वार्षिक प्रतिवेदन
ANNUAL REPORT
2021

भा. कृ. अनु. प. – भारतीय सोयाबीन अनुसंधान संस्थान
ICAR-Indian Institute of Soybean Research
ISO 9001 2015 Certified Organization

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ICAR-Indian Institute of Soybean Research
खण्डवा रोड़, इन्दौर – 452 001 (म.प्र.)
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Preface

It is a matter of great honor and pride for me to present the annual report 2021 of ICAR-Indian Institute of Soybean Research, Indore. It would give a panoramic scenario of research, development and extension activities undertaken by this institute. Soybean crop was introduced in India for commercial cultivation in late 60's, and in a span of 6 decades, it has become the most important oilseed crop of India. At present, the crop is grown in 12.81 million hectares with a production of 12.99 million tones. 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. Soybean seed contains 40% protein and 20% oil and it is one of the most economical sources of good quality protein. Therefore, the crop has a potential to provide nutritional security and eradicate protein malnutrition in the country. Soybean also contains many minerals and bioactive compounds like isoflavones, phytoestrogens, saponins and phytic acid, having many health benefits. Although it has found its way into the animal feed industry, however due to many health benefits, there is a need to incorporate it into the regular human diet too.

Currently, mitigating climate variability related abiotic stress and productivity enhancement of soybean crop are major challenges faced by the soybean researchers. The climatic variability leading delayed monsoon, drought spells of different durations at various growth stages, water-logging conditions, rise in temperatures particularly at seed fill stage and prolonged monsoon at times are the main reasons of low productivity of soybean in India. In addition, increased infestation of insects and diseases due to conducive conditions, further aggravate the situation. It's the endeavor of the scientists of the institute to make all possible efforts to overcome these problems for increasing productivity. Major strategies include identification of trait specific germplasm; understanding underlying mechanism of trait and development of high yielding, nutrition rich and climate resilient varieties; and development of suitable production and protection technologies, for overcoming the problem of low productivity, drought, water logging, high temperature and infestation by insects and diseases.

The most significant achievements of 2021 includes identification of new soybean genotypes with various agronomically important traits such as early maturity, high yield, drought and waterlogging tolerance, charcoal rot, collar rot, anthracnose resistant, YMV resistance, insect resistant, high oil, high oleic acid, KTI free and lipoxygenase-free genotypes. A new variety NRC 142, which is free from KTI and Lipoxygenase 2, having resistance to multiple diseases and insect-pests, was released for Central and Southern Zone. New pesticide molecules were tested for disease and insect control. Technologies were developed and evaluated to mitigate various stresses and crop residue management related problems. The institute intensified its efforts in the transfer of technology especially at the grass root level. It launched an institute level news channel "Madhya Bharat Samachar". The institute spearheaded various webinars and online trainings for national and international collaborations and 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 T. Mohapatra, 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. Thanks are also due to the members of editorial committee for making this report crisp, comprehensive and informative. All the scientific, technical, administrative, account and service staff of the institute who have contributed in bringing out this report are worthy of appreciations. I extend my hearty thanks and congratulations to each one of them.

N Khandekar

(Nita Khandekar)
Director

कार्यकारी सारांश

संस्थान के मध्यम-अवधि जननद्रव्य भण्डारण में सोयाबीन की 14 जंगली प्रजातियों के 74 परिग्रहणों सहित कुल 5946 जननद्रव्य परिग्रहणों का अनुरक्षण एवं संरक्षण किया गया। विशिष्ट लक्षण वाले कुल 257 जननद्रव्यों का बीज उपज और इससे संबंधित गुणों के लिए मूल्यांकन किया गया। कुल 50 जननद्रव्यो का विभिन्न रोगों की प्रतिरोधकता लिए 5 स्थानों पर तथा कीट सहिष्णुता के लिए 6 स्थानों पर मूल्यांकन किया गया। कीट प्रतिक्रियाओं के आधार पर करधनी बीटल और पत्ती खाने वाले की सहिष्णुता के लिए क्रमशः 5 जननद्रव्य (ई सी 251827, ई सी 383165, ई सी 389149, ई सी 457366, और ई सी 458350 और 11 जननद्रव्य (ई सी 251541, ई सी 280149, ई सी 357998, ई सी 389170, ई सी 251827, ई सी 291401, ई सी 383165, ई सी 389149, ई सी 389174, ई सी 457366 और ई सी 458350) आशाजनक पाए गए। कुल 76 जननद्रवयों का तेल की मात्रा के लिए मूल्यांकन किया गया जिनमे तेल की मात्रा 18.08% (AMS MB 100-39) से 24.33% (TGX 854-429) तक की सीमा में एवं 20.95% के औसत के साथ पाया गया।

✲ प्राथमिक जीन पूल (*ग्लाइसिन सोजा*) के नए अंतरजातीय क्रॉस/संकर विभिन्न लाइन जैसेः पी आई 593893, पी आई 407170, पी आई 549046, का उपयोग कर बनाए गए तथा तृतीयक जीन पूल वाले *ग्लाइसिन माइक्रोफिला* का *ग्लाइसिन मैक्स* के साथ भी संकरण कर बनाए गए। बीज उपज और इससे संबंधित गुणों के लिए एस एल 958 की आनुवंशिक पृष्ठभूमि में चार प्रकाशवधि प्रतिक्रियाशील जीनों के विभिन्न आनुवंशिक स्टॉक का मूल्यांकन इन्दौर और लुधियाना में किया गया। इनमें से कई आनुवंशिक स्टॉक की उपज SL 958 से अधिक पाई गयी, जबकि इन आनुवंशिक स्टॉक की परिपक्वता अवधि भी SL 958 से कम थी। उपज परियोजना में अठारह उन्नत प्रजनन लाइनो का बीज उपज और इससे संबंधित गुणों के लिए मूल्यांकन किया गया, जिसमें जे एस 335 x *ग्लाइसिन सोजा* से प्राप्त चार जीनोटाइप YMV 1, 2, 11 और 16 ने सर्वोत्तम चेक जे एस 20-69 की तुलना में अधिक उपज दी और परिपक्वता अवधि भी कम पायी गई। एक जल्दी परिपक्व होने वाली किस्म NRC 138, मध्य क्षेत्र के लिए विकसित की गयी।

✲ KTI और लिपोक्सीजेनेस 2 से मुक्त एक कम परिपक्वता अवधि वाली किस्म NRC 142, मध्य और दक्षिणी क्षेत्र के लिए विकसित की गयी। KTI और लिपोक्सीजेनेस 2 से मुक्त

Executive Summary

A total of 5946 germplasm accessions including 74 accessions of 14 wild species maintained in medium-term storage. A total of 257 trait-specific germplasm evaluated for grain yield and related traits. Fifty germplasm accessions evaluated at 5 locations for different diseases and at 6 locations for insect-pest tolerance. On the basis of insect reactions, 5 germplasm lines (EC 251827, EC 383165, EC 389149, EC 457366, and EC 458350) and 11 germplasm (EC 251541, EC 280149, EC 357998, EC 389170, EC 251827, EC 291401, EC 383165, EC 389149, EC 389174, EC 457366 and EC 458350) found promising for girdle beetle and defoliator tolerance, respectively.A total of 76 germplasm lines evaluated for oil content which ranged from 18.08 % (AMS MB 100-39) to 24.33% (TGX 854-429) with the average of 20.95%.

□ New interspecific crosses of primary gene pool (*Glycine soja*) accessions PI 593893, PI 407170, PI 549046 and tertiary gene pool (*Glycine microphylla*) made with *G. max.* Genetic stocks of four photoperiodic responsive genes in the background of SL 958 evaluated for agronomic traits and grain yield, at Indore and Ludhiana. Several of the genetic stocks surpassed grain yield of SL 958 while their maturity duration was less. Eighteen advanced breeding lines evaluated for yield and attributing traits. Four genotypes YMV 1, 2, 11, and 16 derived from JS 335 x *G. soja* yielded more and matured earlier than best check JS 20-69. NRC 138, an early maturing varienty, was idenfied for relase in the Central Zone.

□ NRC 142, an early maturing variety free from KTI and Lipoxygenase 2 released for Central and Southern Zone, NRC 152 with similar speciality traits promoted to AVT II in Central Zone. NRC 181, a KTI free and early maturing line, and NRC 150, an early maturing line free from Lipoxygenase 2 and high oil content, promoted to AVT I in Central Zone. Two advanced breeding lines namely NRC140 and NRC141, identified with high oleic acid 60± 5%.

जल्दी परिपक्व होने वाली लाइन किस्म NRC 152, मध्य क्षेत्र के लिए AVT II में पदोन्नत की गयी। KTI से मुक्त जल्दी परिक्व होने वाली लाइन NRC 181, उच्च तेल सामग्री तथा लिपोक्सीजेनेस 2 से मुक्त लाइन NRC150, मध्य क्षेत्र में AVT I में पदोन्नत की गयी। अधिक ओलिक एसिड (60±5%) वाली दो उन्नत प्रजनन लाइनों NRC 140 और NRC 141, की पहचान की गयी।

❇ सूखा सहिष्णु परियोजना में उच्च स्टेम रिजर्व मोबिलाइलेशन (SRM) एवं डिलेड सेनेसेंस लक्षण वाली अठारह अग्रिम प्रजनन लाइनों का मूल्यांकन, रेनआउट-संरचना तथा परिवेशी परिस्थितियों में किया गया। इनमें से सात जीनोटाइप S-1-26, BC3, JS 59, S-2-1, S-1-10, S-2-12, S-3-1 और BC3JS52, में चेक एनआरसी 7 और जेएस 97-52 की तुलना में उच्च सूखा प्रतिरोध सूचकांक (DRI>0.8) और सूचा सहिष्णुता संबंधित लक्षण थे। अजैविक तनाव सहिष्णुता में भिन्नता वाले 25 सोयाबीन जीनोटाइप का प्रांरभिक वानस्पतिक अवस्था में जड़ संबंधित लक्षणों के लिए मूल्यांकन हाइड्रोपोनिक कल्चर का उपयोग करते हुए किया गया, जिनमें उच्च जड़ लंबाई और जड़ मात्रा वाले जीनोटाइप एनआरसी 128 और ईसी 538828 की पहचान की गई।

❇ भारत के मध्य क्षेत्र के लिए जारी सोयाबीन की सैतीस किस्मों का मूल्यांकन सूखे से संबंधित लक्षणें जैसे सापेक्ष जल मात्रा, बीज उपज के लिए सूखा प्रतिरोध सूचकांक, 100- बीज भार, जड़ प्रणाली और सूखा प्रतिरोध सूचकांक, के लिए नियंत्रित रेनआउट-संरचना में किया गया। बीज उपज के लिए उच्च सूखा प्रतिरोध सूचकांक (DRIsy>1.0) को 12 जीनोटाइप यानी MAUS 81, MAUS 47, NRC 86,गौरव JS 75-46, Pb 1, PK 472, NRC 127, JS 20-69, JS 335, AMS-100-39, JS 8021 में पाया गया। RIL आबादी (जे एस 97-52 जे एस 90-41 N=110) का मूल्यांकन सूखे से संबंधित लक्षणों जैसे स्टेम रीमोबिलाइजेशन विशेषता और विलंबित पत्ती झड़ना के लिए किया गया एवं सूखा सहने वाले पैत्रक जीनोटाइप जे एस 97-52 की तुलना में उच्च स्टेम रीमोबिलाइजेशन वाले ट्रांसग्रेसिव सेग्रेंट्स की पहचान की गई।

❇ बीज अंकुरण स्तर पर जलमगन सहनशीलता के लिए स्क्रीनिंग तकनीक को मानकीकृत किया गया। कुल 40 सोयाबीन जीन प्रारुपो का V2-V3 चरण में जलभराव सहिष्णुता वाले लक्षणों के लिए मूल्याकन किया गया। एक 82-जीनोटाइप के सेट का क्षेत्रीय परिस्थितियों में प्रजनन अवस्था पर जलभराव सहिष्णुता वाले लक्षणें के लिए

 Eighteen advance breeding lines with high stem reserve mobilization and delayed senescence traits were evaluated in rainout-shelter and ambient conditions. Seven genotypes viz. S-1-26, BC3 JS 59, S-2-1, S-1-10, S-2-12, S-3-1 and BC3 JS 52 had high drought resistance index (DRI >0.8) and drought related traits as compared to tolerant checks NRC 7 and JS 97-52. Twenty-five soybean genotypes varying in abiotic stress tolerance characterized for root architecture traits at early vegetative stage using hydroponic culture, which identified genotypes NRC 128 and EC538828 having high root length and root volume.

 Thirty-seven soybean varieties of Central Zone, evaluated under controlled rainout-shelter condition for drought related traits viz., relative water content, drought resistance index for seed yield, drought resistance index for 100-seed weight and root system architecture traits. High drought resistance index for seed yield (DRIsy>1.0) were expressed in 12 genotypes i.e.MAUS 81, MAUS 47, NRC 86, Gaurav, JS 75-46, Pb 1, PK 472, NRC 127, JS 20-69, JS 335, AMS-100-39, JS 80-21. A RIL population (JS 97-52 x JS 90-41, n=110) has been evaluated for stem remobilization trait and delayed senescence trait. Transgressive segregants with higher stem remobilization than drought tolerant parent JS 97-52 were identified.

 Screening technique for submergence tolerance at seed germination stage standardized. A total of 40 soybean accessions evaluated for waterlogging tolerance traits at V2-V3 stage along with tolerant and susceptible checks under field conditions. A set of 82 genotypes evaluated for waterlogging tolerance traits at reproductive stage under field conditions. Multilocation evaluation trial conducted for 17 genotypes to test reproductive stage water logging tolerance.

 A GWAS panel consisting around 300 diverse soybean accessions along with tolerant and susceptible checks phenotyped for drought and water-logging traits and charcoal rot resistance traits.

मूल्याकंन किया गया। सत्रह जीनप्ररुपों का मूल्यांकन, चार स्थानों पर प्रजनन अवस्था पर जलभराव सहिष्णुता वाले लक्षणों के लिए किया गया।

✲ एक GWAS पैनल जिसमें लगभग 300 विविध सोयाबीन से सहिष्णु और अतिसंवेदनशील जांच जीनप्ररुप शामिल थे, को सूखे, जल-जमाव लक्षणों और चारकोल सड़न प्रतिरोध लक्षणों के लिए फेनोटाइप किया गया।

✲ R-6 अवस्था में एन्थ्रेक्नोज प्रतिरोधकता की स्क्रीनिंग के लिए एक नई कृत्रिम स्क्रीनिंग विधि पॉड-इनोक्युलेसन तकनीक विकसित और मानकीकृत की गई । पी.ए.यू., लुधियाना के सहयोग से विकसित पीला मोजेक प्रतिरोधी और उच्च तेल मात्रा वाली प्रविष्टि NRC 149 को उत्तरी मैदानी क्षेत्र में एवीटी II में पदोन्नत किया गया। इन्दौर आइसोलेट का उपयोग करते हुए कॉलर रोट प्रतिरोधकता के लिए छत्तीस सोयाबीन जीनोटाइप की जांच की गई, जिसमे जीनोटाइप PS16-70, PS 16-61, NRC 137, मध्यम प्रतिरोधी पाए गए।

✲ कट-स्टेम इनोक्यूलेशन तकनीक के माध्यम से विश्लेषण किए गए *एम. फेजोलिना* (चारकोल रोट) के 62 आइसोलेट्स में से आइसोलेट MP36 (मेडजिफेमा, नागालैंड से एकत्रित) अत्यधिक विषैला पाया गया। पृथक-पेटिओल तकनीक के माध्यम से विश्लेषण किए गए *सी. ट्रंकैटम* (एन्थ्रेन्कोज) के 19 आइसोलेट्स में से इन्दौर से एकत्र किए गए आइसोलेट CT 1 को अधिक विषैला पाया गया।

✲ चारकोल रोट और कॉलर रोगों के खिलाफ कवकनाशी के लिए *इन विट्रो* मूल्यांकन किया गया । परिणामस्वरूप पिकोक्सीस्ट्रोबेन 7% +प्रोपिकोनाज़ोल 12% एस सी चारकोल रोट, और पाइराक्लोस्ट्रोबिन 133g/1+ एपॉक्सीकोनाक्सोल 50g/1se का कॉलर रॉट के खिलाफ अधिकतम औसत मायसेलियम अवरोधन हुआ। चारकोल सड़न रोग पर सोयाबीन एंडोफाइट्स के प्रभाव का मूल्यांकन किया गया जिसमें एंडोफाइट EFN 1 (23.20) के साथ बीज ड्रेसिंग में न्यूनतम AUPDC दर्ज किया गया । एन्थ्रेक्नोज रोग पर सोयाबीन एंडोफाइट्स के प्रभाव का मूल्याकन किया गया और PDO में 78.05% की कमी के साथ पायरोक्लोस्ट्रोबिन (20%) के पर्ण अनुप्रयोग में न्यूनतम PDI देखा गया था जो सांख्यिकीय रूप से एंडोफाइट्स EF 42 (22.22%) और EB 111 (26.67%) के पर्ण अनुप्रयोग के बराबर था।

✲ पांच जीनोटाइप जैसे : F4P21 (0.22), CAT 2503 (0.32), G522 (0.46), IC 24997 (0.47), EC 113393 (0.47) ने *स्पोडोप्टेरा लिटुरा* के खिलाफ अधिक एंटीक्सेनोसिस प्रदर्शित किया । *ग्लाइसिन* की तीन

- A new artificial screening method, "pod-inoculation technique" developed and standardized for screening of anthracnose resistance at R6 stage. YMV resistant and high oil content entry NRC 149, developed in collaboration with PAU, Ludhiana promoted to AVT II in North Plain Zone.Thirty-six soybean genotypes screened for collar rot resistance using Indore isolate. Genotypes PS 16-70, PS 16-61 and NRC 137 found to be moderately resistant.

- Among 62 isolates of *M. phaseolina* (Causing charcoal rot) analyzed through cut-stem inoculation technique, isolate MP36 (Isolated from Medziphema, Nagaland), found highly virulent. Among 19 isolates of *C. truncatum* (Causing anthracnose) analyzed through detached-petiole technique, isolate Ct1collected from Indore found to be more virulent.

- In *in-vitro* evaluation of fungicides against charcoal rot and collar rot diseases, Picoxystrobin 7% + Propiconazole 12% SC resulted in maximum mean mycelial inhibition (92.79 %) against charcoal rot and Pyraclostrobin 133g/l + Epoxiconaxole 50g/l SE (84.85%) resulted in maximum mean mycelial inhibition of collar rot. Effect of soybean endophytes on charcoal rot disease evaluated and minimum AUDPC recorded in seed dressing with the endophyte EF N1 (23.20), over the control (67.33) with 65.54% of reduction in AUDPC. Effect of soybean endophytes on anthracnose disease was evaluated and minimum PDI observed in foliar application of pyroclostrobin (20.00%), over the control (91.11 %) with 78.05 % of reduction in PDI, which statistically on par with the foliar spray of endophytes EF 42 (22.22%) and EB 111 (26.67%).

- Five genotypes viz., F4P21 (0.22), CAT 2503 (0.32), G5P22 (0.46), IC 24997 (0.47), EC 113393 (0.47) exhibited strong antixenosis against *Spodoptera litura.* Three Glycine species- *Glycine tomentolla, Glycine canescens, Glycine tabacina* showed antibiosis reaction against *Spodoptera litura* in terms of AD/ECI/ECD. Genotypes EC

प्रजातियां - *ग्लाइसिन टोमेंटोला, ग्लाइसिस कैनेसेंस, ग्लाइसिन टैबसीना* AD/ECI/ECD के संदर्भ में *स्पोडोप्टेरा लिटुरा* के विरुद्ध प्रतिजैविक प्रतिक्रिया दिखाई। जेनोटाइप ई सी 389149 और ई सी 241696 स्टेम फ्लाई के प्रति सबसे कम संवेदनशील पाए गए।

❊ VLSI ई सी 538828 से जनित कुछ आर आई एल, जिसमें उच्च उपज देने वाले लक्षण (28-30 क्यू/हे.), बड़ा बीज (14-17 ग्राम), उच्च बीज कोट लिग्रिन सामग्री, कम बीज कोट क्रैकिंग, अधिक रोग प्रतिरोधक क्षमता है, उनमे परिवेशी परिस्थितियों में 8 महीने के भंडारण के बाद उच्च अंकुरण दर और बेहतर क्षेत्र अंकुरण दर की पहचान भी की गई।

❊ AICRPS के तहत केन्द्रीय कृषि विश्वविद्यालय, इंफाल के सहयोग से विभिन्न मूल्य वर्धित सोया उत्पाद जैसे : बेक्ड सोयाबीन, किण्वित सोयाबीन, अंडे रहित सोया कुकी, सोया लड्डू, सोया चकली, सोया नमकपारे, सोया उपमा मिक्स, सोया फोर्टिफाइड नूडल्स बनाने की विधि तैयार की गयी।

❊ विभिन्न फसल स्थापना तकनीकों में पीबीबीएस + आर (अवशेष के साथ स्थायी चौड़ी क्यारी) के तहत उल्लेखनीय रूप से उच्चतम सोयाबीन उपज पाई गयी। ड्रिप सिंचित और बारानी पारिस्थितिकी तंत्र उल्लेखनीय रूप से उच्चतम सोयाबीन उपज पाई गयी । ड्रिप सिंचित और बारानी पारिस्थितिकी तंत्र के तहत लंबी अवधि की सोयाबीन की छह बीज उपज, जैविक उपज और फसल सूचकांक मिला।

❊ इंडोलएसिटिक एसिड, ब्रासिनोस्टेरॉइड्स (बीज प्राइमिंग) और साइटोकिनिन (पर्ण अनुप्रयोग) का उपयोग, ज्यादा ए. एम. फंगल बायोमास (ग्लोमलिन और रूट कॉलोनाइजेशन) और रूट बायोमास के उत्पादन में प्रभावी पाया गया।

❊ प्रौद्योगिकी के हस्तांतरण के लिए सोयाबीन में ICT उपकरण और मीडिया, विकसित कर प्रभावी ढंग से नियोजित किए एग। संस्थान ने इस वर्ष एक कृषि समाचार आधारित कार्यक्रम : आई सी ए आर - मध्य भारत समाचार शुरु किया, जिसमें इस वर्ष 30 एपिसोड अपलोड किए गए हैं।

❊ मशीन लर्निंग विधि ANN (कृत्रिम तंत्रिका नेटवर्क) का उपयोग कर कीट प्रकोपों के लिए मॉडल तैयार किया गया है। MS- एक्सेस डेटाबेस,एक्सेल और आर्क-जी आई एस सॉफ्टवेयर का उपयोग करते हुए स्थानिक निर्णय समर्थन प्रणाली (एस डी एमएस) सॉफ्टवेयर का उपयोग चार अलग-अलग कीटों के जिलेवार कीट प्रकोपों के हॉट-स्पॉट

389149 and EC 241696 found to be least susceptible against stem fly.

 Promising RILs of cross VLS1 × EC538828, having high yielding traits (28-30 Q/ha), bold seed (14-17 g), high seed coat lignin content, less seed coat cracking, disease resistance (pod blight, YMV, SMV), high germination rate after 8 months of storage in ambient conditions and better field emergence, identified.

 Various value added soy products viz. Baked soybean, fermented soybean, eggless soy ccokies, soy laddoo, soy chakli, soy namakpare, soy upma mix, soy fortified noodles prepared in collaboration with Central Agricultural University, Imphal under AICRP on soybean.

 Among the different crop establishment techniques, significantly highest soybean yield was reported under PBBF + R (Permanent Broad Bed Furrow with Residue). Six long duration soybean cultivars evaluated for grain yield and harvest index, under drip irrigated and rainfed ecosystem. JS 20-69 reported significantly higher grain yield, biological yield and harvest index compared to other cultivars.

 Foliar application of IAA (Indole Acetic Acid), BR (Brassinosteroids) (seed priming) and CK (Cytokinin) found to be most effective in producing higher AM fungal biomass (glomalin and root colonization) and root biomass.

 ICT tools and media developed and effectively employed in soybean for transfer of technology. Institute has also launched ICAR-Madhya Bharat Samachar, an agricultural news based programme this year with 30 episodes uploaded this year.

 Machine learning method ANN (Artificial Neural Networks) used to model the insect incidence. Spatial Decision Support System(SDSS) software using MS-Access database, excel and Arc-GIS software used to prepare district-wise insect incidence hot-spot maps of four different insect pests. A java based

मानचित्र तैयार करने के लिए किया गया। एमवीसी ढांचे का उपयोग करके, फली बेधक प्रकोप के बारे में सोयाबीन उत्पादकों को आगाह करने के लिए जावा आधारित पूर्व चेतावनी डी एस एस (डिसीजन सपोर्ट सिस्टम) सॉफ्टवेयर विकसित किया गया। संस्थान में GIGW अनुरुप नई वेबसाइट विकसित की गई एवं संस्थान में सोयाबीन उत्पाद बिक्री पोर्टल का प्रारंभिक प्रोटोटाइप विकसित किया गया।

✲ संस्थान को 16 जुलाई 2021 को भा. कृ. अ. प. स्थापना दिवस के अवसर पर गणेश शंकर विद्यार्थी हिन्दी पत्रिका (2020) पुरुस्कार से सम्मानित किया गया।

✲ संस्थान ने सोयाबीन अनुसंधान और उत्पादन प्रोद्यौगिकियों के विभिन्न पहलुओं को ध्यान में रखते हुए 15 विभिन्न वेबिनार आयोजित किये। संस्थान ने किसानों के बीच विभिन्न उन्नत सोयाबीन उत्पादन तकनीकों का प्रसार करने के लिए किसानों के लिए कई प्रशिक्षण कार्यक्रम भी आयोजित किए।

forewarning Decision Support System software developed to forewarn the soybean growers about pod borer incidence. GIGW compliant new website is developed at the institute. Preliminary prototype of Soybean Product Sale portal developed at the institute.

 Institute awarded with Ganesh Shankar Vidyarthi Hindi Patrikaaward (2020) on the occasion of ICAR foundation day on 16th July, 2021

 Institute has organized 15 webinars covering various aspects of soybean research and production technologies. Institute has also conducted several training programs for farmer to disseminate various improved soybean production technologies among the farmers.

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.

Physiography

ICAR-IISR campus is located in the village Piplyarao of district Indore, which lies in Vidhyanchal range of Malwa Plateau at 22o 4'37"N latitude and 75o 52'7"E longitude. It is positioned at an altitude of 550 meter above the mean sea level. The institute with an area of 58.05 hectares, is situated at a distance of 4 km from the heart of Indore city and 6 km from railway station.

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 typic chromusterts and fine clay loam, montmorillonitic family of lithic vertic ustochrepts.

Climate

The climate of the Malwa Plateau of Madhya Pradesh is semi-arid with a growing period of 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, drought tolerance, waterlogging and resistance to diseases such as charcoal rot, anthracnose, rust and yellow mosaic and insect pests. Genotypes with high oleic acid (NRC 106, IC 210), low linolenic acid (VLS 59), vegetable soybean genotypes (NRC 105), null kunitz trypsin inhibitor genotypes (NRC 101, NRC 102) 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) have been bred and released for cultivation in different agro-ecological regions of the country. First null KTI genotype in the country, NRC 127, has been released for cultivation in the Central 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 photo periodic genes and early maturity traits, 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.

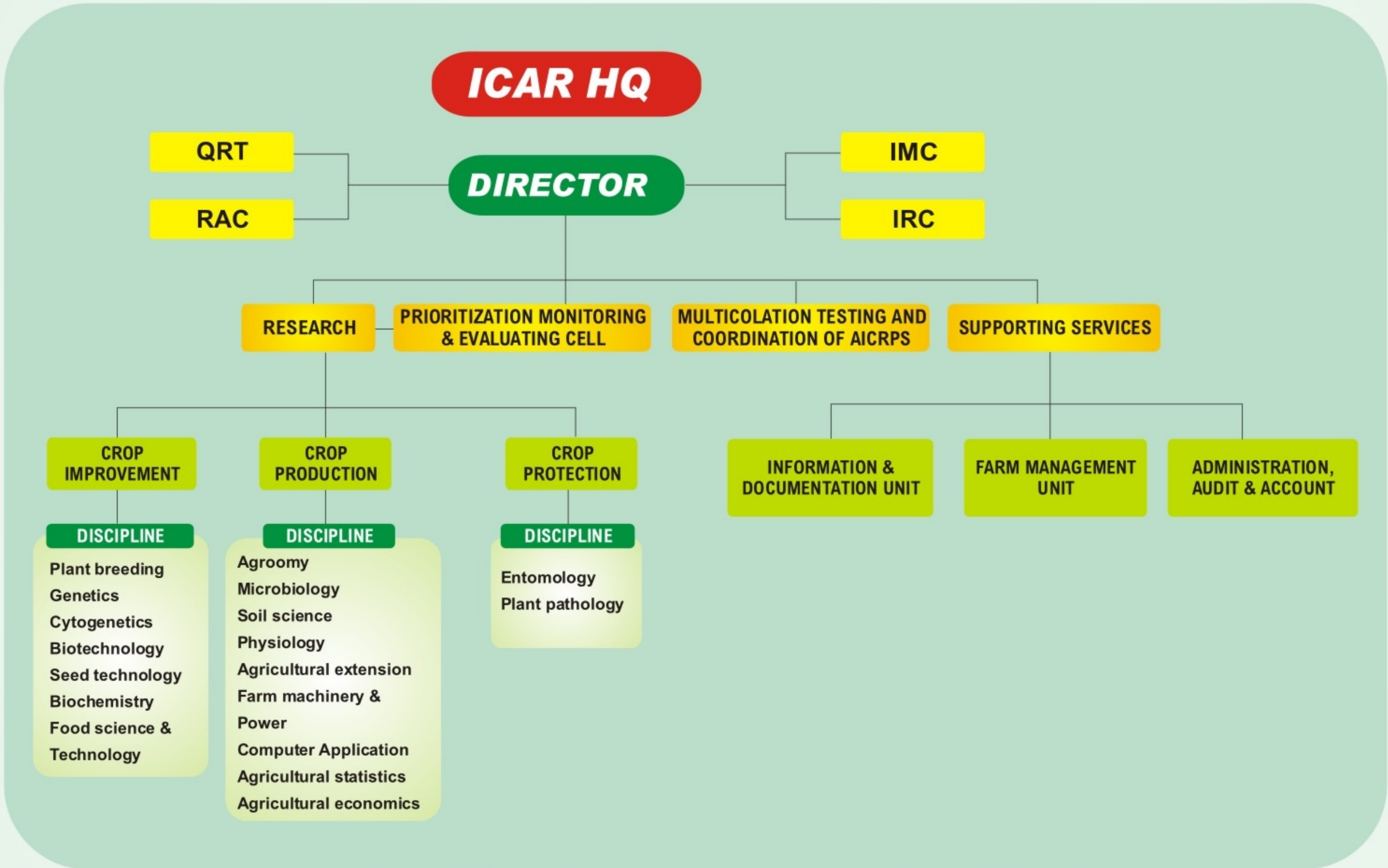
Consequently, the institute has emerged as a catalyzing force to facilitate rapid increase in acreage and production of soybean since 35 years. It has also been instrumental in providing sustainability to soybean cultivation in different regions of the country.

