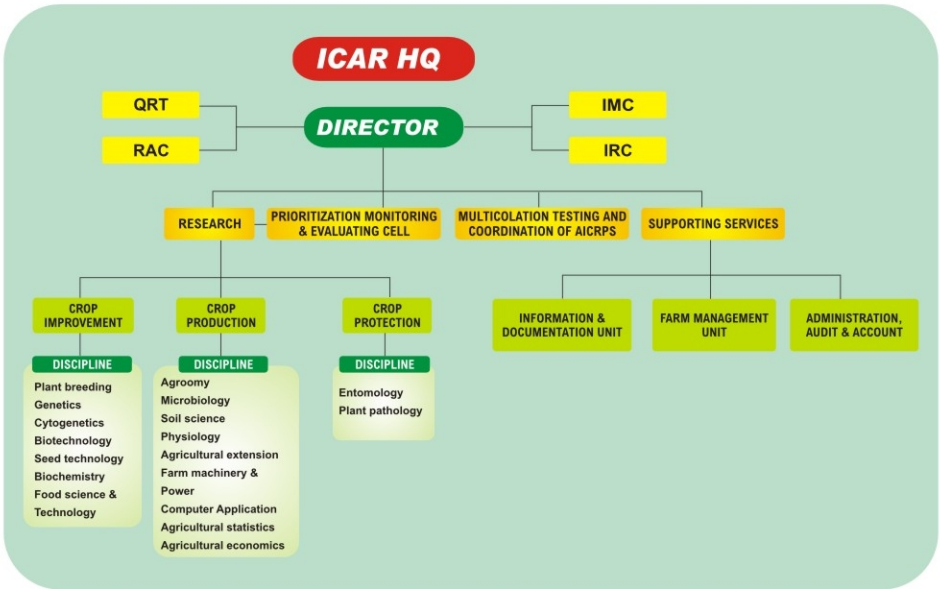
Mandate

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-IISR

Library

Institute has developed a reasonably good library equipped with relevant books, journals, etc. to provide the research support needed to the scientists. At present, the library is equipped with 3269 books and subscribing 01 international and 14 national journals. The library is also a beneficiary of CERA for accessing more than 2000 scientific journals on-line.

Staff and budget

The total sanctioned staff position of ICAR-IISR as on 31st December 2022 is 100 comprising 34 scientific, 22 technical, 17 administrative and 27 supporting positions. Out of which 75 are in positions as on 31st December 2022.The budget during 2021-22 and 2022-2023 is given in Table 2.1 & 2.2, respectively.

Table 2.1 Budget and expenditure of ICAR-IISR for 2021-2022(₹ in lakhs)

Head	R.E.	Actual Expenditure
Pay & Allowances	1171.52	1171.52
T.A.	7.34	7.34
Other Charges -Recurring	354.55	354.55
(a) Information Technology	19.14	19.14
(b) Equipments	46.52	46.52
(c) Works	0.67	0.67
(d) Library	1.19	1.19
(e) Furniture & Fixures	1.96	1.96
(f) Vehicles and Vessels	15.50	15.50
(g) HRD	0.11	0.11
(h) Pension & Retirement Benefits	137.82	137.82
(i) NEH	44.20	44.20
(j) TSP	21.75	21.75
(k) SCSP	55.00	55.00
Total	**1877.27**	**1877.27**
Revenue Generated	35.54	-

Table 2.2 Budget of ICAR-IISR for 2022-2023(₹ in lakhs)

Head	R.E.
Grant in Aid-Pay & Allowances	1200
Grant in Aid-Capital	72
Grant in Aid-General	395
Pension & Retirement Benefits	235
NEH	30
TSP	24
SCSP	60
TOTAL	**2016**

Research Achievements

3.1 Genetic Resources: Conservation, Characterization and Utilization

NRCS1.1/87 : Augmentation, management and documentation of soybean germplasm

PI : Sanjay Gupta, Co-PIs : Vangala Rajesh, Giriraj Kumawat, Gyanesh K.Satpute, Subhash Chandra, Manoj Srivastava, Lokesh Kumar Meena, Laxman Singh Rajput, Savita Kohle and Ram Manohar Patel

Germplasm acquisition and maintenance

A total of 5946 germplasm accessions including 74 accessions of 14 wild species are being maintained in the institute. Trait specific germplasm set having accessions for characters like photo insensitivity (6), long juvenility (7), drought tolerance (22), water logging tolerance (7), high temperature tolerance (6) , salt tolerance (2), YMV resistance (12, rust differentials (7), antibiosis to *Spodoptera* (3), insect tolerance (17), vegetable type (11), early maturity (37), bold seeded (33), high seed longevity (5), high yielding (20), high oil (3), low linolenic acid (1), null *KTI* (5), *Lox 2* free (1), high protein (7), high oleic (1), low lipoxygenase (1), hard-seededness (2) and less mechanical damage (2), is being maintained. In addition to trait specific panel, an allelic panel comprising 13 accessions with known *E* genes, 3 accessions with salt tolerant alleles, two accessions with known hard-seededness alleles and two accessions with known long juvenile alleles is also being maintained. A total of 5914 accessions i.e. *G. max* (5108), *G. soja* (749) and wild tertiary gene pool accessions (55) of soybean were introduced and are under quarantine.

Germplasm utilization for widening of the soybean varietal genetic base

For broadening the genetic base of Indian soybean varieties, diverse 20 exotic accessions were identified and used in hybridization programwith popular soybean varieties of different zones. Hybridity confirmation of F_1s and their multiplication is being undertaken in off-season in glass house.

Evaluation of genetic stocks of SL 958

Genetic stocks developed for photoperiodic (*e1, e2, e3, e4*) and growth habit (*Dt1*) alleles in the background of SL 958 (*E1E2E3E4dt1*) were evaluated with checks of Central Zone. Six genetic stocks (NRC 249, NRC 225, NRC 205, NRC 229, NRC 230 and NRC 244) were significantly superior to the best check JS 20-34 (1300 Kg/ha). However, none of the lines could equate the early maturity of JS 20-34 (84.7 days) and the earliest line NRC 244 with 1409 Kg/ha grain yield could mature in 97 days.

Development of genotypes for delayed sown conditions

A total of 134 breeding lines involving 71 RILs from long juvenile parent (LJ), 54 photoinsensitive near iso-genic lines (PI lines) having either of the *e1, e2, e3* or *e4* alleles, 2 photoinsensitive varieties (JS 20-34, NRC 138) (PI varieties) and 7 conventional juvenile varieties (NRC 152, RVSM 2011-35, RSC 10-52, JS 20-98, SL 958, JS 93-05) (CJ Variety) were evaluated in two sowing dates (1st July and 16th July), keeping a plot size of single row of 3m length. Under late sown conditions, there was reduction in all the phenological traits. Reduction in grain yield in late sown condition was maximum in CJ varieties (62%) followed by PI lines (51%) and was the least in RILs (30%) and PI varieties (33%) (Table 3.1.1).

Table 3.1.1 Identification of breeding lines for late sown conditions

	Date of sowing	Days to Flower	Days to Maturity	Plant Height (cm)	Number of nodes / plant	Seed Yield (g/plot)	Yield reduction under late sown condition	Promising Lines for late sown conditions*
CJ Variety	1st July	42.2 (34.0 - 52.0)	92.4 (83.0 -109.00)	44.7 (23.8-64.8)	10.7 (8.2-12.4)	110.6 (32.0-289.0)	62%	Nil
	16th July	41.0 (33.0 -45.0)	92.6 (77.0 - 102.0)	45.8 (27.8-60.4)	10.4 (8.8-11.8)	41.7 (10.0-87.0)		
LJ	1st July	47.6 (5.0 -62.0)	97.4 (20.0-109.0)	70.4 (39.0-102.0)	13.1 (7.8-32.6)	233.5 (41.0-679.0)	30%	AGS 25, LJ 107, LJ 111, LJ 117, LJ 152, LJ 16, LJ 144, LJ 45, LJ 98, LJ 39, LJ 29, LJ 133, LJ 136, LJ 94, LJ 130, LJ 117, LJ 2
	16th July	46.0 (17.0 -57.0)	92.1 (80.0-100.0)	60.7 (22.3-85.3)	11.9 (6.3-17.2)	162.8 (13.0-411.0)		
PI Lines	1st July	43.7 (33.0 -56.0)	103.2 (83.0-109.0)	49.0 (26.0-74.4)	12.1 (8.4-15.6)	169.2 (13.0-504.0)	51%	Nil
	16th July	40.2 (33.0 -43.0)	91.8 (79.0-104.0)	48.2 (20.5-71.6)	11.4 (7.4-14.0)	83.5 (13.0-240.0)		
PI Variety	1st July	37.1 (33.0 -40.0)	84.0 (83.0--85.0)	33.5 (24.6-44.2)	9.0 (7.2-11.0)	189.7 (13.0-309.0)	33%	Nil
	16th July	34. (33.0 -36.00)	82.8 (82.0-84.0)	34.5 (26.6-42.2)	8.3 (7.8-9.0)	127.5 (89.0-173.0)		

*Less than 20% yield reduction &> 200 g yield under late sown conditions.

Germplasm distribution

A total of 5239 germplasm accessions were distributed from National Active Germplasm Site ICAR-IISR, Indore to various institutes across India, to facilitate soybean research.

Table 3.1.2 List of the institutes and number of germplasm distributed by ICAR-IISR, Indore

S.No	Name of Institute	No. of Germplasm Accessions Distributed
1	M/S Basant Agrotech India LTD.	53
2	College of Agriculture Sciences, UAS Dharwad	253
3	Mandsaur Agriculture University, Mandsaur	87
4	Govt. Agriculture College, Nandurbar	54
5	Lovely Professional University, Phagwara	70
6	Punjab Agricultural University, Ludhiana	1175
7	IARI, New Delhi	1142
8	G.B. Pant University of Agricultural Sciences, Pantnagar	1171
9	J.N.K.V.V, Jabalpur	134
10	Nagaland University, Medziphema	84
11	C.S.K.A.U. Palampur	96
12	KOTA Agricultural University, Rajasthan	79
13	YummanLeikai, Manipur	65
14	AICRP Centers at Adilabad, Bidar, Almora, Ranchi,Raipur, Imphal	406
15	Assam Agriculture University, Jorhat	255
16	Eagle Seeds, Indore	72
17	N.B.P.G.R., New Delhi	43
	Total	**5239**

Pre-breeding activities

Interspecific crosses were attempted *viz., Glycine max* × *Glycine soja* and *Glycine max*× *Glycine microphylla* for early maturity and rapid pod filling trait (Table 3.1.3 & 3.1.4)

Table 3.1.3 List of inter-specific crosses attempted

S.No	Cross	Interspecific Hybridization
1	JS 9560 × PI 549046	*Glycine max* × *Glycine soja*
2	JS 335 × PI 549046	*Glycine max* × *Glycine soja*
3	JS 20-34 × PI 549046	*Glycine max* × *Glycine soja*
4	AGS 25 × PI 549046	*Glycine max* × *Glycine soja*
5	AGS 25 × *Glycine microphylla*	*Glycine max* × *Glycine microphylla*
6	JS 97-52 × *Glycine microphylla*	*Glycine max* × *Glycine microphylla*

Table 3.1.4 List of interspecific backcrosses attempted

S No.	Back cross
1	JS 95-60 × (JS 95-60 × PI 549046)
2	JS 20-98 × (JS 20-98 × PI 549046)
3	JS 335 × (JS 335 × PI 549046)
4	JS 95-60 × (JS 95-60 × PI 593983)
5	JS 20-34 × (JS 20-34 × PI 593983)
6	EC 538828 × (EC 538828 × PI 593983)

Generation advancement and selection

Crosses JS 20-34 × PI 593893, JS 20-34 × PI 549046, JS 20-34 × PI 407170, JS 9560 × PI 593893, JS 9560 × PI 549046, JS 9560 × PI 407170, JS 335 × PI 407170, JS 335 × PI 549046, JS 20-98 × PI 549046, EC 538828 × PI 593893 and EC 538828 × PI 549046 were advanced from F_2 to F_3 by SPD method for earliness and rapid pod filling trait.

Pre-harvest sprouting tolerance

Standardized the protocol for the artificial screening of pre-harvest sprouting tolerance. Forty genotypes were evaluated for pre-harvest sprouting tolerance by standardizing through artificial screening method in 3 replications. Observations were recorded for 9 quantitative characters and one qualitative character. Quantitative characters include fresh pod weight, pod length, pod diameter, pod wall thickness, pod weight after 24 hrs, water imbibition by pods, total seed in pod, number of seed ruptured in pod, seeds germinated in pod (pre-harvest sprouting) and qualitative character was pubescence of the pod.

Genotypes BASARA, RSC 10-46, F4P21, F3P18, EC 34087, RSC 10-46, JS 20-69, JS 20-98, Kalitur, were found resistant as recorded zero reading and JS 20-34, JS 9560, JS 335, EC 457254 were found susceptible in artificial screening suggesting variation in genotypes for the trait which needed to be correlated in field conditions (Figure 3.1.1).

Figure 3.1.1 Genotypes exhibiting resistance and susceptiblity for pre-harvest sprouting tolerance by artificial screening method

3.2 Breeding for Early Maturity, High Yield, Wider Adaptability and Food-grade Characteristics

NRCS1.6/92 : Hybridization, selection and development of multi-parent populations for genetic improvement of yield potential in soybean

PI : Shivakumar M, Co-PIs : Giriraj Kumawat, Nataraj V, Rajkumar Ramteke, V. Rajesh, Lokesh K. Meena, and Ram Manohar Patel

Hybridizations and generation advancement

Fresh crosses were attempted by crossing JS 335 and YP 34 (a high yielding yellow mosaic disease resistant genotype), with PS 1611 having resistance for *Rhizoctonia* aerial blight (RAB). Further, germplasm accession EC 457464 was crossed with YP 34 and F_1 seeds were harvested. True F_1s derived from >50 diverse crosses have been selfed and F_2 seeds harvested. 497 F_2 individual plants were selected based on number of pods per plant from multi-parent crosses. A total of 110 F_4 individual plants were selected based on number of pods per plant and maturity duration (90-100 days). Thirty six row bulks derived from 10 different crosses were selected based on number of pods per plant and maturity duration (90-100 days). The multiparent advanced generation intercross population RILs (MAGIC-RILs) (N= 535) were advanced to F_9 generation.

Evaluation of advanced breeding lines

A total of 189 advanced breeding lines (F_6) consisting of early (up to 90 days), medium (91-100 days), late (>100 days) along with 6 check varieties (JS 20-34, NRC 130, NRC 142, JS 20-29, NRC 128 and JS 20-69) were grown in Randomized Complete Block Design (RCBD). The results revealed that five breeding lines viz., A-302 (2444 kg/ha), EC 457254 x JS 20-34-7 (2325 kg /ha), EC 457254 x JS 20-34-14 (2548 kg/ha), EC 457254 x JS 20-34-15 (2666 kg/ha), EC 457254 x JS 20-34-16 (2324 kg/ ha) yielded better than best check variety JS 20-34 (2070 kg/ ha) in early maturing group (up to 90 days). Similarly, 90-100 days maturity group six breeding lines viz.,A-162 (2731 kg/ha), A-184 (2622 kg/ ha), A-120 (2770 kg/ha) and A-31 (2666 kg/ ha) performed at par with best check variety NRC 142 (2716 kg ha) but matured 7 days earlier to NRC 142. In late maturing group few advanced breeding lines viz., A-83-1 (2903 kg/ ha), A- 221 (2904 kg / ha), NRC 128 x JS 95-60-146 (2918 kg/ ha), NRC 128 x JS 95-60-149 (2755 kg/ha), NRC 128 x JS 95-60-151 (2888 kg / ha) NRC 128 x JS 95-60-152 (2918 kg/ha) and NRC 128 x JS 95-60-154 (2962 kg/ha) out yielded the best check variety JS 20-69 (1866 kg/ha).

DBT : 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 : Shivakumar M, Co-PIs : Giriraj Kumawat, Sanjay Gupta and *V. Nataraj*

Marker assisted selection

Foreground selection was carried out using allele specific markers of photo-insensitivity (*e2*, *e3&e4*) in 53 BC_3F_1 generation derived from JS 97-52 × (JS 97-52 × 14-36A). A total of five plants were found to contain *e3&e4* alleles both and four plants contain *e2*. Further BC_4F_1 seeds were developed by backcrossing of these five plants with recurrent parent JS 97-52 and intercrossing was made among progenies carrying *e3, e4* and *e2*. Fresh F_1 crosses were made between JS 97-52 × EC 538828 for introgression of 100-seed weight and early maturity traits.

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

PI : Anita Rani, Co-PI : Vineet Kumar

Improved varieties & genotypes developed for food grade characters are given in Table 3.2.1

Table 3.2.1 Improved varieties and genotypes developed for food grade

Genotype	Targeted Trait	Status
NRC 152	Early maturing line free from KTI and Lipoxygenase 2	Released for cultivation in Central Zone by CVRC
NRC 181	Early maturing line free from KTI	Commercialized to private industry and promoted to AVT II in Central Zone
NRC 150	Early maturing line free from Lipoxygenase 2 and high oil content	Released for cultivation in Central Zone by CVRC
NRC 197	Early maturing KTI free	Promoted to AVT I in North Hill Zone
NRC 141	Early maturing and high oleic content	Entered into IVT 2022
NRC 261	Early maturing genotype free from KTI	Entered into IVT 2022

Figure 3.2.1 NRC 150 and NRC 152 - Released for cultivation in Central Zone by CVRC

BRNS : Development of high oleic acid mutants of *KTI* and *Lox2* free soybean using gamma and electron beam

PI : Vineet Kumar, Co-PIs : Anita Rani and J.G. Manjaya

During *Kharif* 2022, M_2 generation of NRC142 [from M_1 plants obtained after gamma irradiation(250Gy) and electron beam irradiation (250Gy)] were raised in the field and $M_{2:3}$ seeds were harvested. $M_{2:3}$ seeds from each M_2 plants tested for oleic acid content by gas chromatography. Hitherto, seeds from three M_2 plants were found to high in oleic acid content, which is about 1.6 fold higher than the untreated seeds of NRC142. Further, three early flowering (33 days) and early maturity (90 days) mutants were observed among M_2 population.

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

PI : Anita Rani, Co-PIs : Vineet Kumar. Milind B. Ratnaparkhe

CRIPSR/Cas9 constructs carrying single gRNAs to knock out off-flavor generating genes *Lox1, Lox2* and *Lox3* individually and in common developed at National Agri-Food Biotechnology Institute, Mohali were mobilized to *Agrobacterium tumefaciens* and *Agrobacterium rhizogenes* and provided to ICAR-IISR Indore. The agrobacterium strains were grown on LB media with 50mg/L kanamycin at 28° C for 2 days. Single colony from the plate was picked up and grown in Luria broth containing 50mg/L kanamycin and kept in incubator shaker at 28° C and 200 rpm until OD600 reached 0.6. The glycerol stocks were prepared for the cultures and maintained at -80° C for further use. The agrobacterium cultures harboring different CRISPR/Cas9 constructs were used in *in vitro* transformation of soybean cultivar JS 20-98. The agrobacterium-mediated genetic transformation was performed and the transformed explants were regenerated, and presently most of them are at the hardening stage (Figure 3.2.2).

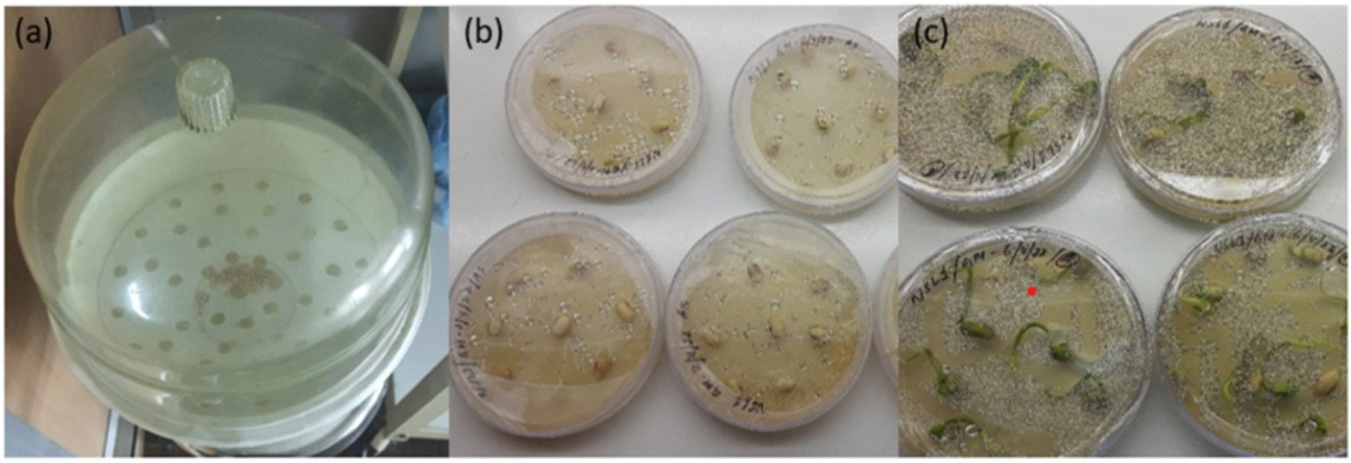


Figure 3.2.2 Steps in hairy root transformation.

NASF : Marker assisted stacking of Yellow Mosaic Disease resistance, null Kunitz Trypsin inhibitor, null lipoxygenase-2 genes, and broadening the genetic base of soybean

PI : Vineet Kumar, Co-PIs : Anita Rani, Sanjay Gupta and Rajesh Vangala

Crosses were effected between the double null soybean variety (*titilx2lx2*) NRC142 and the YMD resistant variety SL955. Based on the multi-location germplasm evaluation in 2021, diverse parents were identified. Hybridizations were conducted in the *Kharif* 2022. F_{1s} from 70 crosses have been planted for hybridity confirmation and generation advancement in *Rabi* 2022 in the glass house.For parental polymorphism survey of parental combinations NRC142 × SL955, PS1347 × NRC142, AVSB2012 × NRC142, and AVSB2013 × NRC142, so far 81 SSR markers were surveyed across 4 linkage groups (A1, A2, B1 and B2) and 32.10, 41.97, 54.32, and 62.96% polymorphism was observed, respectively.

ISSR3.18/21 : Biochemical and genetic characterization of black soybean varieties with enhanced nutritive value

PI : Manoj Kumar Srivastava, Co-PIs : Subhash Chandra, M. K. Kuchlan and Anuradha Bhartiya

Six black seeded soybean varieties along with one yellow seeded variety (VLS 89) were grown and yield and other morphological parameters were recorded (Figure 3.2.3). All the varieties except local bhat had white flowers. All the black soybean varieties took more days for maturity in comparison to yellow variety, VLS 1 (105 days). VRPH 1444 took maximum time to mature (122 days).

Total protein, soluble carbohydrate and fat was analyzed in three black soybean varieties (VLB 201, VLB 202 and VLS 65) and two yellow soybean varieties (VLS 89 and NRC 127). The black soybean variety, VLS 65 had maximum carbohydrate content and minimum protein and fat content. In contrast, the black soybean variety VLB 201 had maximum protein and fat content and minimum carbohydrate content(Table 3.2.2). Iron, Zinc and potassium content was maximum in NRC127 while Manganese content was maximum in VLB 202(Table 3.2.3).1,1-diphenyl-2-picrylhydrazyl (DPPH) reducing power was much higher in the seed coats of black soybean varieties as compared to yellow soybean varieties(Figure 3.2.4). All the photosynthetic pigments (Chl A, Chl B and carotenoids) were more in black soybean varieties than yellow soybean varieties (Table 3.2.4).

Figure 3.2.3 Field view of selected soybean varieties

Table 3.2.2 Major biomolecules in selected soybean varieties

Variety	Crude protein	Soluble sugar (%)	Total oil in seed (%)
VLB 201	36.7	22.5	20.9
VLB 202	34.9	25.0	20.0
VLS 65	33.2	27.5	18.1
VLS 89	33.3	22.5	18.4
NRC 127	34.1	24.6	21.0

Table 3.2.3 Major mineral content in selected soybean varieties

Variety	Potassium (%)	Iron (ppm)	Manganese (ppm)	Zinc (ppm)
VLB 201	0.64	118	21.8	30.4
VLB 202	0.74	84	30.0	29.7
VLS 65	0.73	83	22.6	29.4
VLS 89	0.94	86	20.4	25.0
NRC 127	1.04	170	23.4	31.7

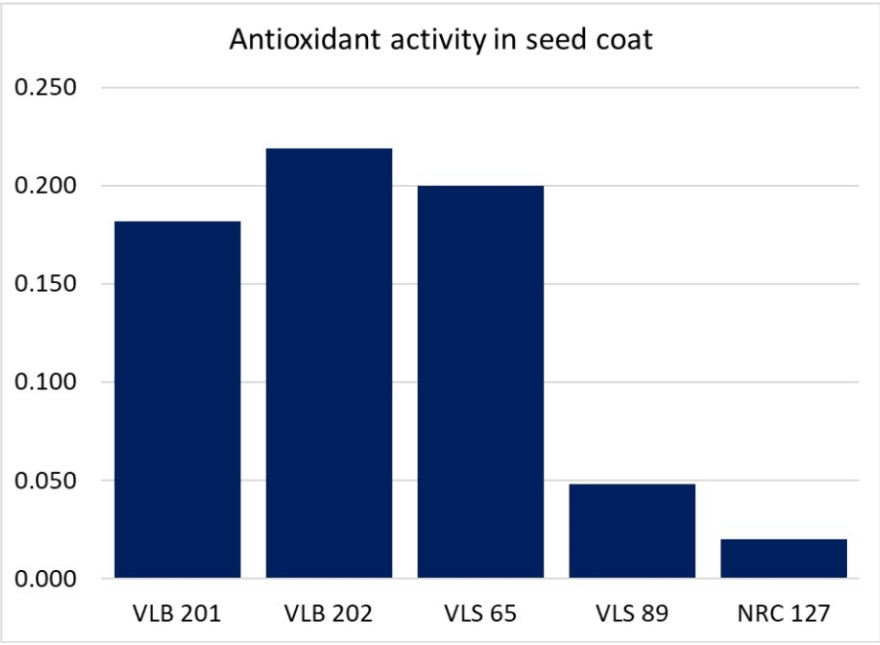


Figure 3.2.4 DPPH reducing activity in seed coat of selected soybean varieties

Table 3.2.4 Photosynthetic pigments in leaves of selected soybean varieties

Variety	Chl A	Chl B	Total Chl	Chl A/ Chl B	Carotenoids
VLB 201	23.26	6.50	29.76	3.58	12.38
VLB 202	21.29	5.30	26.59	4.02	10.29
VLS 65	21.71	6.18	27.89	3.51	9.89
VLS 89	22.54	6.11	28.65	3.69	11.28
JS 2029	20.65	5.01	25.66	4.12	9.80
JS 2098	17.36	4.31	21.67	4.03	8.48

3.3 Breeding for Abiotic Stress Tolerance

DSR5.6a/08 : Breeding for drought tolerant varieties in soybean

PI : Gyanesh Kumar Satpute, Co-PIs : Sanjay Gupta, Milind Ratnaparkhe, Giriraj Kumawat, Subhash Chandra, Prince Choyal,Rakesh Kumar Verma and Laxman Singh Rajput

Hybridization

To achieve introgression of drought tolerance related traits, five multi-parent cross F_1s were achieved (Table 3.3.1).

Table 3.3.1 Multi-parent crosses attempted for drought tolerance

S.	F_1 Crosses	No. of Seeds
1	(38-11-265 x JS 95-60) x (JS71-05 x NRC 37) / (AMS MB 5-18 x JS 95-60) x (PI 159923 x JS71-05)	158
2	(AMS MB 5-18 x JS 95-60) x (PI 159923 x JS 95-60) / (JS71-05 x NRC 37) x TGX 328-049	45
3	(AMS MB 5-18 x JS 95-60) x (PI 159923 x JS 95-60) / (AMS MB 5-18 x JS 95-60) x (PI 159923 x JS71-05)	19
4	(AMS MB 5-18 x JS 95-60) x (PI 159923 x JS 95-60) / (PI 159923 x NRC 37) x (PI 159923 x JS 95-60)	9
5	(JS71-05xNRC 37) x TGX 328-049 / (PI 159923xNRC 37) x (PI 159923x JS 95-60)	2

NRC 136 released in Madhya Pradesh state

NRC 136, a variety recently released for Eastern Zone States and possessing drought tolerance traits, has also been identified by Madhya Pradesh state variety release committee and notified in the gazgette during the CVRC meeting in 2022 for release in Madhya Pradesh for its area expansion.

Figure 3.3.1 NRC 136 : Released for Madhya Pradesh State

Promising entries in AICRP trials and State-level multilocation testing in Maharashtra and Chhattisgarh:

NRC 189 (Davis/ Kaeri 651-6) – a drought and water-logging tolerant entry in AVT I CZ. NRC 190 (JS 97-52/ JS 355) – a drought tolerant entry in AVT I CZ. NRC 256 (JS 95-60/ Young) – a drought and water-logging tolerant entry in IVT. NRC 257 (JS 93-05/ JS 97-52) – a drought and water-logging tolerant entry in IVT. NRC 136 and NRC 137 (JS 97-52/ NRC 37) – drought tolerant entries in 2nd year of testing in Maharashtra (NRC 136 & NRC 137) and Chhatisgarh (NRC 137) State multi-location testing

NRC 190: Drought tolerant entry AVT I CZ

NRC 189: Drought and water-logging tolerant entry AVT I CZ

NRC 256: Drought and water-logging tolerant entry IVT

NRC 257: Drought and water-logging tolerant entry IVT

Figure 3.3.2 Promising entries viz. NRC 190, NRC 189, NRC 256 and NRC 257 in AICRPS trials

First tier screening for delayed leaf senescence

Two multi-parent advanced generation intercross populations *viz*. G2-3 (F_5: 194 lines), derived from [(YoungxJS335)x(JS 97-52xJS 90-41)]/ [(PK 472xJS 335)x(EC 602288xEC 390977)], and G6-2 (F_5: 116 lines), derived from [(C-2797xJS 71-05)x(PK 472xJS 335)]/ [(YoungxJS 335)x(EC 602288xJS 90-41)], were evaluated under controlled irrigation field conditions during off season along with 6 drought-tolerant and 2 sensitive check varieties. Fifteen lines *i.e.* A(E)-17, A(E)-2, A(E)-26, A(E)-30, A(E)-34, A(E)-44, A(M/L)-I-14, A(M/L)-I-29, A(M/L)-II-15, A(M/L)-II-16, A(M/L)-II-23, A(M/L)-II-45, A(M/L)-II-62, A(M/L)-II-92 and B(M/L)-II-50 were identified with high score (5) of delayed leaf senescence trait.

A RIL population (F_5: 282 lines) derived from a biparental cross (EC 602288/ NRC 2) was evaluated under similar controlled irrigation field condition along with 6 tolerant and 2 sensitive check varieties (Table 3.3.2). Days to pod initiation and SPAD chlorophyll meter reading (SCMR) were identified as diverse traits for the population. Transgressive segregation in 2 lines (115-191, 115-295) for delayed leaf senescence and in 5 lines (115-120, 115-143, 115-232, 115-245, 115-248) for canopy temperature depression was identified.