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 as follows :



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 31 December 2021 is 101comprising 35 scientific, 22 technical, 17 administrative and 27 supporting positions. Out of which 81 are in positions as on 31 December 2021.

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**

Research Achievements

3.1 Genetic Resources : Conservation, Characterization and Utilization

Germplasm conservation

Germplasm acquisition and maintenance : A total of 5946 germplasm accessions including 74 accessions of 14 wild species are being maintained in MTS. Trait specific germplasm set (257 accessions) 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), other disease resistance (20), rust differentials (7), antibiosis to spodoptera (3), other insect resistance (17), vegetable types (11), early maturity (37), bold seeded (33), small seeded (1), 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) were maintained.In addition to trait specific panel, 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 were also maintained and multiplied.

Germplasm characterization

Evaluation of trait specific germplasm : A total of 257 accessions of trait specific germplasm set was evaluated for seven yield attributes at Indoreand top performing genotypes for each trait were identified.

Multi-location germplasm evaluation for diseases and insect pests : 50 germplasm lines were screened at 4 locations (Jabalpur, Pantnagar, Palampur and Dharwad) for diseases and 6 locations (Sehore, Indore, Kota, Ludhiana, Dharwad and Imphal) for insect tolerance. Highly resistant resources for charcoal rot (CR), rhizoctonia aerial blight (RAB) and frog eye leaf spot (FLS) were identified at Jabalpur, Pantnagar and Palampur, respectively. None of the accessions was resistant to rust at Dharwad. On the basis of insect reactions, 5 germplasm lines (EC 251827, EC 383165, EC 389149, EC 457366, and EC 458350) and 11 germplasm (EC 251541, EC 280149, EC 357998, EC 389170, EC 251827, EC 291401, EC 383165, EC 389149, EC 389174, EC 457366 and EC 458350) were found to be promising for girdle beetle and defoliator tolerance, respectively.

Evaluation of trait specific germplasm set for yield and related traits

Traits	Mean	Range	Top Performing Accessions
Grain yield per plant (g)	8.16	0.11-26.82	EC 241778, Hardee, EC 572086, EC 572154, EC 241780, NRC 86, EC 528623
Dry biomass per plant (g)	37.58	8.14-73.55	RKS 113, EC 572086, JS 20-116, EC 241780, RVS 20076, EC 528622, DS 3105
100 Seed weight (g)	9.65	4.00-20.84	EC 916032, EC 538828, AKSS 67, PP 1, NRC 105, EC 39150, AGS Farm acc
No. of pods per plant	57.47	2.00-160.60	EC 572154, G 828, AGS 186, Young, JS 20-116, EC 572086, NRC 86
No. of nodes per plant	8.87	3.20-15.80	AGS 25, CM 60, EC 39751, EC 572086, IC 210, EC 456556, NRC 137
No. of branches per plant	4.28	0-14.00	EC 241780, EC 462412, CAT 2740, EC 241778, PI 459025, Dsb 23, NRCSL 2
Plant height (cm)	37.46	14.00-80.40	AGS 25, PLSO 84, CM 60, EC 916033, TGX 317-37E, NRC 186, SL 958

Disease resistant germplasm lines identified at hotspots

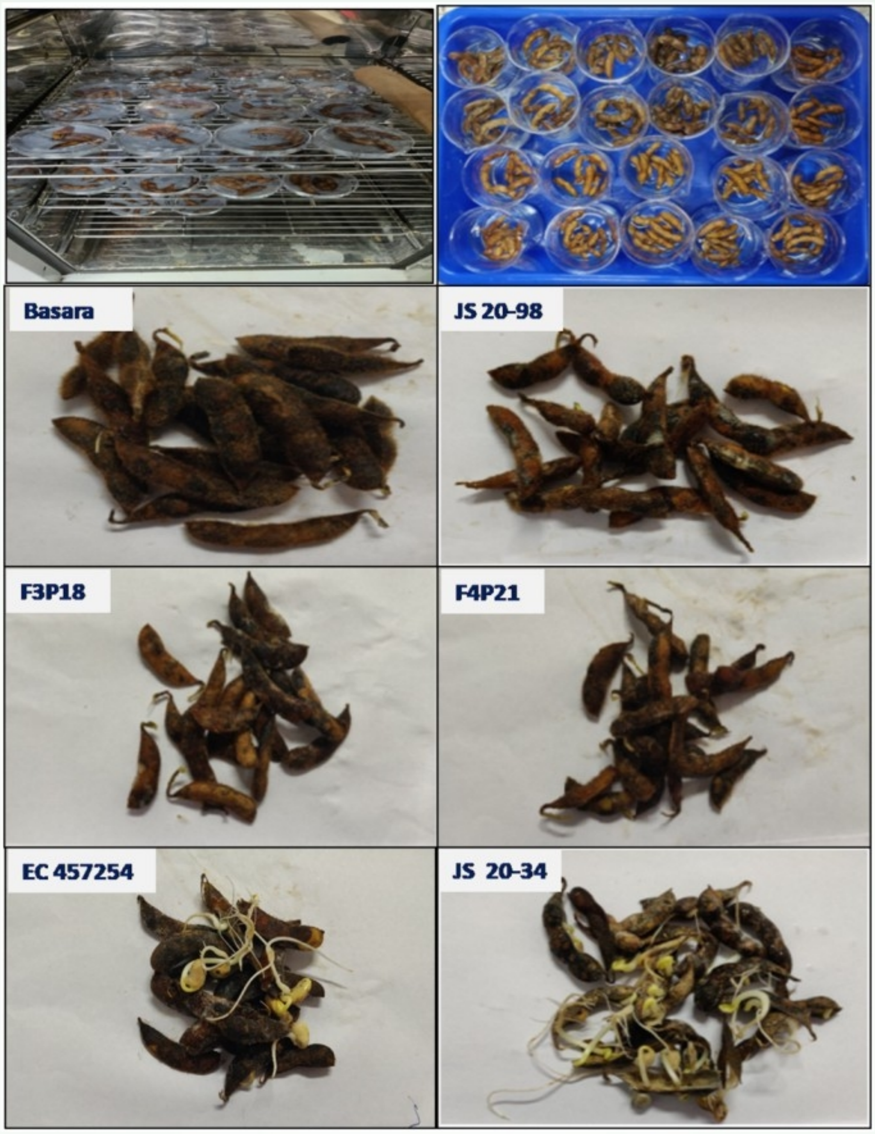
Centre	Disease	Resistant Germplasm
Jabalpur	CR	EC 251876, EC 274755, EC 333880, EC 333892, EC 389153, EC 457366
Pantnagar	RAB	EC 251861, EC 287466, EC 289099, EC 313915, EC 333879, EC 389160, EC 389174 , EC 389179 B
Palampur	FLS	EC 251865, EC 280129 , EC 280149, EC 287466, EC 291401, EC 308312, EC 309537, EC 313915, EC 325098, EC 333879, EC 350664, EC 357998, EC 383165, EC 389149, EC 389153, EC 390981 A

Evaluation of GWAS panel at Indore : A GWAS (Genome wide association studies) panel of 320 germplasm was evaluated for eight quantitative and seven qualitative characters. A large array of variability was observed in the collection for all traits. Purple flower, determinate growth habit, presence of pubescence of tawny color and pointed ovate leaves were predominant qualitative characters.

Genetic variability for 8 quantitative traits in GWAS panel

No.	Trait	Mean	Range	Promising Genotypes
1	Days to 50% flowering	44.59	25.0-55.0	EC 457305, IC 15089, EC 390977, AGS 155, AKSS 67
2	Days to maturity	105.30	74.0-121.0	IC 15089, EC 538828, EC 572109, AGS 155, AKSS 67
3	Plant height	59.24	24.4-121.1	RVS 2001-18, EC 250577, EC 287460, JS 98-02, CO- soy-1
4	Number of branches/plant	3.30	0.4-5.8	EC 602288, PS 1024, EC 389165, TGX 860-11 D, AGS 25
5	Number of nodes	8.77	5.0-20.6	JS 20-76, EC 391181, EC 456613, AGS 25, KHSB 2
6	Number of pods	32.74	3.0-78.8	AMSS 34, AMS-MB-5-18, AGS 25, DS 321, EC 546882
7	100 seed weight	6.34	1.0-18.6	RVS 2001-18, EC 538828, EC 547464, EC 333901, EC 538807
8	Grain yield per plant	3.56	1.1-14.4	B 1665, JS 20-72, TGX 854-429, DS 321, EC 546882

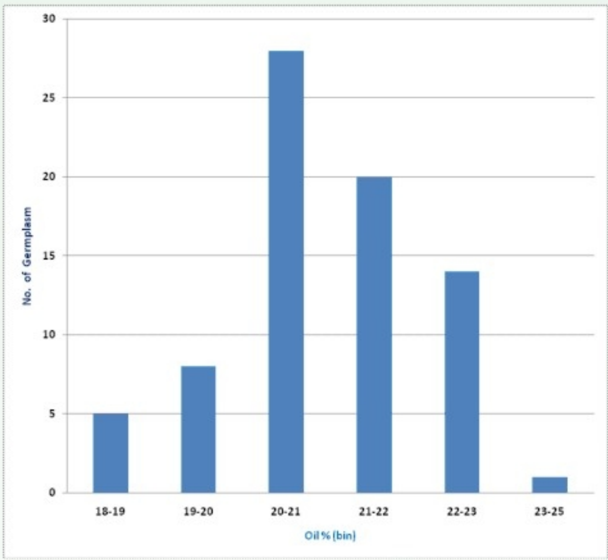
Germplasm evaluation for pre-harvest sprouting tolerance : An artificial screening technique for pre harvest sprouting was standardized and thirty five genotypes were evaluated. Observations were recorded for pre harvest sprouting and related eight quantitative traits related to the pre-harvest sprouting (fresh pod wt, pod length, pod diameter, pod wall thickness, pod wt after 24 Hrs, water imbibition by pods, total seed in pod, number of seed ruptured in pod) and one qualitative character (presence/absence of pubescence). Genotypes viz., EC 34087, RSC 10-46, JS 20-69, JS 20-98, Kalitur, RSC 10-46, F4P21, F3P18, Basara were found resistant as they recorded zero reading. Genotypes JS 20-34, JS 9560, JS 335, EC 457254, JSM 242 were found susceptible in artificial screening.



Screening for post harvest sprouting tolerance

Germplasm evaluation for herbicide tolerance : An experiment has been initiated to screen 140 soybean germplasm accessions in conventional method for glyphosate resistance. Genotypes were sown in 5 replications i.e. for weed control, 50 % and 100% dosage of Glyphosate (SL), 50 % and 100% dosage of ammonium salt of Glyphosate. Data was recorded for symptoms and survival of genotypes after seven days of spray. Promising variation was found in 100% dosage when compared with 50% dosage. Genotypes with less symptoms and survival would further be tested to standardize the protocol.

Germplasm evaluation for oil content : A total of 76 germplasm lines were evaluated for oil content and good amount of variability for oil (%) has been revealed in germplasm lines.Oil content varied from 18.08 % (AMS MB 100-39) to 24.33% (TGX 854-429) with the average of 20.95%. TGX 854-429, EC 546882, EC 357998, Kaeri 651-6, PK 472, EC 95815,and EC 528622 genotypes had more than 22.5% oil content.



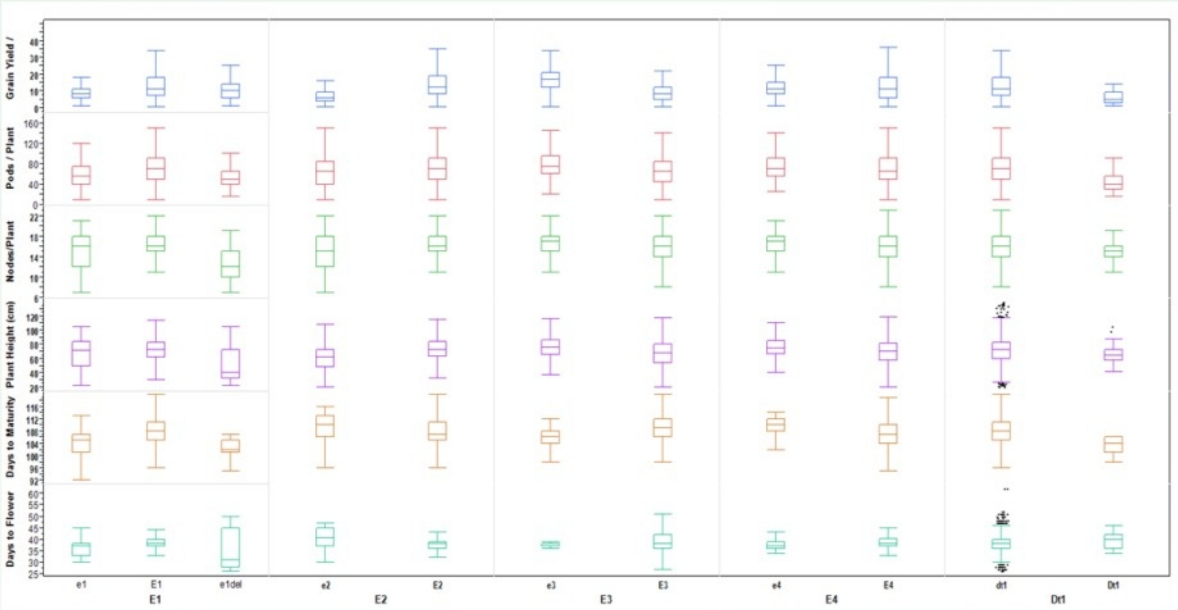
Frequency distribution for oil content

Germplasm utilization

Development of genetic stocks for photoperiodic and growth habit genes

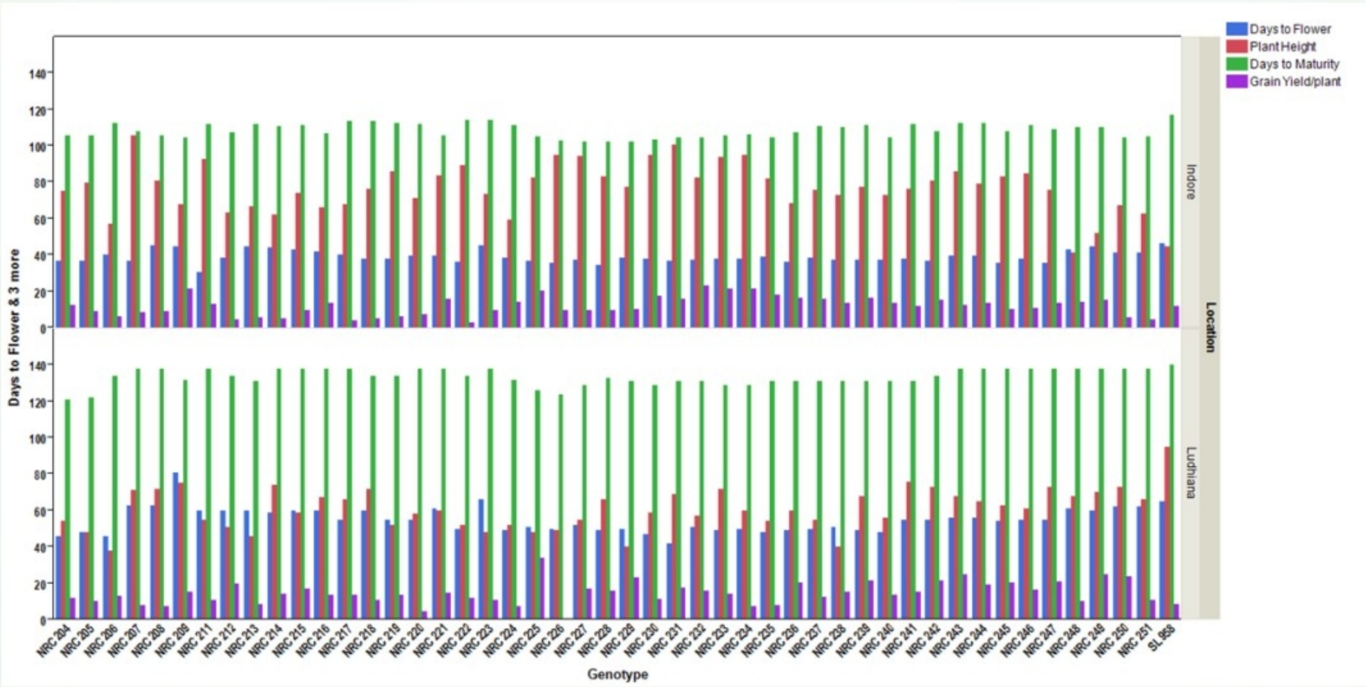
(a) Effect of photoperiodic and growth habit genes on the phenology of SL 958 : SL 958, a YMV resistant variety of Northern Plain Zone, carries dominant photoperiodic *E1, E2, E3 & E4* and recessive growth habit dt1 alleles. Recessive alleles *e1-as, e2, e3, e4* and dominant allele *Dt1* were separately transferred in this variety in a DBT funded project (2017-2020) and near isogenic lines (73) were evaluated with recipient parent in kharif 2021. Mean days to flower and days to maturity were significantly reduced as compared to SL 958 in all the genetic stocks. Mean plant height was not significantly influenced by these alleles except for *Dt1* where increase in plant height was observed. Mean number of nodes per plant were also not influenced except for *e1-del* stocks which had lesser nodes. Number of pods significantly reduced in all the genetic stocks but differences for mean grain yield / plant were not significant.

Phenotypic variation in genetic stocks of SL 958 at Indore



Mean effect of photoperiodic and growth habit loci on phenology of SL 958 at Indore

(b) Multi-location evaluation of genetic stocks of SL 958 at Indore and Ludhiana : Of the 73 genetic stocks, forty-eight were evaluated both at ICAR-IISR, Indore and PAU, Ludhiana and their performance along with that of the recurrent parent is given in below figure. Days to flower and days to maturity were invariably more at Ludhiana for all the genetic stocks as compared to Indore. There was a drastic reduction of plant height at Ludhiana in genetic stocks in comparison to SL 958. Plant height of SL 958 at Ludhiana was 95 cm but it varied from 38-76 cm with a mean of 60.2 cm in genetic stocks. The trend was opposite at Indore with SL 958 being the smallest and stocks having the height of 57.3-105.8 cm representing 28-137% increase as compared to SL 958. At Ludhiana, except for 8 genetic stocks which were comparable to SL 958 (8.4 g) in grain yield / plant, other stocks had 9.9-34 g grain yield / plant with a mean of 16.5 g.



Phenology of genetic stocks of SL 958 at Indore and Ludhiana

Introgression of gene pool of wild species

New interspecific crosses of primary gene pool *(G. soja)*accessions PI 593893, PI 407170, PI 549046 and tertiary gene pool *(Glycine microphylla)* were made. Crosses were successful in *G.soja* but only one seed was obtained in *Glycine max* × *Glycine microphylla* cross. Hybridity of this seed is to be tested in Kharif 2022. F1s developed in crosses of *Glycine max* × *Glycine soja* were backcrossed with their respective *Glycine max* genotype. Three way crosses, for widening of genetic base with gene pool of *G. soja*, were also attempted. Crosses i.e. JS 335 × PI 549046, JS 20-34 × PI 407170, JS 20-34 × PI 593893 and EC 538828 × PI 549046 were advanced from F_2 to F_3 by single pod descent method for earliness and rapid pod filling trait.

Details of interspecific hybridizations attempted in Soybean

Crosses	Backcrosses	Three-way Crosses
Glycine max* × *Glycine soja	***Glycine max* × *Glycine soja***	***Glycine max* × *Glycine soja***
JS 20-34 × PI 593893	JS 9560 × (JS 9560 × PI 549046)	JS 9560 ×(JS 20-34 × PI 407170)
EC 538828 × PI 593893	JS 20-98 × (JS 20-98 ×X PI 549046)	JS 20-34 × (JS 9560 × PI 593983)
JS 9560 × PI 593893	JS 335 × (JS 335 × PI 549046)	JS 20-69 × (JS 335×PI 407170)
JS 20-34 × PI 407170	JS 9560 × (JS 9560 × PI 593983)	(JS 20-34 × PI 549046) × JS 9560
JS 335 × PI 407170	JS 20-34 × (JS 20-34 × PI 593983)	
JS 9560 × PI 549046	EC 538828 × (EC 538828 × PI 593983)	
JS 335 × PI 549046	JS 9560 × (JS 9560 × PI 407170)	
JS 20-34 × PI 549046	JS 20-34 × (JS 20-34 × PI 407170)	
EC 538828 × PI 549046		
Glycine max* × *Glycine microphylla		
AGS 25 × *Glycine microphylla*		
JS 20-69 × *Glycine microphylla*		

3.2 Breeding for Early maturity, Higher yield, Wider adaptability and Food-grade Characteristics

Genetic enhancement for earliness, yield and associated characters

Hybridizations : To increase the diversity in the breeding populations, new crosses were attempted involving diverse exotic germplasm accessions and superior high yielding background. Backcrosses (BC3) were also attempted to reduce the maturity duration and increase the seed weight of JS 97-52 variety.

Details of crosses for yield and associated traits

No	Cross combinations	Traits targeted
1	EC 993175 × NRC 37	Early maturity and yield
2	DSb34 × NRC 128	Rust resistance and yield
3	EC 34372 × NRC 128	Early maturity and yield
4	NRC 181 × NRC 128	Early maturity and yield
5	NRC 128 × YMV2	Yield and YMV resistance
6	NRC 128 × EC 457254	Early maturity, yield and anthracnose resistance
7	NRC 128 × EC 93175	Early maturity and yield
8	NRC 128 × RVS 2011-10	Early maturity and yield
9	NB 136 × NRC 37	Early maturity and yield
10	NRC 37 × NRC 155	Early maturity and yield
11	EC 457254 × RSC 10-46	Early maturity and yield
12	MACS 1407 ×DSb 32	Rust resistance
13	MACS 1460 ×DSb 34	Rust resistance
14	MACS 1407 ×DSb 34	Rust resistance
15	NRC 181 × EC 457254	Anthracnose resistance
16	NRC 128 × 915983	Early maturity and yield
17	EC 457254 ×DSb 34	Rust resistance
18	NRC 128 × RVSM 2012-4	Early maturity and yield
19	JS 9752 × e3e4 (Earliness) (BC3F1)	Early maturity and yield
20	EC 913032 × NRC 128	Early maturity and yield
21	EC 457254 × YMV 2	Early maturity, Yield and YMV resistance

Generation advancement : A total of 51 F_1 plants derived from eight way crosses were selfed to harvest F_2 seeds. A total of 250 and 383 individual plants with higher yield and attributing traits were selected in F_2 & F_3 generations, respectively. Superior bulks for yield and disease resistant (field condition) were selected from the cross viz., NRC128 × JS 20-34, NRC 128 × JS 95-60, NRC 128 × NRC 155, NRC 128 × NRC 156, NRC 128 × EC 538828, EC 457254 × JS 20-34, NRC 155 × EC 538828, JS 20-98 × NRC 155, AGS 155 × JS 20-69, JS 20-98 × NRC 155 and 188 YMV × NRC 128. Multi-parent advanced generation intercross population (MAGIC) RILs (number) were multiplied and advanced to F8 generation.

Evaluation of advanced breeding lines : Eighteen advanced breeding lines of early (up to 80 days), medium (95-100) late maturity groups and of interspecific backcross were evaluated for yield and attributing traits along with check varieties JS 20-34, JS 335, JS 20-29 and JS 20-69. Entry NRC 252 derived from cross MACS 330 × NRC 86 was the earliest in early maturity groupwith 73 days of maturity. Four genotypes i.e. YMV 1, 2, 11, and 16 derived from JS 335 x G. soja yielded more and matured earlier than the best check JS 20-69.

Genotypic means for elite breeding lines evaluated across two seasons

Genotypes	Plant height (cm)	No. of pods	No. of branches	100 seed weight (g)	Grain yield (g)/6.75 m2	Maturity (Days)
Advanced Breeding Lines						
E 13-5	37.4gh	31.33e-g	2.0d-f	12.2e-g	958.3d-f	80f
E 21-2	39.5g	29.40fg	1.7ef	13.7a-d	659.6f-i	78fg
E 21-2-2	36.0gh	32.6e-g	2.4de	13.7a-c	808.0e-i	80f
E 21-4	40.0fg	31.2efg	1.8def	14.0a	599.3g-j	76gh
E 21-6	46.20e-g	33.6efg	1.6ef	14.1a	860.3e-h	79f
E 38-5	51.2d-f	44.2bcde	4.3b	11.1h	514.0ij	114a
E 54-1	70.80a	56.9ab	5.9a	8.4i	891.0e-g	114a
E 65-1	61.4a-d	41.8c-f	2.0d-f	12.6c-f	1238.0b-d	99d
E 65-2	55.60b-e	37.6defg	2.2d-f	13.8ab	1108.0c-e	92e
E 7-1	28.46h	26.2g	2.5de	12.0f-h	668.6fghi	74i
E 7-1-1	37.86gh	25.4g	1.7ef	12.6d-f	542.6h-j	76gh
E 7-2	28.40h	25.1g	2.6de	14.4a	1102.0c-e	75hi
Interspecific Backcrossed Advanced Breeding Lines						
YMV 1	59.0b-d	35.0e-g	2.2d-f	11.3gh	1337.3a-c	99d
YMV 11	62.0abcd	52.3a-c	3.0cd	13.3a-e	1655.3a	99d
YMV 16	61.8a-d	64.0a	4.2b	12.7b-f	1654.3a	106c
YMV 2	62.9a-c	34.0e-g	1.0f	12.5ef	1512.0ab	99d
Checks						
JS 20-29	53.06cde	35.1e-g	4.0bc	9.2i	283.6j	106c
JS 20-34	40.2g	32.6efg	2.0d-f	14.0a	1260.6b-d	92e
JS 20-69	62.1abc	54.6a-c	4.6b	8.5i	1291.0b-d	108b
JS 335	65.9ab	43.1b-f	4.0b	8.9i	795.6e-i	114a
M 8-77	71.8a	49.8bcd	4.1bc	11.0h	624.0f-j	114a
NRC 252	38.40gh	31.3efg	2.4de	12.2e-g	810.3e-i	73i

Breeding for food grade characters and high oil content

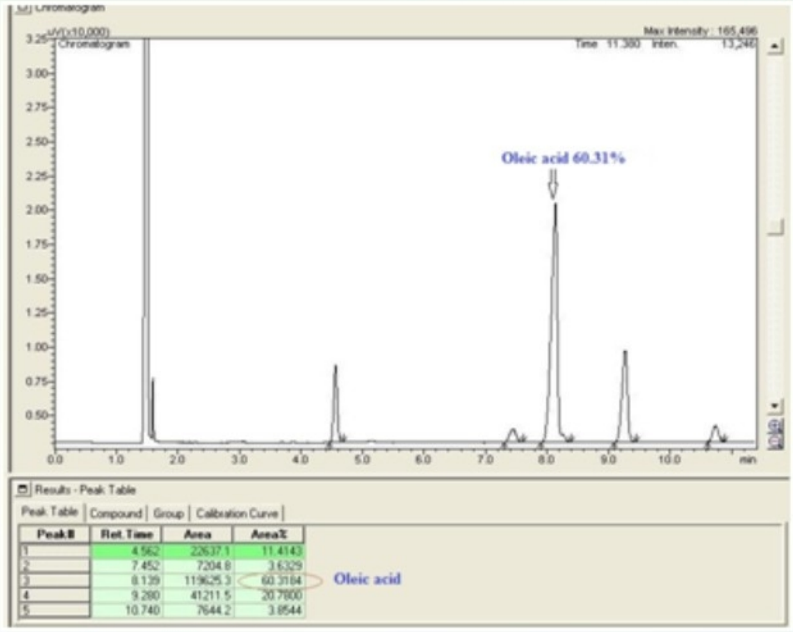
NRC 142, an early maturing variety free from KTI and Lipoxygenase 2 with multiple resistance to diseases and insect-pests was released for Central and Southern Zone. NRC 152, early maturing line free from KTI and Lipoxygenase 2 has been promoted to AVT II in Central Zone. NRC 181, early maturing line free from KTI has been promoted to AVT I in Central Zone. NRC 150, early maturing line free from Lipoxygenase 2 and high oil content has been promoted to AVT I in Central Zone. NRC 197, an early maturing KTI free genotype has been identified for IVT 2021. NRC 198, an early genotype free from lox 2 and KTI has been identified for IVT 2021.

Variety NRC 142

Mapping QTL for oleic acid and development of high oleic acid soybean

Several elite breeding lines possessing approximately 60% oleic acid have been developed. Among them, two advanced breeding lines viz., NRC 140 and NRC 141 with oleic acid 60+ 5%, were early maturing (92 days) and recorded a yield of 2362 Kg/ha and 2461 Kg/ha in Kharif 2021, respectively. Both lines exhibited oleic acid on an average 60%for the third consecutive year. Oleic acid content of these lines was the same when both lines were raised at Indore and AICRP center, Adilabad in 2020.

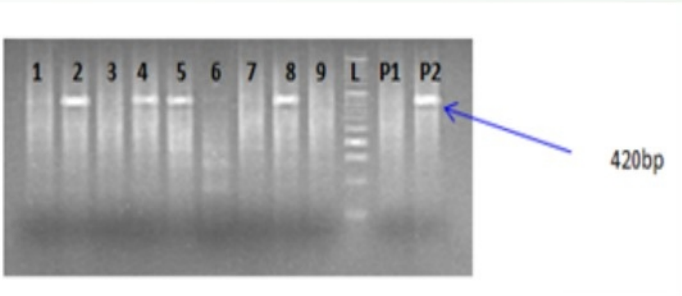
Genotype NRC 141



Chromatogram depicting fatty acid composition of NRC 141

Accelerated development of Kunitz trypsin inhibitor (KTI) free soybean genotypes with charcoal rot resistance

Twelve homozygous recessive plants (titi) carrying null allele of Kunitz trypsin inhibitor were identified in the F_2 population, generated from AMS 5-18 × NRC 127 while three homozygous recessive plants (titi) were identified from the F2 population, generated from AMS 5-19 × NRC 127 using null KTI allele specific marker and Ti locus linked marker. These homozygous recessive plants were backcrossed with their corresponding recurrent parent genotype AMS 5-18/ AMS 5-19 to obtain BC_1F_1 generation, which were confirmed using KTI null allele specific marker. Further, F3 seeds of AMS 5-18 × NRC 127 (127 plants), of NRC 127 × AMS 5-18(144 plants) and AMS 5-19 × NRC 101 (90 plants,) were harvested to advance the generation for making recombinant inbred lines.



Amplification using Kunitz trypsin inhibitor null allele specific marker in BC1F1 generation of AMS 5-18 × NRC 127. Lane L corresponds to 50bp DNA ladder. P1 and P2 correspond to AMS 5-18 (KTI positive) and NRC 127 (null KTI)), respectively. Lanes 1-9 correspond to BC1F1 plants segregating for null allele of Kunitz trypsin inhibitor.

Development of high oleic acid mutants of KTI & lox2 free soybean using gamma & electron beam

NRC 142 is a double null (Kunitz trypsin inhibitor free and off-flavor generating lipoxyeganse-2 free 2) soybean variety released by CVRC in 2021. As oleic acid content present in NRC 142 is about 21% which is at par with the level of this fatty acid present in regular soybean varieties. Freshly harvested seeds of NRC 142 from 2020 harvest were gamma irradiated at Bhabha Atomic Research Centre Mumbai at 2 doses i.e., 200 Gy and 250 Gy. The same seed lot was subjected to e-beam treatment at 2 doses i.e., 220 Gy and 250 Gy at Raja Ramanna Centre for Advanced Technology Indore. 250 gram of seeds were irradiated for each dose. The treated seeds were planted in the field in Kharif season 2021 and each individual plant was harvested for the advancement of the generation and further analysis.

3.3 Breeding for Abiotic Stresses Tolerance

Breeding for drought tolerance

Hybridization: Using recently identified drought tolerant germplasm lines i.e. TGX 822-10E, PI 159923 and advance breeding line 38-11-265, four 4-way crosses were achieved. Six crosses were attempted using recently released drought tolerant variety NRC 136, parental drought tolerant line NRC 137 and drought tolerant high yielding lines.

Crosses realized during Kharif 2021

4-way crosses for attempting 8-way crosses:		
S.No.	**4-ways Cross**	**No. of Seeds**
1	(AMS MB 5-18 x JS 95-60) × (PI 159923 x JS71-05)	22
2	(JS71-05 x NRC 37) × (38-11-265 x TGX 822-10E)	02
3	(38-11-265 x JS 95-60) × (JS71-05 x NRC 37)	11
4	(PI 159923 x NRC 37) × (PI 159923 x JS 95-60)	08
New Crosses:		
S.No.	**Crosses**	**No. of Seeds**
1	(JS71-05 x NRC 37) × Drt2 (TGX 328-049)	05
2	(AMS MB 5-18 x JS 95-60) × (PI 159923 x JS 95-60)	13
Crosses achieved and contributed for AICRPS-NHP:		
S.No.	**Crosses**	**No. of Seeds**
1	GKS 21-3×NRC 136	36
2	GKS 20-4 × NRC 136	16
3	NRC 137 × GKS 20-5	15
4	NRC 137 ×GKS 20-7	13
5	NRC 137 × GKS 21-3	02
6	NRC 137 × GKS 21-4	01
Crosses achieved and advanced:		
S.No.	**Crosses**	**No. of Seeds**
1	(AMS MB 5-18 x JS 95-60) × (PI 159923 x JS 95-60)	10
2	(JS71-05 x NRC 37) × (AMS MB 5-18 x JS 95-60)	06
3	(JS71-05 x NRC 37) × (PI 159923 x NRC 37)	02
4	(JS71-05 x NRC 37) × EC 602288	08

High desiccation tolerant MAGIC lines

Breeding populations (9F_4: 578; 85F_5: 799 and 42F_6: 358) derived from multi parent advanced generation intercrosses (MAGIC) in their early generations (F_2& F_3) were advanced through chemical desiccation (stem reserve mobilization, SRM) method and were subjected to selection. SRM% was high in tolerant checks i.e. JS 335 (77%), NRC 137 (62%), EC 602288 (59%), JS 97-52 (48%), NRC 136 (45%) and lowered in susceptible NRC 37 (28%). Prominent plants were selected accordingly.

Early maturing genotypes with high stem reserve mobilization traits

Population	Cross	Dessiccation Tolerance (SRM%) in selected plants and checks	Maturity duration
G2-3	[(Young x JS 335) × (JS 97-52 x JS 90-41)]× [(PK 472 x JS 335) ×(EC 602288x EC 390977)]	54-91	95-103
G6-2	[(C-2797 x JS 71-05) × (PK 472 x JS 335)] × [(Young x JS 335) × (EC 602288 x JS 90-41)]	45-93	100-105
Tolerant Parent	NRC 136	45	107
Susceptible parent	NRC 37	28	102

Evaluation of advance lines for drought tolerance traits

Eighteen advance breeding lines with high SRM for seed yield &100-seed weight and delayed leaf senescence, were evaluated in rainout-shelter and ambient conditions.Seven genotypes viz. S-1-26, BC3 JS 59, S-2-1, S-1-10, S-2-12, S-3-1 and BC3 JS 52 had high drought resistance index (DRI>0.8) and drought related traits as compared to tolerant checks NRC 7 and JS 97-52. Root system architecture (RSA) analysis in these genotypes found six genotypes viz. S-1-26, S-1-10, S-2-12, S-3-1, S-2-4, SK-34 with deep rooting system.

Promising drought tolerant lines identified with multiple drought-related traits

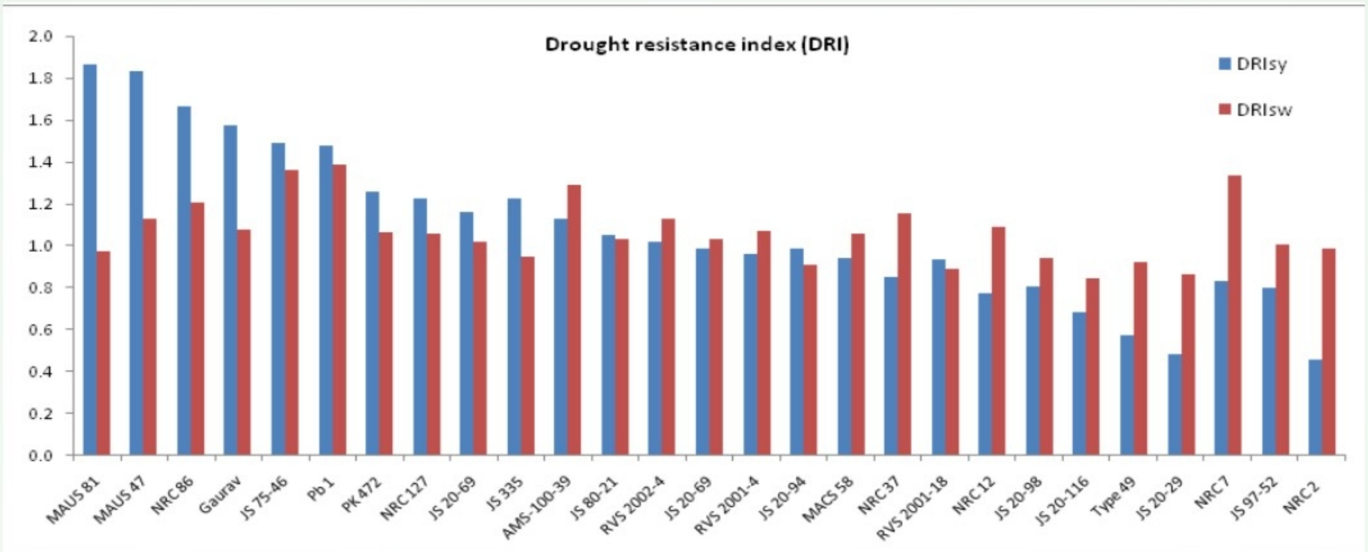
S.No	Genotypes	DRIsy	DRIsw	RWC (%)	SLA (m2.kg-1)	SCMR	CTD (°C)	DS
1	S-1-26	1.4	1.2	92.9	31.6	30.7	-2.4	1
2	BC3 JS 59	1.3	1.1	95.7	26.8	25.8	-2.2	1
3	S-2-1	1.3	1.2	91.5	34.2	30.2	-0.8	1
4	S-1-10	1.2	1.2	78.2	27.1	36.0	0.9	1
5	S-2-12	0.9	1.0	88.6	25.4	35.0	0.9	5
6	S-3-1	0.8	1.2	83.4	28.6	36.1	-2.3	4
7	BC3 JS 52	1.8	0.9	88.5	29.4	27.8	-0.2	1
8	S-2-4	0.7	1.1	84.7	38.6	33.8	3.0	4
9	SK-34	0.7	1.0	91.0	26.8	30.9	0.3	1
10	NRC 7 (C)	0.8	1.3	87.9	27.1	31.0	4.7	5
11	JS 97-52 (C)	0.8	1.0	85.2	32.8	33.2	0.2	2
12	NRC 2 (C)	0.5	1.0	84.7	29.6	31.6	0.3	1
Mean	0.9	1.1	90.5	28.2	33.3	0.5	2	
SD	0.5	0.1	12.1	4.0	3.9	1.8	2	
CV(%)	59.6	11.0	13.4	14.1	11.7	393.2	77	

Among them, high root length density (RLD), root angle in the range of (20-40°), high values for root penetrating traits (i.e. number of tips, forks and crossings), water-extracting traits (i.e. less average diameter, high surface area and root volume) and high nodule dry weight were recorded in S-1-10, S-2-12, S-2-4 and SK 34.

Promising drought tolerant lines showing deep rooting system along with efficient below ground traits

S.No.	Genotypes	Avg Root angle (°C)	RLD (cm/	Rooting depth cm3)	No. of Tips (cm)	No. of Forks	No. of Crossings	Avg Dia m	Surf Area (mm)	RootVol. (cm3) (cm2)	Root/ Shoot ratio	Nodule dry Wt (gm)
1	S-1-26	43	0.03	**190**	3127	16746	2899	1.5	655	24.6	**2.92**	0.37
2	S-1-10	**36**	**0.27**	**188**	**30551**	**127631**	**13034**	1.0	**3760**	**85.6**	**2.69**	**2.03**
3	S-2-12	**40**	**0.37**	**171**	**71647**	**193560**	**23716**	**0.9**	**5071**	**112.4**	**2.51**	0.00
4	S-3-1	58	0.15	**170**	31766	61576	8892	**0.9**	1644	31.7	**3.47**	0.70
5	S-2-4	**34**	**0.26**	**172**	**55875**	**123713**	**14397**	**0.9**	**3556**	**81.4**	**2.87**	**2.60**
6	SK34	45	**0.31**	**198**	**57668**	**139645**	**13851**	1.0	**4851**	**129.2**	**3.36**	**2.53**
7	NRC7 (T)	55	0.10	166	17249	45723	5046	0.9	1575	43.5	4.61	0.48
8	JS97-52 (T)	26	0.24	175	46292	101845	10606	0.8	3118	65.1	2.65	2.02
9	NRC2 (S)	14	0.07	134	18303	38508	6511	1.1	1047	27.4	4.47	0.14
Mean		44	0.15	154	27757	70177	8672	1.0	2084	49.0	3.56	1.15
StdDev		17	0.10	40	18670	49800	5274	0.2	1448	35.6	1.43	0.96
CV%		38	66.11	26	67	71	61	24.3	69	72.6	40.12	83.59

Drought tolerance in Central Zone varieties: Soybean varieties (thirty-seven) released for central zone of India, were evaluated in controlled rainout-shelter for drought related traits. Relative water content ranged from 42.9% in JS 90-41 to 93.2% in JS 20-69. High drought resistance index for seed yield (DRIsy>1.0) were expressed in 12 genotypes i.e.MAUS 81, MAUS 47, NRC 86, Gaurav, JS 75-46, Pb 1, PK 472, NRC 127, JS 20-69, JS 335, AMS-100-39, JS 80-21, along with a range of variation (0.9-1.4) for DRI for 100-seed weight (DRIsw).



Trait variation for drought tolerance traits

Exploratory analysis of RSA data in these varieties revealed that rooting depth and root length density (RLD) had negative though weak association with root angle from soil surface and positive associations with root penetrating traits i.e. number of tips, number of forks and number of crossings, promoting water extracting traits viz. root thickness (AvgDia=mm), surface area and root volume. Seven varieties i.e. MAUS 81, NRC 86, JS 75-46, Pb 1, NRC 127, AMS 100-39 and JS 80-21had deep rooting system (172-189cm) as compared to tolerant check JS 97-52, besides variation in RLD (0.15-0.33cm.cm3), root angle from soil surface (38-68°), root penetrating and water extraction traits.

	Rooting depth (cm)	RLD (cm/cm^3)	Avg Root angle (°C)	No. of Tips	No. of Forks	No. of Crossings	Thickness AvgDiam(mm)	SurfArea(cm^2)	RootVolume(cm^3)	Root/Shoot ratio	Nodule dry Wt (gm)
Rooting depth (cm)	1.00	0.65	-0.27	0.57	0.50	0.42	-0.03	0.65	0.59	0.37	0.43
RLD (cm/cm^3)	0.65	1.00	-0.05	0.91	0.80	0.68	-0.17	0.95	0.81	0.09	0.71
Avg Root angle (°C)	-0.27	-0.05	1.00	-0.06	-0.02	-0.01	-0.22	-0.04	-0.03	-0.26	-0.07
No. of Tips	0.57	0.91	-0.06	1.00	0.92	0.87	-0.18	0.83	0.67	0.07	0.67
No. of Forks	0.50	0.80	-0.02	0.92	1.00	0.97	-0.09	0.79	0.69	0.02	0.55
No. of Crossings	0.42	0.68	-0.01	0.87	0.97	1.00	-0.12	0.64	0.54	-0.01	0.45
Thickness AvgDiam(mm)	-0.03	-0.17	-0.22	-0.18	-0.09	-0.12	1.00	0.01	0.21	0.02	-0.02
SurfArea(cm^2)	0.65	0.95	-0.04	0.83	0.79	0.64	0.01	1.00	0.95	0.13	0.65
RootVolume(cm^3)	0.59	0.81	-0.03	0.67	0.69	0.54	0.21	0.95	1.00	0.17	0.54
Root/Shoot ratio	0.37	0.09	-0.26	0.07	0.02	-0.01	0.02	0.13	0.17	1.00	-0.26
Nodule dry Wt (gm)	0.43	0.71	-0.07	0.67	0.55	0.45	-0.02	0.65	0.54	-0.26	1.00

Root system architecture traits association for deep water extraction

Root system architecture of CZ varieties having high drought tolerance response

CZ Varieties	Rooting depth (cm)	RLD (cm/ cm3)	Avg Root angle (°C)	No. of Tips	No. of Forks	No. of Crossings	Thickness AvgDiam (mm)	Surf Area (cm2)	Root Vol (cm3)	Nodule dry Wt (gm)
MAUS81	181	0.27	50	75713	158137	30183	0.7	2995	54.3	0.90
NRC86	174	0.20	63	37993	103345	13050	0.9	2864	66.0	0.43
JS 75-46	185	0.23	41	43883	125118	16323	1.0	3511	88.2	0.65
Pb-1	172	0.15	56	25939	66348	9859	0.9	1993	43.8	0.28
NRC 127	179	0.33	55	64331	118725	14370	0.7	3744	68.5	1.05
AMS 100-39	179	0.17	38	33497	54676	8329	0.6	1642	26.2	0.61
JS 80-21	189	0.25	56	52813	129563	16996	0.9	3412	77.6	0.69
NRC7	166	0.10	55	17249	45723	5046	0.9	1575	43.5	0.48
JS97-52 (T)	175	0.24	26	46292	101845	10606	0.8	3118	65.1	2.02
NRC2 (S)	134	0.07	14	18303	38508	6511	1.1	1047	27.4	0.14
Mean	150	0.16	48	36197	75272	11225	0.8	1906	38.7	0.60
StDev	39	0.10	13	25669	65506	11554	0.2	1127	24.2	0.52
CV%	26	60.79	26	71	87	103	27.2	59	62.6	87.03

Phenotyping of RIL population for stem remobilization trait and delayed senescence trait : Stem reserve mobilization (SRM) trait contributes towards moisture deficient tolerance during drought stress at seed filling stages. Spraying KI (0.2%) during seed filling stage (~R5), as a chemical descant, disintegrates photosynthesis assemblies in plants and promotes mobilization of stem reserve determining seed size. RIL population (115 lines, F_{10}) evaluated for SRM% showed abundant variability for stem reserve mobilization for seed yield, seed size and delayed leaf senescence. Transgressive segregants with higher SRM% than drought tolerant parent JS 97-52 were identified. Lines with the maximum score of 5 for delayed leaf senescence were also identified.

RIL identified for stem remobilization trait and delayed senescence trait

RIL Population	Segregants with High SRM%	Segregants for high delayed deaf senescence
JS 97-52 x JS 90-41	104-85, 104-22, 104-84, 104-75, 104-53, 104-71, 104-50, 104-99, 104-100*, 104-55, 104-15*, 100-18*, 104-126, 104-61, 104-25*, 104-95	104-100^, 104-118^ and 104-25^
* Performed better than the tolerant parent in both season (2020 and 2021); ^Have high SRM% also		

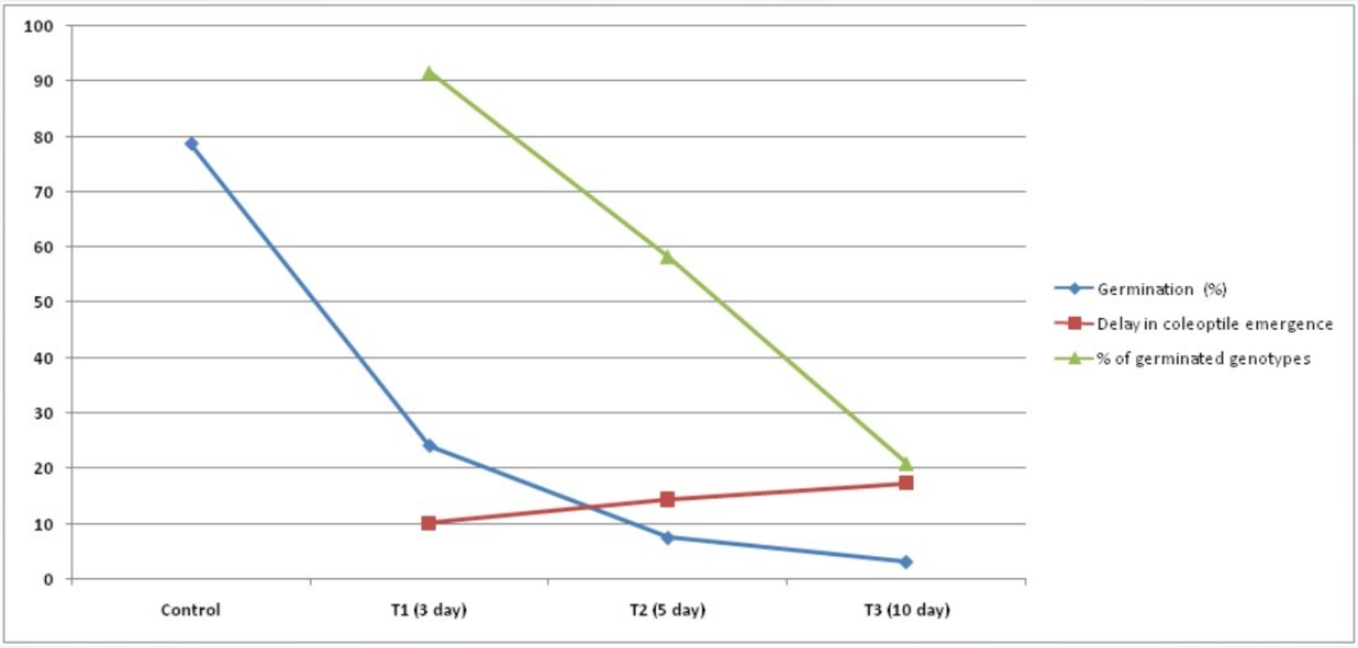
Breeding for water logging tolerance

Hybridization : A total of 15 new crosses were attempted to develop elite breeding lines with the objectives of recombining water logging tolerance and high temperature tolerance with earliness, high yielding and other abiotic stress tolerance traits. Five crosses between contrasting genotypes for waterlogging tolerance were attempted to develop populations with objective of genetic analysis and genes/QTLs mapping. All crosses were attempted in hybridization structure during kharif season 2021.

Details of crossing programme during *kharif* 2021

Crosses for recombining water logging tolerance/high temperature tolerance with high yielding traits, earliness and other abiotic stresses tolerance traits	
1.	(EC 602288 × EC 396065) × (JS 20-98 × CAT 1258)
2.	(JS 20-34 × EC 602288) × (JS 20-69 × CAT 1149)
3.	(JS 20-34 × EC 602288) × (AMS MB 5-18 × EC 456556)
4.	(JS 20-69 × EC 456556) × NRC 128
5.	(EC 602288 × NRC 146) × RSC 10-46
6.	(JS 20-69 × EC 456556) × RSC 10-46
7.	(JS 20-69 × EC 456556) × MACS 1460
8.	(JS 20-34 × TGX 328-049) × RSC 10-46
9.	(AMSMB-5-18 × EC 456556) × NRC 128
10.	(JS 20-69 × EC 396065) × MACS 1460
11.	(JS 20-34 × EC 602288) × MACS 1460
12.	CAT 1149 × NRC 138
13.	EC 456556 × MACS 1460
14.	NRC 138 × JS 20-34
15.	MACS 1460 × NRC 130
Crosses for developing mapping populations for genetic studies	
1.	JS 20-73(T) × JS 95-52(S)
2.	JS 20-76(T) × EC 291399(S)
3.	EC 457464(T) × EC 291399(S)
4.	EC 457464 (T) × JS 95-52(S)
5.	JS 95-52(S) × JS 20-76(T)

Standardization of screening technique for submergence tolerance at seed germination stage: Screening technique standardization was attempted using 24 soybean genotypes of different water logging tolerance status. Genotypes were sown in root trainers filled with farm (black) soil and placed in larger plastic containers to provide similar level of submergence stress. All genotypes were grown under three treatments (3, 5 and 10 days of flooding with level of 3 cm at pre-germination stage) along with control conditions (no submergence). After the submergence period, the trays were drained and observations were recorded after seven days of recovery period. The tolerance reaction of genotypes was measured in terms of percent reduction in seed germination and delay in coleoptiles emergence (days) in relation to control conditions. Submergence stress for 5 days found to be suitable for identifying tolerant genotype for pre-germination anaerobic stress. Germination was found to be most relevant trait to measure submergence/waterlogging tolerance in this study.Genotypes viz., EC 457464, EC 528623 and EC 333876 were found to be tolerant to pre-germination hypoxia.



Germination (%) and delay in coleoptile emergence (days) as affected by increasing waterlogging duration

Evaluation of promising entries in coordinated trails

Seven entries possessing water logging tolerance and high yielding attributes were tested for grain yield and allied traits in station trail- 2020. Two entries viz., NRC 192 (WLP 20-1/Sel 1-34) and NRC 193 (WLP 20-3/Sel 3-60) ranked in top five with good yield advantages over the checks (JS 20-69 and JS 20-98) and identified for IVT 2021. In IVT (central zone) 2021, both water logging tolerant entries i.e. NRC 192 and NRC 193 performed better than best performing check RVSM 2011-35 with average yield advantage of ~17% and ~5%.

Generation advancement, selection and yield evaluation

Thirty-two elite breeding lines derived from numerous diverse crosses involving abiotic stress tolerant parent JS 97-52 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, NRC 128 and JS 20-34, ten prominent breeding lines were found to out-yield best check JS 20-69. Forty prominent breeding lines derived from five different crosses involving water logging tolerant genotype JS 20-38 viz., JS 20-38 × JS 95-60, JS 20-34 × JS 20-38, NRC 7 × JS 20-38, VP 1165 × JS 20-38 and JS 20-38 × DS 31-05 were advanced from F4 to F5 generation and promising breeding lines were identified. Around 65 breeding lines were advanced from F3 to F4 generation and around 70 single plant selections were made in F2 populations developed from crosses involving waterlogging tolerant parents.

Performance of elite breeding lines during Kharif 2021

Promising line	Pedigree	Days to Maturity	Plot yield (Kg/ha)
C 20-11-2	JS 97-52 × JS 21-08	101	2066.29
C 20-14-3	JS 97-52×104-31	99	2005.55
C 20-10-10	JS 97-52 × EC 546882	103	1952.59
C 20-8-7	JS 97-52 × Bragg	105	1907.78
C 20-3-8	JS 97-52 × SL 688	106	1852.22
A-20-17	JS 335 × JS 97-52	103	1793.33
C 20-2-8	JS 97-52 × SL 958	104	1714.07
C 20-10-7	JS 97-52 ×EC 546882	103	1676.66
C 20-11-7	JS 97-52 × JS 21-08	98	1664.44
C 20-12-5	JS 97-52 × NRC 130	97	1664.07
JS 20-69 (Check)		97	1634.52
NRC 128 (Check)		105	1477.50
JS 97-52 (Check)		104	1295.92
JS 20-34 (Check)		89	1250.25

Evaluation of soybean accessions for water logging tolerance at vegetative stage under flooded field

A total of 40 soybean accessions were evaluated for water logging tolerance traits at V2-V3 stage along with tolerant and susceptible checks in field conditions during Kharif 2020. Several morpho-physiological traits i.e foliar damage score (FDS), plant survival rate (PSR), stem elongation rate (SER) and adventitious root score (ARS; 1-5) in stressed plot while yield attributing traits, root nodules number, root nodules dry weight, root dry weight, root volume and SCMR (SPAD chlorophyll meter readings) were recorded from stressed plot as well as counter control plot. On the basis of water logging tolerance coefficient (WTC) calculated based on plant survival and yield advantage in stress conditions, germplasm lines viz., JS 20-38, TGX 317-37-E, EC 389148, PI 283327, EC 456620, JS 20-73, JS 20-76, Hardee and elite breeding lines viz., NRC 192 (Sel 1-34), NRC 186 (Sel 3-73), Sel 3-79, NRC 193 (Sel 3-60), NRC 189 (GKS 20-4) were found be better than tolerant check JS 97-52, PK 472 in trial conducted in 2020

Promising soybean accessions for water logging tolerance traits (2020)

Genotype	PSR (%)	FDS (1-9)	ARS (1-5)	% reduction in SCMR	% reduction in root nodule dry weight /plant	WTC
JS 20-38	92.73	2	5	22.94	37.50	77.91
TGX 317-37 E	89.13	3	4	33.33	34.38	76.54
NRC 146	84.31	2	5	20.66	15.56	69.35
Sel 1-34	84.78	1	5	17.89	6.13	62.33
EC 389148	83.96	2	5	45.02	33.33	60.29
HARDEE	77.27	2	5	38.39	22.22	55.81
PI 283327	77.42	3	3	16.95	16.67	51.84
EC 456620	93.83	3	5	41.82	40.00	51.76
Sel 3-73	75.64	3	5	32.18	50.10	51.74
JS 20-76	90	4	3	44.44	64.12	51.3
JS 20-73	98.21	2	4	25.33	5.63	51.29
Sel 3-79	82.61	4	3	40.38	23.53	50.22
GKS 20-6	80.56	3	4	26.70	11.11	50.06
Sel 3-60	80	2	5	32.88	16.67	49.62
GKS 20-4	73.33	2	3	28.00	5.33	49.57
104-15	81.25	4	3	46.98	4.35	48.69
JS 97-52 (C)	85.17	2.5	5	33.05	8.33	48.5
PK 472 (C)	75.67	3.7	4	42.52	11.76	42.43
Mean	79.12	3	3.78	34.21	28.94	40.14
CV (%)	13.81	32.39	24.25	28.48	67.93	45.62

Evaluation of soybean accessions for water logging tolerance at reproductive stages

During Kharif 2021, a set of genotypes (32 Nos.) comprising 7 entries of drought project (GKS 21-1 to 7), other elite breeding lines of water logging project (WLP), germplasm lines and checks, was evaluated at reproductive stage under field conditions in RBD (3 replications). On the basis of morpho-physiological traits and yield attributes, breeding lines i.e. NRC 192, NRC 193, NRC 189, NRC 186, A 20-26, A 20-33, A 20-25, A 20-3, Sel 3-79, A 20-25 and germplasm lines i.e. TGX 317-37 E, JS 20-76, EC 602288 were found to be better than tolerant check JS 97-52. Similarly, another set (50 Nos) of genotypes consisting of elite breeding lines, germplasm lines and checks, were evaluated at reproductive stage under field conditions in augmented design during Kharif 2021; in this trail, germplasm lines viz., EC 528623, EC 250591, EC 528622, EC 550828, EC 390977, EC 456620, PI 283327 and breeding lines A-20-36, C 20-11-7, C 20-2-1, C 20-8-7, C 20-12-5, C 20-12-9, C 20-11-9,C 20-11-4, C 20-12-4, C 20-11-2,C 20-4-7, C 20-10-10 were found be better than tolerant check (JS 97-52) on the basis of water logging tolerance index, foliar damage score and chlorophyll content (SCMR).

Four elite breeding lines from water logging project (WLP lines) and six breeding lines from drought project (GKS lines) were also evaluated for drought tolerance other than waterlogging tolerance in Kharif 2021. GKS 21-4 and GKS 21-7 were found to be better than tolerant check (JS 97-52). Both lines i.e. NRC 256 (GKS 21-4) and NRC 257 (GKS 21-7) were also identified for IVT- 2022 on the basis of tolerance mechanism and yield potential.