Table 3.3.2 Descriptive statistics of drought related traits in a RILs 115 population

Variability Parameters	Phenological traits Days to 50% Flowering	Days to Pod Initiation	Drought tolerance traits Delayed Leaf Senescence	SPAD Chlorophyll Meter Reading
Mean±SD	56±4.3	78±7.2	3±0.5	35.3±4.6
Range	35-65	50-97	1-5	16.2-45.4
CV(%)	7.7	9.3	17.3	13.0

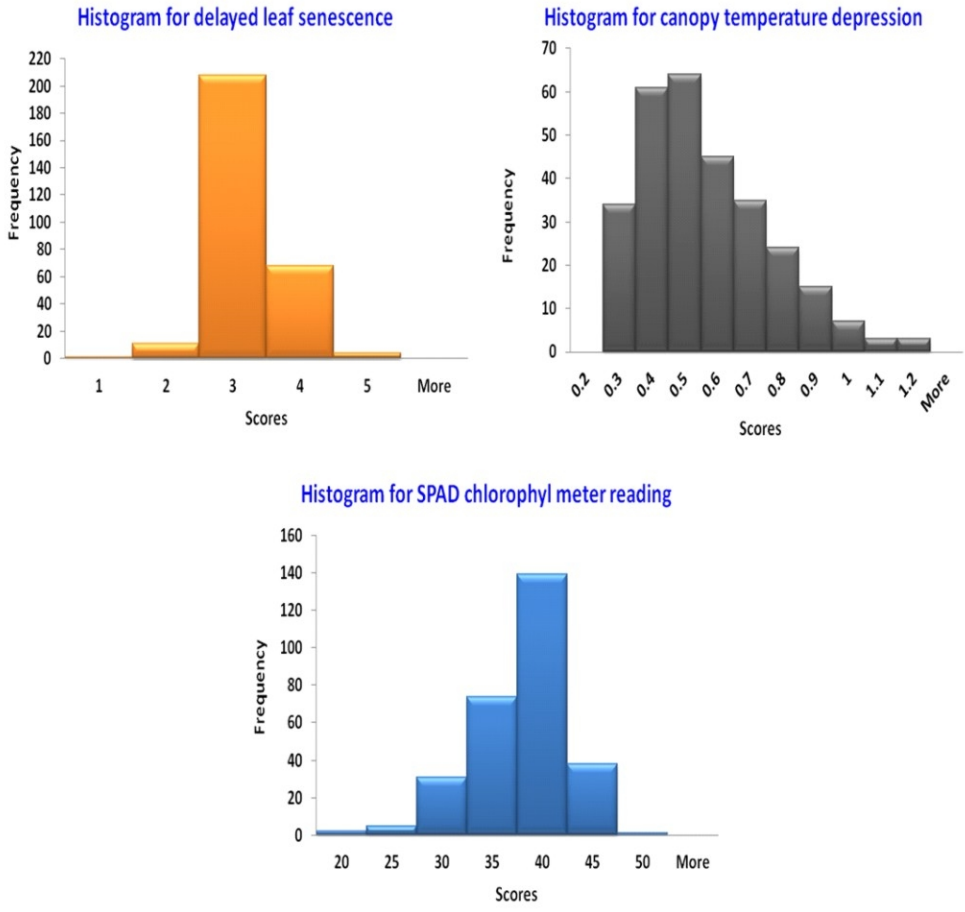


Figure 3.3.3 Response of RIL population (F_5:282 Lines) to drought related traits

Second tier screening for desiccation tolerance

In an advanced breeding population (F_5: 79 lines) derived from a biparental cross (PK 472 / AGS 25), selected 10 lines (116-114, 116-112, 116-125, 116-106, 116-25, 116-18, 116-135, 116-44, 116-136, 116-110) showed increased seed size (48.2 – 74.6%) under desiccation stress (KI 0.2%) condition at seed fill stage.

In an advanced RILs 107 (F_{12}: 162 lines), derived from a biparental cross (JS 97-52 / NRC 37), a range of variability for stem reserve mobilization (2 - 99%), average root angle (15-60°), root length (4-176cm) and root biomass (0.052-9.395gm) traits was recorded in the population (Figure 3.3.4).

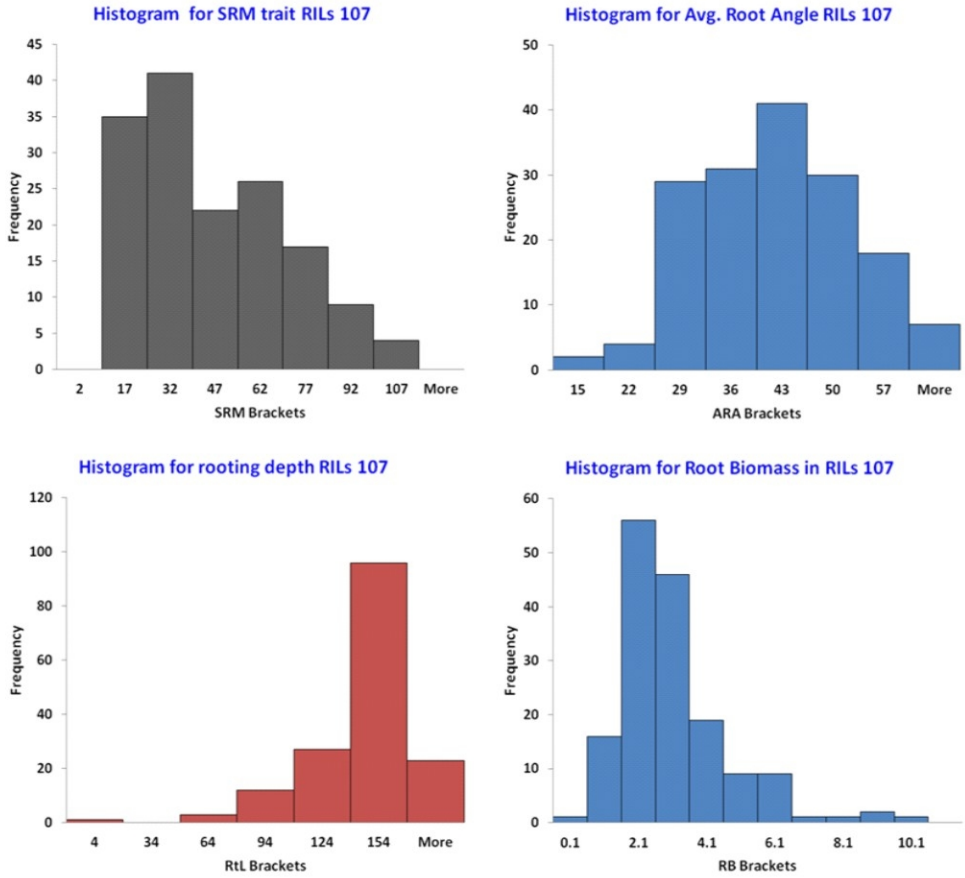


Figure 3.3.4 Histogram for Stem Reserve Mobilization (SRM), Avg. root angle (ARA), root length (RtL) and root biomass (RB) traits in RILs107 (F_{12}: 152 lines derived from (JS 97-52/ NRC 37)

Six multi-parent advanced generation intercross populations (F_4: 281 lines) along with tolerant (NRC 137, JS 335, NRC 136, JS 20-69 and JS 97-52) and sensitive (NRC 2 and NRC 37) checks were evaluated under chemical desiccation stress (KI 0.02%) condition. Tolerant checks were identified with high SRM trait value (21-55%). Newly released tolerant check NRC 136 showed 30% SRM. Ninety-six lines from 4 populations showed desiccation stress tolerance with high SRM values (30-98%) (Table 3.3.3).

Table 3.3.3 Selections fordesiccation tolerance in multi-parent inter-cross populations (F_4)

S.No.	Populations derived from crosses	No. of Lines
1	(PK 472xJS 335)x(EC 602288 xEC 390977)/ (YoungxJS 335)x(JS 97-52xJS 90-41)	61
2	(JS 335xYoung)x(EC 602288 x JS 90-41)/ (C-2797xJS 71-05)x(PK 472 x JS 335)	12
3	(YoungxJS 335)x(EC 602288xJS 90-41)/ (C-2797xJS 71-05)x(PK 472xJS 335)	22
4	(PK 472xJS 335)x(EC 602288xEC 390977)/ (YoungxJS 335)x(EC 602288 xJS 90-41)	1
	Total	**96**

Third tier rainout-shelter evaluation for drought resistance index

A panel of 32 advanced lines, including 23 advance lines derived from two multi-parent advanced generation inter-cross populations, 5 advance breeding lines and 4 checks NRC 136, EC 538828, NRC 37 and JS 20-34, were evaluated in rainout-shelter facility, for seed yield and associated drought tolerance trait *i. e.* drought resistance index (DRI). Tolerant check NRC 136 responded well (DRI=1.04) to the rainout-shelter controlled soil-moisture stress (9.8%) condition. Six lines *viz.* A(M/L)-II-92, A(E)-30, B(E)-21, A(M/L)-II-16, 21(Spd) sel105-13 and 49GH130/1-3 were found high yielder in the third-tier evaluation under drought stress condition (Table 3.3.4). These elite lines will be promoted to station yield evaluation trial.

Table 3.3.4 Elite lines with high drought resistance index under controlled soil moisture stress

S.No.	Entry	DRI	Seed Yield (kg.ha^{-1}) (ROS stress)	(non-stress control field)
1	A(M/L)-II-92	1.13	2370	2387
2	21(Spd) sel 105-13	1.06	1852	2712
3	A(E) -30	1.09	1801	1907
4	49 GH 130/1-3	1.15	1236	2608
5	B(E)-21	1.07	1111	1211
6	A(M/L)-II-16	1.17	1002	1453
7	B(E)-18	1.08	883	905
8	B(M/L)-II-50	1.08	542	235
9	NRC 136	1.04	422	755
Mean			1082	1320
SE(m)			72.7	116.4
CV			11.6	15.3

Exploratory analysis of data generated from this panel of 32 advance lines revealed a strong and inverse relationship of canopy temperature (CT^0) with SPAD Chlorophyll meter reading (SCMR) (r= -0.637**) and relatively strong and inverse relationship with specific leaf weight (SLW mg.cm^2) (r= -379*). The result further confirms a strong and positive relationship of SLW with SCMR (r= 518**) (Figure 3.3.5).

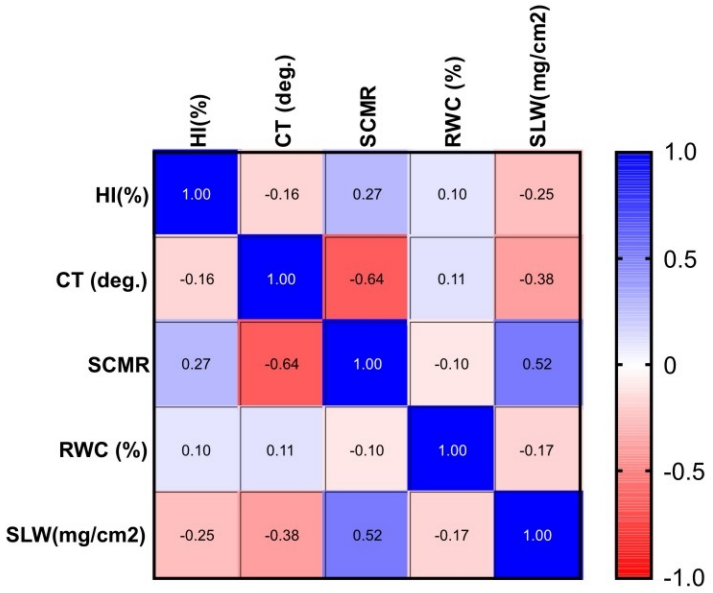


Figure 3.3.5 Heat map of correlation matrix for drought related traits from a panel of 32 advance lines

Seven water-logging tolerant elite lines were evaluated under rainout-shelter controlled drought stress condition. Three lines *viz.* WLP-16, WLP-18 and WLP-20 were found with high drought tolerance index (Table3.3.5).

Table 3.3.5 Elite water-logging tolerant entries also with high drought resistance index under controlled soil moisture stress

S.No.	Entry	DRI	Seed Yield (kg.ha^{-1}) (ROS stress)	(non-stress control field)
2	WLP-16	1.40	437	1013
4	WLP-18	1.07	330	920
6	WLP-20	1.49	289	713
8	NRC 136	1.04	422	755
Mean			466	945
SE(m)			68.4	109.4
CV			20.8	20.1

NASF : Genome wide association studies drought tolerance, water logging tolerance, higher yield and root trait architecture

PI : Milind B.Ratnapharke, Co-PIs : Giriraj Kumawat, Gyanesh Kumar Satpute, Sanjay Gupta, Subhash Chandra

Genomic studies were conducted for the identification of genes and SNPs associated with drought tolerance, water logging tolerance, higher yield and root trait architecture in soybean. New genes associated with drought tolerance, water logging tolerance, higher yield and root trait architecture were identified and characterized. New SNP markers and candidate genes were identified for drought tolerance, water logging tolerance, higher yield and root trait architecture.

GWAS panel consisting around 300 diverse soybean accessions were genotyped with the help of GBS platform. Total of 570139 SNPs distributed on all over 20 chromosomes were identified. Imputations were performed to fill missing data and finally a total of 66300 SNPdistributed all over 20 chromosomes were used for association analysis. GWAS analysis was done for biomass (DBM) and grain yield (DGY) data of three consecutive years (2019-2021), under drought stress condition in 269 soybean genotypes. GWAS analysis revealed a few significant and closely located SNPs for consecutive years (Figure 3.3.6). Flanking regions of significant SNPs were searched for candidate genes. Some candidate genes related to Myb family, cell signalling gene (GPCR), salicylic acid synthesis, oxidative stress, auxin and ABA synthesis pathway were identified in genomic region of above significant SNPs positions. Further few tolerant and susceptible genotypes were also selected for Real-time based expression analysis under drought stress condition (Figure 3.3.7). GWAS analysis was also done for root system architecture related traits such as root length, root diameter,root volume and root dry weight, phenotyped for 3 different years (2019-2021). GWAS analysis revealed few most significant and closely located SNPs in consecutive years. Some candidate genes related to cell signalling gene, auxin transport, Phosphate starvation, oxidative stress and ABA synthesis pathway were also identified in nearby genomic region of these significant SNPs position.

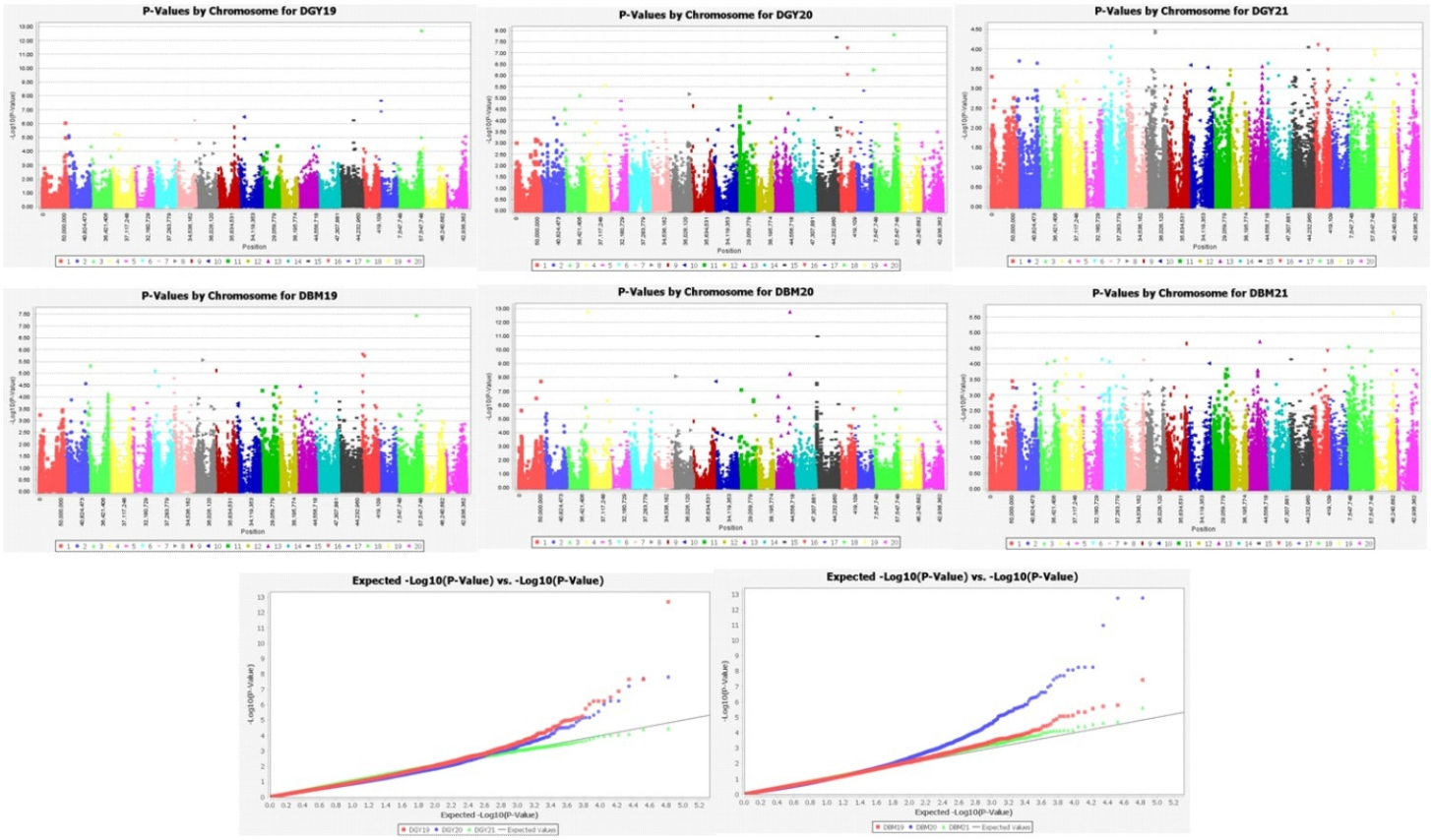


Figure 3.3.6 Manhattan and Q-Q Plots for significant SNPs associated with biomass and grain yield under drought stress condition. DBM; Biomass under drought derived from 2019, 2020 and 2021, DGY; Grain Yield under drought derived from 2019, 2020 and 2021.

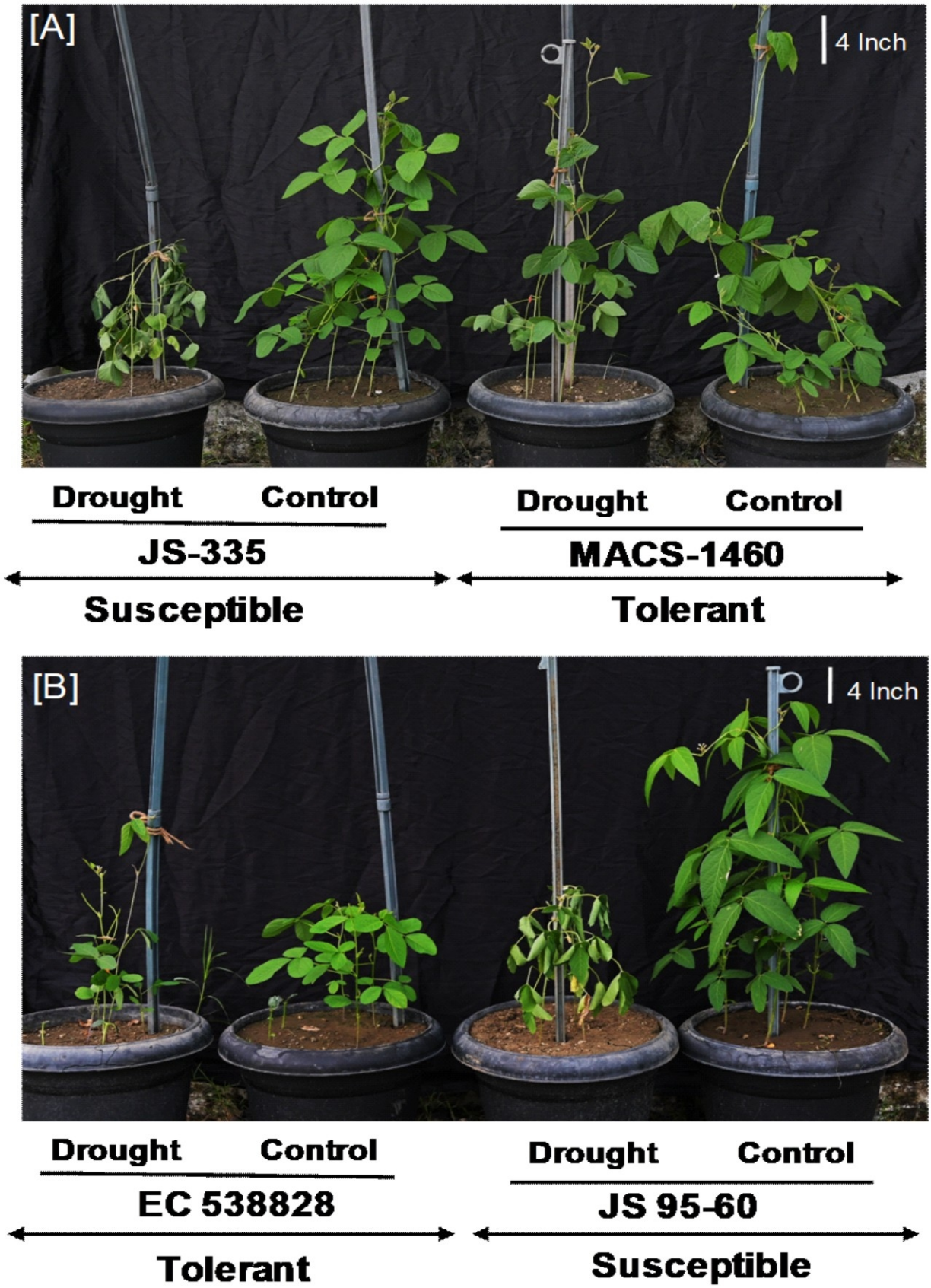


Figure 3.3.7 Phenotyping of tolerant and susceptible genotype under drought stress condition

DSR5.6b/18 : Soybean breeding for water logging tolerance

PI : Subhash Chandra, Co-PIs : Gyanesh K.Satpute, Vangala Rajesh, Sanjay Gupta, Giriraj Kumawat, Milind B. Ratnaparkhe

Hybridization programme

A total of 20 new crosses including 8 ways, 4 ways and 2 ways were attempted to develop elite breeding lines with the objectives of recombining water logging tolerance, drought tolerance and high temperature tolerance with earliness, high yielding traits and other biotic stress tolerance traits. All crosses were attempted in hybridization structure during *kharif* season 2022 (Table 3.3.6).

Table 3.3.6 Details of crossing programme during *kharif* 2022

8 way crosses
{(JS 20-34 X TGX 328 -049) X (JS 20-69 X EC 396065)} X {(EC 602288 X NRC 158) X (JS 20-34 X EC 602288)}
{(JS 20-98 x MACS 250 X JS 20-69 X EC 396065)} X {(EC 602288 XNRC 158) X (JS 20-34 X EC 602288)}
{(EC 602288 X NRC 158) X (JS 20-34 X EC 602288)} X {(JS 20-69 X J 732) X (JS 20-34 X TGX 328 -049)}
{(JS 20-34 X TGX 328 -049) X (JS 20-69 X EC 396065)} X {(JS 20-34 X EC 602288) X (JS 20-69 X J 732)}
{(JS 20-34 X TGX 328 -049) X (JS 20-69 X EC 396065)} X {(JS 20-98 x MACS 250 X JS 20-69 X EC 396065)}
4 way crosses
{RVSM 2011-35 X RSC 10-46} X {JS 20-76 X EC 291399}
{MACS 1460 X RSC 10-46} X {JS 20-69 X VLS 63}
{JS 20-69 X RSC 10-46} X {EC 457464 X EC 291399}
{NRC 181 X NRC 128} X {JS 20-69 X RSC 10-46}
{EC 457464 X JS 95-52} X {NRC 181 X NRC 128}
{JS 20-73 X JS 95-52} X {NRC 181 X NRC 128}
{EC 602288 X NRC 128} X {RVSM 2011-35 X RSC 10-46}
{JS 20-69 X VLS 63} X {EC 602288 X NRC 128}
2 way crosses
NRC 256 X NRC 192
PS 1569 X NRC 256
JS 20-98 X VLS 63
NRC 149 X NRC 256
NRC 192 X YP 34
NRC 192 X JS 22-18
JS 20-69 X NRC 256

Generation advancement, yield evaluation and selection

Thirty two elite breeding lines derived from numerous diverse crosses involving abiotic stress tolerant parents i.e. JS 97-52 & JS 20-38 and high yielding lines were evaluated for yield per plot in augmented design. In comparison with adaptive checks for water logging tolerance and high yielding traits *viz*., JS 20-69, JS 97-52, RVSM 2011-35 and NRC 138, ten prominent breeding lines namely A 20-17, WLS X7, C4-3-4-2, C4-3-3, B1, WLS C6, WLS B1, WLS B8, A8 and WLS C10 were found to be out yield best check JS 20-69. Thirty prominent breeding lines (F_6) derived from three different crosses i.e. JS 97-52 × NRC 130, JS 97-52 × JS 21-08, JS 97-52 × EC 546882 and 45 early generation prominent segregates (F_4) derived from six crosses i.e. JS 20-69 × NRC 146, NRC 146 × AMS MB 5-18, NRC 128 × MACS 1520, Hardee × RSC 10-52, Hardee × JS 20-69, JS 20-98 × AMS MB 5-18 were advanced and evaluated for yield and better agro-morphological traits, subsequently promising breeding lines were identified. A total 72 breeding lines derived from 8 different crosses were advanced from F_3 to F_4 generation and around 90 single plant selections were made in F_2 populations developed from different 16 crosses involving abiotic stress tolerant parents.

Evaluation of soybean accessions for water logging tolerance at reproductive stage under water logged fields

A set of 35 soybean genotypes consist of 25 elite breeding lines, 6 soybean germplasms and 4 checks was evaluated for water logging tolerance at reproductive stage in three replicates under flooded field during *Kharif*2022. Another set of 45 soybean genotypes including advance breeding lines, germplasm lines and checks was also evaluated for water logging tolerance at reproductive stage in augmented design in flooded fields. Water stagnation conditions were provided at R_1 stage for 15 days and normal moisture conditions were maintained in counter control part (Figure 3.3.8). Foliar damage score and yield attributes were recorded from stressed and control genotypes including checks. In RBD trail, elite breeding lines *viz*., NRC 192, NRC 256, NRC 257, NRC 189, C 20-10-10, C 20-11-2, YP 32, GKS 70-3 and germplasm lines *viz.,* EC 528622, EC 528623, JS 20-76, TGX 317-37 E and EC 602288 were identified as water logging tolerant genotypes which performed better than tolerant check JS 97-52 at reproductive stages (Table3.3.7). Whereas in augmented trial, breeding lines derived from water logging parent JS 20-38 *viz.,* C4-3-4-2, C4-3-1, C4-3-3, WLS B1, WLS A8, WLS B8, B1, B5 and germplasm lines viz., EC 457464, EC 250591, EC 550828, EC 456620, PI 283327 and CAT 1341 were found to be promising for water logging tolerance traits in comparison to tolerant check JS 97-52 (Table3.3.8).

Figure 3.3.8 Promising soybean breeding lines after water logging stress in field conditions

Table 3.3.7 Performance of promising lines evaluated under RBD trial

Name	WLTI	FDS
NRC 256 (GKS 21-4)	1.64	2.00
NRC 257 (GKS 21-7)	1.58	1.67
EC 528622	1.51	1.67
EC 528623	1.51	2.00
JS 20-76	1.44	5.00
C 20-10-10	1.38	3.67
C 20-11-2	1.36	3.67
NRC 192	1.23	3.67
YP 32	1.19	5.00
GKS 70-03	1.19	3.67
EC 602288	1.15	4.67
NRC 189	1.13	5.33
TGX 317-37 E	1.12	2.67
JS 97-52 (Tolerant Check)	0.99	5.33

Table 3.3.8 Performance of promising breeding lines and germplasm lines under augmented trial

Genotype	FDS	WLTI
WLS A8	3	1.55
WLS B1	4	1.25
WLS B8	5	1.03
C4-3-4-2	2	1.56
C4-3-1	3	1.97
C4-3-3	5	1.27
B1	4	1.65
B5	3	2.03
EC 550828	2	1.53
EC 456620	1	2.85
PI 283327	3	1.37
CAT 1341	3	1.05
EC 250591	2	1.42
EC 457464	3	1.88
JS 97-52 (Tolerant Check)	5.67	0.77

Inheritance of water logging tolerance trait

Foliar damage score (FDS) is the important parameter, used to measure the status of water logging tolerance in soybean genotypes especially in the situations where flooding/water logging stress occurs in vegetative stages. The F_2 population was developed through hybridization of water logging tolerant parent JS 20-76 (FDS=2.1) with water logging susceptible parent EC 291399 (FDS=8.5). The water logging conditions were provided in Vegetative 2-Vegetative 3 (V_2-V_3) stages of plant for 10 days by saturating the soil with water up to 10 cm above the soil in plastic pots under water logging structures. The segregating population (N=254) along with parents was phenotyped for foliar damage score on the scale of 1-9, where 1 and 9 indicated less than 10 and more than 85% of foliar damage, respectively. During assessment with chi-square ($\chi 2$) test, segregation pattern in F_2 could not fit perfectly in any ratios of one, two or three gene models; However, frequency distribution (Figure3.3.9) showed bi-model distribution suggesting involvement of few major genes in governance of water logging tolerance in this population.