Performance of promising lines evaluated under RBD trial

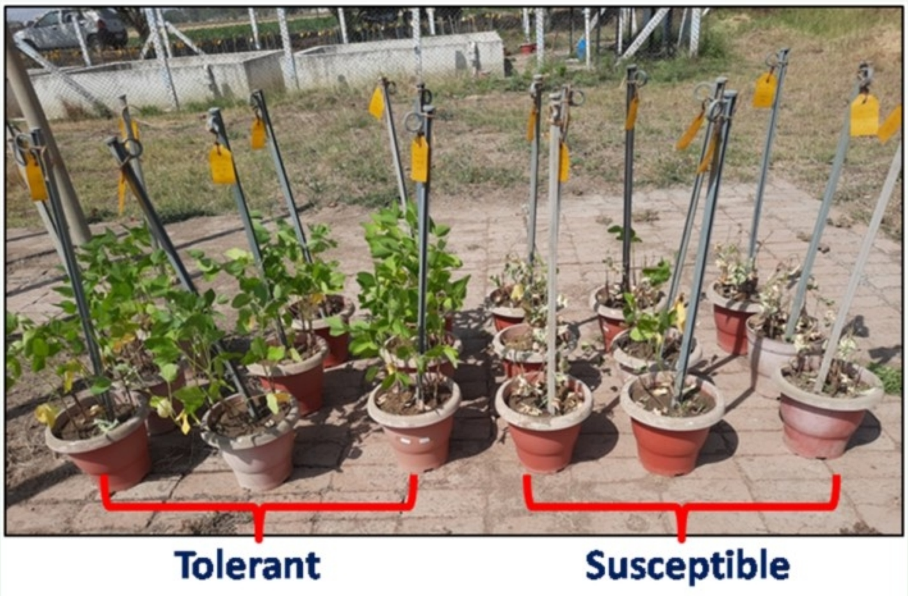
Genotype	Plot yield (Kg/ha)	WLTI	FDS	Percentage reduction in SCMR
NRC 192	2350.74	1.83	2.33	24.49
NRC 189	1985.26	1.48	4.67	30.56
NRC 186	2036.42	1.40	3.33	35.83
NRC 193	1053.70	1.21	3.00	36.69
A-20-33 (JS 97-52 × JS 21-08)	1537.28	1.95	4.33	25.99
A-20-26(JS 97-52 × NRC 130)	1738.39	1.39	3.00	26.78
A-20-3 (JS 97-52 × JS 88-66)	2743.82	1.37	2.67	28.83
Sel 3-79 (JS 97-52 × JS 88-66)	2400.74	1.29	3.00	34.37
A-20-25 (JS 97-52 × NRC 130)	1785.43	1.28	3.33	37.32
TGX 317-37 E	2103.25	1.54	2.67	30.52
JS 20-76	1589.63	1.33	4.33	28.58
EC 602288	1446.79	1.20	4.00	36.70
JS 97-52 (Tolerant Check)	1362.10	1.14	3.33	33.33
JS 20-69 (Tolerant Check)	2491.73	0.91	3.33	33.83
JS 90-41 (Susceptible Check)	1023.85	0.45	6.67	49.40

Performance of elite breeding lines evaluated for both abiotic stress (drought and water logging) tolerance

Genotype	Plot yield (Kg/ha)	DRI	WLTI	Remark
WLP 21-1 (Sel 3-79)	2400.74	0.4	1.3	Water logging tolerant
WLP 21-2 (A-20-5)	2743.70	0.5	0.7	-
WLP 21-4 (A-20-9)	1953.70	1.2	0.7	Drought tolerant
WLP 21-5 (A-20-21)	1870.00	1.2	0.6	Drought tolerant
GKS 21-1	1887.33	1.6	0.8	Drought tolerant
GKS 21-2	908.23	1.0	0.9	Drought tolerant
GKS 21-4	2496.21	0.9	1.7	Drought and Water logging tolerant
GKS 21-5	1428.07	1.1	0.4	Drought tolerant
GKS 21-6	1881.56	1.5	0.5	Drought tolerant
GKS 21-7	2274.40	0.9	1.6	Drought and Water logging tolerant
JS 97-52 (DT and WLT)	1362.10	0.8	1.1	Check
JS 90-41 (WLS)	1023.85	-	0.4	Check
JS 20-69 (Yield and WLT)	2491.73	-	0.9	Check
NRC 2 (DS)	1210.00	0.5	-	Check

Multi-location evaluation for water logging tolerance traits

Twenty five soybean genotypes from same set which were evaluated at Indore during Kharif 2020 were also evaluated for water logging tolerance at Umiam (Kharif), Jorhat (Kharif) and Indore (Offseason) at V2-V3 stages during 2020. On the basis of percentage reduction in seed yield, plant survival rate and foliar damage score, tolerant genotypes (in comparison to tolerant check JS 97-52) were identified at each location.Genotypes i.e. EC 456620, NRC 192 (Sel 1-34), EC 389148, JS 20-76 were identified as water logging tolerant genotype which were performed better at each location including Indore (Kharif) -2020.



Tolerant and susceptible genotypes after water logging stress

Similarly, 17 genotypes including two checks were evaluated for reproductive stage water logging tolerance with RBD (2 replicates) at Indore, Umiam, Jorhat and Kasbedigraj during Kharif season of 2021. On the basis of foliar damage score and water logging tolerance index, various genotypes found to be tolerant in comparison to tolerant checks. GenotypesNRC 192, NRC 186 and JS 20-76 were identified as water logging tolerant genotype which performed better at all locations during Kharif seasonof 2021.

Details of prominent genotypes identified for water logging tolerance during multi-location trails

Location and season	Tolerant genotypes
Indore (Kharif) - 2020	EC 389148, Hardee, TGX 317-37 E, JS 20-38, Sel 3-60, Sel 3-73, GKS 20-6, EC 456620, JS 20-76, JS 20-73, NRC 146, Sel 1-34
Umiam(Kharif) - 2020	JS 20-69, EC 456620, TGX 317-7E, EC 391346, JS 71-05, NRC 37, EC 287754
Jorhat(Kharif) - 2020	JS 20-69, EC 456620, EC 391346, NRC 192 (Sel 1-34), EC 389148, NRC 37, JS 20-76, JS 20-34
Indore (Offseason) - 2020	EC 89148, Hardee, JS 20-76, JS 20-38, NRC 146, GKS 20-6, GKS 20-2, NRC 192 (Sel 1-34), Sel 3-73, Sel 3-60
Indore (Kharif) - 2021	NRC 186, NRC 192, NRC 193, NRC 189, Sel 3-79, TGX 317-37 E, JS 20-76, EC 602288
Umiam (Kharif) - 2021	NRC 186, NRC 192, NRC 189, Sel 3-79, JS 20-76, CAT 2797, Hardee, CAT 1258, CAT 1341
Jorhat (Kharif) - 2021	NRC 186, NRC 192, EC 389148, EC 602288, EC 456556, CAT 2797, JS 20-76, CAT 1341
Kasbedigraj (Kharif) - 2021	NRC 186, NRC 192, NRC 189, Sel 3-79, Sel 3-21, EC 389148, JS 20-76, EC 602288, Hardee

Evaluation of soybean genotypes for high temperature tolerance

During trials conducted in Kharif 2019, summer 2020 for high temperature tolerance, around 20 soybean genotypes which performed better in both seasons, were evaluated in greenhouses in 2021. Different morpho-physiological traits i.e. relative water content (RWC), specific leaf weight (SLW), SCMR (chlorophyll content), canopy temperature and yield attributes were recorded in control and stress conditions. On the basis of recorded traits, genotypes i.e. TGX 780-5A, TGX 824-35E and EC 333876 were found to be better in comparison to tolerant check EC 538828.

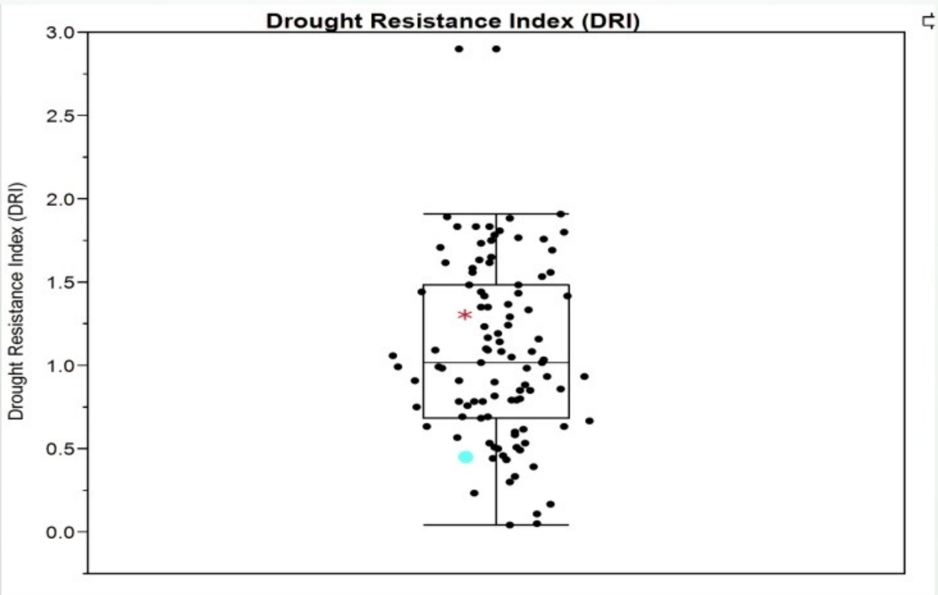
Genomics strategies for improvement of yield under abiotic stress conditions

A GWAS panel consisting around 300 diverse soybean accessions along with tolerant and susceptible checks, was evaluated for yield attributing traits, root system architectural (RSA) traits, drought tolerance and water logging tolerance in Kharif 2020. Same panel was also evaluated for canopy wilting /delayed leaf senescence trait during summer season of 2021.Genotyping by sequencing (GBS) of these 300 germplasm lines was carried out for GWAS studies. Illumina sequencing was conducted on soybean germplasm lines and total data of 40 GB with 390 million reads were generated.

(A) Drought tolerance : GWAS panel consisting around 300 diverse soybean accessions along with drought tolerant and susceptible checks was evaluated at seed filling stage (R5 plus 8-10 days) under rainout shelter-imposed plant stress level of 72-75% relative water content. Control plot was maintained with normal irrigated conditions. The genotypes were evaluated for drought resistance index for seed yield (DRIsy), drought resistance index for 100 seed weight (DRIsw), other yield attributes and different morpho-physiological traits. Delayed leaf senescence trait was also recorded during summer 2021.

Descriptive statistics of drought tolerance traits in GWAS panel

Drought tolerance related traits	Mean	Range	Top genotypes on the basis of particular parameter
DRI for seed yield	1.0	0.2 - 1.8	MAUS-1, AKSS 143, JS 20-34, AMS MB 100-39, Hardee
DRI for 100 seed weight	1.0	0.6 -1.2	EC 456613, JS335, JS 94-67, JSM 288, Hardee
RWC(%) under stress	75.6	20.6 - 98.2	CAT 47, EC 241756, EC 287754, TGX 312-012 E, Hardee
CTD (°) under stress	0.7	-6.8 to8.2	TGX 702-4-8, MAUS 142, EC 572160, M 1085, EC 241712
SCMR under stress	32.1	13.6 - 48.2	TGX 824-35 E, TGX 317-37 E, CAT 2797, TGX 803-99 E, M 1052
SLW (mg/cm2) under stress	5.3	3.0 -12.5	AGS 128, TGX 722-155 F, EC 287460, EC 45732, TGX 573-209-23
Delayed leaf senescence	3	1-5	EC 251456, TGX 780-5A, Hardee, TGX 860-11 D, EC 457475, Bragg

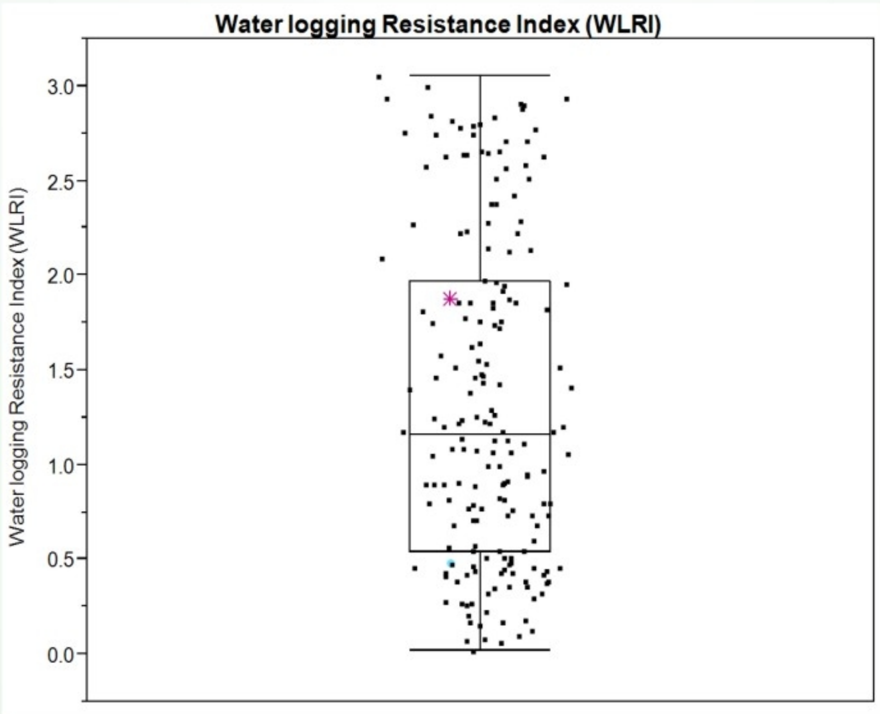


Box plot illustrating variability for drought tolerance in GWAS panel

(B)Water logging Tolerance : The same GWAS panel was evaluated for water logging tolerance along with water logging tolerant and susceptible checks. The water-logged conditions were provided in vegetative 2-vegetative 3 (V2-V3) growth stages of plant for 10 days by saturating the soil with water up to 10 cm above the soil surface in stressed plot while counter control plot was maintained with normal irrigated conditions. Soybean genotypes were evaluated for foliar damage score, plant mortality rate, stem elongation rate, adventitious root rating yield and attributing traits.

Screening for post harvest sprouting tolerance

Water logging tolerance traits	Mean	Range	Top five genotypes on the basis of particular parameter
Foliar damage score	4.90	1 - 9	EC 528623, TGX 854-42 D, EC 457464, JS 20-38, NRC -7
Plant mortality Rate (%)	37.18	0 - 92.50	TGX 854-42 D, EC 528623,EC 528622, EC 457464, TGX 854-429
Stem elongation rate (%)	98.90	13.41 - 233.33	EC 456556, PK 1284, EC 528623, EC 389148, VLS 75
Adventitious root rating	2.83	1 - 5	EC 390977, NRC -7, EC 389148, Hardee, EC 456620
Percentage reduction in seed yield per plant (%)	61.03	0 - 97.80	EC 457475, EC 391346, EC 309537, EC 313974, EC 389148



Box plot illustrating variability for water logging tolerance in GWAS panel

Root trait phenotyping of promising genotypes and gene expression analysis

Soybean is a rainfed crop which frequently experiences drought stress at early vegetative growth. In soybean, limited studies are available on root trait diversity and no root architecture gene is characterized in India. Using hydroponic culture, 25 soybean genotypes varying in abiotic stress tolerance were characterized for root architecture traits at early vegetative stage. Roots of one week and two weeks' plants were scanned and analysed using WinRHIZO software and data were recorded for total root length (cm), root diameter (mm), root tips, surface area (cm2) and root volume (cm3). A drought tolerant genotype EC538828, and a waterlogging tolerant genotype NRC 128, has shown high total root length values. EC538828 also showed highest root surface area and root volume, whereas, genotype JS 20-34 showed lowest values for root surface area and root volume.

Genome wide search for *OsSOR1* homology in soybean genome identified 17 gene models showing significant matches. Expression data of these 17 gene models among 14 different soybean tissues were downloaded from SoyBase. Heat map of gene expression data showed that two genes, *Gm08.SOR1* and *Gm14.SOR1*, have exclusively higher expression in root tissue. These two genes were further analyzed using real-time PCR in contrasting trait genotypes EC538828 and JS 20-34. Relative expression of *Gm08.SOR1* was lower in primary roots but higher in lateral roots of EC538828 as compared to JS 20-34. Whereas, expression of *Gm14.SOR1* was higher in primary roots, as well as, in lateral roots of EC538828, as compared to JS 20-34. This association of high expression of *Gm14.SOR1* in EC538828 compared to primary and lateral roots of JS 20-34 suggests it's potential role in soybean root development.

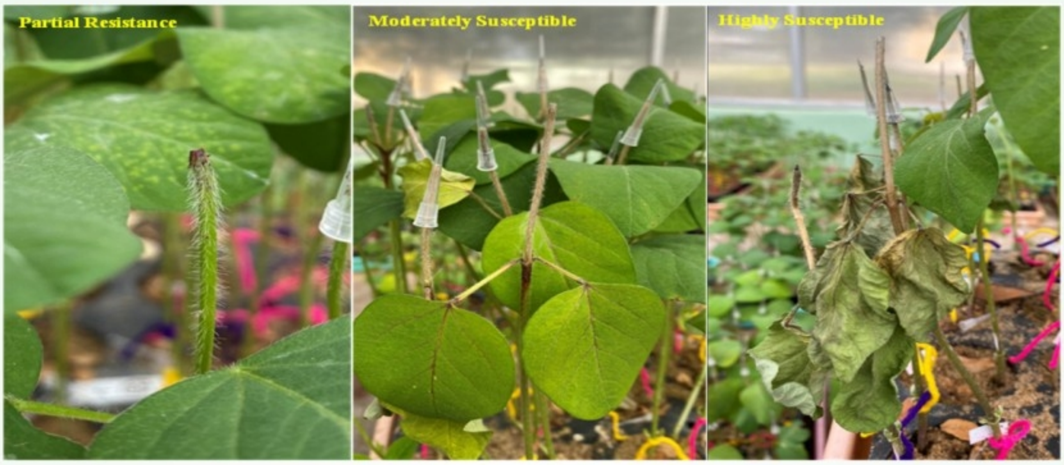
Hydroponics culture for root study

Roots of contrasting soybean genotypes

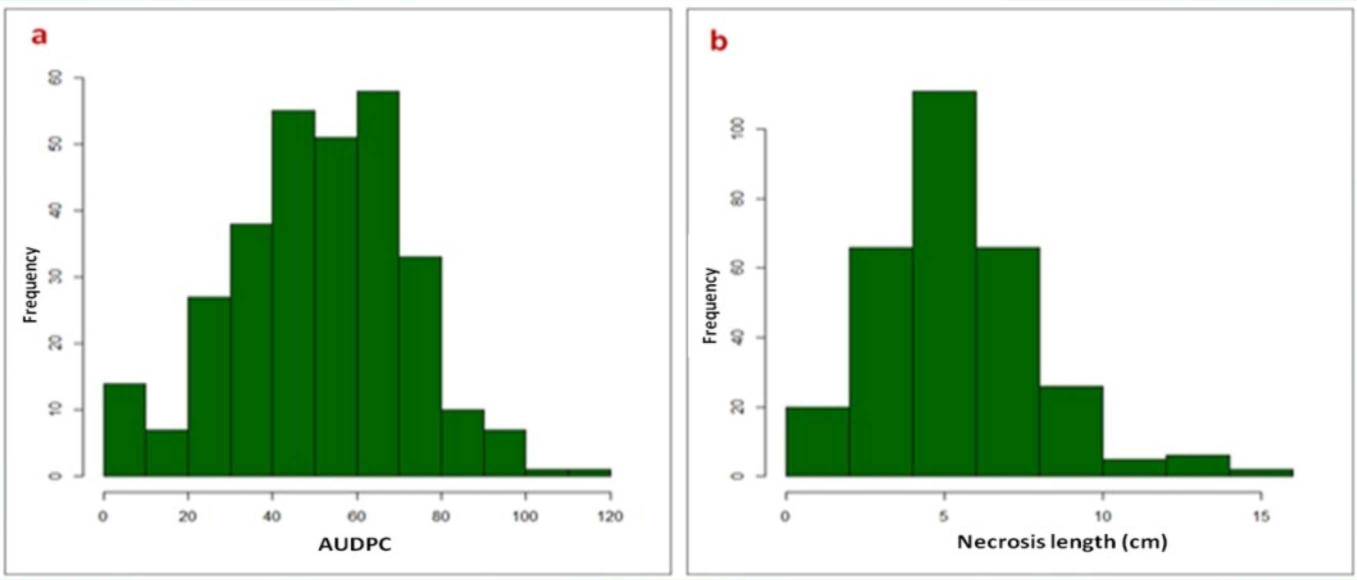
3.4 Management of Biotic Stresses

Screening of soybean GWAS panel for charcoal rot resistance

A GWAS panel (N=302) was screened for charcoal rot resistance at V2 stage using cut-stem inoculation method. Disease evaluation was based on stem necrosis length and area under disease progress curve (AUDPC). The GWAS panel (N=300) was screened for charcoal rot resistance at adult plant stage. Disease evaluation was based on Percent Disease Index (PDI), AUDPC and Root Stem Severity (RSS) Index.



Screening of GWAS panel for charcoal rot resistance at seedling stage using cut-stem inoculation method



Frequency distribution: (a)- Area Under Disease Progress Curve (AUDPC) and (b)-Stem necrosis length (in cm)

Under artificial inoculation experiment, GWAS panel has shown high genetic variation for the traits-AUDPC and PDI. With a mean of 51.1, AUDPC ranged from 1.25 to 127 and with a mean of 5.37 cm, stem necrosis length ranged from 0.1 to 18.8 cm.

Likewise, under field experiment, GWAS panel was found to be diverse with respect to the traits under consideration. With a mean value of 886.00, AUDPC ranged from 0-2090.7 and PDI mean and range were 52.21and 0-100, respectively. Mean of the RSS was 2.97 and range was 1.33-4.66. Mean plot yield was 68.92 g and was ranged from 0-319.86 g. Likewise, 6.33g and 0-12.92g were the mean and range for 100-seed weight, respectively.

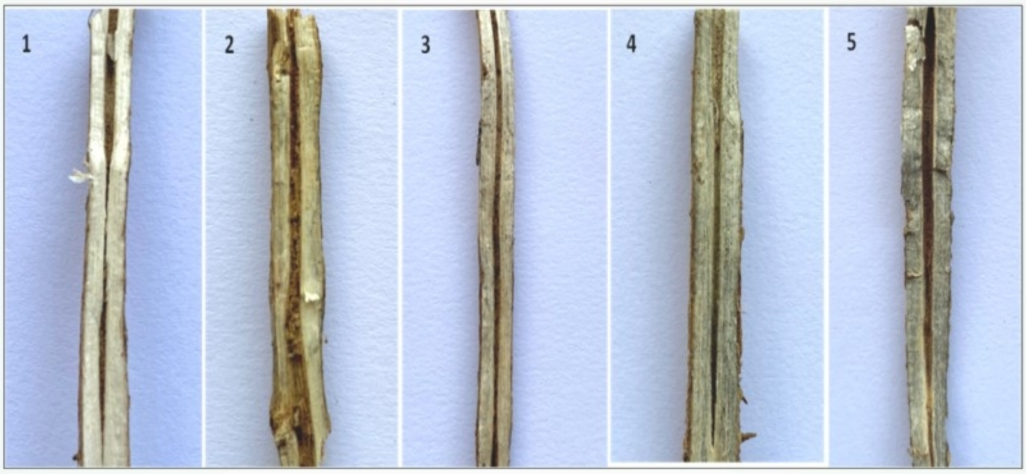
Descriptive statistics and top ten best performing genotypes with respect to the traits studied under artificial screening at seedling stage

Trait	Mean	Range	CV	h2	Top 10 best performing genotypes
AUDPC	51.1	1.25- 127	38.9	91.9	JS 22-10, PS 1613, MACS 1520, IC 15729, JS 22-12, JS 22-05, JS 22-18, JS 22-16, JS 22-15 and B 1667
Stem necrosis length (cm)	5.37	0.1-18.8	44.6	90.03	JS 22-10, PS 1613, MACS 1520, JS 22-12, JS 22-16, JS 22-05, JS 22-15, JS 22-18, JS 335 and Bragg

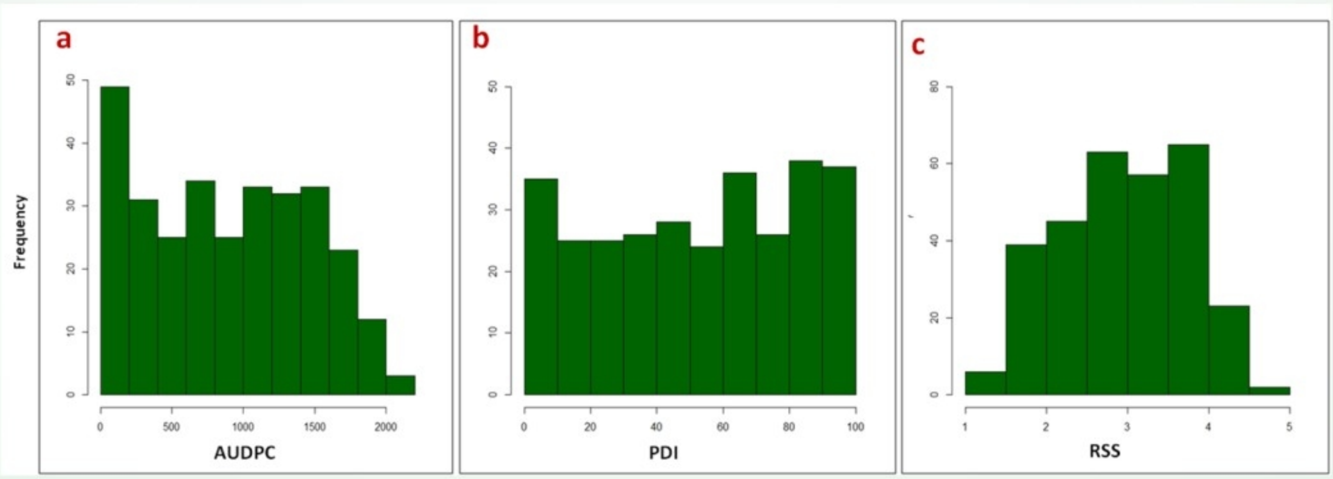
Descriptive statistics and top ten best performing genotypes with respect to the traits studied under field screening at adult plant stage

Trait	Mean	Range	CV	h2	Top 10 best performing genotypes
AUDPC	886.00	0-2090.7	35.4	90.3	MAUS 71, JS 20-38, EC 457464, EC 538807, T 49, JS 20-98, NRC 2396, NEC 7, JS 20-37 and Kalitur
PDI	52.21	0-100	26.1	93.5	MAUS 71, JS 20-38, EC 457464, EC 538807, T 49, JS 20-98, NRC 2396, NRC 7 and Kalitur
RSS	2.97	1.33-4.66	19.2	82.5	EC 393231, CAT 1341, JS 95-52, JS 22-01, JS 21-05, JS 20-20, JS 22-18, BRG 1, JS 20-37 and JS 21-13
Plot yield (g/plot)	68.92	0-319.86	28.5	93.4	AGS 25, JS 22-18, CAT 1341, JS 21-17, JS 20-37, JS 21-05, JS 22-01, EC 592195, EC 457516 and JS 21-72
100-seed weight (g)	6.33	0-12.92	16.5	96.4	EC 457464, JS 21-13, EC 538807, JS 21-72, NRC 2396, JS 22-12, JS 21-71, EC 547464, JS 21-17 and KDS 1073

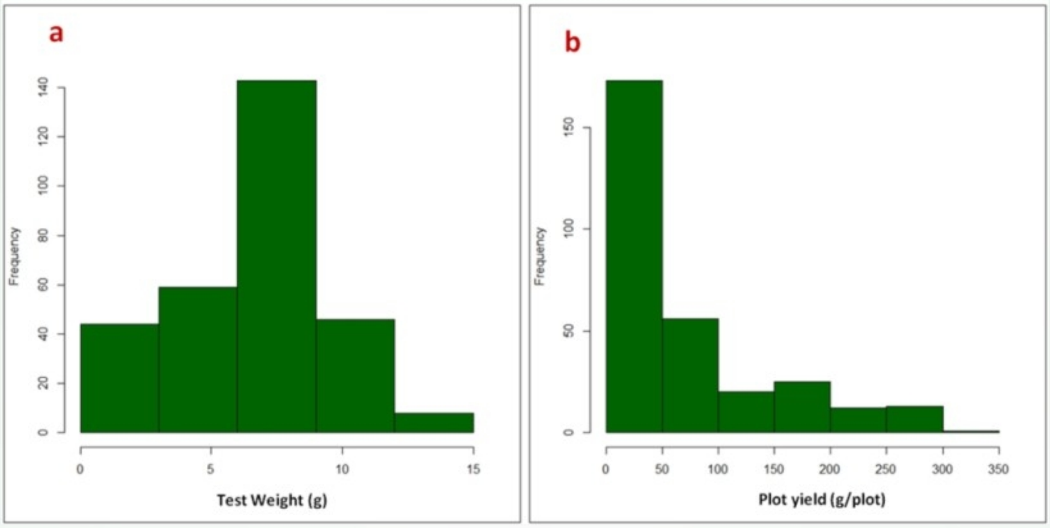
Charcoal rot disease severity in sick-plot



Disease scoring based on root stem severity index using 1-5 scale



Frequency distribution: (a)- Area Under Disease Progress Curve (AUDPC), (b)- Percent Disease Index (PDI) at R7 stage and Root Stem Severity (RSS) index at R7 stage



Frequency distribution: (a)- 100-seed weight, (b)- Plot yield (g/plot)

Development of new screening technique for anthracnose resistance

A new artificial screening technique, earlier used by Montri et al. (2009) for chilli anthracnose resistance, was standardized for soybean. The technique involves injection of R6 stage pods with conidial suspension, their incubation for 5 days and recording of data percent pod infection. Genotype AGS farm accession was found to be resistant followed by EC 538828 and IC 250350. Further standardization is in progress for improving its consistency and correlation with field resistance.

Incubation of soybean pods after sprayer distilled water (control) and fungal suspension (Inoculated)

Disease reaction incomparison to the control

Artificial screening of genotypes for anthracnose resistance at V2 stage

Fourteen soybean genotypes at V2 stage were inoculated and incubated for three days in a humidity chamber. Data was recorded after three days of inoculation, based on percent leaf infection. Genotype DSb32 was found to be relatively resistant followed by JS 93-05 and JS 95-60.

Breeding for charcoal rot and anthracnose disease resistance

Twenty three new crosses were attempted aiming at anthracnose and charcoal rot resistance and given below:

Details of crosses for anthracnose and charcoal rot resistance

Crosses for anthracnose resistance	Crosses for charcoal rot resistance
EC 572136× DSB 34	JS 20-34 × JS 95-60
EC 916032 × NRC 181	EC 34372 × EC 572109
EC 915983 × NRC 37	EC 457254 × RSC 10-46
JS 20-98 × RSC 10-46	EC 572136 × NRC 166A
NRC 181 × EC 993175	EC 572136 × RSC 10-46
EC 457254 × EC 572136	JS 20-98 × EC 457254
EC 457254 × JS 95-60	JS 20-98 × NRC 130
EC 34372 × JS 95-60	JS 20-98 × JS 95-60
EC 572136 × EC 457254	JS 20-98 × NRC 166A
	JS 20-98 × DSB 34
	CAT 2797 × IC 250350
	JS 97-52 × RSC 10-46
	JS 97-52 × JS 21-35
	NRC 166 A × JS 22-18

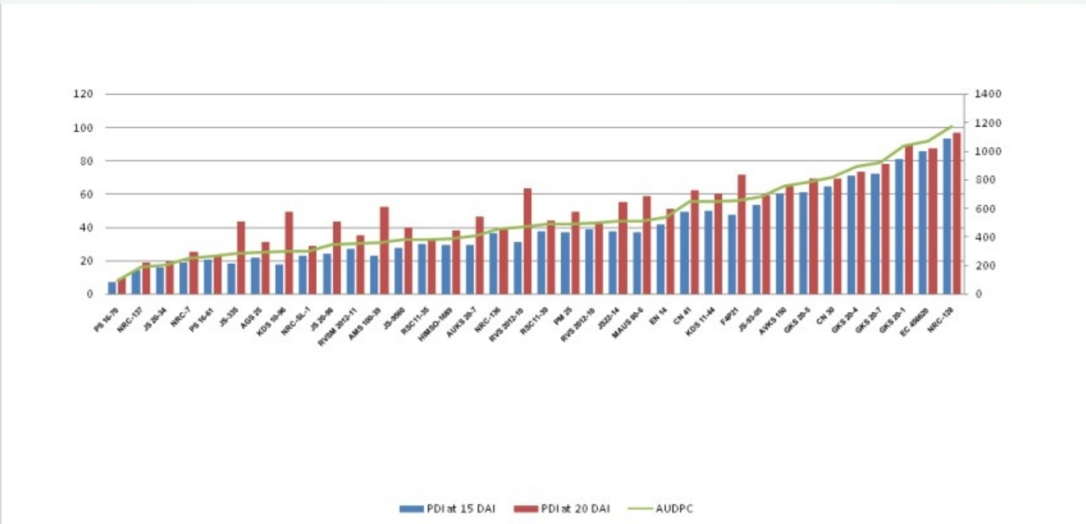
Marker assisted breeding for YMV resistant varieties

YMV resistant and high oil content entry NRC 149, developed in collaboration with PAU, Ludhiana has been promoted to AVT II in North Plain Zone. YMV resistant and high oil content entry NRC 195 has been identified for IVT 2021. Early maturing and YMV resistant entry NRC196 has been identified for IVT (Early) 2021. BC3F1s of NRC 7 × (NRC7 × SL525) were raised and tested for their trueness to hybridity in off-season. BC3F2 of NRC 7 × (NRC7 × SL525) were raised and genotyped with SSR marker GMAC7L for selection of MYMIV resistant plants. F2s of NRC 142 (double null) × NRCSL 2 (YMV resistant EDV of JS 335); NRC 142 (double null) × BC3 of JS 95-60 × (JS 95-60 × SL 525) (YMV resistant) and NRC 105 (vegetable type) × NRCSL 2 (YMV resistant) were raised and the F3 and F4 generations of the former two crosses were raised in glass house using speed breeding method standardized at the institute. F1s of NRC149 × AMS100-39 were raised, tested for their hybridity and backcrossed with AMS 100-39. Different breeding lines develped for YMV resistance were adavanced using marker assisted selection.

Breeding against collar rot disease

Thirty six soybean genotypes were screened through Indore isolate and disease reaction ranged from moderate (PS 16-70, PS 16-61, NRC 137) to highly susceptible (NRC 128) based on disease incidence, mortality %, reduced shoot and root length, and area under disease progress curve (AUDPC).

Screening for collar rot resistance through pot- inoculation technique



PDI and AUDPC for soybean genotypes inoculated with Sclerotium rolfsii

Evaluation of elite genotypes against major soybean diseases

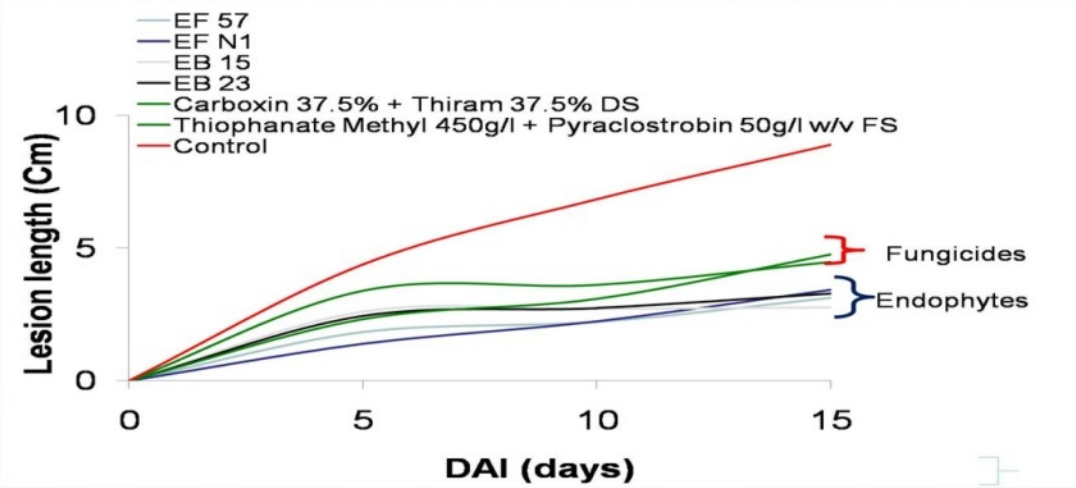
Total 22 elite genotype of soybean was evaluated under field condition against major disease of soybean in Kharif 2021 under station trail at ICAR-IISR, Indore. Among the 22 elite genotypes, two genotypes i.e., WLP 21-2 and YP 34 were found resistance againstanthracnose and charcoal rot diseases.

In-vitro evaluation of endophytes against soybean diseases and growth parameters

Charcoal rot disease: Potential endophytes were evaluated against charcoal rot disease through seed treatment. For comparison, two fungicides - Carboxin 37.5%+ Thiram 37.5%DS and Thiophanate Methyl 450g/l + Pyraclostrobin 50g/l w/v FS were selected. The endophytes treated seeds were inoculated with charcoal rot disease by using cut stem technique at V2 growth stage (2 weeks after sowing). The lesion length of charcoal rot was measured at different time interval and AUDPC was calculated. Minimum AUDPC (23.20) was recorded with seed dressing with EF N1.

Evaluation of elite genotypes against major diseases of soybean

Disease	Disease reaction		
	Highly resistant	Resistant	Moderate resistant
Anthracnose	-	WLP 21-2, YP 34	GK 21-1, GK 21-2, GK 21-3, GK 21-4, GK 21-5, GK 21-6, GK 21-7, WLP 21-5, WLP 21-3, WLP 21-4, WLP 21-1, WLP 21-6, WLP 21-7, YP 31, YP 32, YP 33, NRC 157, NRC 162
Charcoal rot	GK 21-1, GK 21-2, GK 21-3, GK 21-4, GK 21-5, GK 21-6, GK 21-7, WLP 21-5, WLP 21-3, WLP 21-4, WLP 21-2, WLP 21-1, WLP 21-6, WLP 21-7, YP 31, YP 32, YP 33, YP 34, NRC 157, NRC 162	-	-

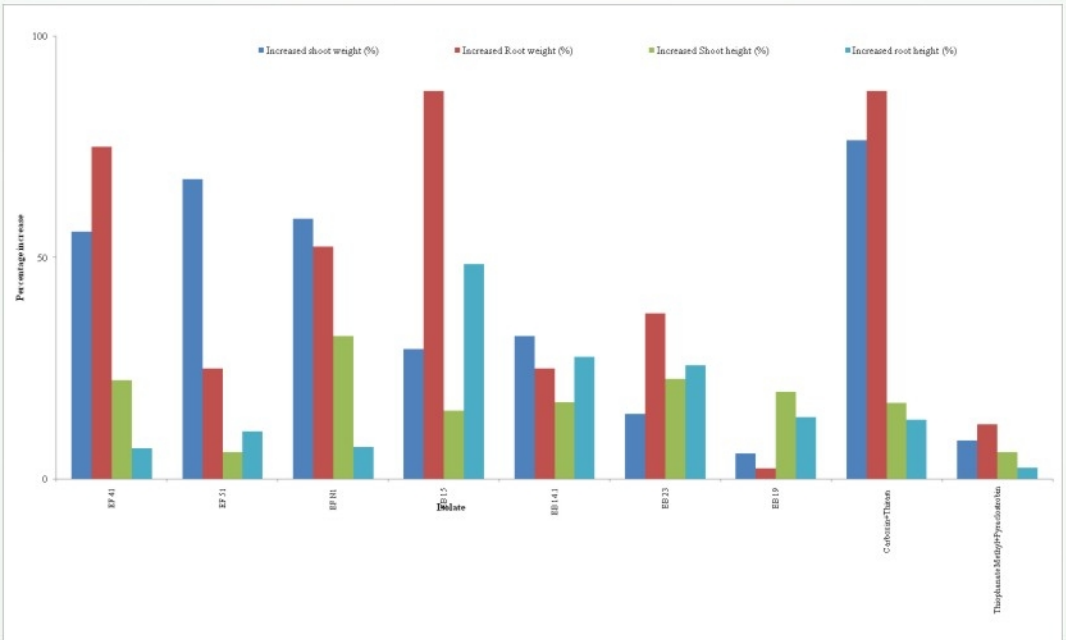


Effect of soybean endophytes on charcoal rot disease

Anthracnose disease: Potential endophytes were evaluated against anthracnose disease through seed treatment and foliar application. After seed treatment of endophytes, minimum PDI (32.96%) was recorded with seed dressing chemical Carboxin37.5%+ Thiram37.5%DS @ 2 g/kg of seed,which was statistically on par with EF 41, EF 51, EF 29, EB 111, EB 15, EB 14.1, EB 23 and Thiophanate Methyl 450g/l + Pyraclostrobin 50g/l w/v FS.After foliar application of endophytes, minimum PDI (20.00%) was observed with foliar application ofPyroclostrobin,which was statistically on par with EF 42 and EB 111.

Growth parameters : Soybean endophytes significantly increase root and shoot height as well as root and shoot weight. Among the endophytes EF 41, EF 51, EF N1, EB 15, EB 14.1, EB 23 and EB 19 were found to show increased plant growth promotion activities.

Effect of soybean endophytes on anthracnose disease



Evaluation of potential endophytes for PGPR activities

Field evaluation of potential endophytes for managing major diseases of soybean

Selected endophytic microbes along with fungicides were evaluated agents against major pests and diseases of soybean. Endophytes were applied through seed treatment and foliar application along with fungicides. Endophytes significantly managed the soybean anthracnose and charcoal rot diseases, and also enhanced the yield compared to control. Application of EB 23 (B. thuringiensis) provided maximum control of soybean charcoal rot disease, yield and BC ratio. Interestingly, EB 14.1 (*Bacillus circulans*) was found most effective in management of soybean anthracnose disease. Application of EB 15 (*Bacillus circulans*) was found effective against management of stem fly, whereas EF N1 (*M. phaseolina*) was against girdle beetle and EB 14.1 (*Bacillus circulans*) against defoliators.

Effect of endophytic fungi, bacteria and fungicides on PDI of soybean anthracnose and charcoal rot, percentage disease control (PDC) during kharif 2021

Treatment*	PDI Anth (%)	PDC Anth (%)	PDI CR (%)	PDC CR (%)	Yield (Kg/ha)	IY (%)	BC ratio
T1	34.08 d-f	39.86	40.00 c-g	46.43	1599.18d-g	18.49	3.83
T2	42.12b	25.67	42.67 b-f	42.86	1489.51ik	12.49	3.57
T3	37.42cd	33.97	38.67 e-g	48.22	1584.87d-h	17.75	3.79
T4	36.86c-e	34.95	48.00b	35.72	1568.10 d-i	16.88	3.75
T5	33.89d-g	40.19	44.00 b-d	41.07	1635.99 de	20.32	3.92
T6	33.89d-h	40.20	42.67 b-e	42.86	1639.67 d	20.50	3.92
T7	32.03f-i	43.49	38.67 e-g	48.22	1622.09 d-f	19.64	3.88
T8	21.52j	62.02	38.23 e-g	48.80	1820.04 a-c	28.38	4.36
T9	23.53j	58.48	37.33 e-g	50.00	1827.40 ab	28.67	4.37
T10	38.89bc	31.37	44.33 b-c	40.63	1545.19 f-j	15.64	3.06
T11	20.12j	64.50	36.00 g	51.79	1905.11a	31.58	3.81
T12	56.67a	0.00	74.67a	0.00	1303.48k	0.00	3.37

*T1 (St (seed treatment) and F (Foliar application) of EF 41, *Aspergillus niger*), T2 (St and F of EF51 *Fusarium solani*), T3 (St and F of EF 57 *Mucor circinelloides*), T4 (St and F of EF 29, *F.solani*), T5 (St and F of EF N1, *M. phaseolina*), T6 (St and F of EB 111, *Panibacillus macerans*), T7 (St and F of EB 15, *Bacillus circulans*), T8 (St and F of EB 14.1, *Bacillus circulans*) and T9 (St and F of EB 23, *B. turingiensis*) T10 (Carboxin37.5%+ Thiram37.5% for seed treatment and Pyraclostrobin as foliar application), T11 (Thiophanate Methyl 450g/l + Pyraclostrobin for seed treatment and Pyraclostrobin as foliar application) and T12 (Control).

Evaluation of soybean bacterial endophytes isolated from drought tolerant genotypes against soybean anthracnose and charcoal rot

Sixty-two bacterial endophytes were obtained from five different drought resistant and one drought susceptible cultivars. Among the soybean varieties JS 95-60 provided maximum number of endophytes. These endophytic bacteria were evaluated against *M. phaseolina* by inhibition zone technique. Out of them, 7 bacterial isolates were found most effective in inhibiting mean mycelial growth (> 70%) of *M. phaseolina*. These 7 isolates were also found effective against *C. truncatum* and *S.rolfsiiin* in vitro evaluation.The endophytic bacteria EB 53 was able to produces hydrolytic enzymes such as cellulose, protease, amylase, chitinase and β 1, 3 glucanase and metabolite such as HCN and siderophore. The endophytic bacteria EB 53 induce plant growth that inducing germination percentages, vigour percentage and shoot and shoot biomass, it also has capacity to mineralize P, Zn and K, and it can also produce IAA. These endophytes were further evaluated against anthracnose and charcoal rot in glass house as well as field conditions. Maximum inhibition of charcoal rot severity was obtained through seed treatment dressing bacteria EB 11. Seed treatment with EB 11 also induces plant defense enzymes such as PPO and PO, which indicate EB 11 induced ISR mechanism of defense. Seed treatment and foliar application of EB 111 provide maximum inhibition of soybean anthracnose in glass house condition. Seed treatment and foliar application of EB 53 provide maximum inhibition of anthracnose and charcoal rot in field condition.

Evaluation of fungicides against major soil borne pathogens

Four seed dressing fungicides viz., Thiophanate Methyl 450g/l + Pyraclostrobin 50g/l w/v FS, Penflufen 13.28% w/w + Trifloxystrobin 13.28% w/w FS, Carboxin37.5%+ Thiram37.5% DS, Carbendazim 25%+ Mancozeb 50% WS at 0.025%, 0.50%, 0.1% and 0.125% concentrationswere tested against *M. phaseolina* and *S. rolfsii*. All the treatments resulted in 100% mean mycelial inhibition of both the pathogens. Germination percentage was significantly improved through application of fungicides. Among the four seed dressing fungicides, Carbendazim 25%+ Mancozeb 50% WS @ 1.5 g/kg was provided maximum increase in seed germination percentage.

Glass house experiment was conducted to assess the possibility of managing the disease by different seed dressing fungicides. Among the four seed dressing fungicides,Thiophanate Methyl 450g/l + Pyraclostrobin 50g/l w/v FS @ 1 ml or 1.5 ml/kg of seedwas found most effective in management of soybean charcoal and collar rot disease with minimum AUDPC, was significantly superior to other treatments.

Studies on morpho-cultural and pathogenic variability in *Macrophomina phaseolina*

Cultural and morphological variability: Cultural and morphological studies were carried out for 62 isolates collected from different agro-ecological zones of India.Cluster analysis of morpho-cultural and pathogenic variation, differentiated these isolates into three different groups. PCA revealed that MP 36 (Medziphema) and MP 26 (Banswada) isolatesshowed positive correlation with pathogenicity characters such as AUDPC on JS 20-98, JS 95-60 and on Shivalik.

Pathogenic variability: After the inoculation of 62 isolates on three soybean cultivars i.e. JS95-60, shivalik and JS20-98 through cut-stem method, lesion length was measured at time intervals. It revealed that maximum AUDPC was observed in isolate MP36 (Medziphema), which was highly virulent isolate. Among the genotypes, maximum AUDPC was observed in variety JS 20-98.Through GGE biplot analysis, isolate MP37 (Ludhiana) was found to be highly discriminative in nature. It was observed that isolate MP 6 (Jabalpur) was highly virulent against the soybean variety JS95-60 and isolate MP37 (Ludhiana) was highly virulent against the shivalik variety. Most of isolates were showed high virulence against JS 20-98. Based on the AUDPC values, 62 isolates of *M. phaseolina* were grouped into two clades according to the similarity exhibited by isolates. Clade 1 includes 26 virulent isolates and while clade 2 includes less virulent 34 isolates.

Study of morpho-cultural and pathogenic variability in *Colleltorichum truncatum*

Thirty isolates collected from six different soybean growing zones of India were characterized for morphological and cultural variability. Cluster analysis of 30 isolates of *C. truncatum* based on 21 cultural and morphological characters resulted in three groups. After the inoculation of 19 isolates of *C. truchatum* in three soybean cultivars, i.e., JS95-60, Shivalik, and JS20-98, anthracnose disease was estimated in both leaves and petiole. Among the 19 isolates of *C. truchatum,* the maximum percentage of petiole infection, 96.67 % was given by isolate Ct1 (Indore). Among the varieties, the petiole of JS 95-60 received maximum infection. In the interaction of variety and isolates, the maximum percentage of petiole infection of 100 % was observed in isolate Ct19 (Khandwa) on JS 95-60.Variety JS 20-98 was also showing susceptible reaction with all isolates collected from different agro-ecological zone of India.

Soybean diseases and insect pest monitoring and pathogen profiling

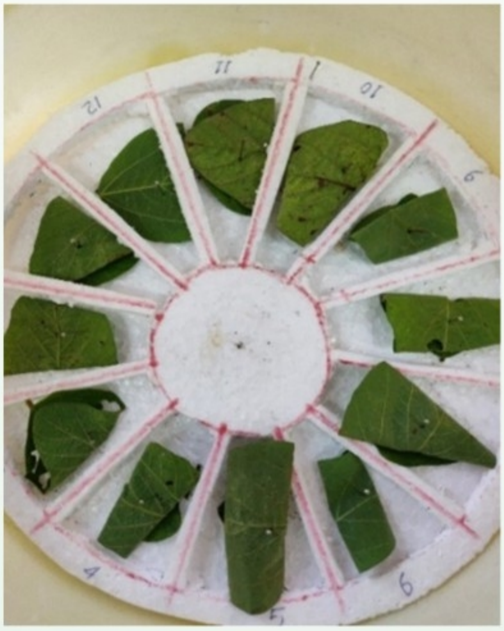
To assess the extent of soybean disease and pest severity, intensive roving survey was conducted during Kharif 2021 in major soybean growing area of Indore district. Five villages of each district were randomly selected on either side of the road when the crop was in pod formation stage. Fields were assessed for anthracnose severity by recording the disease on 0-9 disease ratings scale. Fields in Indore district were having low severity of soybean anthracnose (0.00-27.80%). The soybean mosaic virus severity 0.00 % to 62.36% was recorded in farmer field.

Evaluation of soybean genotypes for defoliating insect resistance

A set of 49 soybean germplasm lines was screened under field and lab conditions against defoliating insects with 4 checks (2 resistant and 2 susceptible). Under field conditions, based on the leaf damage percentage as well as larvae count and under lab conditions, based on preference index (C) of antixenosis for *Spodoptera litura*, soybean accessions were categorized in relation to their resistance level. Five genotypes viz., F4P21 (0.22), CAT 2503 (0.32), G5P22 (0.46), IC 24997 (0.47) and EC 113393 (0.47), exhibited strong antixenosis. Six genotypes exhibited moderate antixenosis (0.61-0.74). Under field screening based on leaf damage percentage those genotypes was less than 25% defoliation, considered as least susceptible genotypes. 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) recorded highly resistant reaction which would further be confirmed in lab conditions.

Performance of antixenosis in soybean genotypes

Genotypes *(Glycine max)*	'C' Values	Interference
F4P21 (PS 564 × TGX 855-53 D)	0.22	Strong Antixenosis
CAT 2503	0.32	Strong Antixenosis
G5P22 (MACS 330 × L 129)	0.46	Strong Antixenosis
IC 24997	0.47	Strong Antixenosis
EC 113393	0.47	Strong Antixenosis
Basara	0.63	Moderate Antixenosis
EC 171215	0.63	Moderate Antixenosis
EC 127503	0.7	Moderate Antixenosis
IC 501254	0.72	Moderate Antixenosis
EC 171194	0.72	Moderate Antixenosis
JS335	1	Preferred host



Antixenosis Studies

Evaluation of F1s for defoliating insect resistance :

Twenty five F1s including 9 interspecific crosses (*Glycine max* × *Glycine soja*) were tested for antixenosis against *Spodoptera litura*. Six F_1 crosses exhibited strong antixenosis and 8 F_1 crosses exhibited moderate antixenosis against *Spodoptera litura.*

Antibiosis studies in wild soybeans :

Five wild species of soybean were studied for antibiosis against *Spodoptera litura. Glycine tomentolla, Glycine canescens, Glycine tabacina* showed antibiosis reaction in terms of AD/ECI/ECD.

Performance of antixenosis in F1s attempted during 2020

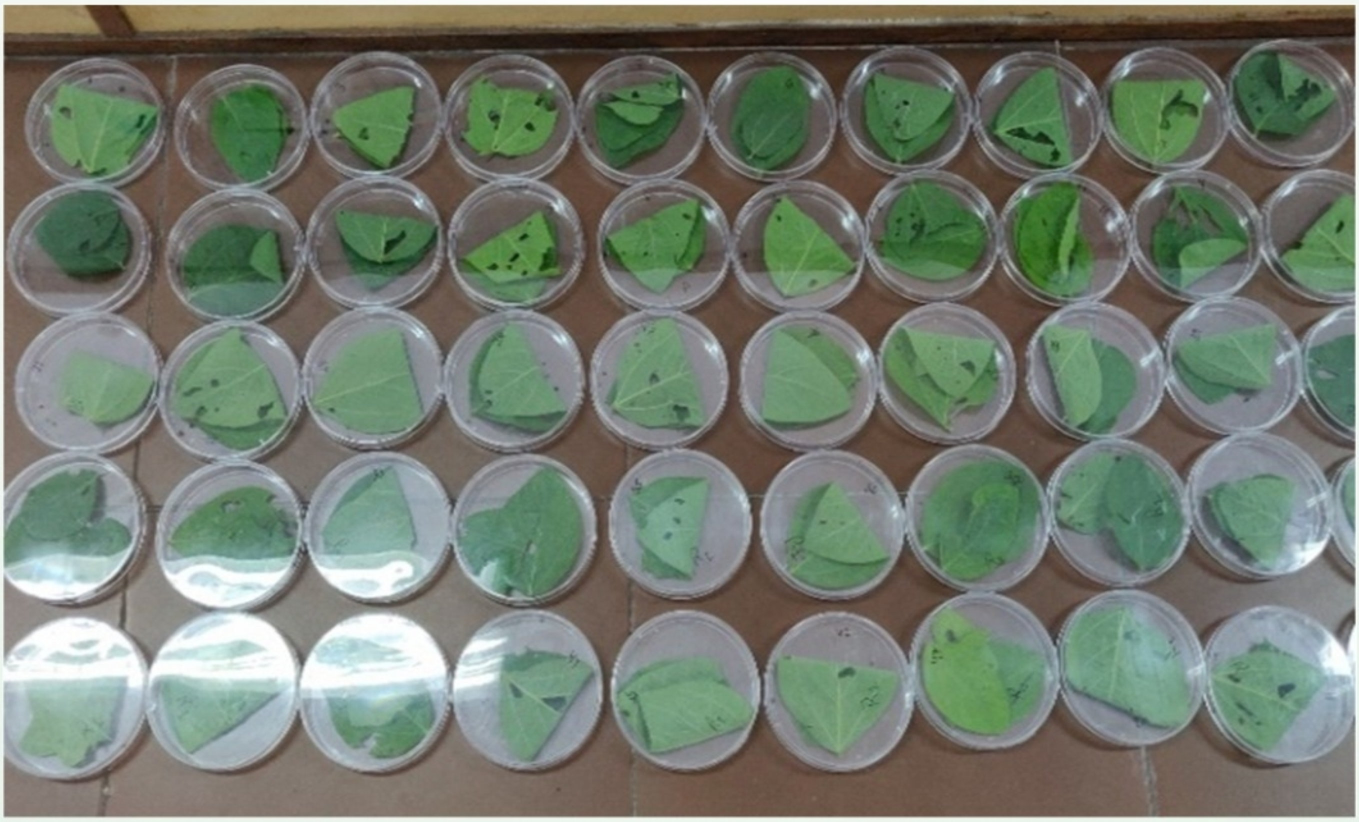
Cross	'C' Values	Interference	Parentage
JS 335 × PI 407170	0.45	Strong antixenosis	Interspecific
JS 20-34 × PI 593983	0.46	Strong antixenosis	Interspecific
JS 9560 × PI 593983	0.46	Strong antixenosis	Interspecific
JS 9560 × AKSS 67	0.49	Strong antixenosis	Intraspecific
JS 9560 × PI 407170	0.5	Strong antixenosis	Interspecific
JS 20-34 × PI 407170	0.5	Strong antixenosis	Interspecific
JS 9560 × G5P22	0.6	Moderate antixenosis	Intraspecific
JS 9560 × PI 549046	0.61	Moderate antixenosis	Interspecific
EC 538828 × PI 593983	0.62	Moderate antixenosis	Interspecific
HARDEE × KARUNE	0.63	Moderate antixenosis	Intraspecific
EC 538828 × PI 549046	0.65	Moderate antixenosis	Interspecific
JS 9560 × LINE 220	0.68	Moderate antixenosis	Intraspecific
JS 335 × PI 549046	0.7	Moderate antixenosis	Interspecific
JS 20-34 × LINE 220	0.75	Moderate antixenosis	Intraspecific
JS 335	1	Preferred host	

Performance of wild soybeans vis-a-vis cultivated soybeans for antibiosis

Genotype	AD	ECI	ECD
Glycine latifolia	97.15 (80.27)	86.91 (68.79)	84.43 (66.76)
Glycine microphylla	90.83 (72.38)	84.91 (67.14)	77.12 (61.43)
Glycine tomentella	71.81 (57.93)	80.25 (63.61)	57.63 (49.39)
Glycine canescens	82.15 (65.01)	58.46 (49.87)	48.02 (43.87)
Glycine tabacina	95.69 (78.02)	51.80 (46.03)	49.57 (44.75)
JS 335	84.99 (66.99)	86.29 (68.27)	64.71 (53.56)

Antibiosis studies in F_2 population

A F_2 population of 101 plants derived from crosses JS 335 × F4P21 which exhibited strong antibiosis in F1 was studied for antibiosis against *Spodoptera litura* revealed considerable variation among the lines for which further studies will be carried out.



Antibiosis studies in F_2 population

Hybridization for insect resistance : Forty one crosses were attempted aiming at combining insect resistance with high yielding attribute and early maturity trait.

Hybridization carried out during 2021

S.No	Cross	S.No	Cross
1	F3P18 × Line 202	22	RSC 10-46 × EC 481369
2	F3P18 × JS 9305	23	JS 20-34 × EC 481369
3	F3P18 × JS 335	24	JS 97-52 × EC 481369
4	F3P18 × DLSB 1	25	JS 97-52 × (JS 20-34 × Line 202)
5	F4P21 × Line 202	26	Basara × (F4P21 × Line 220)
6	F4P21 × EC 481369	27	Basara × Karune
7	JS 20-34 × Line 202	28	Basara × VLS 63
8	JS 20-34 × G5P22	29	Basara × RSC 10-46
9	G5P22 × JS 335	30	Basara × JS 20-98
10	JS 20-98 × G5P22	31	Basara × EC 481369
11	F4P21 × RSC 10-46	32	Basara × JS 9560
12	Harasoya ×(F4P21 × Line 220)	33	JS 20-34 × AGS 25
13	Harasoya × JS 9305	34	RSC 10-46 × AGS 25
14	JS 9560 × (AKSS 67 × G5P22)	35	JS 9305 × AGS 25
15	AGS 155 × (AGS 155 × EC 481369)	36	JS 20-69 × VLS 59
16	AKSS 67 × (AKSS 67 × G5P22)	37	Harasoya × EC 915908
17	AGS 155 × (JS 20-34 × Line 220)	38	Harasoya × JS 9305
18	Harasoya × Karune	39	JS 20-34 × EC 915908
19	Harasoya × RSC 10-46	40	JS 20-34 × (JS 20-34 × EC 993526)
20	JS 9560 × RSC 10-46	41	JS 20-34 × EC 993526
21	EC 457254 × RSC 10-46		

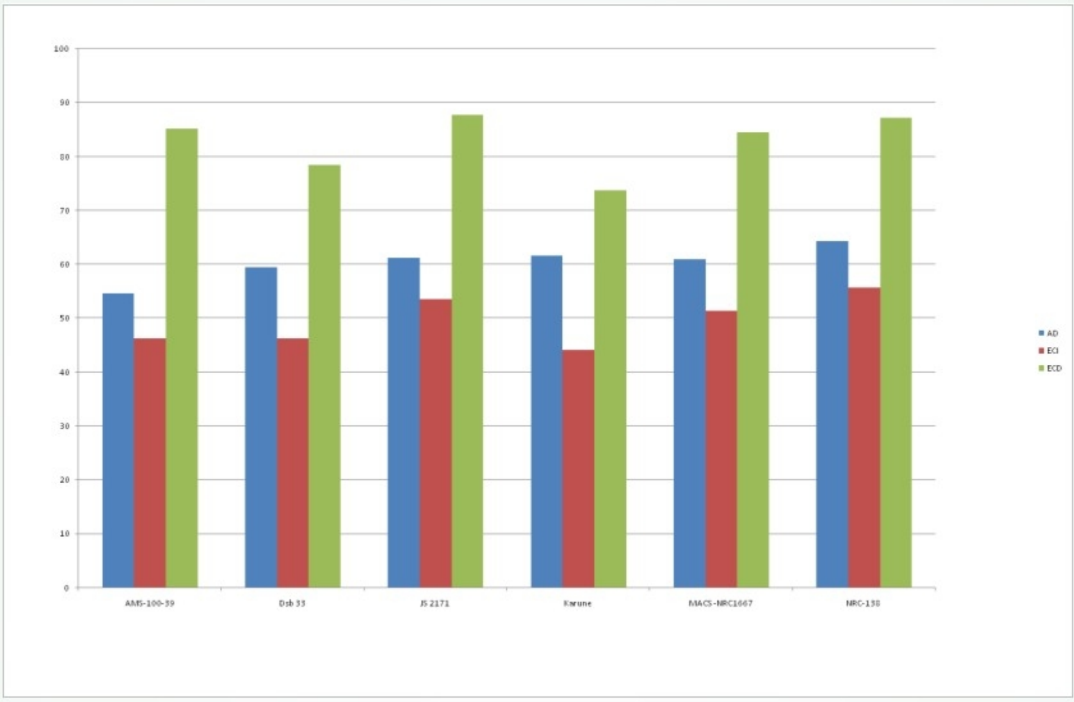
Generation advancement and selection : Crosses ie. JS 20-69 × AKSS 67, AGS 155 × AKSS 67, AKSS 67 × AGS 155, JS 9305 × AGS 155, AKSS 67 × JS 20-34, JS 335 × AKSS 67, JS 9305 × SL 1104, JS 335 × SL 1104, JS 9305 × AKSS 67, JS 20-34 × LINE 202, JS 335 × F4P21, JS 20-34 × G5P22, AKSS 67 × G5P22, EC 538828 × EC 915965 were advanced from F2 to F3 generation by SPD method.