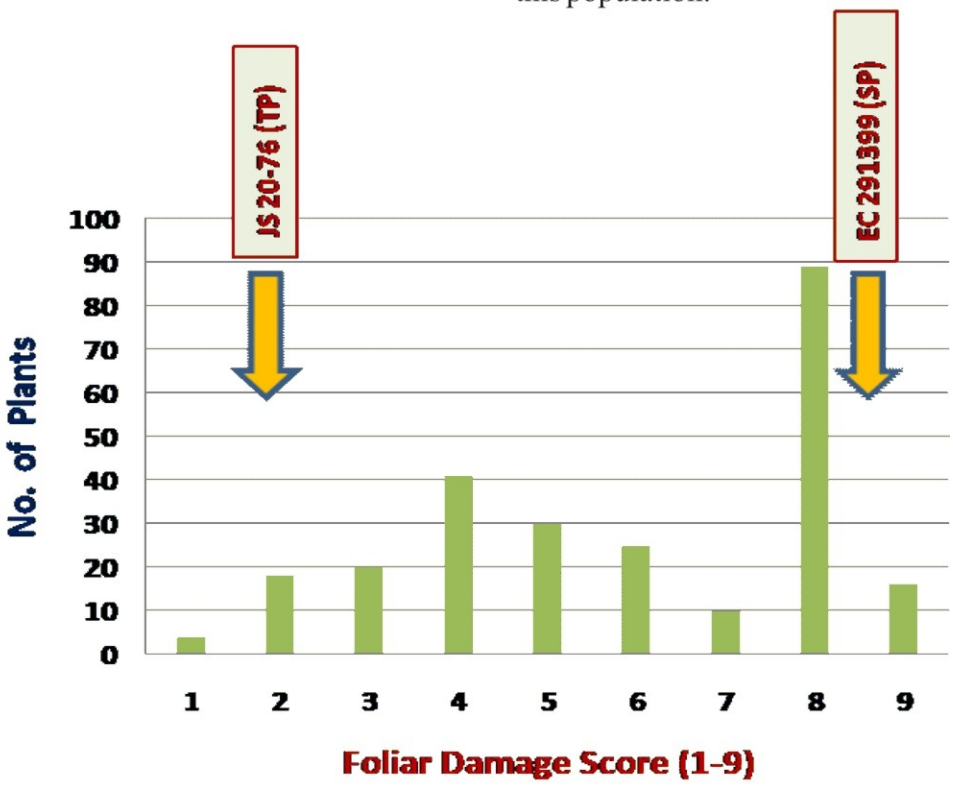


Figure 3.3.9 Frequency distributions for foliar damage score in F_2 population [JS 20-76 (P_1) × EC 291399 (P_2)]

QTL identification for water logging tolerance traits

A RIL population (JS 97-52 × JS 90-41) was phenotyped for water logging tolerance traits i.e Water logging tolerance yield index (2018 and 2019 at reproductive stages in field); foliar damage score, plant mortality rate, stem elongation rate trait (2020 and 2021 at vegetative stage in pots) (Figure 3.3.10). WLYI and FDS are the main traits to identify QTLs associated to WLT. In this study, 72 SSRs out of 648 SSR markers (11.2 %) found to be polymorphic between the parents (JS 97-52 vs. JS 90-41). In this experiment, till now with available genotypic data, four QTLs i.e. *qWLYI9, qFDS20, qSER20, qFDS21* were identified for the traits i.e. water logging tolerance yield index (2019), foliar damage score (2020), stem elongation rate (2020), foliar damage score (2021), respectively (Figure 3.3.11).

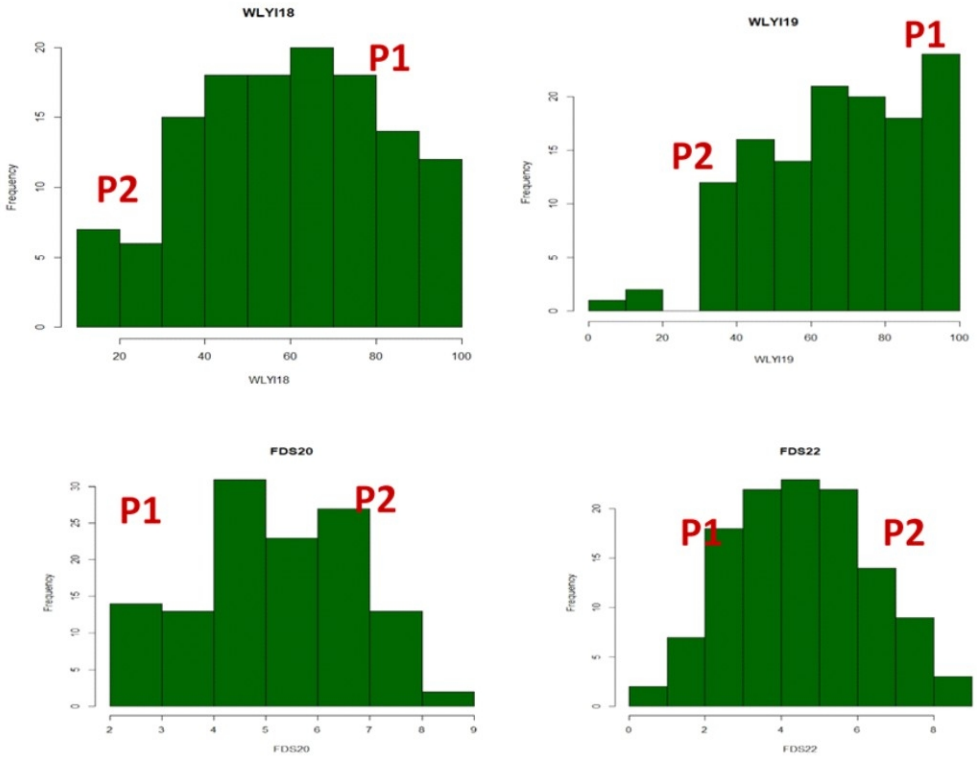


Figure 3.3.10 Variability in RIL population for water logging tolerance traits (WLY = Water logging tolerance yield index; FDS =Foliar damage score in respective years (2018, 2019, 2020, 2021-22)

Figure 3.3.11 Contrasting RILs for foliar damage score (FDS) during phenotyping of water-logging tolerance

GWAS for water logging tolerant traits

A GWAS analysis was performed for water logging tolerance traits i.e. plant survival rate, foliar damage score, stem elongation rate and adventitious root rating in a panel of 265 soybean germplasm accessions with 66719 SNPs. Genome wide association analysis using Mixed linear model (MLM) in TUSSEL 5.0 Software identified 29 significant SNPs for four water logging traits. A total of 20 GWAS loci were identified for plant survival rate for all three years, out of which 10 SNPs (Chr 6, Chr 10 &Chr 13), 6 SNPs (Chr 6, Chr 13 &Chr 15) and 4 SNPs (Chr 6, Chr 10, Chr 13 &Chr14) were significant for *Kharif* 2019, *Kharif* 2020 and *Kharif* 2021 respectively. Among these SNPs, three major SNPs i.e. Gm_13_33563377, Gm_13_33969566 and Gm_15_48546225 were found to be consistently coupled with plant survival rate across two environments. Four SNPs were found to be associated with foliar damage score from chromosome 2, 6 and 16. Another four SNPs were identified from chromosome 7 and 9 which were linked to adventitious root rating and only one SNP (Chr 17) found to be linked with stem elongation rate. In this study, flanking regions of significant SNPs were searched for candidate genes. Some candidate genes related to oxidative stress, auxin and ABA synthesis pathway were identified in the genomic regions of significant SNPs positions.

Phenotyping of RIL population for delayed leaf senescence score

Delayed leaf senescence score is a good indicator for drought tolerance as well as high temperature tolerance in soybean. During summer 2022, a RIL population consisting 112 lines (F_{10}; JS 97-52 X JS 90-41) was evaluated for delayed leaf senescence score (susceptible 1 to tolerant 5) and population showed good variability for the trait (Figure 3.3.12). Some positive transgressive RILs *viz*., 104-3, 104-77, 104-100 and 104-118 found to be better for DLS score during summer 2022 and these 4 elite lines also showed drought tolerance in terms of stem reserve mobilization trait during *kharif* 2020 and *kharif* 2021.

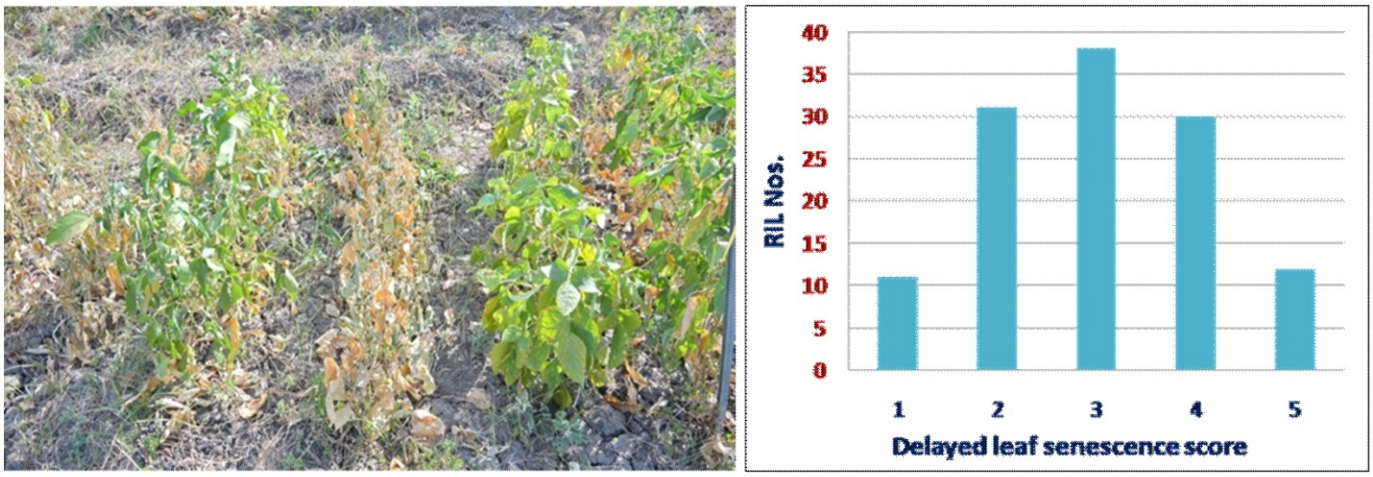


Figure 3.3.12 Variability for delayed leaf senescence in RIL population (JS 97-52 X JS 90-41)

Evaluation of soybean genotypes for high temperature tolerance

During trials conducted in *Kharif* 2019 under playhouses and summer 2020 in ambient hot weather environments for high temperature tolerance, around 20 soybean genotypes which performed better in both seasons, were evaluated in greenhouses in 2021. Later on same set was again evaluated in hot weather conditions of summer 2022 where genotypes were evaluated for morpho-physiological traits i.e. specific leaf weight (SLW), SCMR (chlorophyll content), canopy temperature and delayed leaf senescence score in stress conditions. On the basis of recorded traits, genotypes i.e. JS 75-46, TGX 780-5A, TGX 824-35E, EC 333876 and EC 291399 were found to be better in comparison to tolerant check EC 538828 and JS 97-52.

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

PI : Giriraj Kumawat, Co-PIs : Milind B. Ratnaparkhe, Gyanesh K. Satpute, Subhash Chandra and Prince Choyal

Phenotyping of germplasm for root traits at vegetative stage

A germplasm set of 203 accessions was phenotyped for various root traits using hydroponic culture. Primary root length (PRL), total root length (TRL), root diameter (RDM), surface area (SA), root volume (RV) and root tips, were recorded after two-weeks growth of plant (Table 3.3.9, Figure 3.3.13). PRL, TRL and RV was highest in accession GW76, whereas NRC2 showed lowest value for these traits.

Table 3.3.9 Descriptive statistics of various root traits in 203 germplasm accessions

	PRL (cm)	TRL (cm)	RDM (mm)	SA (cm2)	RV(cm3)
Minimum	27	317.9	0.463	50.9	0.652
Maximum	60.8	1059.8	0.955	214.9	3.471
Mean	44.37	671.7	0.629	131.1	2.06
Standard Deviation	6.84	138.8	0.083	25.1	0.498
CV(%)	15.42	20.66	13.20	19.15	24.17

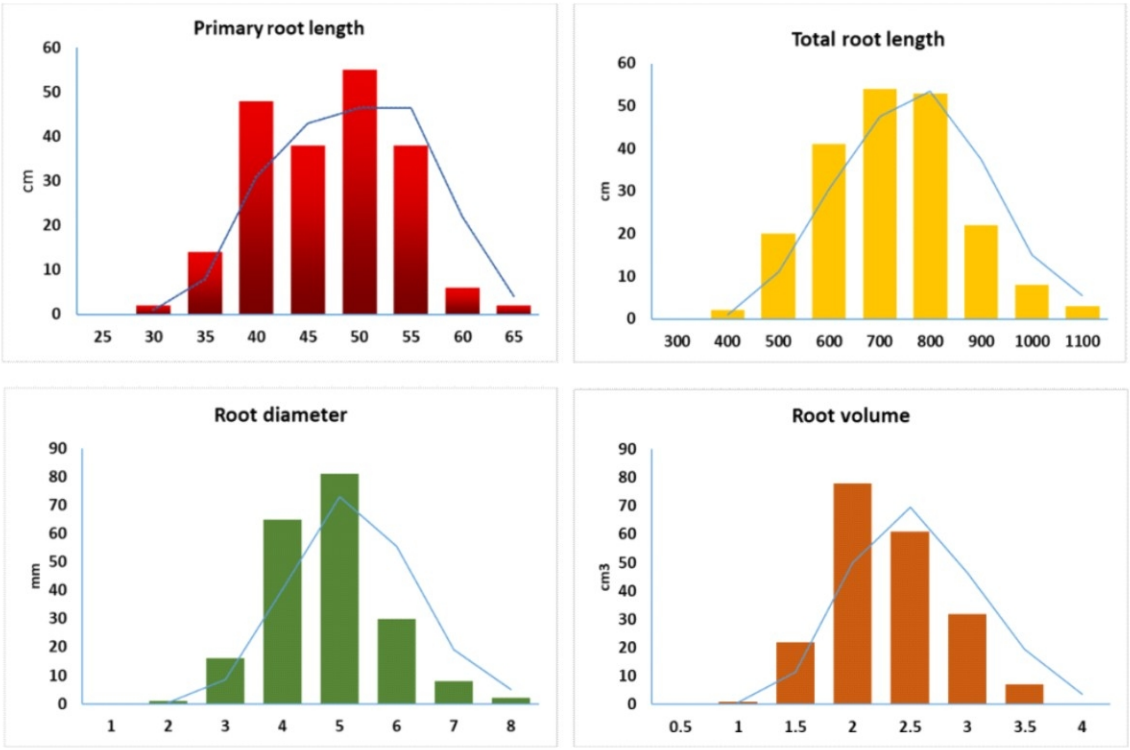


Figure 3.3.13 Frequency distribution of root traits among 203 germplasm accessions at two-week stage

Top five genotypes showing highest TRL and five genotypes showing lowest TRL were again phenotyped in soil medium using PVC pipes (Figure 3.3.14). Observations on PRL, TRL, RDM, SA, RV and root tips, were recorded from roots harvested at two-weeks growth of plants and analyzed using WinRHIZO software. Average of TRL phenotype in soil culture and hydroponic culture was used to identify contrasting genotypes (Table 3.3.10).

Table 3.3.10 TRL in soil culture (pipe) and hydroponic culture

Accession Name	TRL-Pipe (cm)	TRL-Hydroponics (cm)	Average (cm)	Rank
Gw19	1696.7	1003.3	1350	1
GW40	1616.8	1010.8	1313.8	2
GW76	1569.2	1059.8	1314.5	3
GW271	1284.7	993.7	1139.2	4
GW213	1731.5	410.4	1070.95	5
GW60	1059.1	1003.2	1031.15	6
GW186	1623.3	410.7	1017	7
GW116	1588	379.9	983.95	8
GW95	1438.2	400.9	919.55	9
NRC2	1081.2	317.9	699.55	10

Figure 3.3.14 Root trait phenotyping; A. Hydroponic culture, B. Soil culture in pipes

Genome wide association study for root traits at vegetative stage

The 203 accessions were genotyped using genotyping by sequencing and SNP data obtained were used for association analysis of root traits. A total of 65196 SNPs were used for association analysis of six root traits using mixed linear model. Two significant loci were identified for TRL on Chr01 and Chr11, two for surface area on Chr06 and Chr17, four for root diameter, two for root volume and five for root tips (Figure 3.3.15)

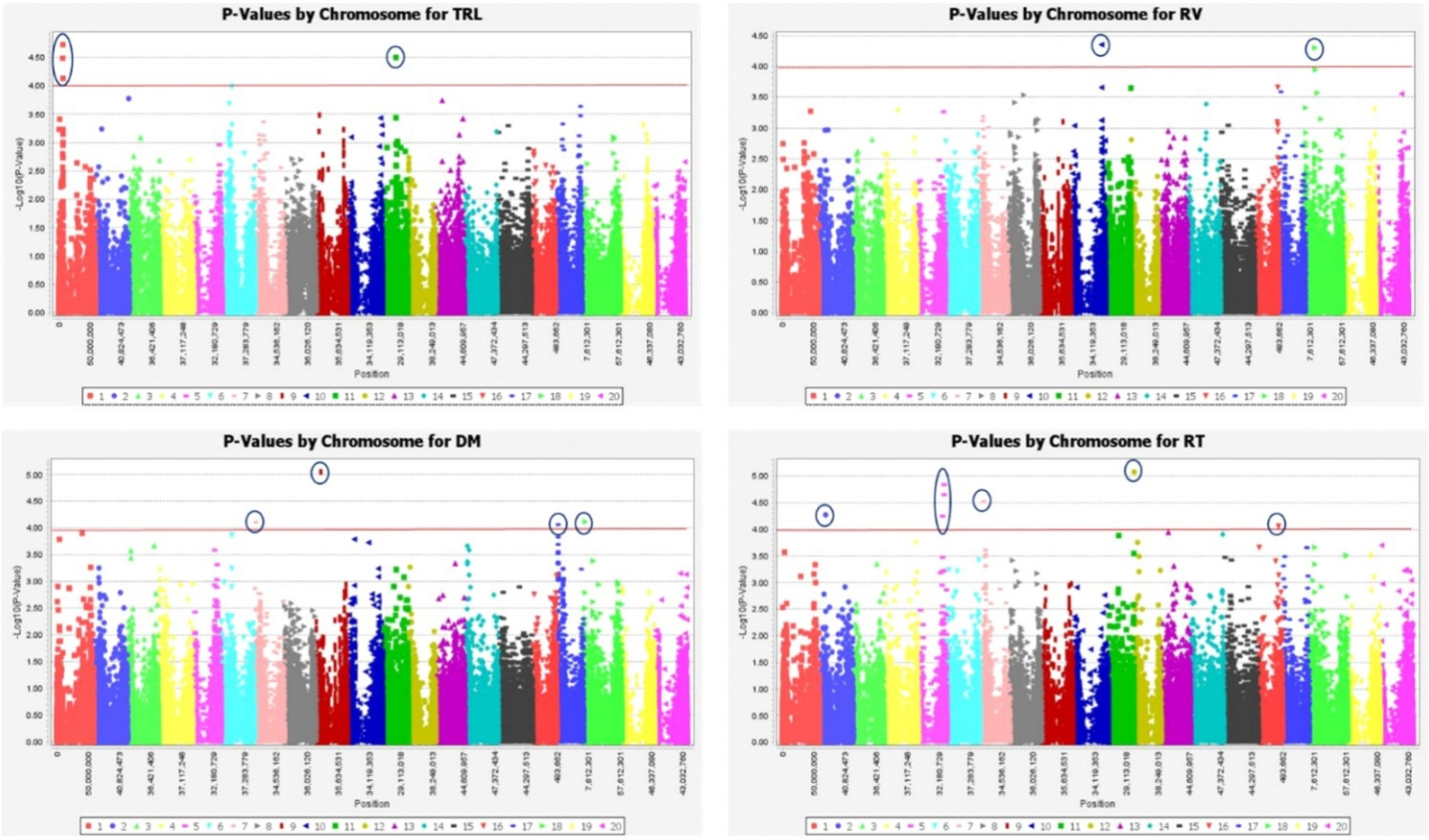


Figure 3.3.15 Significant loci associated with total root length (TRL), root volume (RV), Root diameter (DM) and root tips (RT) among 203 soybean germplasm

3.4 Management of Biotic Stresses

IISR1.33/16 : Development of YMV resistant soybean varieties using marker assisted selection

PI : Anita Rani, Co-PIs : Vineet Kumar and B.S Gill

F_5 generations of NRC142 (double null) × NRCSL2 (YMV resistant EDV of JS335) and F_5 generation of NRC142 (double null) × BC_3 of JS95-60 × (JS95-60 × SL525) (YMV resistant) were raised in kharif and progeny rows were tested for YMV resistance gene, null lipoxygenase alleles using linked and gene specific molecular markers. F_3 generation of NRC105 (vegetable type) X NRCSL2 (YMV resistant) was raised and BC_1F_1s of NRC149 × AMS100-39 were raised, tested for their hybridity and backcrossed with AMS 100-39. Advanced breeding lines developed were raised and evaluated for yield related traits, and were tested for YMV resistance gene using linked SSR markers. Advance breeding lines with YMV resistance genes were planted in the fields of PAU, Ludhiana (hot spot for YMV) for validation of YMV resistance. Four entries were evaluated in AICRP trials (Table 3.4.1)

Table 3.4.1 Entries identified and promoted in AICRP trials

Genotype	Targeted traits(s)	Status
NRC 149 (NRCSL 3)	YMV resistance and high oil content	Identified for release in North Plain Zone
NRC 195	YMV resistance and high oil content	Promoted to AVT 1 in North Plain Zone.
NRC 259	YMV resistance	Entered into IVT
NRC 260	YMV resistance	Entered into IVT

Figure 3.4.1 Field view, single plant and seeds of NRC149

IISR3.11b/18 : Soybean improvement against charcoal rot and anthracnose diseases

PI : V. Nataraj. Co-PIs : Laxman S. Rajput, Sanjeev Kumar, Rajkumar Ramteke, M. Shivakumar, V. Rajesh, Pawan K Amrate, Milind B. Ratnaparkhe and Shalini Huligol

Hybridization & advancement of mapping populations

Three mapping populations viz., JS 20-98 × JS 95-60 (for charcoal rot resistance), JS 20-34 ×JS 95-60 (for anthracnose resistance) and EC 4457254 × JS 95-60 (for anthracnose resistance) were advanced to F_4, F_3 and F_3 generations, respectively.

Table 3.4.2 Crosses attempted aiming at higher-yield, early maturity and resistance against major diseases

Cross	Targeted Trait(s)
PS 1569 × JS 20-38	Early maturity, Charcoal rot resistance and water-logging tolerance
JS 20-98× JS 20-38	Charcoal rot, YMV and RAB resistance and water-logging tolerance
EC 34106 × JS 95-60	Anthracnose resistance
JS 21-05 × NRC 186	Charcoal rot resistance and water-logging tolerance
EC 457254 × JS 20-38	Anthracnose resistance and water-logging tolerance
JS 20-69 × JS 20-38	Charcoal rot, YMV and RAB resistance and water-logging tolerance
JS 20-69 × JS 22-18	Early maturity, Charcoal rot and RAB resistance
JS 20-69 × JS 95-60	Early maturity, Charcoal rot and RAB resistance
JS 20-69 × NRC 204	Early maturity, Charcoal rot, YMV and RAB resistance
JS 20-69 × 21-5-5	Early maturity, Charcoal rot and RAB resistance
[JS 20-98 × RSC 10-46] × [NRC 166A × JS 22-18]	Multiple disease resistance
Hardee × EC 333901	Higher yield, drought and water-logging tolerance

Artificial screening of soybean genotypes for anthracnose resistance using pod-inoculation method

A total of 95 genotypes have been screened for anthracnose resistance at R6 stage using pod-inoculation method (Figure 3.4.2). Disease assessment was based on percent pod area infected. Data was noted 48, 72 and 96 hours after inoculation. Among the genotypes under study, EC 18596, EC 95677, NRC 150, EC 250586 and NRC 181 were found to be resistant.

Figure 3.4.2 Differential genotypic response against *C. truncatum*

IISR3.13/19 : Evaluation of germplasm and breeding for collar rot disease caused by *sclerotium rolsfsii* sacc in soybean

PI : Rajkumar Ramteke, Co-PIs : Laxman Singh Rajput, Sanjeev Kumar, Vennampally Nataraj, Vangala Rajesh, Shivakumar M, Milind Ratnaparkhe, Pawan Amrate and Munmi Borah.

The crosses [(AMS 5-18 MR × NRC 128), (JS 20-98 × JS 95-60) and (JS 20-34 × JS 95-60)] were attempted so as to transfer resistance. They were advanced to F_3 and genetic inheritance of resistance gene(s) will be observed.

IISR3.12/19 : Soybean improvement against defoliating insects

PI : Vangala Rajesh, Co-PIs : Lokesh Kumar Meena, Shivakumar M, Vennampally Nataraj, Viraj Gangadhar Kamble

Evaluation of soybean genotypes for defoliating insect resistance

Based on preference index (C) of antixenosis for *Spodopteralitura*, soybean accessions were categorized. IC 24997, EC 113393 , F4P21, CAT 2503, G5P22 and F3P18 exhibited strong antixenosis, whereas, Basara, EC 171215, EC 127503, IC 501254, EC 171194 exhibited moderate antixenosis.

In field condition, based on larvae count, five genotypes viz., EC 171194 (0.71), EC 1039033 (0.71), EC1039034 (0.71), EC 1039067 (0.71), AKSS 67 (0.71), were identified to be highly resistant.

Antibiosis studies

Five wild species of soybean were studied for antibiosis against *Spodoptera litura. Glycine tomentolla*, *Glycine canescens*, *Glycine tabacina* showed antibiosis reaction for AD/ECI/ECD and in combination exhibiting presence of antibiosis (Figure 3.4.3).

Figure 3.4.3 Antibiosis Studies

F_2 population studies for *Spodoptera litura* in lab conditions

F_2 population of 100 plants derived from cross JS 20-34 × G5P22 and 110 plants derived from F4P21 x Line 220 were studied for antibiosis against *Spodoptera litura* revealed considerable variation among lines for which further studies will be carried out. An F_2 population of 100 plants derived from cross JS 335 × F4P21 were studied for antixenosis against *Spodoptera litura* revealed considerable variation.

Hybridization and generation advancement and selection

Crosses were attempted using resistant sources like F4P21, F3P18, G5P22, Harasoya, Line 220, Line 202, MACS 1460 with susceptible genotypes. Crosses Harasoya × JS 9305, F4P21 × Line 220, F4P21 × Line 202, F4P21 × JS 9560, F3P18 × LINE 202, F4P21 × LINE 202, JS20-98 × G5P22, F3P18 × JS 9305, F3P18 × JS 335, G5P22 × JS 335 were advanced from F_2 to F_3 generation by SPD method.

Antixenosis and antibiosis reaction of soybean genotypes against *Spodoptera litura*

Antixenosis studies and Antibiosis studies were done against *Spodoptera litura* on different soybean genotypes to identify the resistant genotype. In antixenosis studies on 11 soybean genotypes against *Spodoptera litura,* none of the genotype was found strong/ extreme antixenosis. In antibiosis studies on these selected 11 genotypes, the larvae reared on NRC 165 found the lowest AD (58.53%). The lowest ECI value was found in RSC 11-35 (66.99%). The lowest ECD value was found in RVSM 2012-4 (72.87%). The lowest weight of per pupae was found in PS 1569 (0.104 mg) genotype.

Evaluation of Bio-efficacy of some newer insecticides against whitefly

PI : Lokesh Kumar Meena

Nine newer insecticides viz., Thiamethoxam 25 % WG, thiamethoxam 75 % SG, Acetamiprid 20% SP, Emmactin benzoate 5% SG, Chlorantraniliprole 18.5% SC, Thiacloprid 21.7% SC, Propargite 57% EC and cyantraniliprole 25% EC alongwith control were tested for their bio-efficacy against whitefly in soybean under field conditions. Among them, Thiamethoxam 25 % WG was found most effective followed by Thiamethoxam 75 % SG after two sprays of these insecticides.

IISR3.1/21 : Isolation and identification of kairomones and sex pheromones components for soybean stem fly, *Melanoagromyza sojae* management

PI : Lokesh Kumar Meena, Co-PIs : Vangala Rajesh and Kamala Jayanthi

To find the most attractive crop for stem fly for mass rearing, five crops were raised. The results of this experiment indicated that the maximum stem tunneling was made by stem fly larva in soybean crop (14.01%) followed by black gram (7.18%). The rest of the crops, stem tunneling were found in the following descending order- Cowpea (6.43%) > French bean (4.06%) > Green gram (3.03%). For screening of soybean genotypes for identification of resistant and susceptible soybean genotypes against stem fly, 50 soybean germplasm lines were grown. The results of this experiment indicated that out of fifty genotypes, eight genotypes viz., EC 457074 (55.41% stem tunneling), EC 113778 (51.15 % stem tunneling), EC 232019 (57.63 % stem tunneling), JS 20-48 (78.62% stem tunneling), JS 20-61(71.87% stem tunneling), PS 1423(65.8 % stem tunneling), SQL 37(56.33% stem tunneling) and EC 287466 (56.33% stem tunneling) were found highly susceptible (HS) to stem fly and they can be used for mass multiplication suitably for stem fly.

IISR3.11/22 : Soybean improvement against rhizoctonia aerial blight disease

PI : Laxman Singh Rajput,Co-PIS : Vannampally Nataraj, Shivakumar M, Milind Ratnaparkhe, K. P. Singh, Pezangulie Chakruno and Pawan Amrate

Evaluation of elite genotypes against RAB diseases during *Kharif* 2022 at four different locations

Total 84 elite genotype of soybean was evaluated under field condition against RAB disease of soybean at ICAR-IISR, Indore, GBPUAT, Pantnagar, CoA, Medziphema and JNKVV, Jabalpur (Table). Among the 84 elite genotypes, 10 genotypes i.e., EC-528622, EC-171194, UPSL- 50981, UPSL-63, UPSL-390, Cat-2740, IC-073710, EC-572136, EC-456647 and VPSM 1096 A, were found resistant against RAB disease at all four locations (Table 3.4.3).

Table 3.4.3 Evaluation of elite genotypes against RAB diseases of soybean at four locations

S. No.	Germplasm line	Disease reaction against RAB			
		Pantnagar	Indore	Medziphma	Jabalpur
1.	EC-916033	R	S	MR	R
2.	EC-915983	-	HS	R	-
3.	EC-528622	MR	R	MR	MR
4.	IC-243096	R	MR	-	R
5.	Hardee	MR	MR	-	MS
6.	EC-994027	-	-	-	MR
7.	EC-993740	MS	-	R	-
8.	EC-127503	S	R	R	R
9.	EC-171194	MR	MR	HR	MR
10.	EC-39755	MS	HS	HR	HR
11.	EC-39503	MR	HS	-	-
12.	EC-33915	S	MR	-	R
13.	EC-172578	S	MS	R	R
14.	EC-39376	MR	MR	-	MR
15.	EC-109563	MR	MR	-	R
16.	TGX 803-99E	R	R	R	MS
17.	UPSL- 50981	MR	R	R	MR

S. No.	Germplasm line	Disease reaction against RAB			
		Pantnagar	Indore	Medziphma	Jabalpur
18.	UPSL-63	MR	R	R	MR
19.	UPSL-390	MR	R	R	MR
20.	RR-72-2-5-6	S	MR	R	MS
21.	IMP-1	MR	-	R	-
22.	PP-24	MR	MS	R	-
23.	GP-561	HS	MS	R	MR
24.	IC-501228	MS	MR	HR	-
25.	DT-21	MS	MR	R	-
26.	AGS-25	-	R	R	R
27.	Cat-3293	MS	MR	R	S
28.	Young	MR	-	MR	MS
29.	Benning	MR	MR	-	-
30.	Cat-734	MR	MR	MR	MS
31.	Cat-2740	MR	MR	R	MR
32.	IC-415047	MR	R	-	S
33.	IC-073710	MR	R	R	MR
34.	EC-572136	MR	MR	R	R
35.	EC-538807	-	MR	-	MR
36.	EC-685252	MR	MS	MR	MS
37.	EC-547454	-	MR	R	MS
38.	EC-538840	MS	HS	R	MR
39.	EC-528622	R	MS	MR	R
40.	EC-538828	-	MR	R	-
41.	TGX 298-7E	MR	MS	MR	MR
42.	TGX 1073-30 A	R	MR	-	MS
43.	TGX 722-110 E	MR	R	-	MR
44.	TGX 811-10D	MS	MR	MR	HR
45.	VPSM 734	MS	MR	MR	R
46.	VPSM 1096 A	MR	R	R	MR
47.	VPSM 117	MR	R	-	R
48.	VPSM 679	MS	MS	R	MR
49.	UPSL 164	S	R	R	MR
50.	PC 32	MS	MS	-	MR
51.	EC- 389170	S	MR	R	R

S. No.	Germplasm line	Disease reaction against RAB			
		Pantnagar	Indore	Medziphma	Jabalpur
52.	EC- 457214	S	S	R	R
53.	EC- 457120	MS	MR	HR	MS
54.	UPSM- 742	MR	HS	R	MR
55.	UPSL 160	MR	S	-	MR
56.	EC-528623	-	S	-	MR
57.	EC-538828	MS	-	R	-
58.	IC-501153	MS	-	-	R
59.	EC-389163	S	MS	-	MR
60.	EC-389174	S	-	MR	-
61.	EC-456613	S	R	R	R
62.	EC-457052	MR	R	R	-
63.	EC-456647	MR	R	R	MR
64.	EC-467282B	HS	MR	-	HR
65.	EC-113393	MS	MR	R	MR
66.	EC-615184	S	MS	R	MR
67.	EC-638228	S	MS	R	MR
68.	EC-95677	-	MR	R	MR
69.	EC-457415	MS	MR	MR	S
70.	EC-528622	S	MR	R	MR
71.	EC-857105	R	MS	R	MR
72.	IC-49685	HS	MS	-	MS
73.	GP-36	HS	MR	R	MS
74.	G-2251	MS	MR	R	MR
75.	PLSO-40	S	MS	R	MR
76.	TGX 1681-3F	S	MR	MR	MR
77.	TGX 825-3D	-	MR	-	MR
78.	TGX 1025-2F	MS	-	R	MR
79.	EC-232275	MS	MS	R	R
80.	EC-84051-9-1	-	MS	-	R
81.	EC-171536	MS	HS	R	R
82.	EC-100031	-	MS	R	-
83.	EC-100778	MS	MR	MR	MR
84.	EC-590224	S	S	R	R

IISR3.12/20 : Interaction effect of phytohormones and AMF for enhanced nodulation, growth, yields of soybean with improved AMF symbiosis in the rhizosphere

PI : M.P Sharma, Co-PIs : Prince Choyal, A. Ramesh and M. K Srivastava

Role of phytohormones in promoting AM symbiosis

During 2022, at IISR, Indore research on mass production of AM fungi using phytohormones and mycorrhiza helper bacteria was attempted in soil-substrate pots using sorghum as host plant. Three phytohormones with different doses (Indole acetic acid-IAA; 50, 75 and, 100ppm, cytokinin-BR; 0.5, 0.75, 1ppm, and Triacontanol-Tria; 0.5, 1 and 2ppm) when applied through seed and foliar application mode found to significantly enhance the AM fungi biomass assessed in terms spore count (Figure3.4.4), glomalin (AMF-associated soil protein, GRSP) and root colonization (MCP) as compared to control plants. Out of the three phytohormones, Tria- 1ppm followed by IAA 75 applied either foliar or seed treatment found to be more effective in producing higher biomass than other hormones. Nevertheless, BR- 0.75 when applied through seed treatment produced higher biomass than foliar application (Figure 3.4.5). Based on 3-factor analysis, irrespective of mode and inoculation, all hormones responded significantly towards AMF biomass when compared to control (Figure 3.4.6).

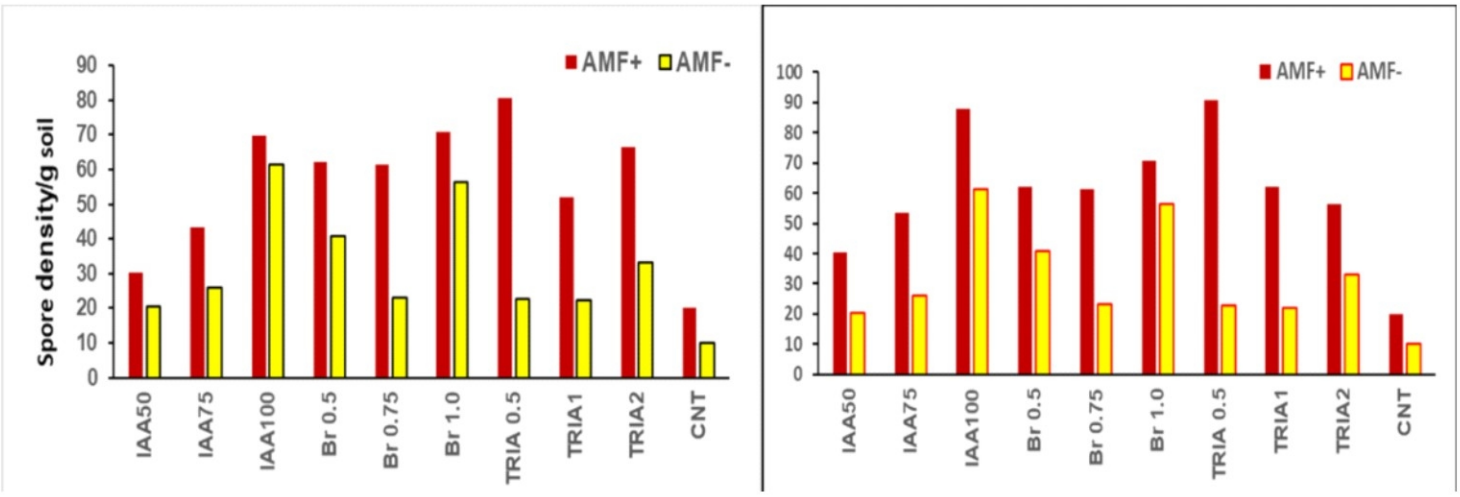


Figure 3.4.4 Influence of phytohormones and their mode of application on AMF root colonization and spore density assessed in the sorghum plants grown under microcosm conditions

During evaluation in field, Tria 1ppm followed by CK 20 and IAA 75 ppm applied as foliar was found to have higher nodule dry weights. Whereas when applied as seed treatment, Tria-1 followed by IAA-75 showed higher nodulation. Overall, Tria-1ppm, IAA-75 and CK 20 either applied as seed treatment or foliar application with AMF showed higher grain yield over other combinations (Figure).

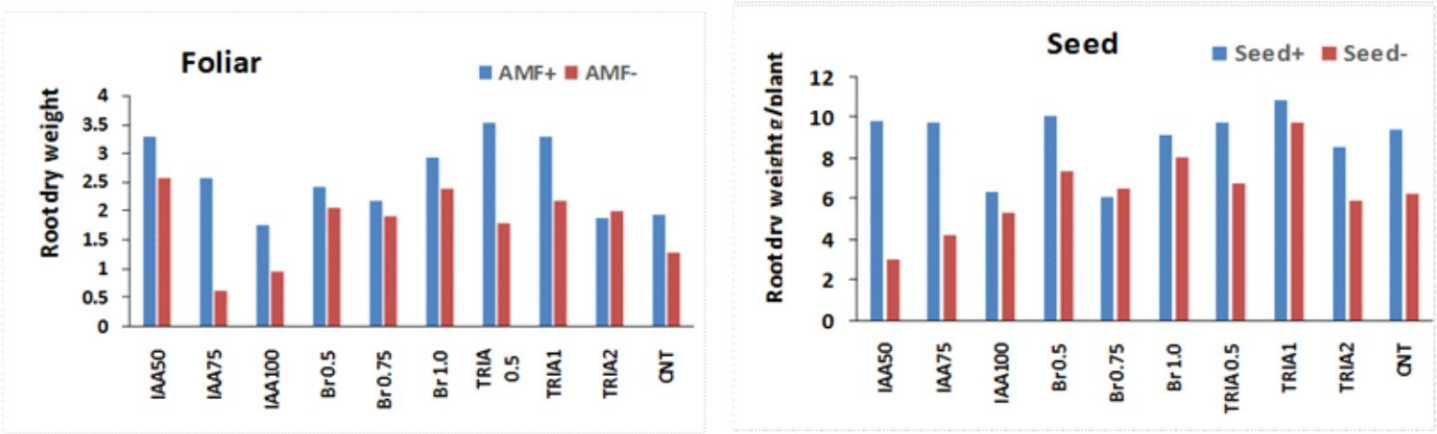


Figure 3.4.5 Influence of phytohormones and their mode of application on AMF-associated root biomass of sorghum plants grown under microcosm conditions

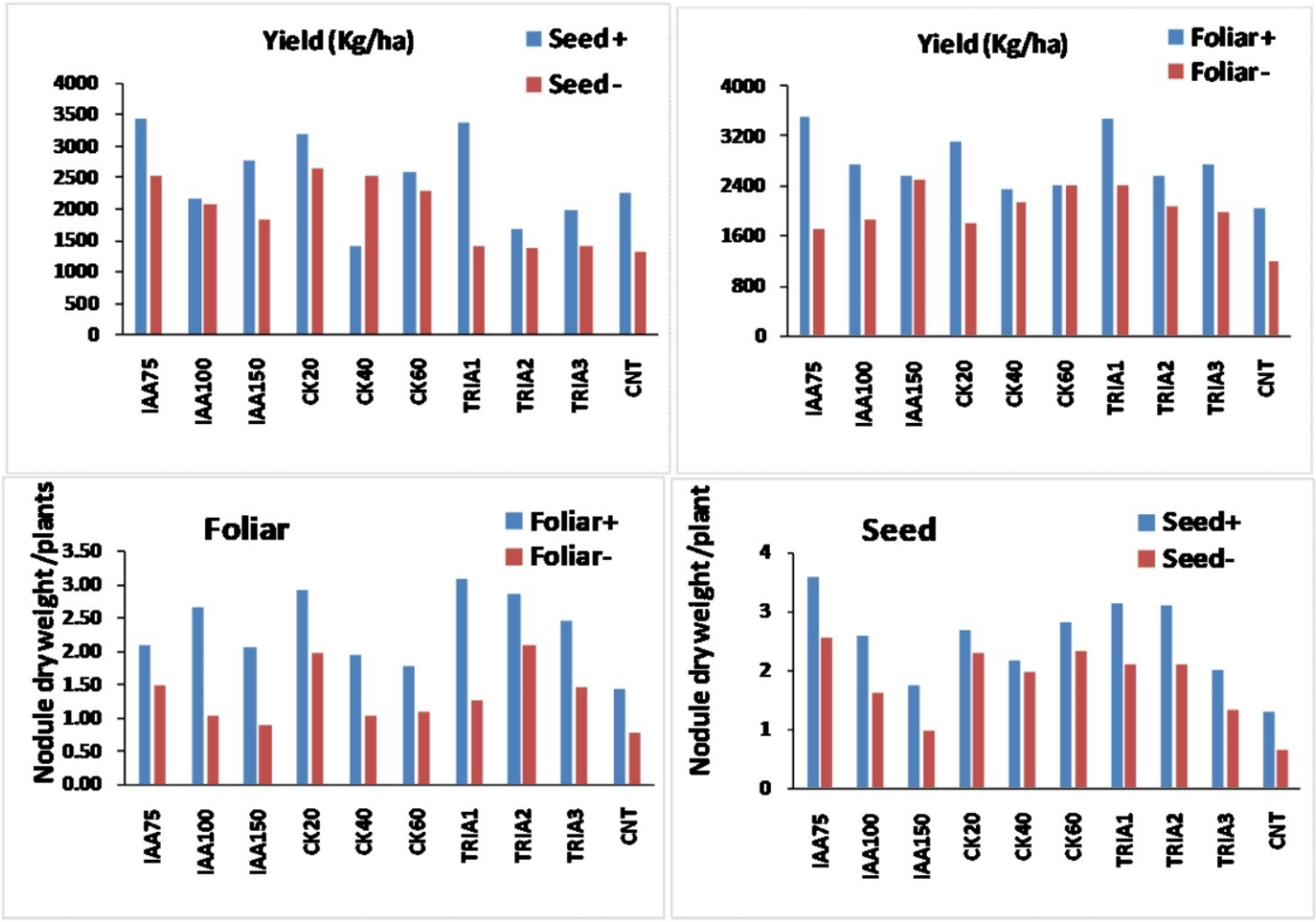


Figure 3.4.6 Influence of phytohormones and their mode of application on nodulation and yield of soybean under field conditions

3.5 Seed Quality Characteristics

IISR1.35/17 : Improvement in soybean seed viability and strength of seed coat by genetic amelioration of seed coat traits

PI : Punam Kuchlan, Co-PIs : Mrinal Kuchlan and Sanjay Gupta

Generation advancement of the crosses Hardee × EC 538828, Hardee × NRC 7, JS 20-116 × NRC 7 and Karune × VC 109.Karune× VC 109, JS 20-69 × EC 538828, VC 117 × NRC 7, NRC127 × MACS 450 and HARASOYA × CK 62 were done. To improve the seed germination ability of variety NRC 7, it was crossed with EC 538828. RILs of NRC 7 × EC 538828 are in F_8 generation. Multiplication of selected genotypes of VLS 1× EC 538828, CAT 2911 × NRC 7 which were found high yielding with high lignin content with high field emergence rate was done. Vegetable soybean genotypes Karune and SwarnaVasundhara are not suitable for Central zone because of very poor seed germination (40%), susceptibility to Rhizoctonia arial blight and anthracnose and slow seed development rate in pod. To address this problem vegetable variety Karune (green seeded) was crossed with EC 538828 (yellow bold seeded with rapid seed development and resistance to multiple diseases),460 RILs were evaluated on the basis of sensory test at vegetative stage, disease resistance, seed size both at vegetative and mature stage and seed germination potential (Table 3.5.1).

Table 3.5.1 Details of some best selected vegetable type RILs (Karune× EC 538828)

line name	100 green seed wt (g)	Pod Length green stage (cm)	Seed Index (DRY) (g)	Germination (%)	Pubescence	RAB
CK(Y)4-3-3	45.13	6.3	18.64	72	Absent	Absent
CK(Y) 4-3-11	53.64	6.5	19.24	75	Absent	Absent
CK(G) 4-47-21	48.77	7.3	21.31	79	Absent	Absent
CK(G)4-34-12	70..19	7.4	19.85	85	Absent	Absent
CK (G) 4-43-19	42.5	7.0	18.03	83	Absent	Absent
CK (Y) 4-2-3	48.21	7.3	17.22	78	Absent	Absent
KVC109-2-7-1	45.71	6.0	21.26	77	Absent	Absent
KVC109-2-7-5	45.71	6.0	21.26	77	Absent	Absent
KVC 109-2-7-7	59.79	6.2	21.22	73	Absent	Absent
KVC109- 2-7-2	54.12	6.3	23.1	65	Absent	Absent
EC538828	55.82	6.5	19.85	86	Absent	Absent
KARUNE	65.13	7.4	20.01	45	Absent	Susceptible

Table 3.5.2 Yield and seed storability of best performing RILs (VLS 1 × EC 538828)

Line	Germination after 6 month of storage	Yield(q)/h	Seed Index (g)	Pod no/Plant
VC II(GP) 126-3	85.0	25.18	15.12	75
VCI (GP) 63-2	88.0	22.86	16.58	66
VCII(SP) 200-1	78.0	19.89	15.10	58
VCI 148-2-1	84.0	25.70	17.30	67
VCII (GP)75-2	80.0	26.15	16.41	62
VCI (GP)188-2	84.0	22.22	15.16	57
VCII (GP)82-1	77.0	19.78	17.16	48
VCII (GP)120-2	83.0	27.82	15.15	71
VCI SP 133-1	79.0	24.15	15.61	65
P-1 VLS 1	70	9.0	16.0	29
PII-EC538828	80	12.50	17.50	35

Table 3.5.3 Performance of promising lines from the cross EC538828×NRC7

Line	Germination(%) after six month	Seed index (g)	Yield Q/h	Maturity days
CN-4 (SP) 29-1	95	16.88	26.72	102
CN-6 (SP) 2	94	15.45	25.68	101
CN 4 (GP)5-2-1	85	15.12	29.63	98
CN7(GP) 28-1	92	14.70	24.10	96
CN 7(GP)120-3	88	15.37	23.21	99
CN 7 GP 3-1	92	14.44	22.22	97
CN 7 GP 232-1	92	16.85	21.23	100
CN 7(GP)120-3	88	15.58	23.21	96
CN 7 SP 7-2	93	13.59	22.22	99
CN 7GP 103	83	15.03	21.73	99
CN7 GP 11-2	88	16.54	21.73	101
PI - CAT2911	65	13.0	19.10	99
PII-NRC 7	80	17.50	12.50	92

Breeder seed production

PI : Mrinal Kuchlan

Soybean breeder seed production of different varieties namely NRC 142, NRC 138, NRC 130, NRC 128, NRC 136, NRC 86 and RVS 24 was undertaken under AICRP Seed (Crop) at IISR, ICARDA and in farmer's field in an area of 70 ha (Table 3.5.4).

Table 3.5.4 Variety wise details of breeder seed production

S. No.	Variety	Production (quintal)
1.	NRC 130	92
2.	NRC 127	39
3.	NRC 128	20
4.	NRC 138	145
5.	NRC 142	290
6.	NRC 136	3.5
7.	NRC 86	22.5
8.	RVS-24	8.0
9.	NRC 147	0.05
10.	NRCSL 1	0.2
	Total	620.25

Foundation, Certified and TL seed production

Seed production for NRC 142, NRC 130, NRC 138 and JS 20-69 was taken up under Seed Hub Project in collaboration with progressive farmers of Indore and Ujjain (Table 3.5.5).

Table 3.5.5 Details of seed production of soybean varieties

Foundation seed production programme		
S. No.	**Variety**	**Production (quintal)**
1.	NRC 142	21.9
2.	NRC 138	14.4
3.	NRC 130	9.9
4.	JS 20-69	112.5
Certified Seed Production		
1.	JS 20-69	481.6
TL Seeds		
1.	JS 20-69	75.0

Maintenance of soybean released and notified varieties as reference collection at IISR-Nodal Centre of DUS testing

PI : Mrinal Kuchlan.

One hundred and forty released and notified soybean varieties were maintained during kharif 2022 at IISR, Indore. These varieties were characterized for 20 DUS Test characteristics. The yield performance varied from 1.1 q to 33.84 q. Nine varieties yielded above 25q/ha, two varieties between 20-25q/ha, 12 varieties between 15-20q/ha, 13 varieties between 10-15q/ha, 27 varieties between 5-10q/ha 51 varieties between 1-5q/ha and 26 varieties failed due to abiotic and biotic stress.

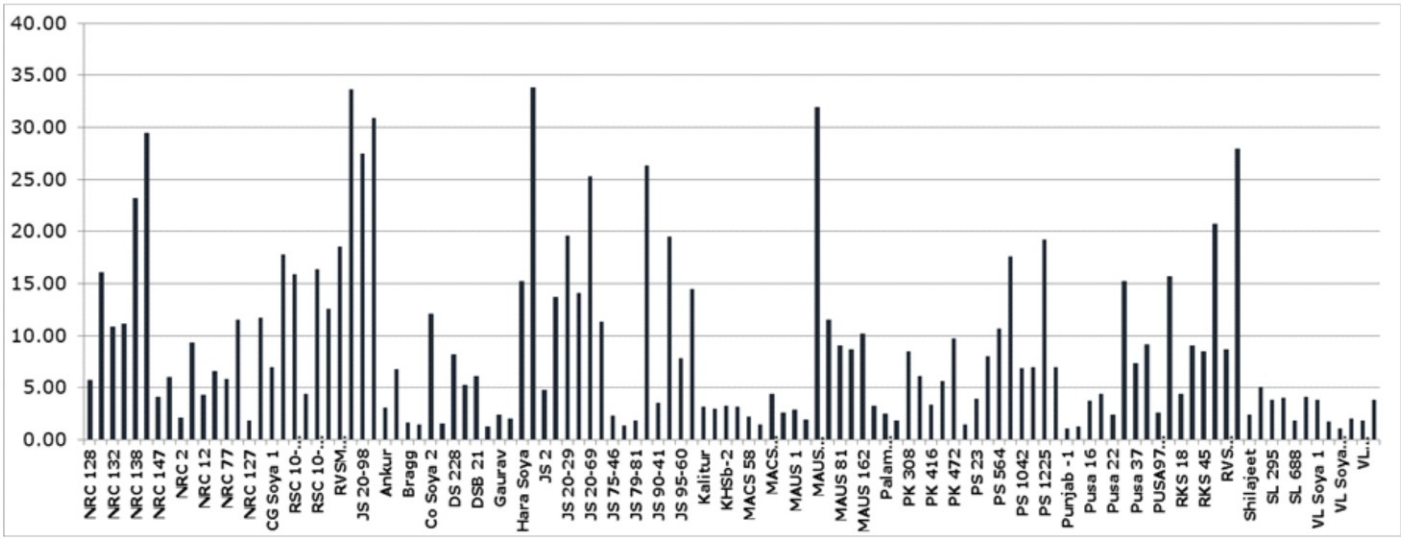


Figure 3.5.1 Yield of soybean varieties

3.6 Crop Production Technologies

IISR4.13/17 : Crop residue and improved land configuration methods to enhance soybean productivity under different soybean-based cropping systems

PI : Rakesh K. Verma, Co-PIs : Raghavendra Nargund, A. Ramesh, M. P. Sharma, Prince Choyal, Nita Khandekar and Laxman Singh Rajput

The highest seed and biological yield of soybean was registered under the soybean-chickpea cropping system followed by (fb) soybean-wheat and soybean-maize. Among the different crop establishment techniques, significantly ($P<0.05$) highest soybean seed yield (18.0%) and biological yield was registered under PBBF + R fb PBBF + WR as compared to CTFP+WR (Figure 3.6.1).

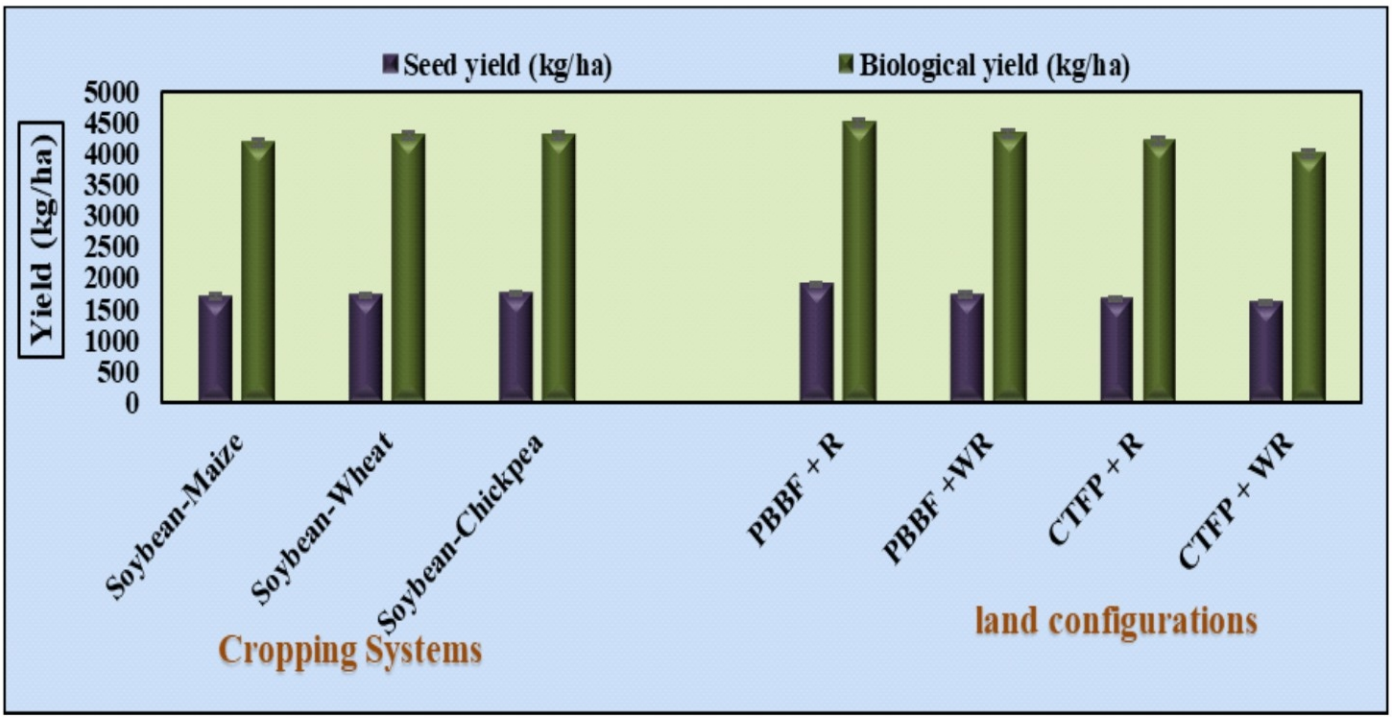


Figure 3.6.1 Seed and biological yield of soybean as influenced by different cropping systems and land configurations (*PBBF + R= permanent broad bed furrow + residue retention; PBBF + WR= permanent broad bed furrow + without residue retention; CTFP + R= conventional tillage as per farmer's practices with residue; CTFP + WR= conventional tillage as per farmer's practices without residue)*

Drip irrigation to enhance soybean productivity under rainfed ecosystem

PI : Raghavendra Nargund, Co-PIs : R. K. Verma, A. Ramesh and S.D. Billore

The pooled (3 year's data) analysis of soybean seed yield (7.66%), biological yield (4.67%) and harvest index of all six long duration cultivars found highest under drip irrigation system compared to rainfed ecosystem. Among different cultivar JS 20-69 reported significantly higher grain yield (82.9%), biological yield (47.8%) and harvest index compared to other cultivars (NRC 37) under both drip and rainfed ecosystem. However, cultivars JS 20-98 and JS 97-52 found to be the next best varieties responding well to drip irrigation. Significantly lowest grain yield, biological yield and harvest index was reported in NRC 37 cultivar followed by NRC 86 and JS 20-29 (Figure3.6.2).

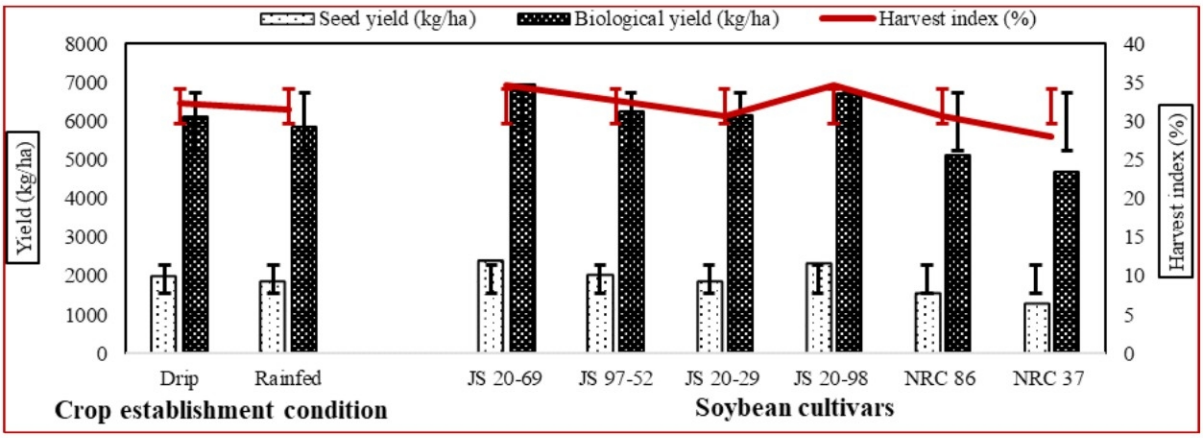


Figure 3.6.2 Response of soybean cultivars to drip irrigation under rainfed ecosystem (Number of replicates, 3; type of test, two-way analysis of variance, split plot design); level of significance α <0.05; error bars indicate, standard deviations).

Soybean intercropping with sugarcane in spring season

PI : Raghavendra Nargund, Co-PIs : R. K. Verma, A. Ramesh, S.D. Billore, M. Shivakumar, G.K. Satpute, S. Gupta, V. Nataraj, Vangala Rajesh and N. Khandekar

To take advantage of initial slow growth of sugarcane (0-3months), different soybean genotypes (YMV-11, NRC 130, NRC 131, NRC 136 and JS 20-34) were evaluated at Indore, under soybean + sugarcane (2:1) intercropping system. All the soybean genotypes performed well under intercropping system with 8.08-15.82 q/ha soybean seed yield during spring season as an additional benefit to sugarcane farmers without hampering cane yield (Figure 3.6.3).

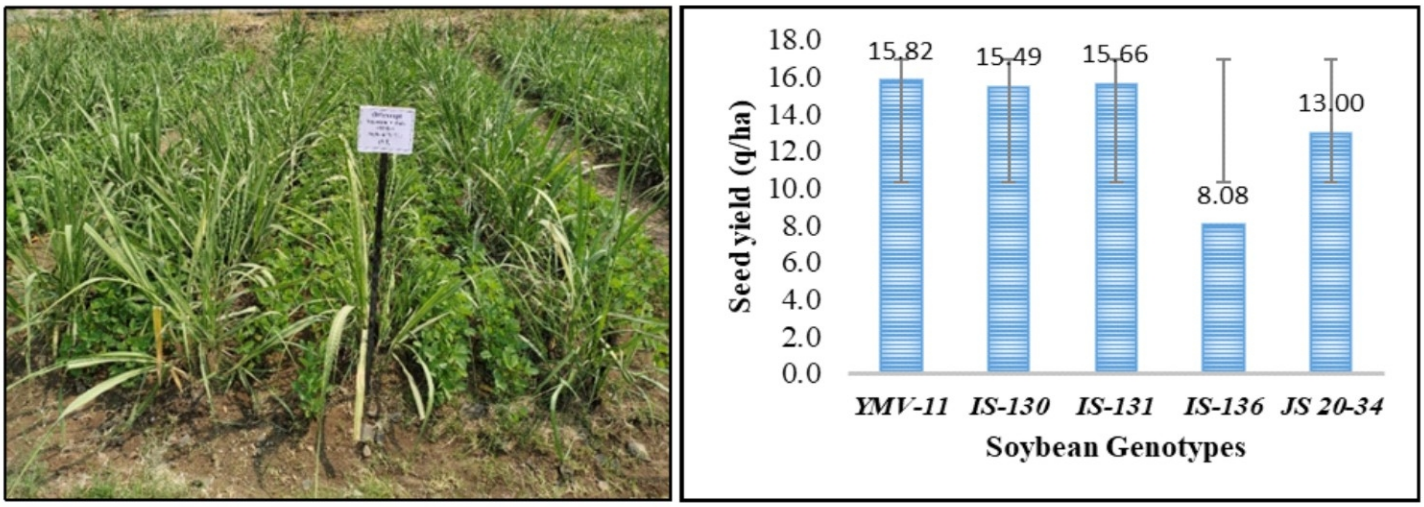


Figure 3.6.3 Evaluation of soybean genotypes under soybean + sugarcane (2:1) intercropping system

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 : A. Ramesh, Co-PIs : M.P. Sharma and Raghavendra Nargund

The results from the field experiment revealed that, significantly more dehydrogenase enzyme activity (DHA) was observed with the inoculation of *Bacillus aryabhattai* alone and along with AM fungi *Bacillus aryabhattai* + *Bradyrhizobium lioningense* + AM fungi as compared other treatments tried at R_2 stage of soybean. Whereas, significant increase in DHA was observed with inoculation of *Bacillus aryabhattai* + *Bradyrhizobium lioningense* + AM fungi and *Burkholderia arboris* + *Bradyrhizobium lioningense* + AMF at R_5 stage of soybean. At panicle initiation stage in wheat, *Bacillus aryabhattai* + AM fungi and *Bacillus aryabhattai* +

Bradyrhizobium lioningense + AM fungi significantly increased DHA as compared to other treatments. Significantly, higher seed yield was observed with the inoculation of *Bacillus aryabhattai* + *Bradyrhizobium lioningense* +AMF,*Burkholderia arboris*+ *Bradyrhizobium lioningense* +AMF and *Bacillus aryabhattai* + AMF in both soybean and wheat. Microbial inoculation with *Bacillus aryabhattai* + *Bradyrhizobium lioningense* + AMF significantly increased macro and micronutrients (N, P, K, Zn and Fe) concentration in soybean seed compared to other treatments under study (Table 3.6.1).