Evaluation of soybean genotypes for stem fly and girdle beetle resistance

A set of 49 soybean germplasm lines were screened in field conditions for stem fly and girdle beetle resistance. In case of stem fly, during first year all genotypes are found to be highly susceptible whereas in second year evaluation genotypes viz., EC 389149, EC 241696 recorded less than 26% stem tunneling which can be considered as least susceptible. In case of girdle beetle, 25 genotypes were found to be moderately resistant and five genotypes were highly susceptible.

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

On the basis of antixenotic studies carried out on 6 soybean genotypes viz., NRC 149, NRC 152, Himso 1689, JS 21-72, VLS 99 and JS 335 against *Spodoptera litura*, NRC 149 was shown moderate antixenosis. Three genotypes viz., NRC 152, Himso 1689 and JS 21-72 were found slight antixenosis and rest found preferred host. On these genotypes, antibiosis studies were also carried out against *Spodoptera litura.* Among them two genotypes namely, NRC 152 and JS 21-72 were shown to good antibiosis. These will be used in insect resistant breeding programs to develop insect resistant varieties.



Weight of pupae, AD, ECI and ECD values of different varieties

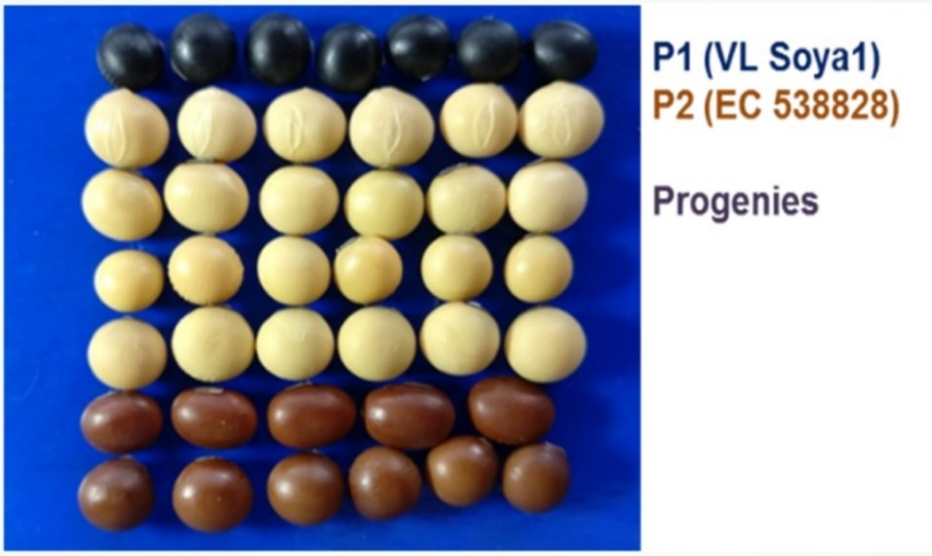
Evaluation of bio-efficacy of some newers insecticides against whitefly

Nine newers 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 Quinalphos 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.

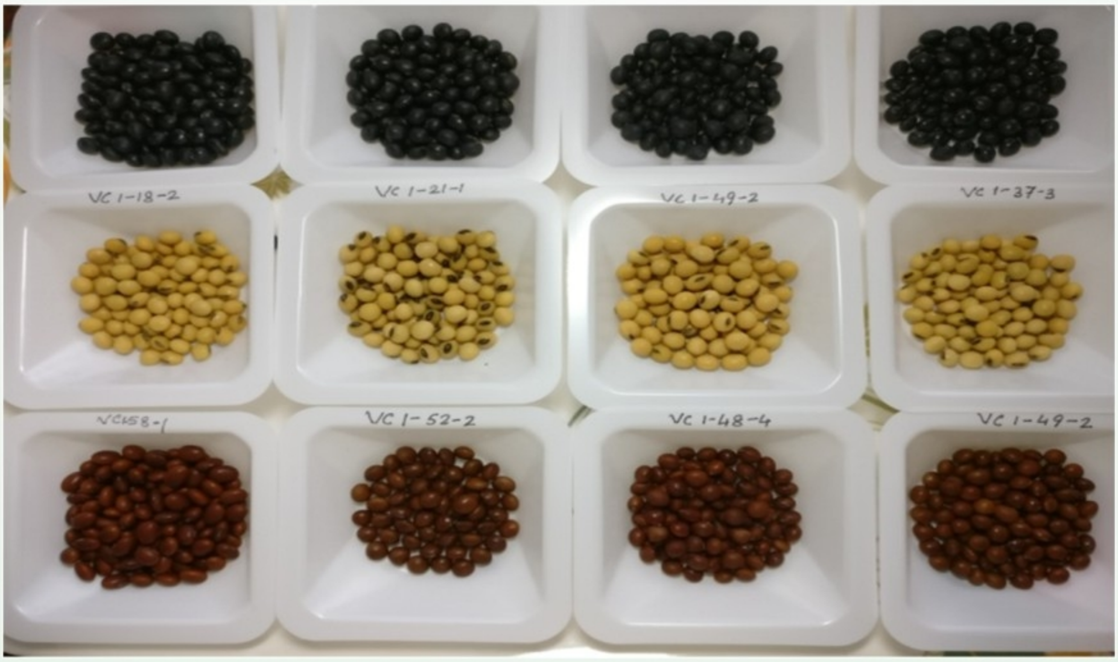
3.5 Seed Quality Characteristics

Improvement in soybean seed viability and strength of seed coat

Six hundred and sixty-one segregating RILs from the cross of vegetable variety Karune (poor seed germination) x EC 538828 (bold seed with rapid seed development) were advanced to F5 with single plant selections based on field emergence rate, rapid seed development, number of pod/plant, seed size, resistance to diseases and non-shattering traits. Twelve green seeded lines from RILs of Karune × EC 538828 had high field emergence rate of 75-80 percent during Kharif 2021. Generations derived from crosses i.e. Hardee × EC 538828, JS 2069 × EC 538828, Hardee × NRC 7, JS 20-116 × NRC 7 and Karune × VC 109 were advanced to F4. Promising RILs of VLS1 × EC538828 have high yielding traits (28-30 Q/ha), bold seed (14-17g), high seed coat lignin content, less seed coat cracking, disease resistance (pod blight, YMV, SMV), high germination rate after 8 months of storage in ambient conditions and better field emergence rate were identified and multiplied.



Resistant RILs (VLS 1×EC 538828) for seed cracking

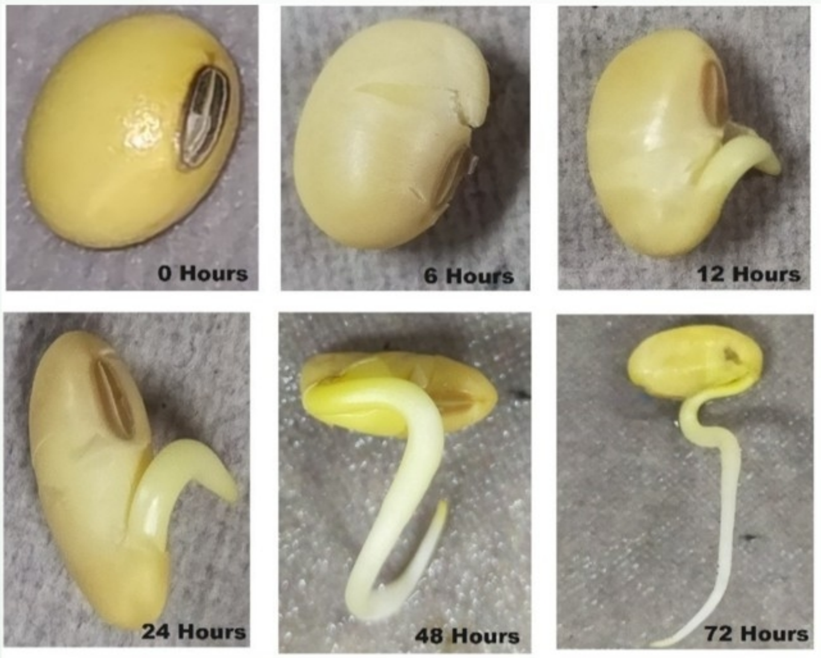


Prominent RIL's derived from cross VLS 1×EC 538828

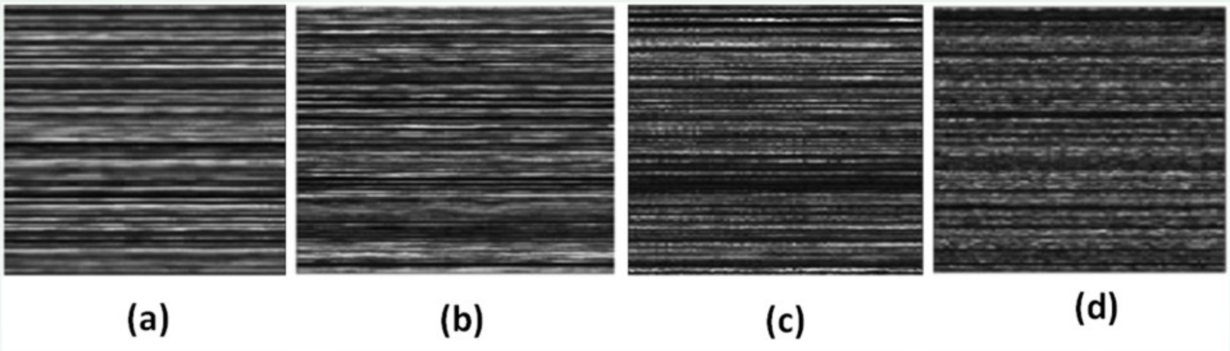
Prominent RIL's derived from cross Karune × EC 538828

Laser biospeckle technique for characterizing impact of temperature and initial moisture content on seed germination

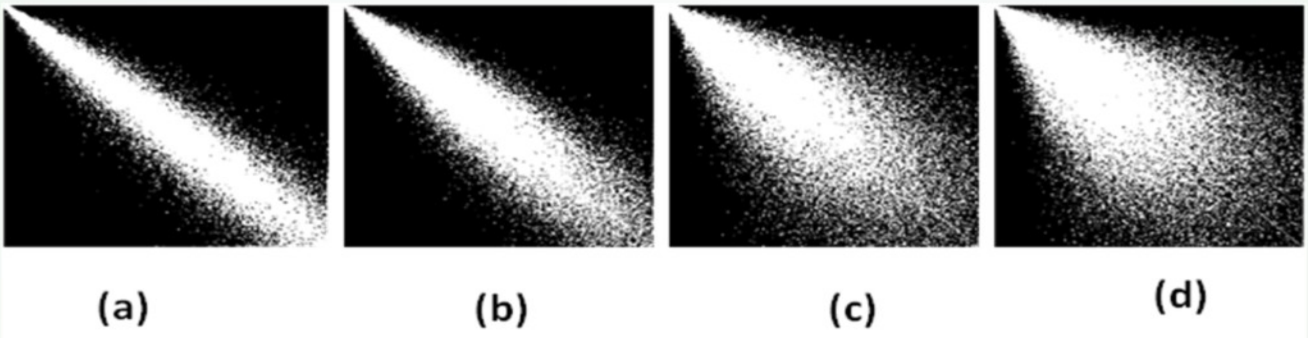
Capabilities of laser biospeckle technique have beenillustrated for analyzing the impact of temperature regimes and initial moisture content on germination characteristics of seed. Obtained results were benchmarked with standard germination test by calculating imbibition rate and germination percentage. Results indicated that the biospeckle activity is significantly ($p<0.05$) dependent on temperature and initial moisture content of the seed during germination. Obtained data also revealed that these two factors regulated the time required to complete the germination process. Additionally, the standard laboratory tests are in agreement with the results acquired by using biospeckle technique. A significant positive correlation ($p<0.01$) between biospeckle activity and standard germination tests prove applicability of biospeckle analysis as an efficient tool for evaluating the impact of temperature and initial moisture content on seed germination characteristics.



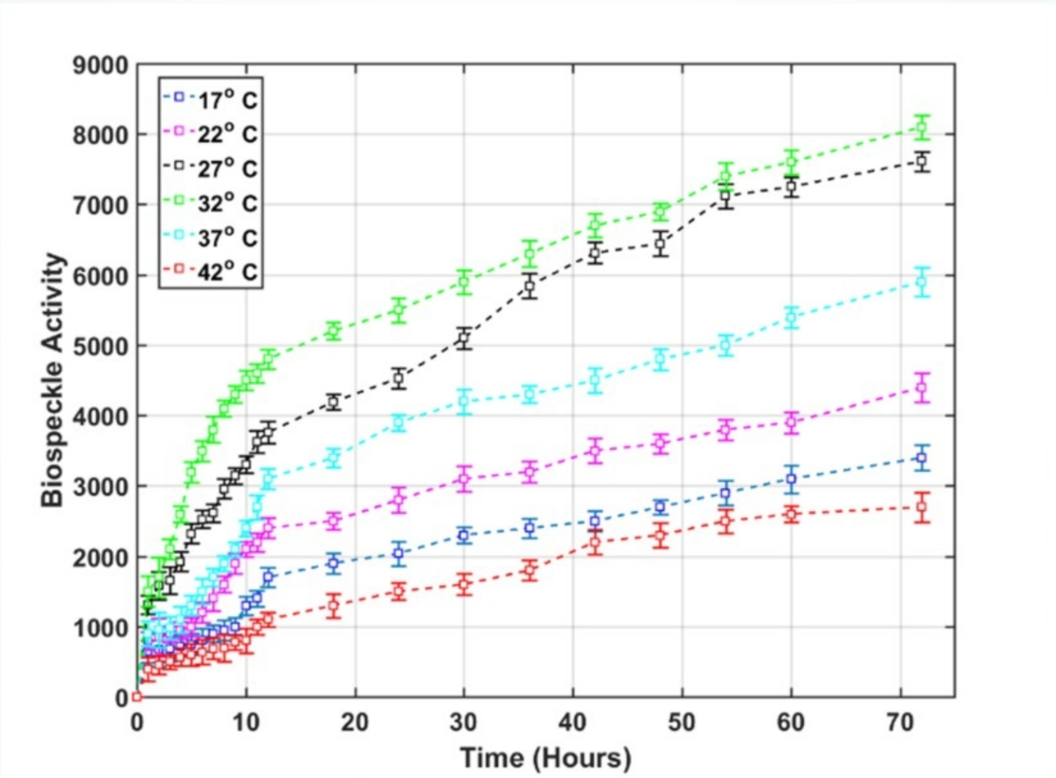
Images for soybean seed germinating at 27° C for different time durations.



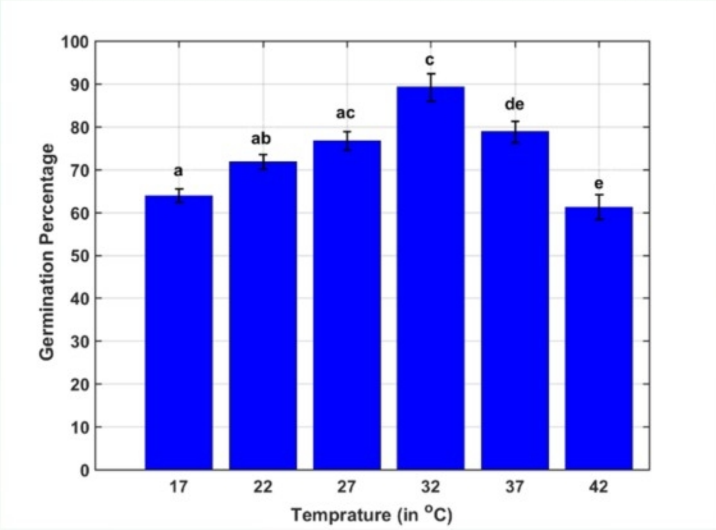
RTHSP for soybean seed germinating at 27° C for (a) t=6 hours, (b) t=12 hours (c) t=48 hours, (d) t=72 hours.



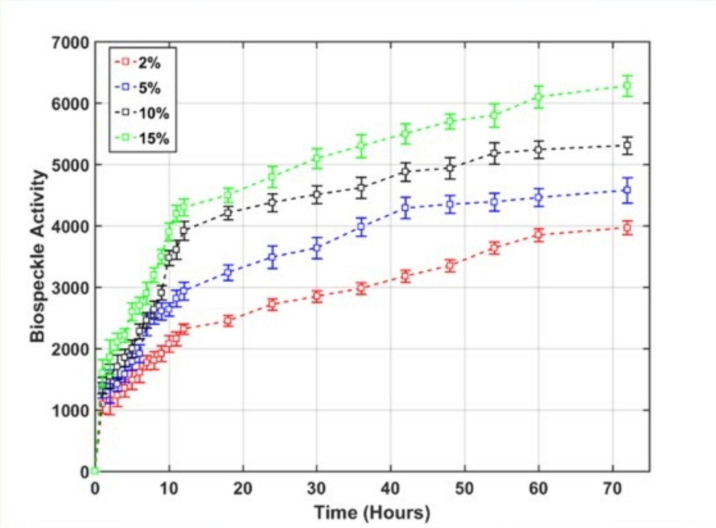
COM for soybean seed germinating at 27° C for (a) t=6 hours, (b) t=12 hours (c) t=48 hours, (d) t=72 hours.



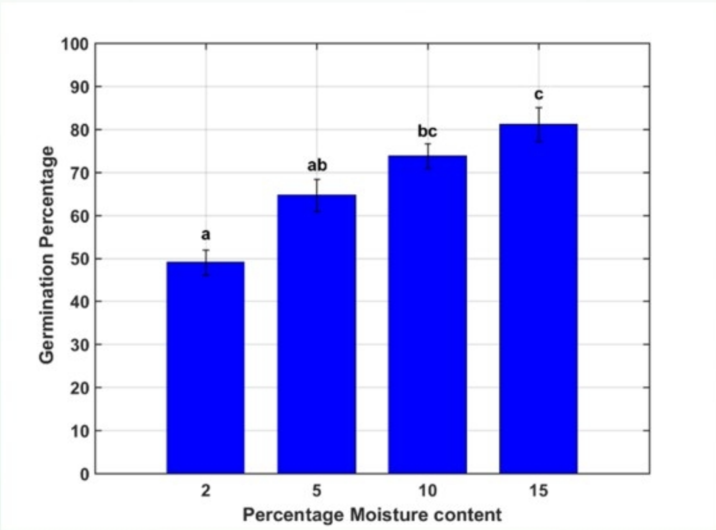
Biospeckle activity curve for soybean seeds germinating at different temperatures.



Seed germinating percentage at different temperature regimes



Biospeckle activity curve for soybean seed germinating at different moisture content



Biospeckle activity curve for the soybean seed germinating Percentage at different moisture contents

3.6 Crop Production Technologies

Evaluation of residue management practices

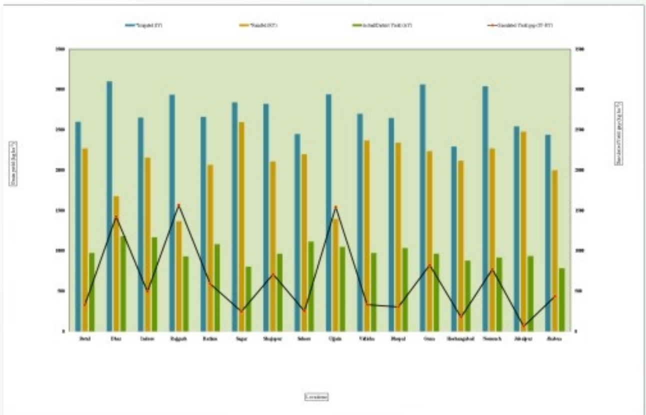
Field experiment was conducted during kharif, 2021 to evaluate the effect of three cropping systems (soybean-wheat, soybean-maize and soybean-chickpea), four crop establishment's method/land configuration [permanent broad bed furrow with residue (PBBF + R), permanent broad bed furrow without residue (PBBF + WR), conventional tillage as per farmers practices with residue (CTFP + R) and conventional tillage as per farmers practices without residues (CTFP + WR)] and residue management practices (50 % soybean residue retained during kharif season and 30 % of each of wheat and maize and 50 % of chickpea residue retained during rabi season), on soybean yield. Results revealed that, significantly high yield was registered under soybean-chickpea cropping system as compared to soybean-maize and soybean-wheat cropping systems. Among the different crop establishment techniques, significantly high yield was reported under PBBF + R followed by (fb) PBBF + WR. Yield was increased by 19.0% under PBBF + R and 12.6% under PBBF + WR as compared to CTFP +WR. The highest cost of cultivation was recorded under CTFP + R fb CTFP +WR and lowest under PBBF + WR. Among the cropping systems, maximum net return and B:C ratio was observed under soybean-chickpea fb soybean-wheat system. Similarly, among the different crop establishment techniques, highest B:C ratio was found under PBBF + R (2.68) fb PBBF + WR (2.53) and lowest under CTFP + WR (2.09).

Drip irrigation experiment vis-à-vis rainfed ecosystem

Six long duration soybean cultivars were evaluated under drip irrigated and rainfed ecosystem. Results showed that, all soybean cultivars responded well to drip irrigation whenever dry spell occurred. Among different soybean cultivars JS 20-69 reported significantly higher grain yield, biological yield and harvest index compared to other cultivars 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 and delayed rains under both the ecosystems. Significantly lower grain yield, biological yield and harvest index was reported in NRC 37 cultivars followed by NRC 86 and JS 20-29.

Strategies for enhancing yield of soybean (*Glycine max L.*) and Pigeonpea (*Cajanus cajan L.*) using climate variability and crop growth simulation models

Soybean cultivar JS 95-60 is widely grown in central India after JS 335 hence it was calibrated and validated to major Madhya Pradesh districts by using Decision Support System for Agro Technology Transfer (DSSAT) model. Grain yield under rainfed and irrigated condition for minimum of 30 years was simulated through DSSAT model. Obtained simulated yield under irrigated and rainfed condition compared with actual yield of each selected districts. Results shown that simulated yield has close agreement with actual yield under rainfed condition was compared to irrigated condition. Further, average simulated yield gap was found 630 kg ha-1 across selected 16 districts of MP.



Comparision of simulated yield of JS 95-60 with actual yield and simulated yield gap

Role of phytohormones in promoting AM symbiosis

Research on mass production of AM fungi using phytohormones was attempted in soil-substrate pots using maize as host plant. Five phytohormones (indole acetic acid (IAA-50ppm), cytokinin (CK-20ppm), salicylic acid (SA-100ppm), abscisic acid (ABA-5ppm), brassinosteroids (BR-0.5ppm) when applied through seed treatment or foliar application to AM inoculated plants were found to significantly enhance the AM fungi biomass in terms of glomalin (AMF-associated soil protein, GRSP) and root colonization (MCP) when compared to control plants. Irrespective of type of phytohormone used in the study, the mode of application was found to have better influence on biomass parameters. All the phytohormones except CK and ABA applied through seed treatment were found more effective in producing higher biomass than the foliar application. CK and ABA were reported more effective when applied through foliar application. Based on 3-factor analysis, irrespective of dose and inoculation, all hormones except ABA responded significantly well towards AMF biomass when compared to control.The study concluded that, application of IAA, BR (seed priming) and CK (foliar spray) was found to be most effective in producing higher AM fungal (GRSP, MCP) and root biomass therefore, suggested for further evaluation under sterilized and unsterilized conditions.

Root biomass enhanced in phytohormone mediated mycorrhizal plants under microcosms

3.7 Computer Application in Soybean

Predicting incidence of stem fly, pod borer and bihar hairy caterpillar

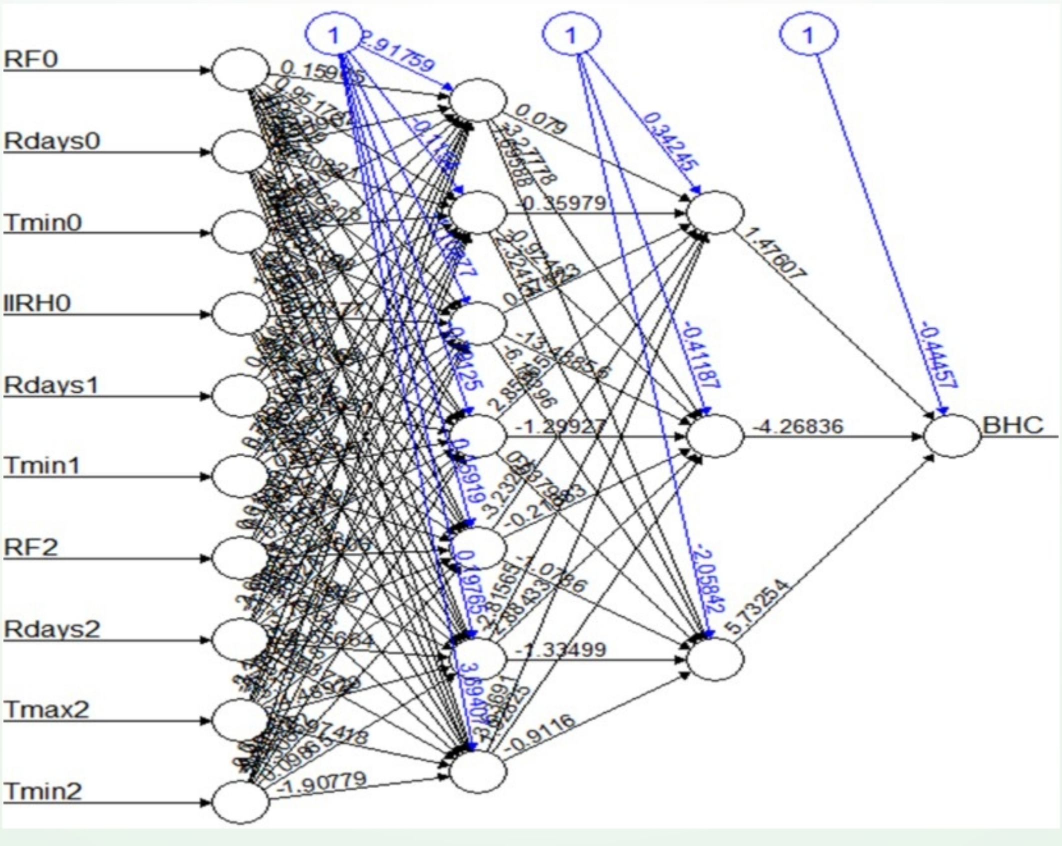
Correlation of insect incidence revealed that Bihar hairy caterpillar (BHC) and pink pod borer (PPB) had a positive significant correlation with all-weather variables. Further, stem fly has significant positive correlation with maximum temperature for all three weeks. Minimum temperature of 1st and 2nd lag weeks and remaining all variables has significant negative correlation.

Multiple linear regression of insect incidence

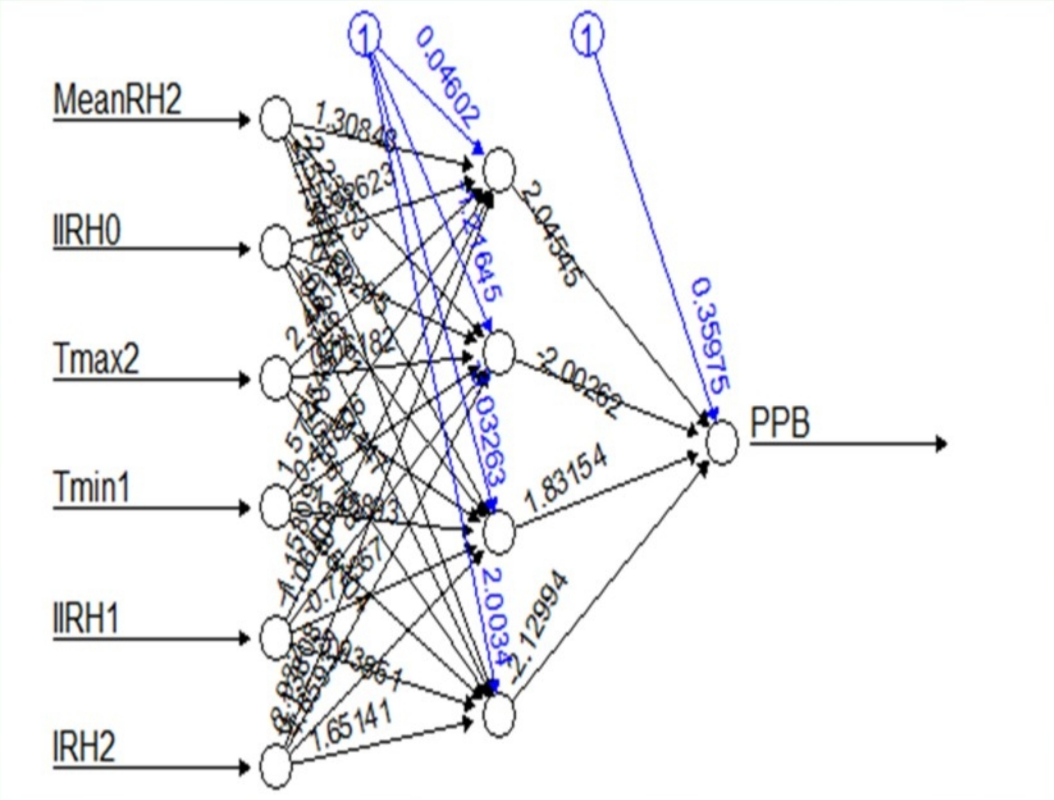
The step-wise multiple regression analysis was carried out with model in JMP softwareby, selecting the significant variables, which are affecting insect incidence. All the variables selected were significant at 5% level of significance. The models of BHC and stem fly have explained very low and pink pod borer explained high variability with R^2 value of 26.3%, 37.4% and 93.1% respectively.