Table 3.6.1 Effect of inoculation of PGPR and AMF on soil enzyme, seed yield and nutrient content under soybean-wheat cropping system

Treatments	Dehydrogenase (µg triphenylformazon g/soil/h)			Seed yield		Nutrient content in soybean seed				
						Macronutrients			Micronutrients	
	Soybean		Wheat	(kg/ha)			(%)		(ppm)	
	R2	R5	Panicle initiation	Soybean	Wheat	Nitrogen	Phosphorus	Potassium	Zinc	Iron
Control	88.20^{e}	115.98^{f}	137.78^{cd}	2282^{e}	4773^{e}	164.6^{e}	9.80^{d}	41.03^{f}	41.73^{ef}	78.93^{de}
Burkholderiaarboris	96.43^{c} d	130.95 d	148.20^{ab}	2400^{d}	5199^{d}	179.7^{d}	10.85^{c}	45.50^{e}	44.33^{de}	84.87 bc
Bacillus aryabhattai	113.58 a	146.97 c	145.67^{b}	2480^{b} c	5420^{c}	188.4^{c} d	11.80^{b}	48.99^{cd}	52.13^{c}	85.92^{a} b
Bradyrhizobiumlioningense	85.17^{e} f	125.63 de	129.57^{ef}	1901^{f}	4515^{f}	142.4^{f}	8.22^{e}	34.57^{g}	39.87^{f}	75.75^{e}
Burkholderiaarboris* + *Bradyrhizobiumlioningense	95.19^{d}	143.29 c	146.54^{ab}	2450^{c} d	5265^{d}	191.2^{b} c	11.59^{bc}	47.89^{de}	43.83^{de}	78.82 de
Bacillus aryabhattai*+ *Bradyrhizobiumlioningense	104.35 b	156.04 b	143.09^{bc}	2549^{a} b	5517^{bc}	202.5^{a}	11.77^{b}	53.52^{ab}	50.81^{c}	85.80^{a} b
***Burkholderiaarboris* + AMF**	102.65 b	155.51 b	136.41^{cde}	2508^{a} bc	5604^{ab}	188.7^{c} d	11.86^{b}	50.34^{bcd}	59.17^{b}	84.06 bc
***Bacillus aryabhattai* +AMF**	114.68 a	154.96 b	133.60^{def}	2554^{a}	5707^{a}	202.9^{a}	12.33^{b}	52.17^{abc}	63.70^{a}	87.01^{a} b
***Bradyrhizobiumlioningense* +AMF**	83.00^{f}	124.01 e	127.90^{f}	1930^{f}	5269^{d}	151.3^{f}	8.62^{e}	35.80^{g}	45.63^{d}	80.99 bc
***Burkholderiaarboris* + *Bradyrhizobiumlioningense* +AMF**	100.53 bc	216.33 a	146.81^{ab}	2519^{a} bc	5592^{ab}	199.2^{a} b	12.24^{b}	51.45^{bc}	56.77^{b}	87.38^{a} b
***Bacillus aryabhattai*+ *Bradyrhizobiumlioningense* +AMF**	116.57 a	220.42 a	153.86^{a}	2573^{a}	5655^{ab}	205.3^{a}	13.24^{a}	54.89^{a}	64.57^{a}	89.87^{a}
LSD(p=0.05)	4.74	6.58	7.45	70	146	10.18	0.82	3.36	3.02	4.69

Data are mean values of three replicates; means with different letters in the same row differ significantly at P=0.05 according to Fisher LSD

IISR6.9/17 : Bacterial mediated sulphur bioavailability in soybean

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

Soil, water, and mud samples were collected from the potential sites for sulphur and iron oxidizing bacteria from Chhattisgarh iron and coal mines areas. Key coalmines sites were South-Eastern Coal Field Limited (SECL) located at Bishrampur (Surajpur), Bhatgaon (Surajpur), Garepelma (IV) (Raigarh), and Jampali (Raigarh). Explored the hot water springs of Tatapani, Shankargarh, NMDC Bailadila, Dantewada, for iron-oxidizing bacteria (Figure 3.6.4).

Figure 3.6.4 Soil sample collection at different study locations

DACFW : 3S1Y (Three Stage One Year) model for rapid soybean seed multiplication for seed rolling: an initiative towards edible oil self sufficiency

PI : N. Khandekar, Co-PIs : S. Gupta, M. Kuchlan, Raghavendra Nargund, P. Kuchlan, V. Rajesh, S.B. Angadi, G.B. Vishwanath, Ravindra Singh and A. Kale

Seed is a critical input that acts as a catalyst for all other inputs to realize higher productivity in crops. However, the climatic adversities affect soybean seed quality in terms of germination and viability, thus causing heavy losses in the seed production in main crop season. Normal seed multiplication chain takes at least 3 to 4 years to reach farmers after notification and with crop failures in light of the climatic adversities it may take even longer. Therefore, the project aimed at developing a self-sustaining model so as to ensure seed availability to farmers in the year following its release. Three stage (breeder to foundation to certified/truthfully labelled) off-season multiplication of seed of the recently released varieties was initiated in Northern Karnataka in the districts of Belgavi, Dharwad, Bagalkot as well as in Southern Maharashtra in the district: Sangli, Satara, Solapur. In both the areas rice fallows and sugarcane fallows were also utilized along with land masses available near the river beds of Krishna River in Northern Karnataka. Sowings of recent soybean varieties KDS 726, KDS 753, NRC 130, NRC 136, NRC 128, NRC 138, NRC 142 were taken up during December and January. Intensive filed visits, monitoring as well as field days were held (Figure 3.6.5). A total of 601 acres was brought under the production with a total production of 248q, 1795q, 1135q and 1665q of breeder, foundation, certified and truthfully labeled seeds, respectively.

Figure 3.6.5 Seed multiplication under 3S1Y

IISR9.10/19 : Predicting the incidence of stem fly, pod borer and bihar hairy caterpillar in soybean – a geo-spatial approach

PI : R. M. Patel, Co-PIs : P. Sharma and Lokesh Meena

Machine learning

The machine learning method Artificial Neural Network (ANN) and Support Vector Machine (SVM) have been used to model the insect incidence. The literature of machine learning application in plant protection is very scanty. The data and feature/variables used are same as regression methodology. Regression was used as a feature selection method for ANN and SVM modeling. Different parameters of ANN and SVM were used and the optimum one which gave most precise results has been displayed in Table 1 and Table2, respectively. For ANN, the coefficient of determination (R^2) for Bihar hairy Caterpillar (BHC), Pink Pod Borer (PPB), Stem fly are 73.15%, 93.09% and 66.45% respectively, and for SVM, R^2 are 62.07%, 92.38% and 69.67%, respectively. ANN has better precision for BHC and PPB, but SVM showed higher precision for Stem fly among regression, ANN and SVM.

Table 3.6.2 Models based on ANN

Variables	Bihar hairy Caterpillar		Pink Pod Borer		Stem Fly	
Model Input Parameters	RF0 + Rdays0 + Tmin0 + IIRH0 + Rdays1 + Tmin1 + RF2 + Rdays2 + Tmax2 + Tmin2		MeanRH2 + IIRH0 + Tmax2 + Tmin1 + IIRH1 + IRH2 + MeanRH0		Rdays0 + Tmin0 + Tmax1 + Tmin2	
Hidden Layers (Nodes)	2(7,3)		2(4,1)		2(4,1)	
	Training	Validation	Training	Validation	Training	Validation
Square	98.99%	73.15%	68.03%	93.09%	77.24%	66.45%
RMSE	3.15	17.29	2.51	2.36	5.02	6.33

Table 3.6.3 Models based on Support Vector Machine

Variables	Bihar hairy Caterpillar		Pink Pod Borer		Stem Fly	
Model Input Parameters	RF0 + Rdays0 + Tmin0 + IIRH0 + Rdays1 + Tmin1 + RF2 + Rdays2 + Tmax2 + Tmin2		MeanRH2 + IIRH0 + Tmax2 + Tmin1 + IIRH1 + IRH2 + MeanRH0		Rdays0 + Tmin0 + Tmax1 + Tmin2	
	Training	**Validation**	**Training**	**Validation**	**Training**	**Validation**
R-Square	85.49%	62.07%	81.32%	92.38%	61.02%	69.67%
RMSE	11.83	18.68	1.53	1.35	6.63	5.93

Pre-disposed conditions

BHC is significantly affected by rainfall, rainy days, Minimum Temperature and evening relative humidity of current week; rainy days and Minimum Temperature of first lag week; and rainfall, rainy days, Maximum Temperature and Minimum Temperature of second lag week. PPB is significantly affected by evening relative humidity, mean relative humidity of current week; Minimum Temperature and evening relative humidity of first lag week; and morning relative humidity, Maximum Temperature and mean relative humidity of second lag week. Stem Fly is significantly infested by rainy days and Minimum Temperature of current week; Maximum Temperature of 1st lag week and Minimum Temperature of 2nd lag week (Table3.6.4).

Table 3.6.4 Pre-disposed conditions of BHC, PPB and Stem Fly

Bihar Hairy Caterpillar		Pink Pod Borer		Stem Fly	
RF_0 (mm)	2.6 - 109.4	$IIRH_0$ (%)	67.0 - 85.1	$Rdays_0$	0 - 4
$Rdays_0$	0-6	$AvRH_0$ (%)	79.0 - 92.9	$Tmin_0$ (°C)	18.3 - 26.6
$Tmin_0$ (°C)	19.0 - 22.9	$Tmin\text{-}_1$ (°C)	19.3 - 20.9	$Tmax\text{-}_1$(°C)	26.0 - 33.9
$IIRH_0$ (%)	55.1 - 84.3	$IIRH\text{-}_1$ (%)	65.0 - 85.1	$Tmin\text{-}_2$ (°	19.0 - 26.9
$Rdays\text{-}_1$	0 – 6	$IRH\text{-}_2$ (%)	88.1 - 95.7		
$Tmin\text{-}_1$ (°C)	19.0 - 23.6	$Tmax\text{-}_2$ (°C)	26.1 - 29.8		
$RF\text{-}_2$ (mm)	1.4 - 135.2	$AvRH\text{-}_2$ (%)	79.0-90.0		
$Rdays\text{-}_2$	0.0-7.0				
$Tmax\text{-}_2$ (°C)	25.2 - 32.8				
$Tmin\text{-}_2$ (°C)	19.3 - 23.2				

Spatial Decision Support System (SDSS)

The precision agriculture based soybean insect forewarning advisories has been published and disseminated on ICAR website. The advisories were developed based on Spatial Decision Support System (SDSS) software using and Arc-GIS software to prepare district-wise Insect Incidence Maps of 4 insects to forewarn farmers through soybean advisories using forecasted weather of IMD (Figure 3.6.6).

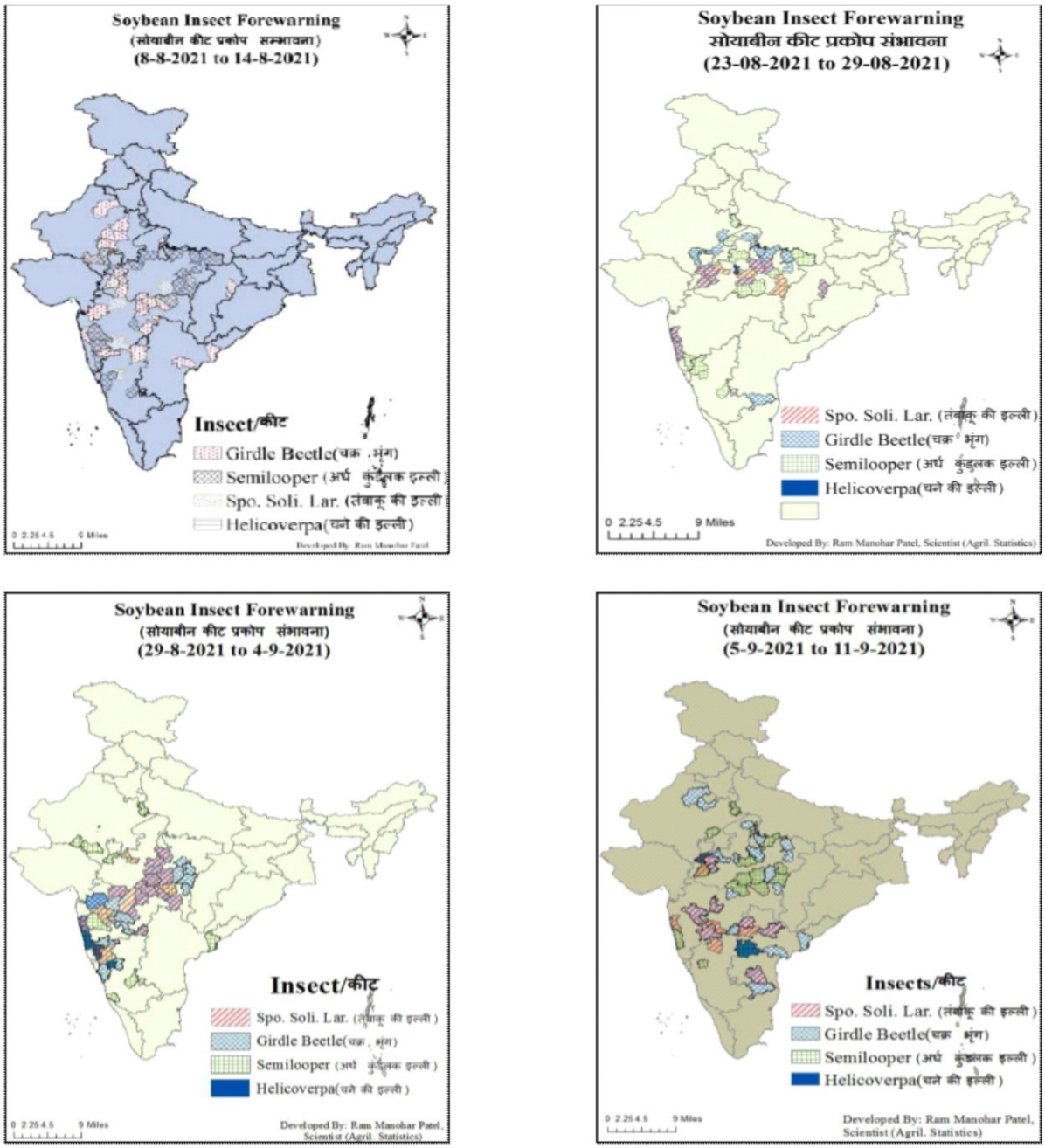


Figure 3.6.6 Incidence maps of four insects of soybean

Decadal cropping pattern and expansion dynamics of soybean in MP

Cropping pattern change analysis (Markov Chain analysis) and Growth rate of major *rainfed* crops, revealed that cotton, sorghum, maize, pearl millet, and other minor crops were the major competing crops to soybean in MP (Figure 3.6.7 and Table 3.6.5). Soybean, initially grown on fallow lands but later replaced less remunerative and adaptive crops. Since 1970s, soybean area has increased by about 800 times (from 7.7 to 6194 thousand hectares), sorghum lost 95% (from 2155 to 108 thousand hectares) of area to other crops (groundnut, finger millets, other oilseeds, pigeon pea and other pulses etc.) but not to soybean directly. The transition probability matrix (TPM) revealed that, soybean area has declined in its shares from previous year, from 100 percent (in 1970-79) to 33 percent (in 2010-19) over the years and becoming less stable. It gained area mainly from current fallows, maize, other minor crops, and cotton.

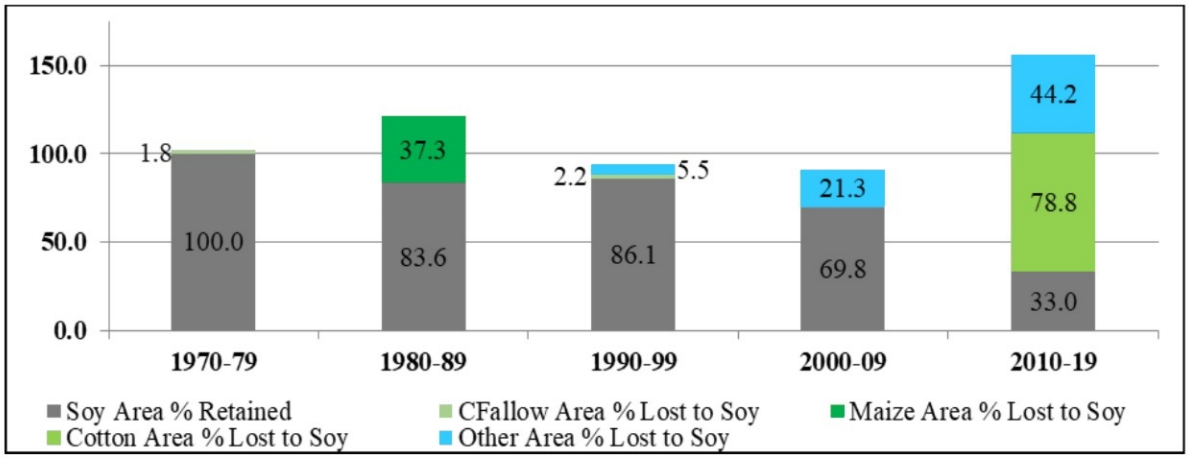


Figure 3.6.7 Decadal Soybean percentage of area retained and gained from others

Table 3.6.5 Decadal growth rates of different crops and current fallow land in Madhya Pradesh

Year	1970-79 (DecadeI)	1980-89 (DecadeII)	1990-99 (DecadeIII)	2000-09 (DecadeIV)	2010-19 (DecadeV)	Overall CAGR
Soybean	56.83	19.94	8.23	2.32	-0.34	12.06
Cotton	-0.79	-1.02	-1.25	2.39	-0.32	-0.10
Sorghum	-0.91	-2.54	-9.22	-4.45	-13.94	-5.52
Maize	2.51	1.28	-0.23	-0.74	6.59	1.06
Pearl Millet	-2.83	-0.78	-4.32	0.37	8.47	0.39
Current Fallow	4.35	0.93	-1.94	-2.79	1.03	-1.38
Other	0.03	-0.39	-0.71	-3.51	-0.35	-1.91

Development of soybean product sale portal

Savita Kolhe

A Web-based seed and product sale portal for soybean has been developed by the institute to promote online marketing using the potential of information technology. The system is developed using ASP.NET at front end and SQL Server at 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 such as Tofu, Milk, Upma mix, Cookies, Sev, Laddu etc. The user can initially book the items to purchase. 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 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 institute website https://iisrindore.icar.gov.in. Farmers and different clienteles 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 soya food uses 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 (Figure 3.6.8).

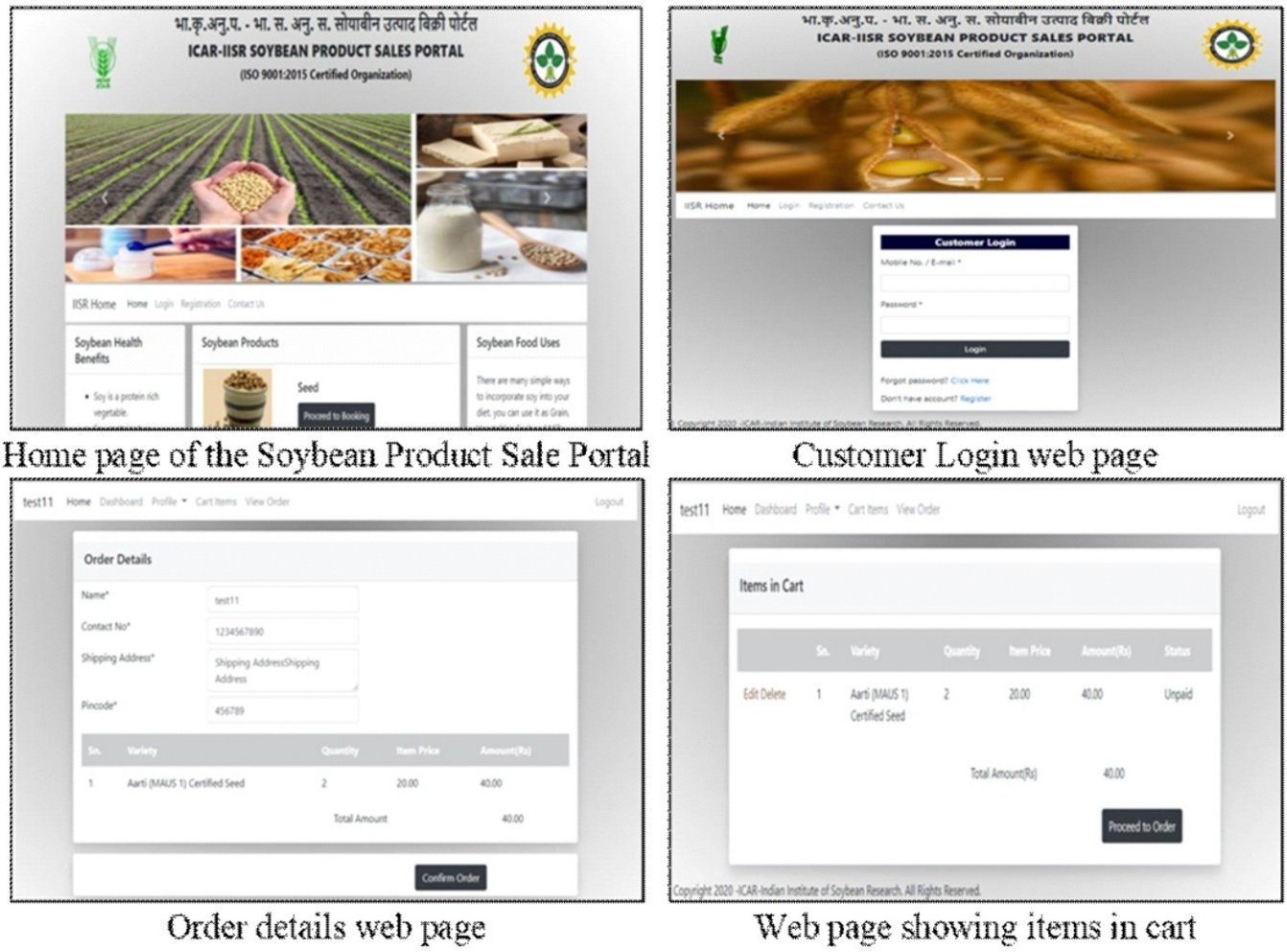


Figure 3.6.8 User interference of Product Sale Portal

4. Transfer of Technology

IISR8.17/20 : Development and evaluation of ICT tools and media for TOT of soybean

PI : B.U. Dupare, Co-PI :Savita Kolhe

Under the ICT initiatives, the institute this year has started using three more social media i.e. Instagram, Twitter, and Telegram channels in addition to a YouTube Channel, Facebook Page, and WhatsApp groups for the flow of information and interaction/feedback technologies among the different stakeholders. A Total of 124 videos comprising different themes has been produced and uploaded on the YouTube channel of the institute and were popularized by sharing on other social media. The playlist includes 42 episodes of ICAR-Madhya Bharat Samachar (Season 2), 20 videos on weekly advisories, 11 videos on Soya Samvad, 23 videos on improved soybean varieties, which also includes 12 videos on varieties developed by AICRPS centers (Figure 4.1).

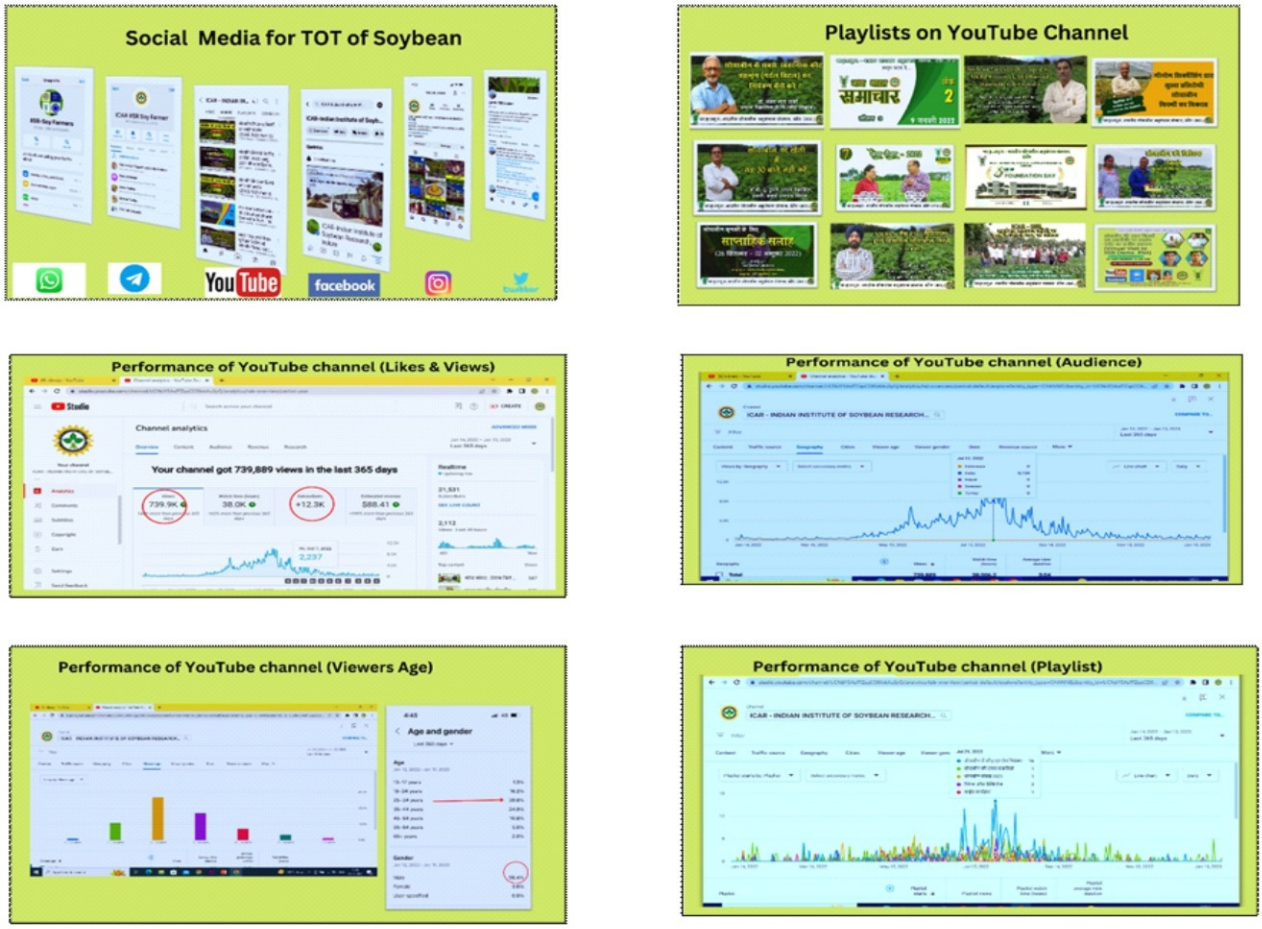


Figure 4.1 Screenshots about the performance of institute's YouTube Channel

Training programmes organized

Training on improved soybean production technologies

B. U. Dupare

From time to time, farmers and other soybean stakeholders visit the institute for capacity building and up-gradation of technical know-how. The visits are usually sponsored through any of the ongoing schemes implemented by the Department of Agriculture of the State. During their visit, they were exposed to the institutional background and technologies developed and recommended for their area along with interaction on pertinent issues. The institute has been conducting online farm seminars on various occasions as per the instruction of ICAR headquarters. The list of training programmes as well as online programmes organized during the year 2022 is given in Table 4.1 and 4.2. The institute has been successful in updating the technical know-how of 542 farmers who visited the institute and also 687 farmers through online programmes.

Table 4.1 Online Seminars & Farmers' training programmes

S. No.	Title	Date	No. of participants
1	Farmers' Seminar on Organic Soybean Production during *AnnadataDevo Bhava Abhiyan*	23.04.22	1000
2	Farmers' Seminar on Food Uses of Soybean during *AnnadataDevo Bhava Abhiyan*	24.04.22	1400
3	Farmers' Seminar during on Biofortication During Kisan *Bhagidari Prathmikta Hamari*	28.04.22	1400
4	Farmers' Seminar: Awareness Programme on Balance Use of Fertilizers in Soybean	20.06.22	825
5	Online Framers' Training on Improved Soybean Production Technology	28.06.22	2200
6	Farmer Scientist Interactive Seminar on Crop Management during Kharif 2022	14.07.22	4400
7	Interactive Session during "Virtual Demonstration on Soybean Varieties and Package of Practices"	27.09.22	3400
8	Farmers' Seminar during PM KisaanSammelan	17.10.22	510
9	Farmers Seminar on "Soil Nutrition in Soybean: Then and now" during World Soil Day	05.12.22	687

Table 4.2 Farmers' Training Programmes on "Improved Soybean Production Technology"

S. No	Date	District	State	Male	Female	Total
1	12.01.22	Bhopal	MP	26	0	26
2	23.02.22	Bara	Rajasthan	42	0	42
3	23.2.22	Ujajin	MP	0	28	28
4	25.02.22	Ujajin	MP	41	0	41
5	26.02.22	SawaiMadhopur	Rajasthan	50	0	50
6	28.02.22	Navada Bihar	Bihar	42	0	42
7	08.03.22	Bundi	Rajasthan	45	0	45
8	11.03.22	Mandsaur	MP	10	0	10
9	15.03.22	Mandsaur	MP	0	30	30
10	22.03.22	Jhalawad	Rajasthan	50	0	50
11	23.03.22	Khargone	MP	50	0	50
12	23.03.22	Mandsaur	MP	9	0	9
13	26.03.22	Bihar UP	Bihar&UP	22	0	22
14	20.07.22	Ujjain	MP	40	0	40
15	14.11.22	Khandwa	MP	10	0	10
16	07.12.22	Baran	Rajasthan	47	0	47
			Total	**484**	**58**	**542**

Conducting demonstrations, trainings and impact assessment of permanent broad bed furrow technology on farmers' filed

Rakesh K. Verma, N. Khandekar, Raghavendra Nargund, Lokesh Meena

Stagnant soybean productivity and production over the year in the wake of the change in the monsoon pattern, and with the growing importance of sustainable agriculture this project was undertaken. Training of 400 (10 trainings of 40 farmers each) beneficiaries from ITC's project villages from five districts of Madhya Pradesh such as Indore, Ujjain, Sehore, Dewas and Vidisha was held at the institute during *kharif and rabi,* 2022 on soybean-wheat cropping system. The topics covered the detailed package of practice. Demonstrations were initiated in1acre plots for validation, dissemination and popularization of the broad bed furrow technology for sustainable development. Control plots were also identified in the same districts. Field visits were conducted to monitor the progress. The use of BBF along with the improved package of practices led to an improvement in the yield of the respondents.The results of the field demonstrations revealed that the highest yield of soybean was registered under the broad bed furrow crop establishment method (BBF, demonstration plot) as compared to farmer's practices or without BBF in all districts (Figure 4.2. & 4.3). Overall, irrespective of the district's the average seed yield of soybean was 25.2% higher under BBF as compared to farmer's practices or without BBF. The cost of cultivation was 5.3% more under farmer practices or without BBF as compared to demonstration plots.

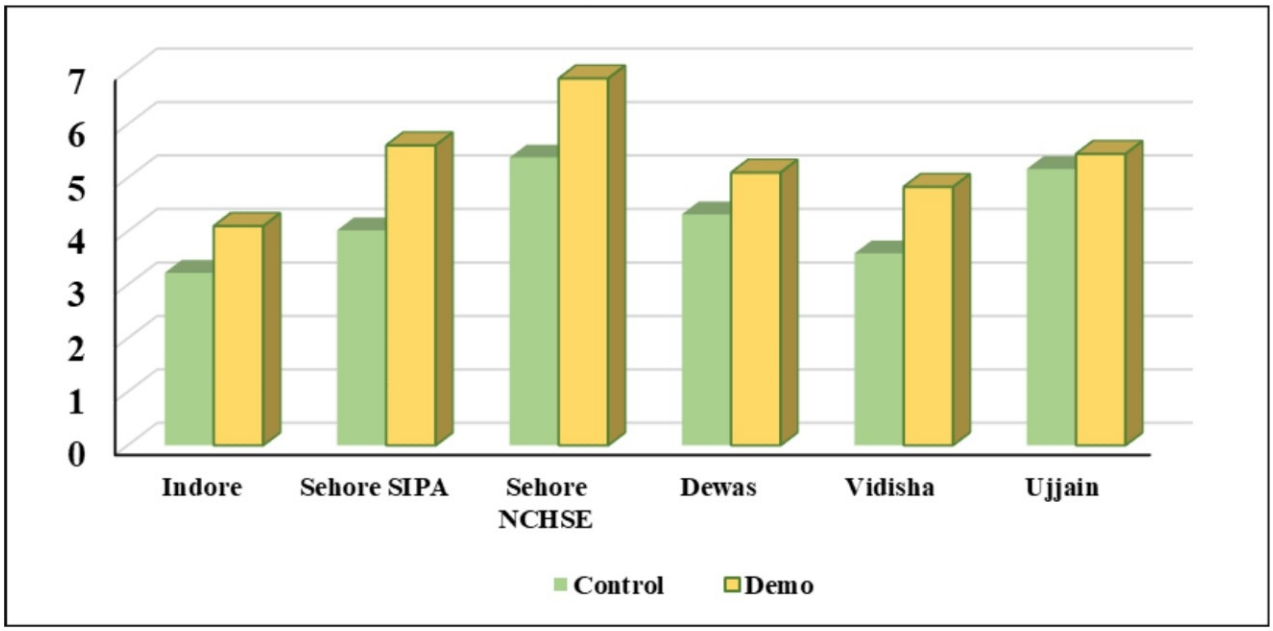


Figure 4.2 Average soybean yield (q/acre)

Figure 4.3 Glimpses of training programmes

Figure 4.4 Monitoring of demonstration plots at different districts of Madhya Pradesh

Climate smart technologies in soybean

To ensure right guidance and to keep farmers abreast with the technological developments five one-day training programmes were organized between July 25-29, 2022 by the institute under ITC Limited's 'Mission Sunehra Kal'. The training was organized at the institute under which more than 200 farmers from the Indore, Ujjain, Bhopal, Sehore, Dewas, and Vidisha districts of Madhya Pradesh were trained on the advanced technological interventions in soybean in the wake of climate change. Dr Rakesh Kumar Verma (Agronomy) the nodal officer of the initiative along with Dr Raghavendra Madar, (Agronomy), Dr Laxman Singh Rajput (Plant Pathology), and Dr Lokesh Kumar Meena (Entomology) covered all the important aspects. The farmers were also taken to the demonstration field of the institute.

Processing and byproduct utilization of soya-based products

The possibilities for wider utilization of "Golden Bean" soybean has not only attracted the farmers of the country but has also provided business opportunities for the food industry. In the light of this scenario, a three-day training program was organized from August 4-6, 2022 at the institute for budding entrepreneurs in food start-ups. Dr Mahaveer Prasad Sharma, Principal Scientists (Microbiology), Dr Manoj Shrivastava (Biochemistry-Plant sciences), and Scientist Dr Neha Pandey (Food technology) were the main trainers and discussed about the soy products like soy paneer, soymilk, tofu, soy-made bakery products, and their by-product utilization. During this three-day training program four trainees from Bangalore (Karnataka), Parbhani (Maharashtra), and Kanpur (Uttar Pradesh) participated. In addition to this, the trainees were also exposed to the Agri-business Incubation Center of the institute, and explained the health benefits of soybean and soy-based food products. On the successful completion of the training program, the trainees were awarded a certificate by the Director of the institute, Dr Nita Khandekar. Dr Khandekar assured the trainees of all possible assistance for the smooth beginning of a successful enterprise.

5. Events and Meetings

Events

Germplasm day

ICAR-IISR, Indore and University of Agricultural Sciences (UAS), Bangalore jointly organized Germplasm day on April 23, 2022. Dr Rajendra Prasad, Vice-Chancellor, UAS, Bengaluru, Dr Nita Khandekar, Acting Director, ICAR-IISR Indore, Director Research, UAS, Bengaluru, Dr Sanjay Gupta, Principal Scientist & Incharge, Crop improvement, Dr Gyanesh Satpute, Principal Scientist, Dr Subhash Chandra, Scientist, Dr Rajesh Vangala, Scientist, from ICAR-IISR, Indore, along with scientists from the AICRP centres of Imphal, Kasbe Digaraj, Pune, Amravati, Parbani, Dharwad, Morena, Sehore and Adilabad participated in it. Interested faculty and students of UAS, and ICAR-IIHR, Bengaluru also attended the event. About 8000 germplasm accessions were grown for display. Dr Rajendra Prasad explained the importance of the germplasm maintenance. Dr Khandekar briefed about the importance of this collaboration in the wake of creating a mini-core of soybean under the Indian conditions for use by scientists. All the collaborators made observation of the material for their research.

Soya Mahakumbh- 2022

A three-day fair cum exhibition – 'Soya Mahakumbh' a conglomeration representing different stakeholders, soybean growers, scientists, officials from development departments was jointly organized by the ICAR-IISR, Indore; Society for Soybean Research & Development, Solidaridad, Bhopal and SOPA, Indore from May 29-31, 2022. The theme of the fair was '*Aatm se Atmnirbhartaki Aur*' with the aim of achieving self-sufficiency in oilseeds. The programme was inaugurated by the Hon'ble Union Minister of State for Agriculture, Shri Kailash Chaudhary in the presence of Shri Kamal Patel, Minister of Agriculture, Madhya Pradesh; Hon'ble Shri Shankar Lalwani, Member of Parliament; Dr TrilochanMohapatra, Secretary, DARE & DG, ICAR, New Delhi; Dr Sanjeev Gupta, ADG (OP), ICAR, New Delhi; Dr Renu Jain, Vice Chancellor, DAVV, Indore; Dr Nita Khandekar, Director, ICAR-IISR, Indore; Smt Priya Pagnis, Solidaridad, Bhopal; Shri D.N. Pathak, SOPA, Indore; Dr Sanjay Gupta, President, SSRD, Indore, Dr Mahaveer Sharma, General Secretary, SSRD, Indore and other eminent personalities.

The chief guest of the function, Hon'ble Union Minister of State for Agriculture, GOI Shri Kailash Chaudhary applauded the hard work and contribution of farming community in the country's economy especially during the pandemic. He appreciated the scientists in the development of 164 soybean varieties suitable for different agro-climatic conditions of the country. The guests of honour Shri Kamal Patel, Minister of Agriculture,

Madhya Pradesh informed that the maximum limit on purchase through MSP has been removed which has benefited the famers of the state. In his address, Shri Shankar Lalwani, Hon'ble Member of Parliament said that the Union Government is committed to protect the interest of small and marginal farmers, the backbone of agricultural economy. Dr T. Mohapatra, Sec. (DARE) & DG (ICAR), New Delhi expressed his concern on the stagnating productivity over the last decade. He said that, the quality seed production and its efficient multiplication alone can increase the soybean productivity by 20%. He called for increasing the Varietal Replacement Rate in order to have varietal diversification especially considering the prevailing aberrations.

During the occasion, the dignitaries launched 'Eco-friendly edible soya bowl released a technical bulletin on 'Technology for Increasing the Soybean Productivity' and latest variety seeds under the brand name 'ISKA' produced under the 3S1Y project, an off-location off-season initiative to develop a model. Fifteen progressive and innovative farmers from different parts of the contry were felicitated by Dr Mohapatra. On second day two technical sessions were organized on 1) Fantastic Seven-Soybean in food, feed, fodder, fertilizer, medicinal and cosmetics 2) Modern extension systems for sustainable soybean production were organized. About 5000 farmers attended the event in person and an equal number via online mode. The exhibition had 54 stalls representing ICAR institutes, development departments, public & private sector organizations and input industries. The scientist-farmers interface and exhibition including interaction with the stall representative were telecast live on all the three days reaching audiences across the length and breadth of the country. The last day of Soya Mahakumbh, the farmers also attended live webcast of "Distribution of Kisan Samman Nidhi" and "Garib Kalyan Sammelan" programme wherein Honb'le Prime Minister Shri Narendra Modiji has deposited Rs 11,000 crore directly in the bank account of the small and marginal farmers of the country. The webcast programme was conducted in the auspicious presence of Honb'le Shri Shankar Lalwani ji, Member of Parliament from Indore.

36th Foundation day

The Institute celebrated its 36th Foundation Day on December 11, 2022. Vice-Chancellor of Devi Ahilya Vishwavidyalaya Dr Renu Jain graced the occasion as the chief guest, former director of the institute Dr V.S. Bhatia, was the guest of honour whereas Dr S.P. Tiwari, Former Vice-Chancellor, Swami Keshavan and Rajasthan Agricultural University, Bikaner; former director, ICAR-IISR, Ex-DDG (Edn.) and Ex-DDG (CS), ICAR, New Delhi presided over the function. Dr K.H. Singh, Director of the institute presented the year's achievement. The chief guest of the function Dr Renu Jain, said that Devi Ahilya Vishwavidyalaya is looking forward to signing an umbrella MOU with the ICAR-IISR mutually benefiting the university scholars as well as soya farmers in general. The former director of the institute, Dr V.S. Bhatia said that in the last 35 years, the institute has developed a number of varieties with desirable traits like high yield and food grade characters which need to be promoted through the formal extension mechanisms. Dr S.P. Tiwari expressed the need of commercializing soybean varieties and technologies using various approaches including policy measures so that farmers can get maximum economic benefits. During the programme two extension folders on 'Seed germination test' and 'Seed Storage' and 'Extension bulletin' were released. Three progressive soybean farmers were also felicitated. Acknowledging the efforts of institute staff outstanding scientist award were conferred to Dr Giriraj Kumawat and Dr B.U. Dupare while Shri Shyam Kishore Verma and Shri Shakti Pal Singh Verma were awarded in the technical and administrative category, respectively. A farmer-scientist interaction was also organized wherein farmers from Indore, Khargone, Dhar, and Shajapur districts participated.

Talks/Seminars/Webinars/Field Day/Interaction meets

Raising drought and salinity tolerant crops: Learning lessons from mother nature

Prof. Ashwani Pareek, Executive Director, National Agri-Food Biotechnology Institute (NABI, DBT, Govt of India), Mohali, delivered a talk on 'Raising drought and salinity tolerant crops: Learning lessons from mother nature' on July 4, 2022 for scientist and students. The lecture was educative and described use of various molecular biology tools in crops. He also talked about the use of RNAi and CRISPR/Cas9 technology for developing abiotic stress tolerant cultivars. He interacted with the scientists about the research work at the Institute and possible collaboration with NABI.

Awareness programme on Protection of Plant Varieties and Farmer's Rights (PPV & FR) Act 2001

The ITM unit of the Institute in collaboration with Krishi Vigyan Kendra, Kasturbagram, Indore organized an online webinar to spread awareness on 'Rights and Protection of Plant Varieties and Farmers act 2001' among the farming community on Sept. 01, 2022. Farmers from all over the country participated in the programme. Dr Dinesh Kumar Agrawal, Registrar General, PPV &FR, was the guest speaker. Dr Agarwal appraised the farmers that they could register the traditional varieties as well as the variety developed by them so that their rights are protected. Dr Agrawal answered all the doubts and questions of the farmers. Dr M.P. Sharma convened the webinar, Dr Mrinal Kuchlan, Scientist, ICAR-IISR and Dr Alok Deshwal, KVK, Kasturbagram were the Co-convener.

Bodoland Territorial Council, Assam

Hon'ble Shri Ghanshyam Das, Executive Member, Agriculture Department of Bodoland Regional Council and Dr Manoranjan Das, Director, Agriculture Department and progressive farmers from Assam visited the institute on 29 June 2022. ICAR-Indian Institute of Soybean Research, Indore has been emphasising the need to increase the area under soybean production in various regions of the country. As part of the initiative of expansion of soybean in the non-traditional areas the potential of soybean cultivation in the Bodoland territorial region of Assam is being explored on an experimental basis. The team interacted with the scientists of the institute and discussions on the modus operandi were held with the main focus on how the crop is to be introduced in the Bodoland region. Considering the possibilities of introduction of soya-based food products the team also visited the Agri-business incubation centre of the Institute. The institute assured all possible assistance related to the production of soybean in the Bodoland region.

A-IDEA-National Academy of Agriculture Research Management (NAARM), Hyderabad

Government of India has launched a scheme of Technology Business Incubation (TBI) to help entrepreneurs to ideate, incubate, and accelerate innovative early-stage start-ups and further scale their capacities to become competitive ventures. One of such incubator “a-IDEA” is being operated at ICAR- NAARM, Hyderabad the Chief Executive Officer & Principal Scientist of the scheme, Dr S. Senthil Vinayagam visited the institute on September 24, 2022. During his visit, an interactive session was organized, in which scientific, technical staff, and youth (JRF, SRF, and YP) participated. Dr Vinayagam informed that through an “a-IDEA” project NAARM is providing guidance and finance to youth for innovative business in the field of agriculture. He called upon the youth to take full advantage of such schemes and become self-dependent financially by

establishing their own businesses. He also visited the institute's Agri-Business Incubation (ABI) centre and took a brief on ongoing activities like making tofu (soy paneer), soy cookies, soy namkeen, and liquid microbial formulation for seed treatment.

Soybean-wheat cropping system field day

A field day was organized at the Village Kiloli of the tehsil Badnagar of district Ujjain under the soybean-wheat cropping system under Scheduled Caste Sub Planon 24th February 2022.Demonstrations using conservation technologies had been laid under the guidance and critical inputs from the institute. Dr Nita Khandekar, Acting Director along with Dr Gyanesh Satpute, Principal Scientist, Dr Giriraj Kumawat, Senior Scientist and Dr Rakesh Kumar Verma, Scientist, interacted with the farmers and advised on the advanced production technologies. All the demonstration plots were visited and discussion held at the field to encourage the participating farmers to also adopt the innovative technologies. A total of 75 farmers attended the event.

Sugarcane-Soybean intercropping interface meet, field day and exhibition

Intercropping of soybean in sugarcane is being promoted for off season soybean production and to maximize profits of farmers. ICAR-ATARI, Bengaluru in association with KLE Society, Belagavi, ICAR-KrishiVigyan Kendra, Mattikopp (KVK-Belagavi-II), ICAR-IISR, Indore, ICAR-SBI, Coimbatore and CB Kore Sahakari Sakakre Kharkhane Niyamita, Chikodi organized Soybean & Sugarcane Farmer-Scientist- Industry Interface Meeting at Shivalaya, Ankali, Chikodi on March 14, 2022. The programme was inaugurated by Shri B.C. Patil, Hon'ble Minister of Agriculture, Govt. of Karnataka, Bengaluru. Speaking on the occasion, the Minister emphasized to increased production of soybean by extending the area in new regions and enhancing the productivity in the existing area. He stressed for adoption of soybean based intercropping system to boost the soybean production. Dr Prabhakar Kore, Ex-MP, Rajya Sabha and Chairman KLE Society, Dr Venkata Subramanian, Director ATARI Zone-11, Bengaluru, Dr Nita Khandekar, Acting Director, ICAR-IISR, Indore, Scientists from ICAR-SBI Coimbatore and several other dignitaries graced the occasion. Dr Khandekar also addressed the farmers and encouraged them to take soybean for seed production with sugarcane. More than 1500 farmers participated in the event and also visited the exhibition and the fields.

Scientific Meetings

36th Institute Research Council

The meeting of the Institute Research Council (IRC) of ICAR-IISR was held during April 21-22, 2022. Dr Nita Khandekar, Chairman of IRC & Director ICAR-IISR chaired the session, while Dr Sanjeev Gupta, ADG (OP) presided over the two-

day meeting. Dr Y.S. Shive. Principal Scientist (Agronomy), IARI, New Delhi, Dr A.P. Ruhil, Principal Scientist (Computer Science) ASRB, New Delhi, Dr M.S. Yadav, Principal Scientist (Pathology) NCIPM, New Delhi were the experts in their respective disciplines. The Member Secretary, Dr Manoj Srivastav presented the action taken and an overall brief of IRC. The ADG (OP) emphasized the need to make plans for quick multiplication and distribution of seed of newly developed varieties. He added that emphasis should be given on incorporating stress tolerance and disease resistance in varieties. Special emphasis also be given to adaptation of traits like photo-thermo-insensitivity, long juvenility etc. The expert members, also gave suggestions on the futuristic role of the institute with regard to basic and strategic research.

52nd Annual Meeting - All India Co-ordinated Soybean Research Project

The Annual Group Meet of the All India Coordinated Research Project (AICRP) on Soybean was organized during May 17-18, 2022. Dr T. R. Sharma, DDG (CS), ICAR, New Delhi was the Chief Guest and Dr Sanjeev Gupta, ADG (OP), ICAR, New Delhi, was the guest of honour in the inaugural session. Dr Nita Khandekar, Director, ICAR-IISR, Indore presented the overall achievements. The meet was conducted under the chairmanship of Dr T.R. Sharma and Co-Chairmanship of Dr Sanjeev Gupta with Dr Prabhakar (Genetics & Breeding) and Dr Malligwad L. (Agronomy) as experts in their respective disciplines. Seven technical sessions covering disciplines of Breeding, Agronomy, Pathology, Microbiology, Food Technology, Breeder Seed Production and Transfer of Technology were held. The principal investigators of the respective disciplines presented the research achievements-2021. The breeder seed production programme was reviewed and variety wise demand for the coming year was finalized. The frontline demonstrations of technologies across the country were also presented. Concerns on the yield gaps were raised and discussion on bridging the same were held. The progress under the Tribal Sub-Plan Scheme with the basic objective of improving the livelihood status of the marginalized tribal farmers was reviewed. The technical programme for the coming soybean season were also finalized. During the AGM, the specially constituted Varietal Identification Committee recommended identification of six soybean varieties, suitable for cultivation in three agro-climatic zones of the country. NRC 150, NRC 152, JS21-72, HIMSO 1689 were identified for Central Zone, NRC 149 was indentified for Northern plain Zone and VLS99 was identified for Northern Hill Zone. The meet was attended by about 150 scientists from the AICRP centres across the country as well as invited stakeholders.

25th Research Advisory Committee meeting

The 25th Research Advisory Committee meeting of ICAR-Indian Institute of Soybean Research, Indore was held during September 8-9, 2022. The meeting was held under the Chairmanship of Dr S.K. Sharma, Ex-Vice Chancellor, Himachal Pradesh KrishiVishwavidyalaya, Palampur with Dr K.R. Kaundal, Ex-Director, NRCPB, IARI, New Delhi, Dr T.K. Adhya, Ex-Director, ICAR-NRRI, Cuttack, Dr O.P. Sharma, Ex Director, ICAR-NCIPM, New Delhi, Dr Sanjeev Gupta, ADG(OP), ICAR, New Delhi as members. A comprehensive report about the overall research and development activities was presented by Dr Sanjay Gupta, In-charge Director, The Secretary of the RAC, Dr Mahaveer Prasad Sharma presented the action taken report of the recommendations of previous meeting. The Chairman, Dr S.K. Sharma suggested that there is a need for to incorporate photo-thermal insensitivity in soybean and collaborate with other institutions for research and development programme. He emphasized the need for skill upgradation of the scientists. Dr Sanjeev Gupta, ADG (OP), ICAR said that suitable soybean varieties should be developed to diversify rice-wheat-based cropping systems of North India. He highlighted the need to address issues related to deficiency of micronutrients like zinc, molybdenum, iron, and sulphur. The committee members appreciated the efforts made by the institute. The committee also undertook field visit to the research farm as well as nearby village and interacted with soybean farmers.

Azadi ka Amrit Mahotsav –programmes commemorating 75 years of India's independence

Annadata devo bhav abhiyan

An awareness programme under the "Azadi Ka Amrit Mahotsav" was organized at the Institute virtually on April 23, 2022 in association with Solidaridad and ITC Limited. Dr Vineet Kumar, Principal Scientist presented a talk on 'Bio-fortification of Soybean for food uses' appraising the participant of suitable varieties as well as method of domestic level preparation of various food items from soybean that are easy viz; soymilk, soya paneer (tofu), soya flour, soya nuts, soya pakoras, sev, mathri, papad, biscuits, chakli, shakkarpare etc. More than 750 soya farmers/women associated with the institute, Solidaridad, Bhopal and ITC Ltd. participated in the seminar. Dr Nita Khandekar, Acting Director highlighted the lack of protein in the diet of rural people of the country leading to various malnourishment related problems and the need for inclusion of soybean-based foods in the diet as a worthwhile solution. Mr Bhuvnesh, I.T.C. Ltd., Madhya Pradesh and Dr Suresh Motwani of Solidaridad Bhopal, gave a brief about the programmes being carried out in the field of technology transfer with the ICAR-IISR for increasing the soybean production among the farmers.

Kisan bhagidari prathmikta hamari abhiyan

The Institute organized a Nationwide Campaign through a webinar on 'Biofortification' on April 28, 2022 jointly in association with IARI Regional Centre, Indore; Solidaridad, Bhopal and ITC Limited, Madhya Pradesh. The webinar was attended by more than 650 soya farmers. Dr B. U.Dupare, Principal Scientist and convenor briefed about nutritional and anti-nutritional properties of soybeans, processing technology suitable bio-fortified soybean, varieties suitable for soy food for promotion in rural areas. Mr Bhuvnesh, of ITC Limited Madhya Pradesh as well as Shri HimanshuBais, Solidaridad, Bhopal also participated in the event. Dr Raghavendra Madar and Dr Rakesh Kumar Verma spoke on 'Bio-fortification of Soybean by Agronomic Techniques', and discussed about the use of zinc and iron element for increasing the availability of micronutrients in the crop.

National Campaign

17th '*Parthenium hysterophorus*' awareness week

Parthenium hysterophorus is known by different names in different parts of the country. It is one of the most persistent weeds and the ill effects of which have been seen mainly in the form of reduction in crop production and diseases like eczema, asthma, and allergies etc. in humans. To get rid of the problems caused by this grass a week-long awareness program was organized across from August 16-22, 2022. In the week-long programme, a session was organized at the institute re, in which Dr Rakesh Kumar Verma, Scientist (Agronomy) appraised the personnel about the problems caused by *Parthenium heterophorias*. Different events like cleaning of fields, cleaning of campus etc were also held

Kisan samman nidhi 2022- II &agri start-up conclave

The Prime Minister's programme 'Kisan Samman Nidhi 2022-II and Agri Start-up Conclave' which was inaugurated by the Prime Minister Shri Narendra Modi in the presence of Shri Narendra Singh Tomar, Minister of Agriculture & Farmers Welfare and Shri Mansukh Mandaviya, Minister of State for Chemicals and Fertilizers of India, at ICAR-IARI, New Delhi on October 17, 2022 which was live webcast by the institute. Hon'ble Lok Sabha M.P., Indore, Shri Shankar Lalwani, Rajya Sabha M.P., Smt Kavita Patidar and 54 farmers were physically present at the institute to attend the programme. A total of 350 farmers joined the event including those who joined the institute webcast virtually. Shri Shankar Lalwani Ji, Hon'ble MP of Indore apprised the house about the new "One Nation - One Fertilizer" policy of the Government of India. Smt Kavita Patidar Ji informed that the Government of India had implemented various farmers' welfare schemes in the last eight years. She appreciated the role of farmers in sustaining the Indian economy during the corona period. Dr Sanjay Gupta, Director-in-Charge urged the farmers to adopt new technologies developed by the institute.

Swacchta pakhwada 2022

The Institute celebrated 'Swachhta Pakhwada 2022' from December 16-30, 2022 and conducted various activities. During the inaugural programme of Swacchta Pakhwada, all the scientific, administrative, and technical staff led by the director of the institute Dr K.H. Singh, took oath of a clean and green India. Banners on the theme were displayed at various locations of the city and institute. A cleanliness drive was conducted at the institute and the residential campus of ICAR-IISR, Indore. Poster and essay competition were organized for the students of Shri Ram Convent School, Musakhedi, Indore. The programme was concluded with the prize and certificate distribution to the winners during the valedictory programme organized.

Har ghar tiranga abhiyan

ICAR-IISR, Indore organized various activities from August 13-15, 2022 under the "Har Ghar Tiranga" campaign, celebrating the completion of 75 years of independence of the country with great fervour. Under this a team lead by Dr B. U. Dupare conducted awareness among student of the Shri Ram Convent School, Musakhedi, Indore with regard to the struggle our country went through to attain freedom in 1947. Dr Dupare appealed to the students, stating that the country is tied together in one thread despite its diversity of languages and communities and all should show solidarity by hoisting the national flag '*Tiranga*' at their homes. In addition to this, employees came out in the streets of the city in a two-wheeler rally. The rally was led by the Director and raised slogans of patriotism to motivate and remind the citizens of the city to hoist the tri-colour in every home and building.

International yoga day

The institute celebrated the International Yoga Day on June 21, 2022, the longest day of the year in the northern hemisphere (shortest in the southern hemisphere), having special significance in many parts of the world. In Indian calendars, the summer solstice marks the transition to Dakshinayana. The day is aimed to raise awareness world-wide of the many benefits of practicing yoga. A yoga session was organized under the guidance of Smt Mandeep Kaur, Yoga expert who encouraged the staff to practice yoga. The event was attended by 118 participants online and in person. Dr Savita Kohle convened the event.

Memorandum of Understanding signed

ICAR-IISR, Indore and NABI & CIAB, Mohali

The institute signed the MoU with the National Agri-Food Biotechnology Institute (NABI) and Centre of Innovative & Applied Bio-processing (CIAB), Mohali, Punjab under the Department of Biotechnology, Government of India to mutually benefit from the strengths of the respective Institutions on July 19, 2022. Dr Nita Khandekar, Acting Director and Dr Ashwani Pareek signed the MoU on behalf of their respective institutes in the presence of Dr M. P. Sharma Chairmen, ITMU and other scientists of IISR. The main areas of the collaboration envisioned are training of ICAR-IISR Scientists in the field of CRISPR/Cas genome

editing technology for soybean improvement, development of sensor-based technology for detection and quantification of microbes in bio-fertilizer formulations, encapsulation of bacteria in hydrogel and characterization of its efficacy & stability using the sensor-based technology, isolation and characterization of triacontanol as bio-stimulant for soybean production, estimation of kunitz trypsin inhibitor in the recently released soybean varieties, and characterization of soybean food products for its shelf-life and storability.

ICAR-IISR, Indore and ITC Limited

The institute signed an MoU with ITC Limited on July 23, 2022 for improving the adoption of climate smart technologies for improving the productivity and consequently the status of farmers. Shri Akhilesh Kumar Yadav (Regional Manager), Shri Nilesh Patkar (Program Officer), Shri Sahyog Tiwari (Program Executive), and Shri Prasad Deshkar (Accountant) from ITC, Bhopal were present on this occasion. Highlighting this memorandum Dr Nita Khandekar, Director (A) of the institute, said that under this MoU, various farmers of Indore, Ujjain, Dewas, Sehore, and Vidisha districts of the state would be trained by the institute. The training will focus on the proper use of BBF and climate-smart technologies. Demonstrations as well as monitoring shall also be carried out by the institute scientist for improving the productivity under the Soybean-Wheat cropping system under the BBF crop establishment.

Staff Trainings

Reservation roster for administrative employees

A three-day training session for capacity building was organized by the institute from August 29-Sept. - 01 Oct. 2022 on 'Reservation Roster for Administrative Employees', in which participants from various regions participated and improved their knowledge. The Chief Administrative Officer of ICAR-Central Sheep & Wool Research Institute, Avikanagar, Jaipur, Shri I.B. Kumar was the master trainer. The public appointments under the reservation policy of the Government of India reservation roster creation and maintenance of reservation registers according to the posts were the main topics covered. Demonstration session, on calculation of vacancies, compassionate appointments, reservation roster upgradation preparation of reservation rosters on the basis of posts, as well as, maintaining L-shape roster were held. All the participants were awarded certificates on the successful completion of the training.

Distinguished Visitors

1. Dr T. Mohapatra, Secretary, Department of Agricultural Research and Education& Director General, Indian Council of Agricultural Research, New Delhi, May 29, 2022.

2. Dr T. R. Sharma, Deputy Director General (Crop Science), Indian Council of Agricultural Research, New Delhi, May 17, 2022.

3. Prof. Ashwani Pareek, Executive Director, National Agri-Food Biotechnology Institute (DBT, Govt of India), Mohali, July 04, 2022.