Artificial neural networks (ANN)

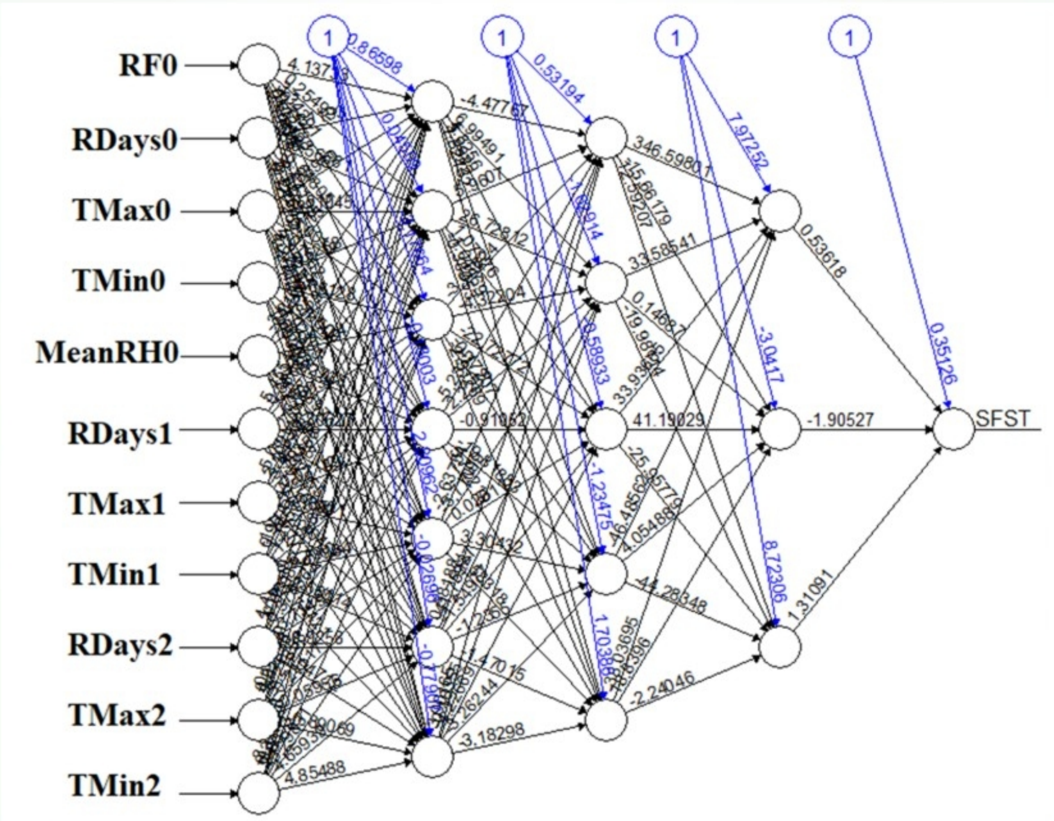
Machine learning method ANN has used to model insect incidence. ANN was used to get better precision than regression methodology. The coefficient of determination (R^2) for BHC, PPB, stem fly are 98.09%, 94.78% and 95.5% respectively, which is much higher than regression models.



ANN for BHC



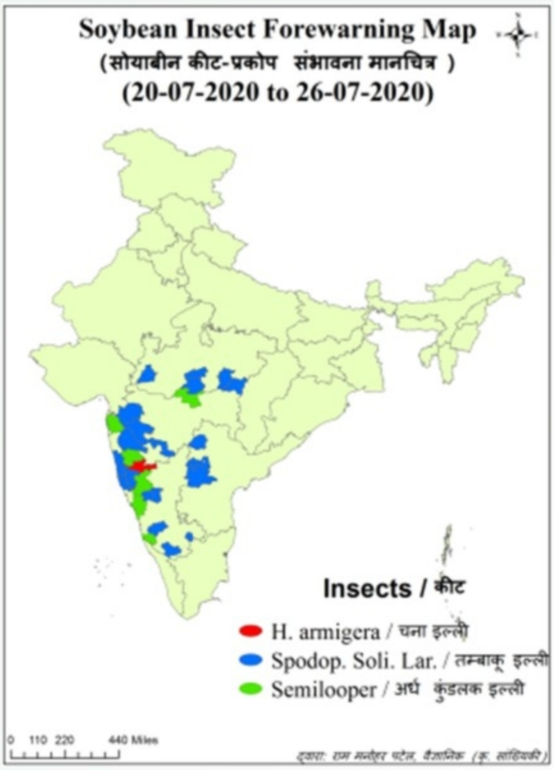
ANN for PPB

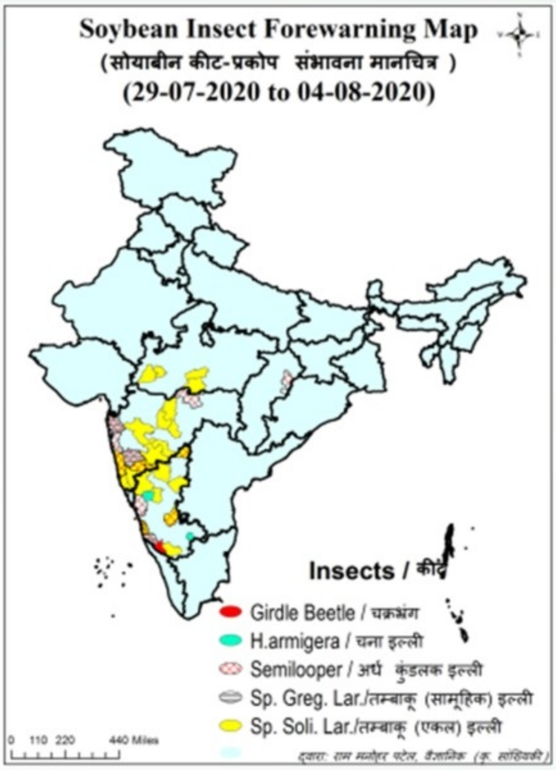


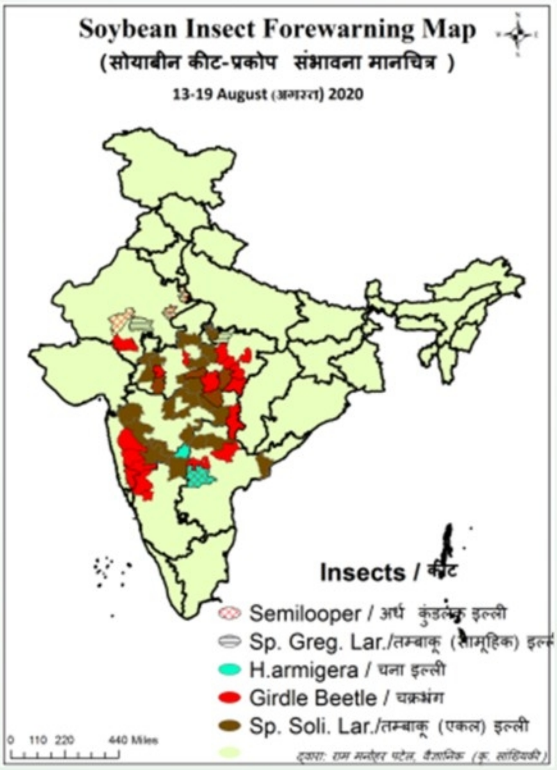
ANN for Stem Fly

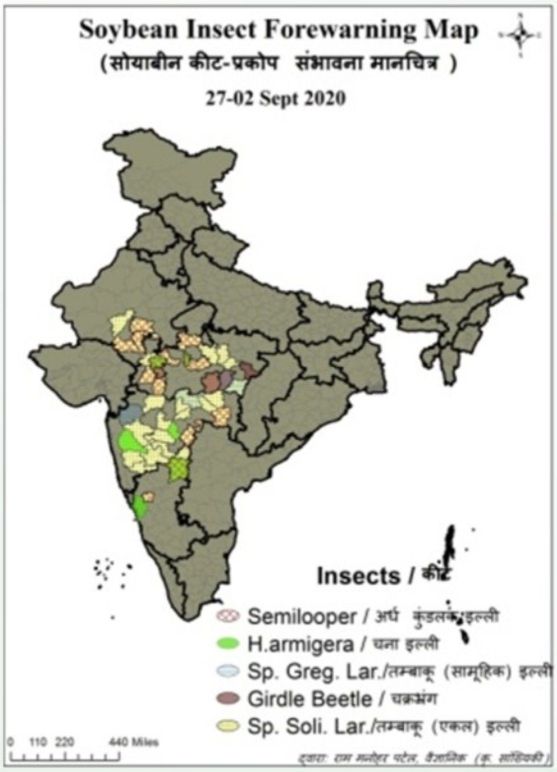
Spatial decision support system

Spatial Decision Support System (SDSS) software was developed using MS-Access database, excel and Arc-GIS software to prepare district-wise Insect Incidence Hot-Spot Maps of 4 insects to forewarn soybean farmers through soybean advisories using forecasted weather parameters from IMD



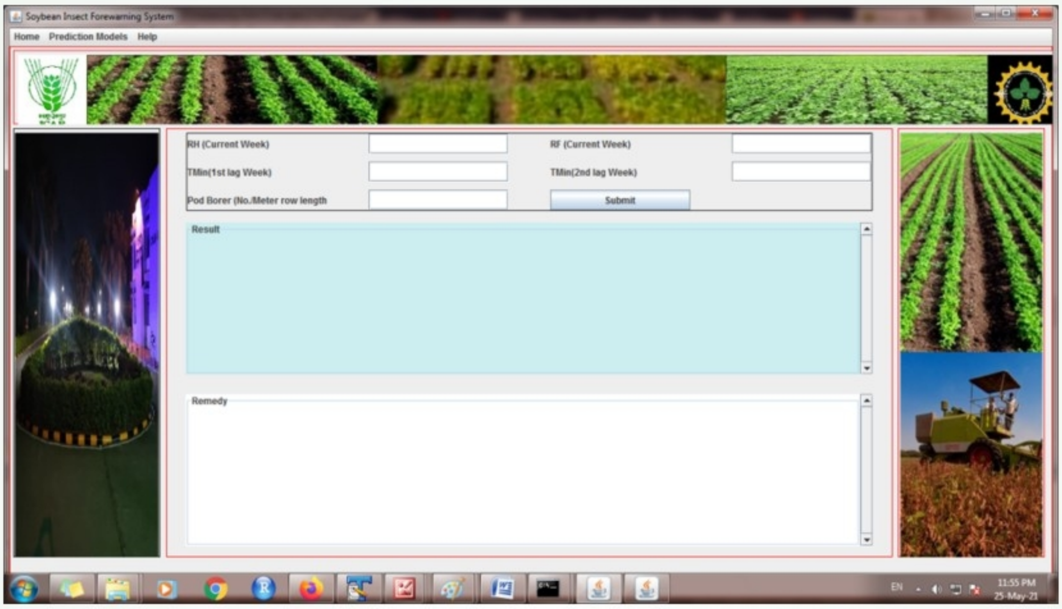






Forewarning Software

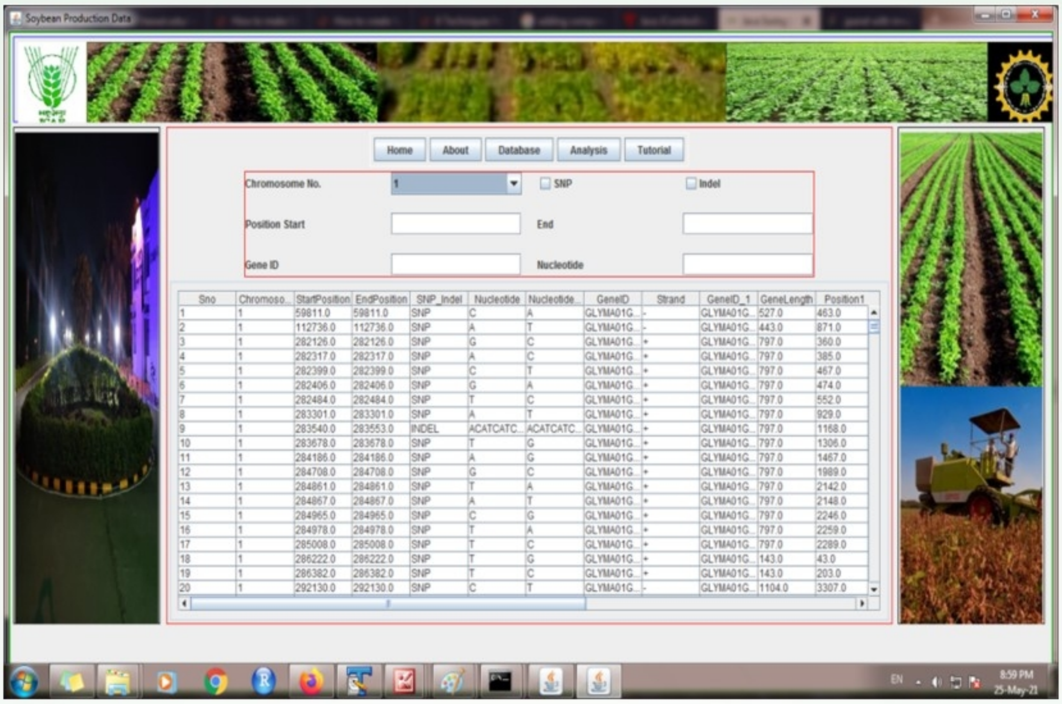
Developed a Decission Support System (DSS), to forewarn the soybean growers for pod borer incidence. DSS was developed by using the MVC framework in which Java Swing as View, Java as Controller and Excel database as Model architecture. The DSS takes the input of significantly affecting the meteorological and other parameters to work out the low or high incidence of pod borer and farmers will get precautionary and curative measure.



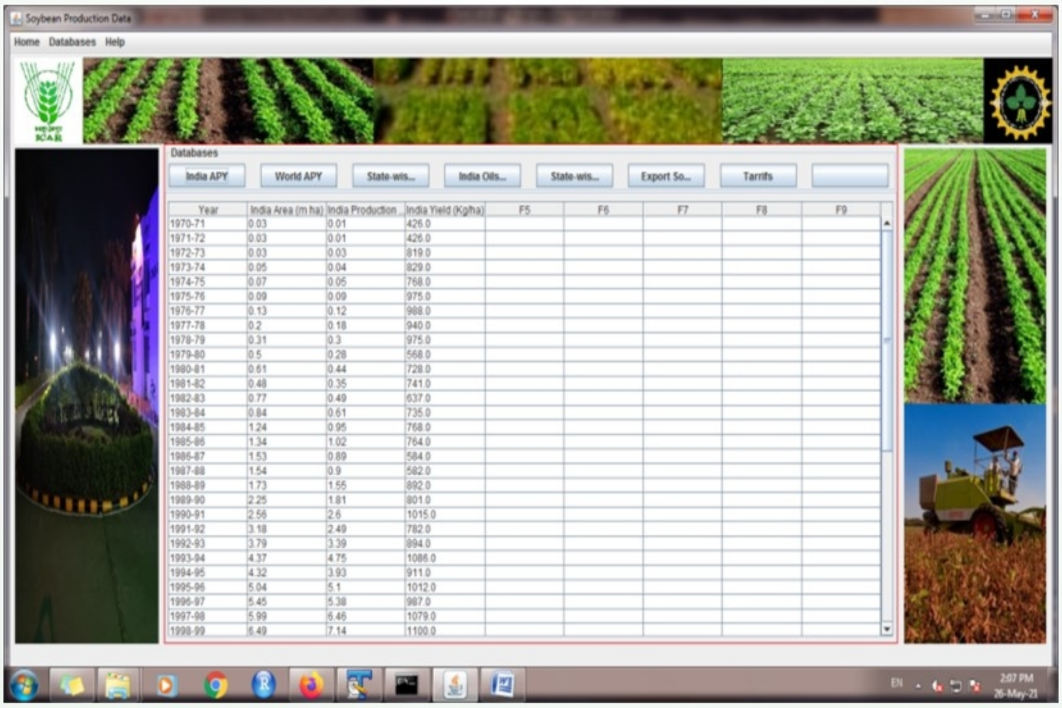
Screenshot of insect forwarning system

Databases

1) *Whole genome sequence database :* Whole genome sequencing in soybean is advancing at a fast pace and the data from over large number of soybean accessions are currently available. *In Silico* studies it will be for identification and characterization of Microsatellites, Single nucleotide polymorphisms and insertion and deletions in soybean genome. Soybean SNP data were collected from publicly available sources such as NCBI and SoyKB.Whole genome sequence database prototype of microsatellites and SNP markers has been designed and developed for soybean variety JS 335 and EC 241780. Design and development of front-end data retrieval system was done by using Java Swing, Java for back-end for processing as a controller and database linking through Java and JDBC technology.



2) *Production databases :* Developed three databases such as Area (A), Production (P) and Yield (Y) of India, World, and state-wise for soybean crop. Java Swing Java and Excel technologies were used. The Excel based files can be accessed by Java based database system through menus



Screenshot of production database

Development of GIGW compliant institute website

GIGW compliant new website was developed. The institute website is hosted on IASRI data center with domain name www.iisrindore.icar.gov.in. The website is developed in English and Hindi languages to meet the requirement of Rajbhasha Rule 3(3). Further, it is uploaded regularly eith latest information in both the languages

Screenshot of new website of ICAR-IISR

Development of preliminary prototype of soybean product sale portal

Initial prototype of Soybean Product Sale portal with E-payment gateway has also been developed. The user required to register in the portal and can access the system through customer login. The users can order soybean seed and different soybean food products such as tofu, cookies, sev, nachos etc using this application. Items can beselected, added into the cart and confirm the booking. The booking will be sent to the nodal officer who may accept the booking after which the user can proceed to payment using E-payment gateway provided in the system. After successful payment online receipt will be generated for users so that the products can be collected by production of this receipt.

Home page of the soybean product sale portal

3.8 Soybean Value Added Products

Soybean processing and value addition

Soybean also known as wonder bean is rich in good quality protein, fibers, minerals, vitamins and phytochemicals. With the objective of improving daily intake of essential nutrients, value addition of traditional food products was achieved. Soy enriched products viz. Baked soy nuts, eggless soy cookies, soy laddoo, soy chakli, soy namakpare, soy upma mix were optimized on basis of sensory evaluation and analysed for shelf-life and proximate composition.

Baked soy nuts : baked soy nuts were prepared with objective of reducing fat content in soy nuts as compared to fried counterparts. Fried nuts, traditional oven and microwave oven method based soy nuts were compared on basis of sensory evaluation. Microwave treatment was optimized as method for roasting due to lesser roasting time and crispy texture. Roasted soy nut had 1.5 times more protein than fried soy nuts used as control. The fat content was 3.7 times less in the roasted soy nuts than control. The final accepted soy nuts were packed in LDPE /polyethylene bags and the sample was sealed using heat sealing machine and could be kept in the ambient temperatures for up to three months of storage period.

Soy upma mix : soy upma mix contained tofu and soymilk industry by-product i.e. okara. The addition of okara up to 50% did not significantly affect overall acceptability of soy upma mix. Upma mix could be sold as ready to cook product due to high hydration rate. Protein content and fat content in soy okara upma mix were comparable to non-fortified sample. The final acceptable soy upma mix were packed in aluminum laminates and could be kept for three months of storage period.

Soy upma

Soy nuts

Soy cookies : Addition of roasted soy flour improved taste of cookies but texture score of samples reveal negative impact of soy flour on lightness of cookies. However, the cookies had acceptable overall qualities for up to 40% replacement of wheat flour with roasted soy flour. Protein content in baked soy cookies was 2.1 times higher as compared to control made with 100% wheat flour. Fat requirement to bake soy cookies was less than control. The final acceptable soy cookies were wrapped with cling wrap and packed in rectangular Poly propylene packaging material which could be kept in the ambient temperatures for upto three months of storage period.

Soy Cookies

Soy Laddoos

Soy Chakli

Soy Namakpare

Soy laddoo : Addition of soy flour improved taste and overall acceptability of soy laddoo. Soy flour in optimized soy enriched laddoo, was in the ratio of 1:1 (whole wheat flour: soy flour). Protein content in soy fortified laddoos (50% wheat flour replacement with soy flour) showed 4.3 fold increase in protein content as compared to control made with 100% wheat flour. As soy flour contains more fat than wheat flour, the fat content of soy laddoo sample was slightly higher than control. The optimized soy laddoos were packed in Poly Propylene rectangular packaging material and kept in the ambient temperatures for up to one month of storage period.

Soy chakli : Soy chakli with 20% replacement of rice flour with soy flour was taken as optimized soy flour concentration. Texture of baked chakli got lesser sensory score as compared to fried counterparts. Protein content in baked soy chakli showed 1.4 fold increase in protein content as compared to control made with 10% rice flour replacement with gram flour. As the soy fortified product was baked and control was fried, there was 1.6 times decrease in fat content of baked soy chakli as compared to fried control sample.

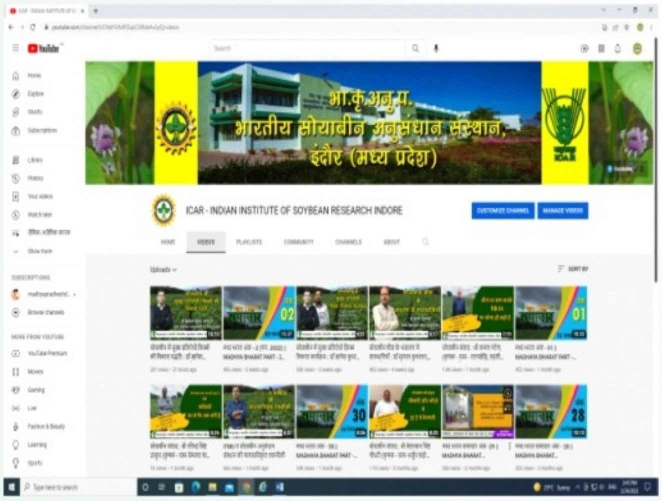
Soy namakpare : As per sensory analysis, the addition of roasted soy flour in higher percentage did not affect overall acceptability of soy namakpare significantly. Optimized soy namakpare contained 30% replacement of wheat flour with roasted soy flour. Protein content in baked soy fortified namakpare showed 7 fold increase as compared to non-fortified control with 100% wheat flour. There was 3 times decrease in fat content of baked soy namakpare as compared to fried counterpart.

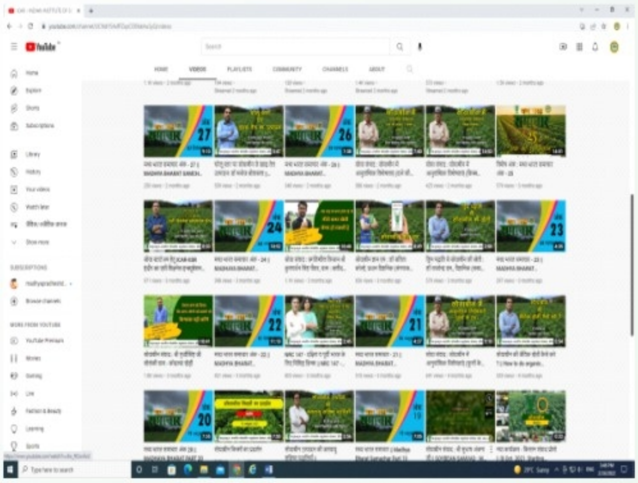
All optimized soy enriched products were made by 100% natural ingredients with addition of any preservative and results reveled significant increase in nutritive value of products with compromising sensory score significantly.

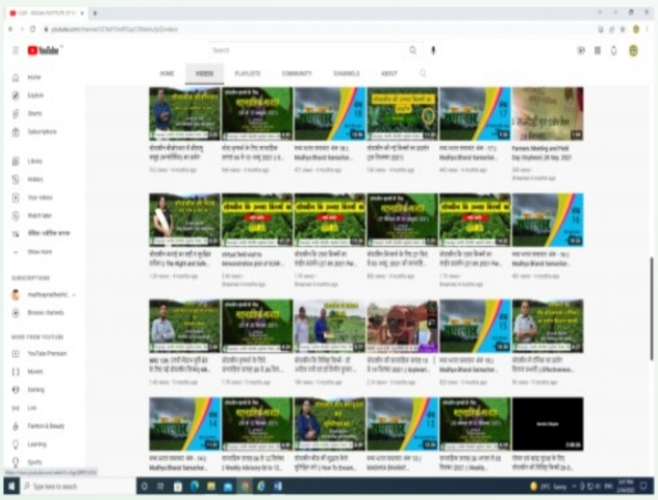
Transfer of Technology

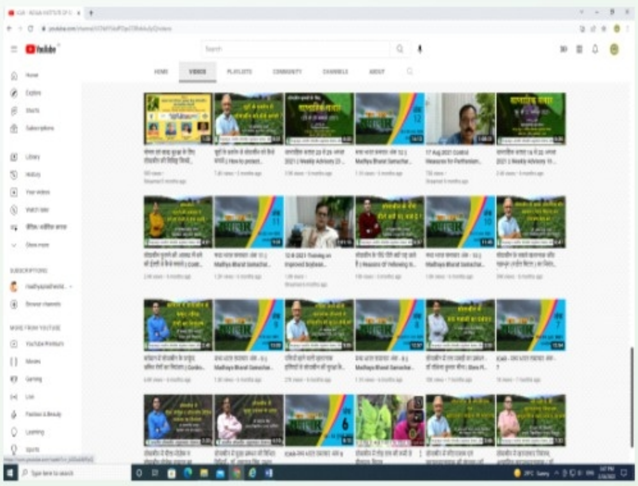
Development and evaluation of ICT tools and media for transfer of technology

The institute has created three social media viz., YouTube Channel, Facebook Page and WhatsApp group as a means of dissemination of information and technologies among the stakeholders. A new group was created during the period under report on Telegram App looking into the high demand for membership. The institute Facebook page has also been used for dissemination of information related to institute activities. Facebook page had 1950 likes and 2245 followers in the period under report. Whereas, the WhatsApp group had 168 progressive members and extension professionals who further disseminate the information including weekly advisories to their respective WhatsApp groups. Institute also launched "ICAR-Madhya Bharat Samachar", an agricultural news based programme. During the current period, the institute YouTube Channel had 2,95,970 views and more than 9252 subscribers. This year, institute has created and uploaded about 86 new short videos on different aspects viz., Madhya Bharat Samachar (31), package of practices (14), plant protection (09), improved varieties (08), weekly advisory (08), soya sanwad (07), Virtual visit to institute's demonstration plot (05), technology commercialization (03) and technology transfer (01).









Trainings organized

The institute had organized several training programmes for the benefit of farmers and extension workers and agricultural officers. Details of these training programmes are given below:

Date	Training Name	Organizers/ Collaborators	No. of participants benefitted
June 16, 2021	Improved Soybean Production Technology and New Innovative Practices of soybean Production	ICAR-IISR and ITC Ltd .	550
June 19, 2021	Improved Soybean Production Technologies	ICAR-IISR and ITC Ltd.	7500
17th June 2021	Climate Smart Soybean Production Technologies for Increasing Soybean Productivity	ICAR-IISR and Solidaridad, Bhopal	250
August 12, 2021	Online Farmers Training Programme on Improved Soybean Production Technology for Gujarat State	ICAR-IISR and Tribal Research and Training Centre, DeogadhBaria (Gujarat)	77
May 18, 2021	Climate Resilient Technologies and Practices for Increasing the Soybean Productivity	ICAR-IISR and National Institute of Agricultural Extension Management, Hyderabad	160
May 31, 2021	Improved Soybean Production Technologies and Management of Biotic Stresses	ICAR-IISRand Deptt. of Agri., Yavatmal	290
June 04, 2021	Improved Soybean Production Technologies and Management of Biotic Stresses	ICAR-IISRand Deptt. of Agril., Indore	220
August 02, 2021	Improved Soybean Production Technologies , at Khandwa	ICAR-IISR and DBT, Govt. of India	45
August 03, 2021	Improved Soybean Production Technologies , at Khandwa	ICAR-IISR and DBT, Govt. of India	40
August 04, 2021	Improved Soybean Production Technologies , at Barwani	ICAR-IISR and DBT, Govt. of India	38
August 05, 2021	Improved Soybean Production Technologies , at Barwani	ICAR-IISR and DBT, Govt. of India	40
January 20, 2021	Improved Soybean Production Technologies , at Barwani	ICAR-IISR and Govt. of India	100
January 22, 2021	Improved Soybean Production Technologies , at Khandwa	ICAR-IISR and Govt. of India	61
October 21, 2021	Improved Soybean Production Technologies , at Barwani	ICAR-IISR and Govt. of India	35
October 2 2, 2021	Improved Soybean Production Technologies , at Khndwa	ICAR-IISR and Govt. of India	40

Training to input dealers under DAESI programme :

Institute also organized several training programmes for agricultural input dealers under DAESI programme details of which are given below.

The main attraction of the live programme was direct interaction of farmers with breeders and scientists who have developed these varieties and technologies. This innovative and novel initiative was attended by about 750 farmers belonging to soybean growing states of the country. The whole programme was coordinated by Dr B.U. Dupare and Dr Savita Kolhe.

S. No.	Title	Collaborating agency	Date	No. of participants
1	Management of Biotic Stresses	Deptt of Agri. Indore	28.08.21	40
2	Management of Biotic Stresses	Deptt. Of Agril. Ratlam	18.09.21	40
3	Management of Biotic Stresses	KVK, Shajapur	17.11.21	40

Field days organized

Live-virtual field day

ICAR-IISR organized “Live virtual field day” of the demonstration plot and shown improved soybean varieties and production technologies. The program was live on 'YouTube channel' and 'Facebook page' for the first time on 27th September, 2021 under the celebrations of "Azadi ka Amrit Mahotsav". Dr Nita Khandekar, Acting Director of the institute, addressed the farmers and informed about the latest soybean varieties and other technologies & practices developed by the institute. She also briefed about the ICAR-IISR is formulating new strategies and mechanisms for the spread of the new varieties' seed released by the institute among the farmers of Madhya Pradesh.

At Institute demonstration plot, nine latest soybean varieties developed under the AICRPS, recommended for different regions/states of the country were demonstrated in the institute's farm for the benefit of farming community. In addition, other agronomic practices especially useful in case of adverse weather conditions like drought and excessive rainfall viz; cultivation using Broad Bed Furrow/Ridge & Furrow method were demonstrated which are visited physically every year by the farmers of major soybean growing states of the country. As the farmers are not able to visit in large numbers under the COVID restrictions, this innovative method have been used to reach the soybean stakeholders.

Field days

Field Day and a Farmer's seminar was organized on 28th September 2021 at village Nipania, Tehsil Ichhawar, district Sehore. Acting Director, Dr Nita Khandekar, and the team of scientists from the institute including Dr Dupare, Dr Punam Kuchlan, Dr Neha Pandey and along with the team of scientists from Krishi Vigyan Kendra, Sehore and Mr. Bhunesh (I.T.C. Ltd.) have participated in the program. The program was organized under the DBT schemes and SCSP wherein about 200 farmers participated. Dr Nita Khandekar addressing the audience explained how more production can be achieved in less cost. Field visit was also organized at the fields of scheduled caste farmers. Two field days were organized under SCSP plan at kilogi and Bafapur villages, on soybean crop. About two hunded farmers had participated in these field days. In these field days, progressive farmers adopting the institute's technologies narrated their success in soybean production and their experiences about the technologies developed from this institute.