4. Dr S. Senthil Vinayagam, CEO, ICAR-NAARM Agriculture Innovation unit a-IDEA. Sept 24,2022.

6. Ongoing Research Projects

Project No.	Duration	Project Title	PI/CC-PI
CROP IMPROVEMENT			
Mega theme-Soybean genetic resource management - Acquisition, conservation, characterization, documentation and utilization			
NRCS 1.1/87	1987-LT	Augmentation, management and documentation of soybean germplasm	Dr Sanjay Gupta
Mega theme- Genetic improvement of soybean for yield, agronomic traits, resistance to biotic stresses and improvement in quality of soybean seed			
NRCS 1.6/92	1992-LT	Hybridization, selection and development of multi -parent population for genetic improvement of yield potential in soybean	Dr Shivakumar M
IISR 1.33/16	2016-LT	Development of YMV resistant soybean varieties using marker assisted selection	Dr Anita Rani
IISR 1.35/17	2017-2022	Improvement in soybean seed viability and strength of seed coat by genetic amelioration of seed coat traits	Dr P. Kuchlan
IISR 3.11b/18	2017-2022	Soybean improvement against charcoal rot and anthracnose diseases	Dr Nataraj V
IISR 1.34/17	2018-2023	Enhancing disease resistance in soybean using genomic approaches	Dr Milind B. Ratnaparkhe
IISR 3.12/19	2019-2024	Soybean improvement against defoliating insects	Dr V. Rajesh
IISR 3.13/19	2019-2024	Evaluation of germplasm and breeding for collar rot disease caused by *Sclerotium rolsfsii* Sacc in soybean	Dr R. Ramteke
Mega theme- Managing the impact of current and future climate variability in soybean			
DSR 5.6a/08	2009-2021	Breeding for drought resistance / tolerance varieties in soybean	Dr G. K. Satpute
DSR 5.6b/18	2018-2023	Soybean breeding for waterlogging tolerance	Dr S. Chandra

IISR 3.14/20	2020-2025	Characterization of abiotic stress tolerance factors in soybean using biochemical and molecular approaches	Dr Manoj Kumar Srivastava
ISSR 3.16/21	2021 2026	Identification of genes/loci for better root system in soybean	Dr Giriraj Kumawat
Mega theme- Development of specialty soybean varieties for secondary agriculture and industrial uses			
NRCS 1.12/02	2002-LT	Breeding for food grade characters and high oil content	Dr Anita Rani
IISR 3.15/2020	2020-2024	Development of genome edited soybean lines with improved oil quality	Mr Viraj Kamble
ISSR 3.18/21	2021-2024	Black soybean for nutritive value and further uses as biofortification agent	Dr Manoj Srivastava
CROP PROTECTION			
Mega theme- Surveillance, forecasting and control strategies for insect pest complex in soybean			
New Project	2022-2027	Soybean improvement against Rhizoctonia aerial blight disease	Dr L axman Singh Rajput
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
CROP PRODUCTION **Mega theme- Development of technologies for soybean based cropping system efficiency enhancement through resource conservation technologies, nutrient management, plant growth promoting microbes and farm machineries**			
IISR 3.12/2020	2020-2023	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	Sh. Hemant Maheshwari
IISR 9.9/17	2017-2020	Design, development and validation of (A) Tractor PTO operated root stock cutting/shaving machine (B) Tractor PTO operated root stock picking machine to prevent burning of root stock for	Dr Devvrat Singh

IISR 4.13/17	2022-2027	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	Dr Rakesh Kumar Verma
IISR 4.14/18	2018-2023	Agronomic biofortification of micronutrients in conservation agriculture based soybean-wheat cropping system	Dr Raghavendra M
IISR 9.10/2019	2019-2022	Predicting the incidence of stem fly, pod borer, and Bihar hairy caterpillar in soybean- A Geo-spatial approach	Sh. R. M. Patel
IISR 9.11/20	2020-2023	Field evaluation of potential plant growth promoting rhizobacteria (microbial consortia) on nutrient dynamics and mineral biofortification under soybean-wheat cropping system	Dr A. Ramesh
EXTENSION			
Mega theme- Information digitization, technology dissemination, impact analysis and socio-economic research for soybean			
DSR 7.6/19	2019-2022	Development of field monitoring support system for All India Co-ordinated Research Project trials.	Dr Savita Kolhe
IISR 8.17/20	2020-2025	Development and evaluation of ICT tools and medias for TOT of Soybean	Dr B. U. Dupare

EXTERNALLY FUNDED PROJECTS

DAC, Government of 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	2018-2022	Creation of Seed Hubs for enhancing quality seeds availability of major oil seed crops under NFSM-Oil Seeds	Dr Mrinal K. Kuchlan
NASF, ICAR	2018-2022	Genomics strategies for improvement of yield and seed composition traits under drought stress conditions in soybean	Dr Milind B. Ratnaparkhe

SERB, DST Govt. Of India	2022-2025	Genomics strategies for improving anthracnose resistance in soybean (*Glycine max* L.)	Dr Milind B. Ratnaparkhe
DBT, Government of India	2022-2025	Expansion of activities of biotech -KISAN hub in eight aspirational districts in Madhya Pradesh – Phase II	Dr Nita Khandekar
SERB, DST Govt. Of India	2019-2022	Development of laser biospeckle technique for applications in agriculture	Dr Laxman Singh Rajput
DBT, Government of India	2020-2023	Accelerated development of Kunitz trypsin inhibitor free soybean genotypes with charcoal rot resistance	Dr Vineet Kumar
SERB, DST, Govt. Of India	2021-2024	Genome - wide association mapping of charcoal rot resistance in soybean (*Glycine max* L.)	Dr V. Nataraj
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 Government of India	2021-2024	Developing food - grade soybean using CRISPR/Cas9 mediated multiplex genome editing	Dr Anita Rani
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 Government 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.

* LT: Long Term

7. Publications

Research papers

1. Agnihotri, R., Gujre, N., Mitra, S. and Sharma, M.P. 2022. Decoding the PLFA profiling of microbial community structure in soils contaminated with municipal solid wastes. Environmental Research.219: 114993.https://doi.org/10.1016/j.envres.2022.114993.

2. Agnihotri, R., Pandey, A., Bharti, A., Chourasiya, D., Maheshwari, H.S, Ramesh, A., Billore, S.D. and Sharma, M.P. 2021. Soybean processing mill waste plus vermicompost enhances arbuscular mycorrhizal fungus inoculum production. Current Microbiology. 78: 2595-2607. https://doi.org/10.1007/s00284-021-025327.

3. Agnihotri, R., Sharma, M.P., Bucking, H., Dames, J. and Bagyaraj, D.J. 2022. Methods for assessing the quality of AM fungal bio-fertilizer: Retrospect and future directions. World Journal of Microbiology and Biotechnology. 38(6): 97. DOI: 10.1007/s11274-022-03288-3.

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5. Anshu, A.K., Kumar, V., Rani, A., Tayalkar, T. and Parmar, H.S. 2022. Identification of quantitative trait loci governing biosynthesis of phospholipids in soybean. Crop and Pasture Science. https://doi.org/10.1071/CP22095.

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11. Chandra, S., Choudhary, M., Bagaria, P.K., Nataraj, V., Kumawat, G., Choudhary, J.R., Sonah, H., Gupta, S., Wani, S.H. and Ratnaparkhe, M.B. 2022. Progress and prospectus in genetics and genomics of Phytophthora root and stem rot resistance in soybean (*Glycine max* L.). Frontiers in Genetics. 3170.

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Books and book chapters

Book chapters

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8. Goud, B.R., Raghavendra, M., Prasad, P.S., Hatti, V., Halli, H.M., Nayaka, G.V., Suresh, G., Maheshwari, K.S., Adilakshmi, G., Reddy, G.P. and Rajpoot, S.K. 2022. Sustainable management and restoration of the fertility of damaged soils. Agriculture Issues and Policies. Pp 113.

9. Nataraj, V., Rajput, L.S., Shivakumar, M., Kumawat, G., Kumar, S., Maheshwari, H.S., Gupta, S., Amrate, P.K., Tripathi, R., Agrawal, N. and Ratnaparkhe, M.B. 2023. Crop improvement against *Colletotrichum truncatum* using molecular breeding approaches. In QTL Mapping in Crop Improvement. Academic Press. Pp 45-56.

10. Ratnaparkhe, M.B., Nataraj, V., Shivakumar, M., Chandra, S., Ramesh, S.V., Kumawat, G., Kamble, V.G. and Nguyen, H.T. 2022. Genomic design for biotic stresses in soybean. In: Kole, C. (Eds) Genomic Designing for Biotic Stress Resistant Oilseed Crops. Springer, Cham. Pp 1-54. https://doi.org/10.1007/978-3-030-91035-8_1.

11. Ratnaparkhe,M.B., Satpute, G.K., Kumawat, G., Chandra, S., Kamble, V.G., Kavishwar, R., Kumar, V., Sudhakaran, S., Srivastava, M.K., Ramesh, S.V., Shesh, N., Jajoo, A., Gupta, S., Singh, M., Xu,D., Singh, V., Singh,J., Singh, A.K., Bhattacharya, M.,Nguyen, H.T. 2022. Genomic designing for abiotic stress tolerant soybean. In: Kole, C. (Eds) Genomic Designing for Abiotic Stress Resistant Oilseed Crops. Springer, Cham. Pp 1-73. https://doi.org/10.1007/978-3-030-90044-1_1.

12. Satpute, G.K., Shroti, R., Shesh, N., Kamble, V.G., Kavishwar, R., Ratnaparkhe, M.B., Srivastava, M.K., Chandra, S., Gupta, S., Kumawat, G., Verma, R.K., Pandey, S.K., Rajput, L.S., Kuchlan, M., Kuchlan, P., Meena, L., Raghvendra, M. 2022. Dissection of physiological and biochemical bases of drought tolerance in soybean (*Glycine max*) using recent phenomics approach. In Soybean Improvement. S. H. Wani et al. (Eds.), Springer Nature Switzerland, pp. 47-72. https://doi.org/10.1007/978-3-031-12232-3_2.

Books

1. S.H Wani, V. Nataraj and G.P Singh. 2022. Transcription Factors for Biotic Stress Tolerance in Plants. ISBN: 978-3-031-12990-2. Springer Nature Switzerland AG.

Popular Articles

1. Hanamant, M.H., Raghavendra, M. and Verma. R.K. 2022. Water-saving techniques in pulses for higher productivity. Agriculture Letters. 3 (08): 55-58.

2. Raghavendra, M., Verma, R.K., Meena, L.K., Rajput, L.S., Nataraj, V., Shivakumar, M., Rajesh, V., Chandra, S., Giriraj, K., Billore, S.D., Ramesh, A., Khandekar N. and Hanamant, H. 2022. Organic soybean production: An eco-friendly approach to enhance soybean production in India. Agriculture Letters. 3 (03): 45-46.

3. Singh, K., Meena, V.S., Shekhawat, N., Ram, D., Choudhary, M. and Rajput, L.S. 2021. Dry root and stem rot disease of sesame: extent and management. Popular Kheti. 9(4): 49-53.

4. Singh, K., Meena, V.S., Shekhawat, N., Ram, D., Choudhary, M. and Rajput, L.S. 2021. Sesame phyllody disease: extent and management. Popular Kheti. 9(3): 27-30.

5. दुपारे, बी.यू., मदार रा., वर्मा आर. के. एवं नटराज वी. (2022), सोयाबीन फसल में क्या नहीं करें ? किसान की गाथा, जुलाई 2022 पृष्ठ क्रमांक 7.

6. दुपारे, बी.यू., कोल्हे, स., मदार, रा., एवं नटराज, वी. (2022). सोयाबीन फसल में क्या नहीं करें ? हरितमालव. 1 जुलाई 2022. पृष्ठ क्रमांक 7.

Technical/ Extension bulletins/ folders

1. दुपारे, बी.यू. एवं बिल्लौरे, एस.डी. 2022 सोयाबीन उत्पादन उन्नत कृषि पद्धतियाँ एवं तकनिकी अनुशंसाए. विस्तार बुलेटिन क्रमांक 17. भा.कृ.अनु.प. भारतीय सोयाबीन अनुसंधान संस्थान प्रकाशन. पृष्ठ : 60

2. मृणाल कुचलान एवं पुनम कुचलान (2022) किसान सोयाबीन बीज को इस तरह से भंडारित करें । विस्तार फोल्डर क्रमांक 26/(2022) प्रकाशन भारतीय सोयाबीन अनुसंधान संस्थान।

3. मृणाल कुचलान एवं पुनम कुचलान (2022) किसानों के स्तर पर सोयाबीन बीज के अंकुरण की जाँच । विस्तार फोल्डर क्रमांक 25/(2022) प्रकाशन भारतीय सोयाबीन अनुसंधान संस्थान।

4. Dupare, B.U. and Billore, S.D. (2022). Improved practices and methods for soybean production and technical recommendation. Extension Bulletin No. 17. Published by Director, ICAR-Indian Institute of Soybean Research, Indore. 60

5. Kuchlan, M.K. and Kuchlan, P. 2022. Bilingual mannuals on **सोयाबीन की गुणवत्ता पर किषण के लिए जैव रासायन कि तकनीक** " / "Biochemical Techniques For Testing of Soybean Seeds Quality".

6. Kuchlan, M.K. and Kuchlan, P. 2022. "सोयाबीन बीज पर किषण की नियमवली"/"Seed Testing Manual For Soybean".

7. Sharma and Dipanti Chourasiya 2022. Exploitation of AM fungi in enhanced plant production and soil carbon sequestration in training manual of ICAR sponsored 21 days winter school on "Advance Biofertilizer Technologies Nutrient use Efficiency, Soil health and Greenhouse gas mitigation" organised by ICAR-IISS, Bhopal during Feb 08- 28, 2022.

Conference presentations/attended

1. Chandra, S., Ratnaparkhe, M.B., Satpute, G.K., Gupta, S. et al. 2022. Genome wide association studies (GWAS) for water logging tolerance in Soybean: Comprehensive phenotyping for multiple traits. Abstracts of 43 Annual Meeting of PTCA(I) & International Symposium on "Advances in Plant Biotechnology and Nutritional security" APBNS-2022, April 28-30, 202 (Oral Presentation)

2. Chourasiya, D., Prakash, A., Ramesh, A., Shrivastava, M.K., Singh, M. and Sharma, M.P. 2022. Exploring the role of bio-stimulants in enhanced production of AM fungi in potting mixes of sorghum presentation made during Dr. M.J. Thirumalachar Merit Awards (Oral) contest in National Conference (Virtual) on Mycology and mankind: Marching ahead in the new era, March 8-10, 2022.

3. Ghate, T., Misra, S., Manuka, R., Verma, R.K., Chandra, S., Papanastasiou, M., Amtmann, A. and Srivastava, A.K. (2022). GWAS-based identification of genetic candidates for regulating salt-tolerance and thiourea-responsiveness in soybean. "Oral Presentation" in Newton - Bhabha Researcher Link Workshop on "Sustaining Food Production under Environmental Stress" held during 18-21 January 2022 at NABI, Mohali, India.

4. Khandekar, N., Kuchlan, M., Hanchinal, R.R., Sridevi B. Angadi, Vishwanath, G.B., Singh, R., Kale, P.A., Madar, R., Kuchlan, P. and Gupta S. (2022) Off season- off location - A Pilot for Soybean Seed production. 11th National Seed Congress on Recent advances in Quality Seeds for Self Sufficiency in Oilseeds & pulses August 21-23, 2023

5. Kumar S. attended International e-conference on "Postharvest Disease Management and Value Addition of Horticultural Crops" Aug 18-20, 2021.

6. Kumar, S., Rajput, L.S., Ramteke, R.H., Vennampally, N., Ratnaparkhe, M., Maheshwari, H.S. and Maranna, S. 2022. First report of root rot and damping off disease in soybean (*Glycine max*) caused by *Pythium deliense* in India. In book of abstracts, National e-Conference "Biotic Stress Management Strategies for Achieving Sustainable Crop Production and Climate Resilience". 19-21 May 2022 (Oral

presentation).

7. Kumawat, G., Choudhary, A., Chandra, S., Satpute, G.K., Shivakumar M., Nataraj, V., Kamble, V.G., Rajesh, V., Ratnaparkhe, M.B., Srivastav, M.K. and Gupta, S. 2022. Phenotyping of root traits and characterization of OsSOR1 orthologs in soybean. In book of abstracts, Annual Meeting of PTCA(1) & International Symposium on "Advances in Plant Biotechnology and Nutritional security" (APBNS-2022), April 28-30, 2022, pp146.(Oral Presentation)

8. Kumawat, G., Ratnaparkhe, M.B., Gupta, S., Srivastava, M.K. and Khandekar, N. 2022. Prospectus of genome editing for soybean improvement in India. In book of abstracts, International Conference on Advances in Agriculture & Food System Towards Sustainable Development Goals, University of Agricultural Sciences, Bangalore, August 22 - 24, 2022, pp 173.

9. Satpute, G.K., Kamble, V.G., Shesh, N., Shroti, R., Solanki, V., Kavishwar, R., Ratnaparkhe, M.B., Chandra, S., Kumawat, S., Srivsatava, M.K., Pandey, S.K., Verma, R.K., Rajput, L.S. and Gupta, S. (2022). Dissecting lateral root development and improving drought related traits in soybean. In Proc. COSPAR 2022 44th Scientific Assembly held in Athens Greece on 16th – 24th July 2022. Paper No. F1.1-0006-22 (Oral Presentation).

10. Sharma, M.P. 2022.Delivered a lead talk on AMF inoculum production and its quality assessment during 48th AMI Annual Conference on Mycology & mankind: Marching ahead in the new era organized at ICAR Research Complex for NEH Region, India March 8-9, 2022.

Invited talks in conference/ meetings/ lecture delivered

1. Dr R. K. Verma, delivered lecture (Soybean area expansion in Bodoland, Asam): One - day panel discussion cum workshop was attended as soybean agronomist and discussed various key points regarding soybean cultivation in Kokrajhar, Asam. The main objective of this workshop to developed 5-year comprehensive blueprint for Bodoland Territorial Council, Kokrajhar, Asam.

2. Dr R. K. Verma, delivered a lecture on Agronomic Package of Practices for Soybean to the students of Govt. PG collage, Barnagar, Ujjain on 16.12.2022.

3. Dr R. K. Verma, Delivered a lecture on "Improved soybean production technology under Changing Climate Scenario to the extension workers/ master trainers on 05-05-2022. This training organized by Regional Agricultural Extension Management Training Institute, Amravati, Maharashtra under the master trainer training on soybean.

4. Dr R. K. Verma, delivered a lecture on "Improved soybean production technologies to sustain the productivity under changing climate scenario to the extension worker's/ staff of national fertilizer Limited's on 03-09-2022.

5. Dr R. K. Verma, delivered a lecture on "Improved soybean production technologies to sustain the productivity under changing climate scenario in kisan sanghosti organized under azadi ka amrit mahotsav on 14-07-2022.

6. Dr R. K. Verma, delivered a lecture on "Improved soybean production technologies in kisan sanghosti organized under azadi ka amrit mahotsav on 28-06-2022.

7. Dr Nita Khandekar, attended meeting of stakeholders for Crop Diversification and achieving self – sufficiency in Oilseeds and Pulses (By Dr A. P. Singh) Addl. Commissioner (Crops) DA&FW, ND May 10th 2022

8. Dr Nita Khandekar attended soybean in edible oil self-sufficiency – The research strategy. Experts' Meet on Self-sufficiency

in Edible Oil Production Organized by NAAS, New Delhi 28.03.2022

9. Dr Nita Khandekar attended soybean for Edible Oil Self-sufficiency. National Workshop on Self-sustainability in Edible Oils in India by NAARM, Hyderabad 20.4.2022

10. Dr Nita Khandekar attended amalgating new technologies & farming – New Vistas. Workshop on Sustainable Agriculture Using Bharat Agri-Grid Ecosystem under NSM from Super Computer Education & Res. Centre (SERC) by IIT Indore. IISR Indore, IIT Jodhpur, C-DAC Pune, IISC Bangalore, CEERI-Pilani, NCL Pune June 28 & 29, 2022

11. Dr Nita Khandekar attended importance of adoption of soybean production technologies. Farmers Training Programme at IISR Indore organized by NSC, Bhopal 27.4.2022

12. Dr Nita Khandekar attended, soybean revolution in India. Organized by Society for Plant Research (Online) 05-05-2022

13. Dr Nita Khandekar, participated in Sugarcane & Soybean Farmers, Scientist-Industry Interface Meet, ICAR-ATARI Zone IX, Bengaluru, KLE Society, Belgavi, KLE KVK, Belgavi, ICAR-IISR Indore, ICAR-SBI, Coimbatore, CBKSSKN, Chikodi

14. Dr Nita Khandekar, delivered a radio talk on Soybean ki Kheti, Hello Kisan, Doordarshan, New Delhi July 4, 2023.

15. Ratnaparkhe M.B.,delivered a talk GM soybean and its derivatives with a focus on animal feed: Status and potential in India, 9th March, 2022, Guru Angad Dev Veterinary and Animal Sciences, University, Ludhiana

16. Ratnaparkhe M.B., Central University of Punjab organized an expert lecture on "Applications of genomics for drought tolerance and disease resistance in soybean" 10th March, 2022

17. Dr Shivakumar M.,delivered virtual talk Hybridization Technique in soybean- In an International training organized at ICRISAT, Hyderabad, on 19.09.2022

18. Dr Nataraj V.delivered an invited lecture on "Data analysis and interpretation using 'R' for faculty and scientists organized by NAARM, Hyderabad under sub plan SC at College of agriculture, Indore

19. Dr Giriraj Kumawat, delivered a virtual presentation on "Current trends in molecular breeding for Soybean Improvements" to trainees from University of Kwazulu-Natal, Malawi, during Technical Cooperation Scientific visit at ICRISAT, Hyderabad (Sponsored by IAEA), delivered on 21 July 2022.

20. Dr L.S Rajput, delivered guest lecture on "Unraveling tripartite interaction of endophytes and their applications for sustainable Crop protection" in the "National Training Programme on Multidimensional Quantitative Approaches to Unravel Host Pathogen Interaction in Crop Plants" which will be held on 3rd November -10th November, 2022 at ICAR-NBAIM, Mau, UP-275103.

21. Dr M.P. Sharma, delivered a talk on Managing AMF fungi for enhanced plant production and soil carbon sequestration during 21 days winter school on Advance Biofertilizer Technologies Nutrient use Efficiency, Soil health and Greenhouse gas mitigation" organised by ICAR-IISS, Bhopal during Feb 08- 28, 2022.

22. Sharma M.P. (2022). Exploitation of AM fungi in enhanced plant production and soil carbon sequestration talk delivered during 3-day online workshop on "Arbuscular Mycorrhizal Fungi: Biodiversity, Taxonomy and Propagation" organized by Department of Botany, Rajiv Gandhi University, Doimukh, Arunachal Pradesh from January 19-21, 2022.

Expert in agricultural exhibition/ field day/farmers fair/ Kisan Sangoshthis

S. No.	Trainers/exhibitors	Name of the Agricultural exhibition/ Field day/Farmers fair	Place	Dated
1.	Dr. R. K. Verma	Two (02) Field days organized under SCSP during Rabi season 2021-22	Village-Kiloli (Ujjain) and Bafapur (Sehore)	Rabi season 2021-22
2.	Dr. R. K. Verma, Dr Giriraj Kumawat, Dr Gyanesh K. Satpute	Exhibition of institute stall in PMs Door Step Policy Distribution Drive programme (Meri Policy mere hath) and farmer fair	Budhi barlai, Sanwer, Madhya Pradesh	26, February, 2022
3.	Dr. R. K. Verma	Exhibition of institute stall in Farmer's fair	KVK Kasturba gram, Indore	26 April 2022
4.	Dr. Shivakumar M., Dr. Raghavendra Nargund	Exhibition of institute stall in 3 days Kisan Mela	Ambedkar mela ground, Morena, M.P.	11-13, November 2022

8. Patents, Awards and Recognition

Patent Published

1. Dr Savita Kolhe. 2023. IOT Based Humidity Monitoring System Using Machine Learning Approach in Agriculture Field. Application No.202341001498 A, Publication Date: 13/01/2023, Patent Office Journal No. 02/2023 Dated 13/01/2023.

Awards and Recognition

1. Dr Nita Khandekar, Conferred Honorary Fellow 2022 by Society for Plant Research, Uttar Pradesh.

2. Dr Subhash Chandra awarded with the "Best poster Presentation Award" for the paper entitled "Seed viability in soybean: Inheritance and Molecular mapping" by Manish Saini, Raju R Yadav, Subhash Chandra et al during National Symposium on Tending Mendel Garden's for a perpetual and bountiful harvest commemorating birth bicentenary of Gregor Johann Mendal during 19-21 July, 2022 held at ICAR-IARI, New Delhi.

3. Dr L. S. Rajput awarded the best oral award for paper presentation on "Development of machine learning laser bio-speckle method for early identification of seed infection of soybean anthracnose" at 8th International Conference Plant Pathology: Retrospect and Prospectsheld from March 23-26, 2022 at SKNAU, Jobner-Jaipur, Rajasthan

4. Dr M.P. Sharma,Associate Editor in Frontiers in Microbiology: Section Microbial Symbioses

5. M.P. Sharma Associate Editor, European Journal of Soil Science (Nov 2021 onwards)

6. Dr M.P. Sharma,Guest Editor in Frontiers in Agronomy: Soil-plant interactions for a special volume on Managing native AM fungi microbiome through crop and soil management practices in agro-ecosystems (other co-editors are from Spain, China, Switzerland, India).

7. Dr M.P. Sharma, National Scientific Advisory Board ofthe Long-term farming systems comparison (SysCom) project hosted by FiBL, Frick, Switzerland at Bio Re India, Kasrawad, Khargone, MP, India (Nov 2020 onwards)

8. Dr M.P. Sharma, Guest Editor, Agriculture-MDPI journal on the role of AM fungi for crop growth.

9. Linkages and Collaborations

Effective linkages and collaborations were made with the following International, National and Regional institutions/organizations for soybean research and development and extension activities:

International

Asian Vegetable Research and Development Centre, Taiwan
International Institute of Tropical Agriculture, Ibadan, Nigeria
Brazilian Agricultural Research Enterprise, National Soybean Research Center, EMBRAPA.
University of Illinois, Urbana, Illinois, 61821, USA.
University of Arkansas, USA
Soybean Production Research, USDA, ARS, Stoneville, Mississippi 38776, USA.
IOWA State University, USA.
International Potash Institute, Switzerland.
International Plant Genetic Resources Institute, Rome, Italy

National

SAUs in the States of Madhya Pradesh, Chhatisgarh, Maharashtra, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Rajasthan, Punjab, Haryana, Jharkhand, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, North-Eastern States.
ICAR-National Bureau of Plant Genetic Resources, New Delhi
ICAR-Central Research Institute for Dryland Agriculture, Hyderabad
ICAR-Indian Institute of Pulses Research, Kanpur
ICAR-Central Institute of Agricultural Engineering, Bhopal
ICAR-National Research Centre for Plant Biotechnology, New Delhi
ICAR-Indian Institute of Oilseed Research, Hyderabad
ICAR-Indian Agricultural Research Institute, New Delhi
ICAR-National Academy of Agricultural Research Management, Hyderabad
National Bank for Agriculture and Rural Development
National Fertilizer Limited
Agharkar Research Institute, Pune
Indian Institute of Technology, Indore
ICAR-National Institute of Abiotic Stress Management, Baramati, Maharashtra
ICAR-Directorate of Groundnut Research, Junagadh, Gujarat
University of Delhi, New Delhi
National Agri-Food Biotechnology Institute, Mohali

Regional

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

10. राजभाषा – कार्यान्वयन

संस्थान में जनवरी–दिसम्बर 2022 के दौरान राजभाषा कार्यान्वयन संबंधी विभिन्न गतिविधियाँ

भारतीय संविधान में हिन्दी के संघ की राजभाषा के रूप में स्थापित किया गया है एवं संविधान के भाग सत्रह, अनुच्छेद तीन सौ इक्यावन में वर्णित है की राज भाषा हिन्दी को इस तरह से विकसित किया जाय ताकि वह भारत की विविध संस्कृति को व्यक्त करने में समर्थवान हो। अतः राजभाषा के रूप में हिन्दी की भूमिका अत्यंत महत्वपूर्ण तथा दायित्व युक्त है। इस उदेश्य का वहन करते हुये भा. कृ. अनु.प.- भारतीय सोयाबीन अनुसंधान संस्थान, इन्दौर में राजभाषा हिन्दी के प्रचार-प्रसार हेतु अनेकानेक कार्यक्रम किये जा रहे है। जिनका स्वरूप भारतीय सोयाबीन अनुसन्धान संस्थान में राजभाषा कार्यान्वयन के क्षेत्र में उत्तरोत्तर प्रगति के साथ दृष्टिगोचर होते है, जो राजभाषा के प्रगामी प्रयोग में अत्यंत सार्थक सिद्ध हो रहे है। इस क्षेत्र में किये जा रहे क्रिया - कलापों का संक्षिप्त विवरण निम्नवत है :

(क) राजभाषा नियम 1976 के नियम का अनुपालन : संस्थान के अधिकारी एवं कर्मचारी शासकीय कार्यों हेतु राजभाषा नियम 1976 के उपनियम (1) तथा (4) के अनुसार लिखे जाने वाली टिप्पणियों एवं अन्य कार्य हिन्दी में करते हैं।

(ख) राजभाषा कार्यान्वयन समिति की तिमाही बैठक :

प्रथम बैठक	:	07 अप्रैल 2022
द्वितीय बैठक	:	13 जुलाई 2022
तृतीय बैठक	:	14 अक्टूबर 2022

(ग) हिन्दी कार्यशालाएं : संस्थान के अधिकारीयों एवं कर्मचारियों की हिन्दी में कार्य करने के दौरान होने वाली समस्यायों के निराकरण हेतु संस्थान में हिन्दी कार्यशालाओं का आयोजन किया जाता है।

इसके अतिरिक्त कार्यशालाओं के आयोजन का मुख्य ध्येय यह भी होता है कि हिन्दी का प्रयोग किस प्रकार सरल से सरलतम की ओर बढ़ाया जा सकता है। इसलिए प्रत्येक तिमाही में कम से कम एक हिन्दी कार्यशाला का आयोजन किया जा रहा है। ताकि संस्थान के सभी संवर्गों में हिन्दी में कार्य संपन्न करने के रुझान में उत्तरोत्तर प्रगति हो सके। इस उद्धेश्य हेतु सम्बंधित विषयानुसार कार्यशालाएं संपन्न की जाती हैं।

2022 में अब तक 04 कार्यशालाओं का आयोजन किया गया, जिसकी सूची इस प्रकार से है :

क्र.	दिनांक	विषय	अतिथिवक्ता
1.	03 मार्च 2022	संसदीय राजभाषा समिति के निरिक्षण से सम्बंधित विषयों पर विश्लेषण	श्री ए.के. जगदीशन, उपनिदेशक राजभाषा, भारतीय कृषि अनुसंधान परिषद, नई दिल्ली
2.	30 जून 2022	''विश्व पटल पर हिन्दी का प्रयोग एवं स्वकार्यता''	प्रोफ़ेसर श्याम सुन्दर पलोड़, राष्ट्रीय कवि, विभागध्यक्ष एवं प्रकाशक संस्कार कॉलेज ऑफ़ प्रोफेशनल स्टडीज
3.	23 सितम्बर 2022	राजभाषा के इतिहास एवं वर्तमान में इसकी प्रासंगिकता	डॉ. जयश्री बंसल, सहायक निदेशक मानव संसाधन विकास केन्द्र, देवी अहिल्या विश्वविद्यालय, इन्दौर
4.	15 दिसम्बर 2022	सरकारी कार्यालय में हिन्दी भाषा का प्रयोग	श्री हरेराम वाजपेयी हिन्दी साहित्य कवी एवं प्रबंध सम्पादक वीणा हिन्दी पत्रिका

(घ) प्रशिक्षण : संस्थान में राजभाषा के प्रचार - प्रसार हेतु कृषकों एवं प्रशिक्षणार्थियों को प्रशिक्षण संबन्धित सारी सामग्रीयां हिन्दी में प्रदान की जा रही है।

(ड़) शब्द कोष का वितरण : संसदीय राजभाषा समिति के निरीक्षण के दौरान प्रो. रीता बहुगुणा जोशी, संयोजक, दूसरी उप समिति संसदीय राजभाषा कि अध्यक्षता में संसदीय राजभाषा समिति ने निरीक्षण के दौरान आश्वासन दिया था कि संस्थान में सभी कार्मिको को हिन्दी शब्द कोश प्रदान किया जाये जिससे किसी भी कार्मिकों को हिंदी में कार्य करने में असुविधा न हो। इस आश्वासन के प्रतिपालन स्वरुप संस्थान के सभी कार्मिकों को हिन्दी से अंग्रेजी एवं अग्रेंजी से हिंदी के शब्द कोष, हिन्दी प्रकोष्ठा द्वारा क्रय कर प्रदान किया गया ताकि कर्मचारियों, अधिकारियों एवं वैज्ञानिकों के हिन्दी शब्द ाान में वृद्धि करने के साथ ही साथ हिन्दी के कार्यालयीन उपयोग में भी सहायता प्रदान कर सके।

(च) अनुवाद द्विभाषीय प्रपत्र : संस्थान में कार्यलयीन कार्य में प्रयुक्त होने वाले विभिन्न पत्रों, प्रपत्रों आदि का अनुवाद कार्य भी प्रगति पर है, जिससे दैनं दिन के साथ ही प्रायः प्रयुक्त होने वाले सभी प्रकार के पत्रों, प्रपत्रों का द्विभाषी मुद्रित रूप सम्मिलित है । यह कार्य राजभाषा कार्यान्वयन की दिशा में स्थाई एवं आधारभूत उपलब्धि है।

(छ) राजभाषा तिमाही रिपोर्ट का प्रेषण : संस्थान में राजभाषा हिन्दी से सम्बंधित समस्त कार्यों का विवरण तिमाही हिन्दी रिपोर्ट के माध्यम से संबंधित विभागों को ऑनलाईन एवं द्वित्गामी डाक सेवा से प्रेषित किया जाता है।

इस कार्य को धरातलीय रूप प्रदान करने में संस्थान के समस्त संबंधित अनुभाग का सक्रिय एवं सराहनीय योगदान होता है।

(ज) राजभाषा अधिनियम, 1963 की धारा 3 (3) : संस्थान में राजभाषा अधिनियम, 1963 की धारा 3 (3) से संबंधित दस्तावेजों जैसे : सामान्य आदेश, अधिसूचनांए, प्रेस विज्ञप्ति, संविदा, लाइसेंस, परमिट, टेंडर के फार्म और नोटिस, संकल्प, नियम इत्यादि को (हिन्दी और अंग्रेजी) द्विभाषी रूप में निकला जाता है, ताकि राजभाषा सम्बंधित दिशा-निर्देशों का पालन सतत होता रहे।

(झ) यूनिकोड की सुविधा : संस्थान के अधिकारियो तथा कर्मचारी की हिन्दी में कार्य करने की रुचि में वृद्धि करने हेतु समस्त कम्पुटर में हिन्दी यूनिकोड की व्यवस्था प्रदान की गई है, जिससे एक समान फॉण्ट के माध्यम से पूरा संस्थान एक ही दिशा की ओर अग्रसित हो सके।

(ञ) मौलिक लेखन कार्य का प्रादुर्भाव : संस्थान में राजभाषा संबंधि विभिन्न क्रियाकलापों के साथ मौलिक लेखन कोद्विगामी आयाम प्रदान करने में अधिकारियों एवं कर्मचारी की रूचि अद्वितीय है । संस्थानों द्वारा प्रकाशित होने वाली ''सोयावृतिका पत्रिका'' में अपने लेख प्रदान करते हैं।

(ट) संसदीय राजभाषा समिति का निरीक्षण : प्रो. रीता बहुगणुा जोशी, संयोजक, दूसरी उपसमिति संसदीय राजभाषा कि अध्यक्षता में ससदीय राजभाषा समिति ने भारतीय सोयाबीन अनुसंधान संस्थान में हो रहे हिन्दी में कार्यो का निरीक्षण दिनांक 2.03.2022 को किया।

इस दौरान समिति ने मंत्रालय एवं विभाग के वरिष्ठ अधिकारीयों कि उपस्थिति में हिन्दी के कार्यों का अवलोकन किया। इस निरीक्षण बैठक में संस्थान कि और से कार्यपालक निदेशक डॉ. नीता खांडकर, प्रभारी राजभाषा एवं प्रधान वैज्ञानिक डॉ. पूनम कुचालन, प्रशासनिक अधिकारी श्री सौरभ मीना, वित्त एवं लेखा अधिकारी श्री रविन्द्र कुमार एवं हिन्दी अनुवादक श्री विकास केशरी सम्मिलित हुए तथा परिषद की और से डॉ. एस. के. झा, पूर्व सहायक महानिदेशक (दलहन व तिलहन) एवं प्रधान वैज्ञानिक, श्री ए. के. जगदीश, उपनिदेशक (राजभाषा) एवं श्री आशुतोष कुमार ने भाग लिया।

भारतीय सोयाबीन अनुसंधान संस्थान के निदेशक को संसदीय राजभाषा समिति के दूसरी उपसमिति के संयोजक द्वारा प्रमाण पत्र प्रदान करते हुए।

राजभाषा कार्यान्वयन के क्षेत्र में भा.कृ.अनु.प. - भारतीय सोयाबीन अनुसंधान संस्थान की प्रगति आख्या का एक स्वर्णिम झलक आपके समक्ष प्रस्तुत है।

उपरोक्त गतिविधियों पर यदि दृष्टि पात करें तो ज्ञात होता है कि संस्थान में राजभाषा कार्यान्वयन की दिशा में एक सकारात्मक एवं सार्थक कार्य हो रहा है , जो संस्थान ने राजभाषा हिन्दी के सुनहरे भविष्य का आभास कराती है।

हिन्दी पखवाड़ा आयोजन (16-29 सितम्बर 2022)

भा.कृ.अनु.प. - भारतीय सोयाबीन अनुसंधान संस्थान, इन्दौर में हिन्दी पखवाड़ा का आयोजन दिनांक 16-29 सितम्बर 2022 में किया गया। हिन्दी पखवाड़ा के माध्यम से हमारा प्रयास रहा कि संस्थान के वैज्ञानिकों , अधिकारियों एवं कर्मचारियों की रूचि हिन्दी में काम करने के प्रति निरंतर बढ़ती रहे तथा राजभाषा हिन्दी का प्रगामी विकास और प्रचार-प्रसार निरंतर होता रहे। परिषद् के दिशा-निर्देश एवं हिन्दी के क्षेत्र में संस्थान द्वारा प्राप्त गरिमा को बनाए रखने के लिए दिनांक 16-29 सितम्बर 2022 के दौरान ''हिन्दी पखवाड़ा'' का आयोजन पूर्ण हर्षोल्लास के साथ किया गया। इस कार्यक्रम का आयोजन संस्थान की प्रभारी राजभाषा अधिकारी डॉ. पूनम कुचलन एवं संचालन श्री रविशंकर कुमार द्वारा किया गया। हिन्दी पखवाड़ा के दौरान विभिन्न प्रतियोगिता का आयोजन किया गया, जो निम्नवत है :-

हिन्दी पखवाड़ा 2022 का उद्घाटन समारोह दिनांक 16 सितम्बर 2022 को संस्थान के प्रभारी निदेशक एवं अध्यक्ष, राजभाषा कार्यान्वयन समिति, डॉ. संजय गुप्ता, डॉ. पुनम कुचलान, प्रधान वैज्ञानिक एवं प्रभारी अधिकारी (राजभाषा), अनुभाग प्रभारी - फसल उत्पादन, डॉ. बी.यू. दुपारे, प्रधान वैज्ञानिक तथा अनुभाग प्रभारी - फसल संरक्षण, डॉ. एम.पी. शर्मा द्वारा भा.कृ अनु.प. भारतीय सोयाबीन अनुसंधान संस्थान, के प्रेम स्वरूप भटनागर व्याख्यान कक्ष कार्यक्रम का शुभारम्भ किया गया। इस समारोह के दौरान संस्थान के निदेशक महोदय डॉ. संजय गुप्ता ने राजभाषा के प्रगामि प्रयोग के साथ ही साथ अनुसंधान के प्रचार-प्रसार, संप्रेषण एवं मौलिक लेखन सहित शोध- पत्रों तथा तकनीकी लेखन का कार्य शत्- प्रतिशत हिन्दी में करने हेतु कर्मचारियों एवं अधिकारियों को स्वयं समर्पण करने की प्ररेणा प्रदान की। संस्थान में हिन्दी के निरंतर प्रयोग एवं उसके प्रति समर्पण के द्वारा उसे अत्यधिक समृद्ध बनाने एवं दैनिक काम-काज में हिन्दी के प्रयोग करने पर बल दिया। डॉ. पुनम कुचलान, प्रभारी अधिकारी- राजभाषा ने हिन्दी पखवाड़ा -2022 के दौरान आयोजित होने वाली विभिन्न गतिविधियों के बारे में विस्तार पूर्वक जानकारी से अवगत कराया।

* दिनांक 17 सितम्बर 2022 को अपराह्न 03.00 बजे तक संस्थान के कुशल सहायक ग्रेड के कर्मचारियों हेतु हिन्दी में श्रुति लेखन-प्रतियोगिता का आयोजन किया गया, जिसके निर्णायक श्री संजय पाण्डेय एवं डी. एन. बारस्कर रहे।

* दिनांक 19 सितम्बर 2022 को अपराह्न 03.00 बजे संस्थान के समस्त कार्मिकों हेतु विषयः आजादी का अमृत महोत्सव पर मौलिक हिन्दी स्लोगन प्रतियोगिता का अयोजन किया गया, जिसके निर्णायक डॉ. अनीता रानी प्रधान वैज्ञानिक एवं निखिलेश पंडया, मुख्य तकनिकी अधिकारी थे।

* दिनांक 20 सितम्बर 2022 को अपराह्न 03.00 बजे को संस्थान के समस्त कर्मचारियों के लिए टिप्पण लेखन प्रतियोगिता का आयोजन किया गया । इस प्रतियोगिता के निर्णायक डॉ. श्री रविन्द्र कुमार, वित्त एवं लेखाधिकारी एवं श्रीमती प्रियंका सावन साहयक प्रशासनिक अधिकारी थे।

* दिनांक 22 सितम्बर 2022 को संस्थान के समस्त कर्मचारियों के लिए हिन्दी में निबंध लेखन प्रतियोगिता का अयोजन किया गया। इस प्रतियोगिता के निर्णायक डॉ. मनोज श्रीवास्तव एवं. डॉ. सविता कोल्हे, प्रधान वैज्ञानिक थे।

* संस्थान में हिन्दी पखवाड़ा-2022 के दौरान दिनांक 23 सितम्बर 2022 को तिमाही हिंदी कार्याशाला अयोजित किया गया। इस कार्यशाला के मुख्य अतिथि वक्ता डॉ. जयश्री बंसल, सहायक निदेशक, मानव संसाधन विभाग देवी अहिल्या विश्व विद्यायल, इन्दौर थी । उन्होने हिंदी के प्रारंभिक से लेकर वर्तमान समय में इस भाषा की प्रासंगिकता से भी श्रोतागणों को अवतगत करवाया।

* दिनांक 26 सितम्बर 2022 को संस्थान के समस्त कर्मचारियों हेतु प्रश्न-मंच प्रतियोगिता का आयोजन किया गया । समस्त प्रतियोगिताओं में कर्मचारियों ने बढ़-चढ़कर अपनी सहभागिता का प्रदर्शन किया तथा प्रतियोगिता के माध्यम से अधिकारियों एवं कर्मचारियों में हिन्दी के प्रति और अधिक कार्य करने का उत्साह और प्रेरणा जागृत हुई इस प्रतियोगिता का संचालन डॉ. पुनम कुचलान, प्रधान वैज्ञानिक एवं प्रभारी अधिकारी राजभाषा ने किया।

* दिनांक 29 सितम्बर 2022 को हिंदी पखवाड़ा कार्यक्रम का समापन एवं पुरस्कार वितरण समारोह संपन्न हुआ, जिसमे सभी पात्र प्रतिभागियों को पुरस्कार देकर सम्मानित किया गया तथा कार्यक्रम के सफल संचालन एवं समापन पर संस्थान के डॉ. संजय गुप्ता, प्रभारी निदेशक द्वारा सभी प्रतिभागियों को बधाई एवं शुभकामनाओं के साथ हिंदी में अधिक से अधिक कार्य करने का अनुरोध किया गया।

संस्थान के प्रभारी निदेशक डॉ. संयज गुप्ता कि अध्यक्षता में दिनांक 16.09.22 से 29.09.2022 तक होने वाली हिन्दी पखवाड़ा 2022 कार्यक्रम का शुभारंभ

हिन्दी पखवाड़ा 2022 उद्घाटन सामारोह के दौरान डॉ. पुनम कुचलान, प्रधन वैज्ञानिक एवं प्रभारी अधिकरी राजभाषा द्वारा सभा को पखवाडा कार्यक्रम से अवगत कराते हुए।

हिन्दी पखवाड़ा 2022 के दौरान आयोजित तिमाही हिन्दी कार्यशाला (जुलाई–सितम्बर) में संस्थान के अधिकारियो एवं कर्मचारियों को संबोधित करते हुए डॉ. जयश्री बंसल, सहायक निदेशक, मानव संसाधन विभाग, देवी अहिल्या विश्वविद्यालय इन्दौर।

हिन्दी पखवाड़ा 2022 के दौरान आयोजित विभिन्न प्रतियोगिता के विजेता प्रतिभागियों को पुरस्कृत करते हुए संस्थान के प्रभारी निदेशक एवं राजभाषा अधिकारी, वित्त एवं लेखा अधिकरी, अनुभाग प्रभारी, व.प्र. अधिकारी।

11. Important Committees

Institute Management Committee

Rule	Name	Designation	Validity
66(a)1	The Director, ICAR-IISR, Indore	Chairman	09.01.2022
66(a)2	The Deputy Director (Agriculture) Indore Division, Govt. of MP.	Member	09.01.2022
66(a)3	Director (Extension), Govt. of Maharashtra, Shivajinagar, Pune	Member	09.01.2022
66(a)4	Director (Research), RVSKVV, Gwalior (M.P.)	Member	09.01.2022
66(a)5	Sh. Bansilal Gurjar, Village Lal Ghati, Post Sabakhada, Thes. + Distt. Mansore MP	Member	09.01.2022
66(a)6	Dr Nita Khandekar, Principal Scientist, ICAR - IISR, Indore.	Member	15.09.2022
	Dr Anita Rani, Principal Scientist, ICAR - IISR, Indore.	Member	15.09.2022
	Dr S. V. Saiprasad, Head, IARI Regional Station, Indore. Principal Scientist, ICAR-IIRR, Hyderabad	Member	15.09.2022
	Dr A.K. Talukdar, Principal Scientist, Division of Genetics, ICAR-IARI, New Delhi.	Member	15.09.2022
66(a)7	The Assistant Director General (O&P) Krishi Bhawan, ICAR, New Delhi	Member	15.09.2022
66(a)8	The Finance and Accounts Officer, ICAR-IISS, Nabibagh, Berasia Road, Bhopal (M.P.)	Member	09.01.2022

Research Advisory Committee

Chairman	Dr S.K. Sharma, Former Vice Chancellor, CSK H.P. Krishi Vishwavidyalaya), Shanti Kunj, Ghuggar Tanda, Palampur-176062
Member	Dr T.K. Adhya, (Former Director, ICAR -NRRI, Cuttack and Professor, School of Biotechnology, KIIT University, Bhubaneswar) Flat # B-423 Rajendra Vihar,ForestPark Bhubaneswar (Odisha) 751 009
Member	Dr K.R. Koundal, Former Jt. Director (Research), ICAR -IARI & Director, ICAR-NIPB, New Delhi C-402, Dhauladhar Appartment, Plot 15, Sector 5, Dwarka, New Delhi - 110075
Member	Dr P.G. Karmakar, Former Director, ICAR-CRIJAF, Barrackpo re, Kolkata Chittaranjan Colony, Halisahar, Post Office Nabanagar, North 24 Pargana, West Bengal -743136
Member	Dr Rekha S. Singhal, Professor of Food Technology, Former Head, Food Engineering and Technology Department, Dean (Research, Consultancy and Resource Mobilization), Institute of Chemical Technology, N.P. Marg, Near Khalsa College, Matunga, Mumbai - 400 019 (M.S.)
Member	Dr Nita Khandekar, Acting Director, ICAR-Indian Institute of Soybean Research, Khandwa Road Indore 452001 (M.P.)
Member	Dr Sanjeev Gupta, ADG. (Oil Seeds & Pulses), ICAR, Krishi Bhawan, New Del hi-110001
Member	Shri Bansilal Gurjar, Village Lal Ghati, Post Sabakhada, Distt. Mandsaur (M.P.)
Member	Dr M.P. Sharma, Principal Scientist (Microbiology) ICAR-Indian Institute of Soybean Research, Khandwa Road, Indore -452001

Institute Joint Staff Council

Chairman	Director, ICAR-IISR
Official side	
Member	Dr Savita Kolhe, Principal Scientist
Member	Dr G.K.Satpute, Senior Scientist
Member	Dr Subhash Chandra, Scientist
Member	Shri R.N. Srivastava, ACTO
Member	Finance & Accounts Officer
Member Secretary	Administrative Officer
Staff Side	
Secretary	Shri Balveer Singh, SSG-II
Member	Shri Francis Damasus, Sr. Technical Assitt. Smt. Priynka Sawan, Assistant Shri Anil Kumar Carrasco, Sr. Clerk and (CISC Member) Shri Sanjeev Mishra, Duplicating Operator.

Other Committees

1.	**Official Language Implementation Committee** Ex-officio Director, ICAR -IISR (Chairman) Dr Punam Kuchlan Dr S.K. Pandey Dr D.N. Baraskar Shri Ravi Shanker Kumar Sr. Administrative Officer Sr. Finance & Accounts Officer Shri Vikas Kumar Keshari (Member Secretary)	2.	**Institute Technology Management Committee (ITMC)** Director, ICAR-IISR (Chairman) Dr M.P. Sharma(ITMU Nodal officer) Dr K. C. Sharma Dr S. D. Billore Dr Sanjay Gupta Dr D V Singh Dr M K Srivastava Dr Mrinal Kuchlan
3.	**Priority Setting Monitoring and Evaluation (PME) Cell** Dr M. K. Srivastava(Chairman) Dr Shivakumar M. Dr Laxman Singh Rajput Dr Raghvendra Madar Dr Nikhilesh Pandya Dr Giriraj Kumawat (Member Secretary)	4.	**Purchase Advisory Committee (PAC)** Dr Savita Kolhe (Chairman) Dr A Ramesh Dr G K Satpute Dr Laxman Singh Rajput Dr Rakesh Kumar Verma Dr V. Nataraj Sr. Administrative Officer Sr. Finance & Accounts Officer
5.	**Human Resource Development Committee** Dr Rajkumar Ramteke (Chairman) Dr Shivakumar M. Dr Giriraj Kumawat Dr S. K. Pandey Ms. Avinash Kalanke Sr. Administrative Officer	6.	**Consultancy Processing Cell (CPC)** Dr M.P. Sharma (Chairman) Dr Mrinal Kuchlan Dr LokeshMeena Dr Raghvendra Madar Sr. Finance & Accts. Officer Sr. Administrative Officer

7.	**Student Affairs Committee & Higher Study Committee** Dr Laxman Singh Rajput (Chairman) Mrs. Jyoti meena Dr Vangala Rajesh	8.	**Technology Transfer and Extension Activities Committee** Dr Nita Khandekar (Chairman) Dr Sanjay Gupta Dr M. P. Sharma Dr B.U. Dupare (Nodal officer MGMG) Dr Subhas Chandra (Nodal officer NEH) Dr Lokesh Meena (Nodal officer TSP) Dr M. K. Srivastava Dr Rakesh Kumar Verma(Nodal officer SCSP) Dr Laxman Singh Rajput Sr Administrative Officer Sr Finance& Accounts Officer
9.	**Estate and Guest House Management Committee** Dr Subhash Chandra(Chairman) Shri S. P. Singh Shri R.N. Shrivastava Sh. R.C. Sakya Dr D.N. Barasakar Sh. O.P.Vishwakarma Ms. Jyoti Meena Ms. Seema Chauhan Sr. Administrative Officer	10.	**Publication Committee (Annual Report/Newsletter)** Dr. Giriraj Kumarwat (Chairman-Annual Report) Dr A. Ramesh Dr V Nataraj Dr M. K. Srivastava (Chairman-Newsletter) Dr Vangala Rajesh Dr Raghavendra Madar Dr. Subhash Chandra
11.	**Library Advisory Committee** Dr. Anita Rani (Chairman) Shri Ram Manohar Patel Dr V. Nataraj Shri R. N. Singh Sr. Finance & Accounts Officer Sr Administrative Officer	12.	**Foreign Deputation and Higher Study Committee** Dr Milind B. Ratnaparkhe (Chairman) Dr Savita Kolhe Representative from PME Sr Administrative Officer
13.	**Works Committee** Dr G. K. Satpute (Chairman) Dr Raghvendra Madar (Co-Chairman) Dr Vangala Rajesh Sh R. N. Singh Sr. Administrative Officer Sr. Finance & Accounts Officer Estate Officer	14.	**Agriculture Knowledge Management Unit** Dr Savita Kolhe (Chairman) Dr B.U. Dupare Shri Ram Manohar Patel Dr Avinash Kalanke
15.	**Women Complaint Committee on Sexual Harassment** Dr Punam Kuchlan (Chairman) Ms. Priyanka Sawan Ms Seema Chauhan	16.	**House Allotment Committee** Dr Rajesh Vangla (Chairman) Dr Raghvendra Madar Shri Vikas Keshari Mrs. Jyoti Meena

17.	**Centralized Public Grievance Cell and Monitoring Systems (CPGCMS)** Dr Vineet Kumar	18.	**Store Management Committee** Dr Nikhlesh Pandya Mr I R Khan Shri Vikas Keshari
19.	**Liaison Officer (SC/ST/OBC)** Dr. Punam Kuchlan (SC/ST) Dr. Savita Kohle (OBC)	20.	**Security Cell** Dr Rakesh Kumar Verma (Chairman) Dr Lokesh Meena Shri S. P. Singh Shri O.P. Vishwakarma Shri R. C. Shakya
21.	**Farm Management , Price Fixation , Farm item Disposal Committee** Dr M.K. Kuchlan (Chairman) Dr Laxman Singh Rajput Dr Rakesh Kumar Verma Sh R C Saakya Store Officer S Finance & Accts. Officer S Administrative Officer	22.	**Sport and Staff Welfare Committee** Dr. Shiva Kumar M. Dr. Subhash Chandra Sh. R. N. Shrivastava Sh. S. P. Singh Shri. R. C. Shakya Ms. Seema Chauhan Sh. Sanjeev Mishra Sh. Balbir Singh SAO SFAO
23.	**Swachh Bharat Abhiyaan Committee** SAO Sh. R.N.Shrivastava Dr. D.N. Baraskar Shri S.K. Verma Mrs. Jyoti Meena Shri I.R.Khan Shri R. C. Shakaya Shri. Anil Crasco SFAO Sh. Surla	24.	**Institute Publication /Printing, Press & Media Committee (General)** Dr B.U. Dupare (Chairman) Dr Savita Kohle Dr Lokesh Meena Dr D.N. Baraskar Shri S.K. Verma
25.	**Vehicle Management Committee** Dr G. K. Satpute (Chairman) Dr Lokesh Meena Dr Sanjay Pandey	26.	**Physical Verification and Condemnation Committee** Dr. Vineet Kumar (Chairman) Dr. Rajesh Vangala Dr. S. K. Pandey Shri R. N. Shrivastava Shri I R Khan Shri Balbir Singh

12. Personnel

S. No.	Name	Designation
Director and Scientific staff		
1.	Dr Kunwar Harendra Singh	Director
2.	Dr Nita Khandekar	Pri. Scientist
3.	Dr Sanjay Gupta	Pri. Scientist
4.	Dr Anita Rani	Pri. Scientist
5.	Dr Mahaveer P. Sharma	Pri. Scientist
6.	Dr Vineet Kumar	Pri. Scientist
7.	Dr A. Ramesh	Pri. Scientist
8.	Dr Buddheswar U. Dupare	Pri. Scientist
9.	Dr Savita Kolhe	Pri. Scientist
10.	Dr R. Ramteke	Pri. Scientist
11.	Dr Manoj K. Srivastava	Pri. Scientist
12.	Dr Punam Kuchlan	Pri. Scientist
13.	Dr M.B. Ratnaparkhe	Pri. Scientist
14.	Dr Gyanesh K. Satpute	Pri. Scientist
15.	Dr Mrinal K. Kuchlan	Sr. Scientist
16.	Dr Giriraj Kumawat	Sr. Scientist
17.	Dr M. Shivakumar	Sr. Scientist
18.	Mr. Ram Manohar Patel	Sr. Scientist
19.	Ms. Neha Pandey	Scientist SS
20.	Dr V. Nataraj	Scientist SS
21.	Dr Rajesh Vangala	Scientist SS
22.	Dr Raghavendra Madar	Scientist SS
23.	Dr Lokesh Kumar Meena	Scientist SS
24.	Dr Rakesh Kumar Verma	Scientist SS
25.	Dr Prince Choyal	Scientist
26.	Mr. Sanjeev Kumar	Scientist
27.	Mr. Hemant Maheshwari	Scientist
28.	Mr. Viraj Kamble	Scientist

Administrative Staff		
1.	Mr. Saurabh Meena	SAO
2.	Mr. Ravindra Kumar	SF&AO
3.	Mr. Ajay Shrivastava	AAO
4.	Ms. Priyanka Sawan	AAO
5.	Mr. S.P. Singh	Private Secretary
6.	Mr. Ravi Shankar	Assistant
7.	Mr. Avinash Kalanke	Assistant
8.	Mr. Anil Carrasco	Assistant
Technical Staff		
9.	Sh. Raghu Nath Singh	T-9 (CTO)
10.	Dr Nikhilesh Pandya	T-9 (CTO)
11.	Dr V.P.S. Bundela	T-9 (CTO)
12.	Mr. Sanjay K. Pandey	T-9 (CTO)
13.	Mr. Ramendra N. Shrivastava	T-9 (CTO)
14.	Mr. Devdatt N. Baraskar	T-9 (CTO)
15.	Mr. Shyam K. Verma	T-6 (ACTO)
16.	Mr. Om P. Vishwakarma	T-5 (T.O.)
17.	Mr. Rakesh C. Shakya	T-5 (T.O.)
18.	Mr. Irfanur R. Khan	T-5 (T.O.)
19.	Mr. Francis Damasus	T-5 (T.O.)
20.	Ms. Jyoti Meena	T-3 (T.A.)
21.	Mr. Bilbar Singh	T-2 (Sr. Tech.)
22.	Ms. Seema Chouhan	T-1

Skilled Supporting Staff		
1.	Mr. Sanjiv Mishra	Duplicating officer
2.	Mr. Nirbhay Singh	Skilled Supporting Staff
3.	Mr. Balbir Singh	Skilled Supporting Staff
4.	Mr. Janglia	Skilled Supporting Staff
5.	Mr. Surla	Skilled Supporting Staff
6.	Smt. Fulki Bai	Skilled Supporting Staff
7.	Smt. Raida Bai	Skilled Supporting Staff
8.	Shri Mangilal	Skilled Supporting Staff
9.	Smt. Kamli Bai	Skilled Supporting Staff
10.	Shri Deepak	Skilled Supporting Staff
11.	Smt. Chunki Bai	Skilled Supporting Staff
12.	Smt. Sagri Bai	Skilled Supporting Staff
13.	Smt. Sagar Bai	Skilled Supporting Staff
14.	Smt. Rekha Bai	Skilled Supporting Staff
15.	Smt. Meera Bai	Skilled Supporting Staff
16.	Smt. Parvati Bai	Skilled Supporting Staff
17.	Smt. Romu Bai	Skilled Supporting Staff
18.	Smt. Teju Bai	Skilled Supporting Staff
19.	Smt. Surja Bai	Skilled Supporting Staff
20.	Smt. Rumli Bai	Skilled Supporting Staff
21.	Smt. Sarita Bai	Skilled Supporting Staff
22.	Smt. Sangeeta Bai	Skilled Supporting Staff
23.	Smt. Hira Bai	Skilled Supporting Staff
24.	Smt. Antar Bai	Skilled Supporting Staff
25.	Smt. Mangi Bai	Skilled Supporting Staff
26.	Smt. Naki Bai	Skilled Supporting Staff
27.	Smt. Santo Bai	Skilled Supporting Staff

Joining, Promotions, Transfer, Retirement

Promotions

S.No.	Name	Promoted to the post of	w. e. f.
1	Shri Ram Manohar Patel	Senior Scientist	15.12.2021
2	Dr. Mrinal Kanti Kuchlan	Senior Scientist	07.01.2022
3	Shri Anil Carrasco	Assistant	27.04.2022

Joining

1. Dr. K.H. Singh, Director, joined on 31.10.2022
2. Dr. Prince Choyal, Scientist (Plant Physiology), joined on 04.04.2022

Transfers

S.No.	Name of the employee	Post	Transferred to	Date of transfer
1	Dr Laxman Singh Rajput	Scientist SS	ICAR-CAZRI, Jodhpur	14.12.2022
2	Dr Subhash Chandra	Scientist SS	ICAR-CICR, RS Sirsa	04.11.2022
3	Mr. Vikas Keshari	T-4	ICAR-CRIJAF, Barrackapur	31.05.2022

Retirements

S.No.	Name of the employee	Post	Date of Retirement
1	Dr. Sunil D. Billore	Principal Scientist (Agronomy)	31.07.2022
2	Dr. Dev Vrat Singh	Principal Scientist (Farm Machinery)	31.08.2022
3	Mr. Sur Singh	Skilled Supporting Staff	31.01.2022
4	Smt Bhurli Baai	Skilled Supporting Staff	28.02.2022

भा. कृ. अनु. प. – भारतीय सोयाबीन अनुसंधान संस्थान

ICAR-Indian Institute of Soybean Research

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