Online talks/Webinars organized

Institute had organized 10 online talks which were delivered by subject experts. These online talks helped immensely to increase knowledge and skills of farmers and other stakholders during COVID19 lockdown period. Details of these online talks are given below:

Date	Title	Speaker	Number of attendees	Co-ordinator
11th May 2021	Soybean Breeder Seed Production and Infrastructure requirements and Selection of soybean varieties and methods of sowing	Dr M.Kuchlan IICAR-IISR, Indore)	136	Dr Laxman Singh Rajput
13th May 2021	Organic Farming	Dr A.B. Singh (ICAR- Indian Institute of Soil Science, Bhopal)	205	Dr R.K. Verma and Dr L.K. Meena
17th May 2021	Balance and integrated nutrient management for sustainable crop production and soil health	Dr R. H. Wanjari (ICAR- Indian Institute of Soil Science, Bhopal)	115	Dr R.K. Verma
24th May 2021	Integrated farming system in dry land agriculture	Dr S. K. Choudhary (College of agriculture, Indore)	76	Dr S.D. Billore
27th May 2021	Increasing soybean production through precision agriculture	Dr M. Karthikeyan (CSIR-National Chemical Laboratory, Pune)	59	Dr Milind Ratnaparkhe
4th June 2021	Specialty Soybean Varieties: Addressing the needs of Farmers, Industry and Consumers	Dr Vineet Kumar (ICAR-IISR, Indore)	92	Dr B.U. Dupare and Dr Savita Kolhe
	Soybean varieties and Seed Availability	Dr M.Kuchlan (ICAR-IISR, Indore)	220	Dr B.U Dupare and Dr Savita Kohle
7th June 2021	Soybean Disease Management in Changing Climate Scenario	Dr L.S Rajput (ICAR-IISR, Indore)	82	Dr M.Kuchlan
14th June 2021	Integrated Pest Management in soybean	Dr A.N Sharma	110	Dr Subhash Chandra
17th August 2021	Eradication of Parthenium Grass	Dr Sushil Kumar (ICAR-Directorate of Weed Research, Jabalpur)	75	Dr Maharaj Singh

Farm school on air

Five radio talks (farm school on air) were aired in which subject experts given information on soybean and other crops production technologies and solution to various problems.

Frontline demonstrations

Front line demonstrations (FLDs) were organized and various farm inputs were distributed under DBT Biotech KISAN Hub, Scheduled Caste Sub Plan (SCSP) and Tribal Sub Plan (TSP) projects.

FLDs conducted under expansion of activities of DBT Biotech KISAN Hub in seven aspirasional district in MP:

S.N.	District	No of demonstration	Crop
1	Khandwa	13	Cotton
2	Badwani	13	Sorghum

FLDs conducted under Scheduled Caste Sub Plan:

S.N.	District	No of demonstration	Crop
1	Ujjain	1000	Soybean
		150	Wheat
		100	Moong
2	Sihore	100	Soybean
		100	Wheat
		100	Moong
3	Khandwa	100	Soybean
		50	Safflower
		120	Moong

FLDs conducted under Tribal Sub Plan:

S.N.	District	No of demonstration	Crop
1	Barwani	280	Maize
		200	Vegetable
		200	Moong
		50	Safflower

Glimpses of trainings and input distribution under SCSP and TSP plans

Interaction with Farmers on field days

Events and Meetings

5.1 Annual Group Meeting of All India Coordinated Research Project on Soybean

The 51st Annual Group Meeting of All India Coordinated Research Project on Soybean was held on March 12-13, 2021 through online mode.Dr Nita Khandekar, Acting Director, ICAR-IISR, Indore welcomed the dignitaries and briefly highlighted the research achievements of soybean accomplished during 2020-21.Chairman of the session was Dr T.R. Sharma, DDG (Crop Science) ICAR, New Delhi.In the inaugural address, Dr Sharma, DDG (Crop Science) emphasized for promoting diversity of soybean varieties as well as climate-resilient, high-yielding soybean varieties among the farmers of different soybean-growing states. He also emphasized the use of molecular tools like Pre-breeding, Marker Assisted Selection, Genome-Wide Association Studies for fastening the process of varietal development in the shortest possible time. He congratulated the AICRP for developing 33 high yielding and disease resistant varieties during last 10 years. He emphasized that since soybean crop has high protein and other desirable components, it should be exploited as food crop. He suggested that experiments for use of soybean for protein isolate manufacturing may be taken up by utilizing the technology developed by ICAR-CIPHET, Ludhiana. Increasing production and productivity of the major oil seed crop is extremely important since it will help in reducing import of edible oil to a greater extent. He also emphasized that there is need to develop short duration varieties, herbicide tolerant soybean varieties and directed pre-breeding for specific traits. He further suggested that since soybean genome has been sequenced, focus may be given on integration of biotechnological tools like MAS, GWAS and Comparative genome analysis for genetic improvement. He further urged for strong human resource development programme (HRD) for AICRP scientists and to set mile stone driven research based on objectives identified for the centres and involving incentives and more resources to better performing centres.

On this occasion, Dr Sanjeev Gupta, ADG (O&P), highlighted the current status of the soybean seed replacement rate which is relatively low as compared to other crops, and the need for the popularization of location-specific new varieties. He, congratulated the AICRP group on developing new soybean varieties with high yield, earliness and food usages. He expressed his concern related to poor varietal diversity and replacement rate and informed that out of 48 soybean varieties only 4 varieties make up the 60% of total breeder seed indent and if two more varieties are added the indent comes to 80%. He was seriously concerned about soybean new emerging biotic and abiotic stresses and development of varieties to overcome new challgenges. Further, emphasized for increasing the varietal diversity. He suggested for innovative steps like breeding hubs in the zones where varietal development is poor, shuttle breeding, sharing of segregating material among centres, utilization of off-season nurseries. For large yield gaps resulting due to rainfed kharif nature of the crop, and suggested to develop good agronomy as contribution from varietal improvement is 40% but 60% is from management. He suggested for land engineering, residue management, conservation agriculture. He expressed his concern on non-sustainability of of soybean pigeonpea intercropping and suggested for taking up experiment for finding out the reasons and specially for deficiency of micro nutrients like boron.

During the technical session on the breeding for the development of varieties with specific traits and high yield, the Chairman of the session, Dr S.P.Tiwari (Former Vice-Chancellor, University of Agriculture, Bikaner and former Deputy Director-General, Education and Crop Sciences, Indian Council of Agricultural Research, New Delhi), expressed satisfaction over the work carried out by the ICAR-IISR regarding the development of food-grade specialty soybean varieties, conservation and evaluation of germplasm as well as the National Hybridization Program on Soybean, which may bear fruits in the coming years.

Co-chair Dr R. R. Hanchinal (Former Chairman, Protection of Plant Varieties and Farmers Right Act) stated that to break the yield ceiling in soybean, the research work using Induced Mutation Breeding in collaboration with Bhabha Atomic Research Center may be taken up.

The committee constituted for the screening of proposals for identification of new soybean varieties approved a total of 7 new soybean varieties suitable for different regions of the country, out of which 4 varieties were recommended for the central zone i.e. RVSM 2011-35, NRC 142, NRC 138; AMS 100-39. Similarly, for the Southern Zone, bold seeded soybean variety KDS-992, MACSNRC-1667, and Karune as the First Indian Vegetable type soybean variety for green pod consumption, were reccommended.

5.2 Webinars organized

International webinar on "Genetic management of Asian soybean rust"

The institute organized an International Webinar on theme "Genetic management of Asian soybean rust: current status and future perspectives" on 18th June, 2021,in which a talk on topic "Studies on Asian Soybean rust at JIRCAS" was delivered by Dr Naoki Yamanaka, Senior Researcher from Japan International Research Centre for Agriculture Sciences (JIRCAS) Japan. Dr. Yamanaka said that genetic management of soybean rust is most economical and ecological way. Dr Yamanaka presented his work on genetic studies on soybean rust including mapping and characterization of rust resistant genes and development of gene pyramided rust resistance lines. Asian soybean rust is an important disease of soybean causing significant yield losses in the states of Karnataka, Maharashtra, parts of Madhya Pradesh and North-east region. Increased monoculture practices and the emergence of new rust races may wreak havoc any time, which necessitates proactive measures to create durable resistance. Dr Nita Khandekar, Director, ICAR-IISR, Indore, said that to improve soybean rust resistance in Indian soybean varieties, scientists in India will make efforts to use the resistant genetic material developed by JIRCAS through collaborative project. Dr R.R. Hanchinal, President of Society for Plant research and former President, PPVP&FR, presided over the webinar and urged for more collaborative efforts to insulate soybean from diseases. Dr S. K. Rao, Vice Chancellor, RVSKVV, Gwalior, said that there is no alternative to soybean crop for farmers in the central India and therefore multiple disease resistant soybean varieties are needed. Dr S. Rajendra Prasad, Vice Chancellor, UAS, Bangalore, and guest of honor, said that along with genetic management, biological control of diseases using microbial agents will be a cost effective and economical method for rust control. Dr P. G. Patil, Vice Chancellor, MPKV, Rahuri, said that the rust is threat to soybean production in southern Maharashtra and the webinar have benefited soybean scientists of the state. Dr Sanjeev Gupta, ADG (Oilseeds and Pulses), ICAR, special invitee of webinar said such webinars are very important for sharing knowledge and international collaboration. Coordinator Dr Giriraj Kumawat presented vote of thanks.

National Webinars

The institute had organized 4 national webinars during the past one year, discussing various aspects of soybean research and development. Details of these webinars are given in below table.

Date	Title	Speaker	Number of attendees	Co-ordinator
31st May 2021	Current trends in genomics- assisted breeding of agronomic traits in Soybean	Dr Giriraj Kumawat (ICAR-IISR, Indore)	82	Dr G.K. Satpute
10th June 2021	Phenotyping strategies for screening of drought tolerance in soybean	Dr G.K Satpute	40	Dr Giriraj Kumawat
November 29, 2021	GM Soybean: Status and Biosafety Aspects	1. Dr Milind B. Ratnaparkhe (ICAR-IISR, Indore) 2. Dr Sujit K Dutta (Joint Commissioner, Department of Animal Husbandry and Dairying) 3. Dr Amrish Kumar Tyagi (ADG, Animal Nutrition & Physiology) 4. Dr B. Dinesh Kumar (Former Director ICMR-National Institute of Nutrition (NIN))	60	Dr Milind B. Ratnaparkhe
10th December, 2021	Plant variety protection intricacies and impact on trait development	Dr R. R. Hanchinal, Ex Chairman, PPV&FR Authority and Ex-Vice Chancellor, UAS, Dharwad	50	Dr R.K Verma and Dr Giriraj Kumawat

5.3 Launch of Agribusiness Incubation Centre

Two-day sensitization workshop on launch of "Agribusiness Incubation Centre", was organized by the Institute from 16-17th March, 2021. The Agribusiness Incubation Centre (ABIC) has provision of facilitating the capacity building programme for the upcoming entrepreneurs, as well as, those desirous to initiate agri start-ups on soybean farming and allied sector. The Chief Guest of the programme Dr T.R. Sharma, Deputy Director General (Crop Science) of ICAR, New Delhi expressed satisfaction over the recent initiatives of the institution with response to the call given by the Prime Minister's Office to make the country self reliant (Atmanirbhar). Conducting startup activities for design and development of various products using low cost and indigenous technologies such as use of protein hydrolysate (an amino acid available in soymeal) in food products and other ancillary uses like organic fertilizer after its degradation, were appreciated by the chief guest.

He called for developing and strengthening linkages with different stakeholders to ensure a grand success of the ABI. The workshop was inaugurated on virtual mode in the august presence of Dr Sanjeev Saxena, Assistant Director General (Intellectual Property and Technology Management, ICAR) who appreciated the efforts of ICAR-IISR to initiate ABIC and commented that centre has a potential for creating multiple ventures. On this occasion, Dr Sanjeev Gupta, Assistant Director General (Oilseed & Pulses), Indian Council of Agricultural Research emphasized on area expansion and utilization of soybean in secondary agriculture.

Dr Nita Khandekar, welcoming a conglomeration of nearly 150 participants from different sectors, as well as, the dignitaries from the ICAR headquarters highlighted the importance of oilseed sector vis-à-vis soybean in the national economy which necessitate fulfilling the role of soybean in meeting the sustainable development goals (SDGs) of United Nations Agenda 2030.

The programme included several technical sessions including "Commercialization of technologies developed by ICAR-IISR" held on 16th March 2021. Dr Sudha Mysore, CEO, Agrinovate India (Department of Agricultural Research and Education, GOI), special guest, highlighted the mechanisms for commercialization of ICAR technologies.

The Second Technical Session, chaired by Dr Vilas A. Tonapi (Director, Indian Institute of Millet Research, Hyderabad) and co-Chaired by Dr K. Shrinivas (CEO, a-idea, National Academy of Agricultural Research and Management, Hyderabad) included discussion on issues related to establishing start-ups, funding opportunities, rules and regulations for registration, labeling/branding & marketing of the final product, certification from Food Safety Standards Authority of India, National Center of Organic Farming (DAC, GOI) etc. The session included eminent speakers from NABARD, MSME, National Institute of Rural Development etc. who provided guidance on these aspects.

5.4 Swachh Bharat Mission

Special cleanliness programme at Patalpani & Tinchha waterfall

Cleanliness programme at the popular picnic spots i.e Patalpani and Tinchha waterfall under the special cleanliness campaign has been organized throughout the country commemorating the birth anniversary of Mahatma Gandhi. A team especially constituted by the institute for the purpose, have collected garbage like plastic, paper, food wrap etc. in the premises of both these tourist places and put them in the dustbins. In addition, the team tried to make the tourists aware of the importance of cleanliness and its impact on health. A Gram Sabha was also organized by the ICAR-IISR in its selected village Katkatkhedi under the "My Village My Pride" program, in which the team members interacted with the farmers and villages about various issues of cleanliness The team included Dr Rajkumar Ramteke, Chairman and other members like Dr B.U. Dupare, Shri Shyam Kishore Verma, and Shri Rakesh Chandra Shakya.

Cleanliness awareness program at Arjun baroda village

Commemorating the 75 glorious years of India's Independence i.e. “Amrit Mahotsav” as well as birth anniversary of Mahatma Gandhi, the institute conducted a “Cleanliness Awareness Programme” on 27th October 2021 at Arjun Baroda, an adopted village under Mera Gaon, Mera Gaurav (MGMG) Programme. On this occasion, a team comprising of scientists and technical staff of the ICAR-IISR briefed the villagers on “Agriculture, cleanliness and health in rural India” and urged them not to use non-degradeble material which is responsible for degradation of natural resources. The team included Dr Rajkumar Ramteke, Chairman and other members like Dr BU. Dupare, Shri Shyam Kishore Verma, and Shri Rakesh Chandra Shakya.

Cleanliness awareness program at Musakhedi school

A “Cleanliness awareness programme for school children” was conducted on 30th October 2021 at Shriram Convent School, Musakhedi village. Dr B.U. Dupare, Principal Scientist, explained the school children about how they can play a pivotal role in making their home, neighborhood, city and country not only neat and clean but also a best place in the world by maintaining the clean and pollution free environment. The programme was conducted in presence of Dr Rajkumar Ramteke, Chairman and other members like Dr B.U. Dupare, Shri Shyam Kishore Verma, Shri Rakesh Chandra Shakya, Ms. Seema Chauhan along with Shri Pramod Raghuwanshi, the Director of Shriram Convvent School as well as Principal Mrs. Arti Raghuwanshi.

Swachhta Pakhwada

Swachhta Pakhwada was organized from 16-31, December, 2021. On the occasion of valedictory session, member secretary of committee briefed about the activities carried out viz., banner, cleaning of premises by staff, various competitions held on swachhta, awareness of cleanliness through social media, poster competition for school children, creating awareness of cleanliness among women labours, planting saplings and various activities were carried out. The program was chaired by Dr Anita Rani, Principal Scientist emphasized the importance of cleanliness on regular basis and appreciated the efforts of staff in keeping the institute clean. Mr Sourabh meena, SAO, chairman of committee addressed the participants stating that cleanliness has to be followed as a responsibility and appreciated the committee on successful conducting of the Swachhta Pakhwada.

5.5 Miscellaneous

International year of nutritious cereals and plantation program

On the occasion of the 71st birth anniversary of Honorable Prime Minister Shri Narendra Modi, several programs were organized at the ICAR-Indian Institute of Soybean Research, Indore on 17th September. Dr Sanjeev Gupta, Assistant Director General (Oilseeds and Pulses) of Indian Council of Agricultural Research, New Delhi, Dr S.S. Tomar, former Director Research, JNKVV Jabalpur, Dr Nita Khandekar, Acting Director, ICAR- IISR, Indore and staff planted 100 Aonla trees in the institute. Hundred Anola, mausambi, custard apple trees were also planted and hundred vegetable seed packets distributed among the villager from Rayan village of Dhar district.

This day is being celebrated by the Indian Council of Agricultural Research, New Delhi as the International Year of Millets, Kisan Diwas was also organized on 16th September in Rayan village of Dhar district in which about 100 farmers were participated. The scientists of the Institute also addressed the farmers with regard to the prevention of damage to the crop due to diseases and pests and adoption of latest varieties. Speaking on the occasion, Dr Nita Khandekar, Director of the institute called upon the farmers to use new varieties in soybean and adopt the new technological packages and also informed the farmers about the usefulness of nutritious grains like Bajra, Ragi, sorgham etc. in human food. On the occasion of the 71st birthday of Prime Minister Shri Narendra Modi ji, 71 girls were made aware of the role of millets in daily diet in order to be the torch bearers of the nutrition campaign.

35th Foundation day celebration of ICAR-IISR

The Institute celebrated its 35th Foundation day on 9th December, 2021. The programme was graced by the presence of well-known researchers and policy makers of national repute. Dr R.R. Hanchinal, Ex Chairman, Plant Variety Protection and Farmers Right Act (PPVFRA) and Ex-Vice Chancellor, University of Agricultural Sciences, Dharwad presided over the function and Dr Tilak Raj Sharma, Deputy Director General (Crop Science), ICAR was the chief guest. Dr Sanjeev Gupta, Assistant Director General (Oilseeds and Pulses), ICAR, New Delhi and Dr S.K. Sharma, (Former Vice Chancellor, CSK Himachal Pradesh Krishi Vishwa Vidyalaya, Palampur and Chairman, Research Advisory Committee of ICAR-IISR, attended the programme in virtual mode. More than 100 researchers belonging to different centers of All India Coordinated Research Project on Soybean spread across the country, institute staff, retired employees and selected progressive farmers from Madhya Pradesh attended the event.On the occasion Dr Nita Khandekar, Acting Director, presented the institute highlights.

The chief guest, Dr T. R. Sharma, delivered the second Dr Prem Swaroop Bhatnagar Memorial Lecture. He enlightened the use of new breeding technologies like Marker Assisted Breeding, Genome editing techniques, Genome wide association studies (GWAS) and transgenic development for improving soybean crop. According to Dr Sharma, the improvement in the productivity can be seen in the horizontal as well as vertical expansion of the soybean crop in the country. The special guests Dr Sanjeev Gupta and Shri D. N. Pathak expressed their satisfaction about the contribution made by the IISR scientists in the development of technologies as well as varieties which would help in mitigating the adverse impact of aberrant weather conditions currently experienced by the soybean growers.

In his presidential remark, Dr R. R. Hanchinal, mentioned that farmers are more interested in the taking two to three crops per year for harnessing more economic benefit which can be attained by developing early maturing varieties. He also emphasized that with the help of modern gene pyramiding technology popular soybean varieties can be improved further by staking multiple traits.

The institute felicitated its retired employees which included Dr G K Gupta (Retired Principal Scientist), Shri Chaudhary Charan Singh (Retired Technical staff) and Shri Dhan Singh (Retired skilled Staff). The progressive soybean farmers beneficiery under the Scheduled Castes Sub-Plan and Tribal Sub-Plan scheme of the Institute from different districts of Madhya Pradesh were also awarded.

Six publications viz. “Soya Vrttika”- a Rajbhasha magazine; e-book on “Front Line Demonstration of All India Co-Ordinated Research Project on Soybean”; folders on “Soybean me ajaivik tanavo ka prabandhan”, “Soyabin bhandaran takniki” and “soyabin ka ankuran parikshan kaise Kare?”; and extension bulletin on "Soyabin ki unnat kheti, navintam paddhatiyan evam takniki anushansaye” were released by the diginitaries on the occasion. Institute has also signed MOUs with 9 Small Scale Industries/Startups,for commercialization of institute technologies. A cultural fiesta was also organized in the evening where the institute staff participated with great enthusiasm.

Celebration of 93rd ICAR foundation day

Commemorating with the 93rd ICAR Foundation day, a plantation programme was conducted on 16th July, 2021 at the experimental farm of the instiute in the auspicious presence of Dr Ashok Sharma, Dean, Agricultural College, Indore, Dr S.V. Saiprasad, Head, Regional station, Indian Agricultural Research Institute (IARI), Indore and Dr Alok Deshwal, Head, KVK, Kasturabagram, along with institute Director (A) Dr Nita Khandekar and, scientists and employees of the institute. Saplings of guava and lemon were planted during the programme, which was coordinated by the farm-in-charge of the institute, Dr Maharaj Singh. The institute was awarded with the Ganesh Shankar Vidyarthi Hindi Patrika (2020) consolation prize on the occasion of ICAR foundation Day in a function held in hybrid mode by the Indian Council of Agricultural Research, New Delhi.

World water day

The Institute in collaboration with Krishi Vigyan Kendra, Kasturbagram, Indore celebrated the "World water day" on March 22, 2021 at Tillore Khurd Village in Indore district. On this occasion, Dr Nita Khandekar, Director (A), called for joint efforts for collection of rainwater and its conservation. She urged the farmers to adopt recommended practices and technologies for harnessing rain water, as well as,in-situ moisture conservation for maximizing yields especially looking at the present aberrant weather conditions. She also said that training may be imparted keeping in mind the water conservation technology.

During this occasion, Dr Alok Deshwal, Senior Scientist and Head of Krishi Vigyan Kendra highlighted the problem of scarcity of irrigation water and ground water level which is decreasing day by day. Dr S.D. Billore (Principal Scientist, IISR), advised the farmers with regard to the technologies available in soybean for conserving water. He also advised on the varieties to be grown under changing climate scenario. Dr. D.K. Mishra, Scientist (Horticulture) from the Krishi Vigyan Kendra also discussed about the importance of new irrigation methods like drip, as well as, sprinkler and their utility especially in horticultural crops. Mr Arun Kumar Shukla and Mr Nitin Pachalania, KVK, Indore also interacted with the farmers during the programme.

Programme on "Entrepreneurial opportunities in soybean sector"

Institute organized a programme on "Entrepreneurial opportunities in Soybean sector" for the school childrens of Sunshine School, Indore on 26th November 2021, under the Azadi Ka Amrit Mahotsav commemorating 75 glorious years of Independent India. In this program, school students and teachers were briefed about the Agri-Business Incubation Center, recently established at the ICAR-IISR, primarily for conducting skill oriented training programmes for the youth intrersted to initiate start up programme on soybean food derivatives.

Participants were informed about the prospects of entrepreneurial opportunities in soybean along with the health benefits associated with the soybean based food products. Dr B. U. Dupare, Principal Scientist, said that despite successful commercial cultivation of soybean crop for the last 40 years in the state of Madhya Pradesh, and its usefulness due to neutraceutical composition i.e. richness in protein, vitamins, iron, calcium and other medicinal properties, the food uses of soybean till now are negligible.During the programme, the winners of the poster competition Kumari Khushi, Dipesh Chauhan and Nitin Chauhan were honored by giving first, second and third prizes. The programme was conducted in the presence of School Director Mrs Anjana Kuishwaha and Vice Principal Shri Abhishek Mandloi, who appreciated the activities conducted by the ICAR-IISR in promoting secondary agriculture in soybean sector.

Vigilance awareness week

A weeklong celebration on account of "Vigilance awareness week"was organized from 26^{th} October to 1^{st} November 2021. The program was concluded with the Valedictory-cum-Prize distribution programme. Dr Nita Khandekar. Institute's Director, has organized various competitions on the theme "Independent India @ 75: Self-reliance with integrity" which included essay writing, ex-tempore, poster making and slogan competition etc. On this occasion, Dr Manoj Shrivastava, the organizer presented a brief report on persons who have been facilitated with an appreciation certificate and a gift. On this occasion, the Vigilance Officer of the Institute, Dr Sanjay Gupta appraised about the various efforts made by the ICAR-IISR for bringing transparency as well as eradication of corruption. Dr Khandekar, called upon the employees to follow the office ethics, protocol, guidelines as well as conduct rules and to work for the institute with full integrity and honesty.

ICAR-IISR, Indore and PIEMR signed MOU

ICAR-IISR and Prestige Institute of Engineering Management and Research (PIEMR), Indore, MP, India signed an MOU on 5th August, 2021 to collaborate and undertake R & D, Technology development and Extension activities to benefit the farming community, Agro & allied industries, academia and society as a whole. Dr Davish Jain, Chairman, PIEMR, expressed his pleasure over signing the MOU between two institutes for uplifting the farmers in the region and emphasized on lab to land programme. He urged both institutes to work on application and calibration of the technologies developed at PIEMR so as to have practical applicability at the farmer's field. Dr Nita Khandekar, in her address mentioned the need for precision agriculture and machine learning modules for doubling the production. She emphasized on the need for exchange of ideas, development of collaborative research project between both institutes. Dr M P Sharma, Dr Mrinal Kuchlan Dr Shivakumar M, Dr Raghavendra M, Dr Laxman Singh Rajput from ICAR-IISR were present in the event.

Previously, ICAR-IISR has also signed memorandum of understanding for research and higher education with the Telangana State Agricultural University, Hyderabad; Integral University, Lucknow; Agriculture University Jodhpur; Institute of Excellence in Higher Education, Bhopal; Kota Agriculture University, Kota; Barkatullah University, Bhopal and St Aloysius college, (autonomous) Rani Durgavati University, Jabalpur during 2021-22. These efforts will help in intensifying quality research and training manpower that are industry ready.

Visits

Visit of Dr Sanjeev Gupta, Assistant Director General, (Oilseeds and pulses), ICAR, New Delhi

The Assistant Director General, (Oilseeds and pulses), Indian Council of Agricultural Research (ICAR) New Delhi, Dr Sanjeev Gupta visited ICAR- IISR, Indore on 17th Sept 2021 and reviewed the progress of experiments and research trials being conducted at the Institute during Kharif season. The institute for the first time has been successful in identification, release and notification of twenty-four varieties in a single year having suitability to various soybean growing states of the country. These include eight soybean varieties especially suitable for Madhya Pradesh having characters like earliness, disease resistance, insect pest tolerance, food grade characters etc. Dr Gupta appreciated the efforts made by the scientists

He stressed upon the dire need for identification of more germplasm having characteristics of water logging tolerance, climate resilience, high oleic acid content and also for the development of disease resistant varieties for major diseases which occur across the soybean belt of the nation. He also drew the attention of house towards incorporation of qualities like anti dehiscence (non seed shattering), anti pre-harvest sprouting (Anti-vivipary) and several other important characters in the ongoing research activity. He emphasised further working on resource conservation technologies in soybean.

Visit of Shri Kanwal Singh Chauhan, a Padma Shri awardee progressive farmer

Padma Shri awardee Shri Kanwal Singh Chauhan, progressive farmer and member of ICAR, New Delhi governing body visited ICAR-IISR on 12th November, 2021. He visited tofu plant and Agri Business Incubation centre. Scientists briefed him about new varieties released and production technologies by the institute. He urged that technologies developed by the institute need to reach the farmers timely and at the earliest for the benefit of the farmers.

Visit of Dr A.K. Tiwari, Director, Directorate of Pulse Development, Bhopal

Dr AK Tiwari, Director, Directorate of Pulse Development, Bhopal, along with Deputy Director Agriculture District Indore, Shri S.S. Rajput visited the Institute on July 15, 2021.They discussed various issues including research trials being undertaken for development and promotion of climate resilient technologies and practices recommended by the institute in order to meet the needs of technologies and technical know-how for soybean farmers in the context of changing climate scenario. Dr Nita Khandekar, Director (A), of the institute informed about achievements of ICAR-IISR especially about the development of climate resilient varieties, as well as, practices,strategies for mitigating problems arising due to changing climatic conditions. She further elaborated about the overall scenario of varietal preference given by majority of the farmers to single short duration variety i.e. JS 95-60 which of late facing problems due to prolonged monsoon, as well as, increased insect pest load. She appraised the dignitaries about the institute efforts in promoting mid and long duration varieties in this changing climate scenario.

Ongoing Research Projects

Project No.	Years	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			
IISR 3.11c/18	2018-2021	Selection of potential fungal and bacterial soybean endophytes and their evaluation against major diseases of soybean	**Dr L. S. 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 (S D Billore)			
IISR	2020-	Interaction effect of phytohormones and AMF for enhanced nodulation,	**Dr M. P. Sharma**

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 Vertisols and associated soils	**DrDevvrat Singh**
IISR 4.13/17	2017-2022	Evaluation of tillage and crop establishment and residue management practices for sustaining/improving resources use efficiency, soil health 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** (Rs 6.5 Lakhs/Year)
ICAR	2006-LT	ICAR – Seed Project: Seed Production in Agricultural Crops.	**Dr Mrinal K. Kuchlan** (Rs 8.5 Lakhs/Year)
DBT , Government of India	2015-2020	Marker assisted elimination of off flavor generating lox II gene from KTI free genotypes	**Dr Vineet Kumar** (Rs. 46.59 Lakhs)
DBT, Government of India	2017-2020	Assessing the bio -availability of nutrients and reduction of heavy metals in soil amended with inorganic and organic waste in presence of AM fungi and biochar	**Dr M.P. Sharma** (Rs.19.73 Lakhs)
CSIR, Government of India	2017-2020	Development of an Efficient Scalable Clustering Algorithms for Big Data and investigation of Integrated system for Protein Sequence Classification	**DrMilind B. Ratnaparkhe** (Rs 30.00 Lakhs)
DAC, Minister of Agriculture	2018-2020	Creation of Seed Hubs for enhancing quality seeds availability of major oil seed crops under NFSM-Oil Seeds	**Dr Mrinal K. Kuchlan** (Rs 1.5 Crore)
DBT, Government of India	2018-2021	Development of genetic stocks for maturity and growth habit genes in soyabean (*Glycine max* (L.) Merr.)	**Dr Sanjay Gupta** (Rs 42.88 Lakhs)
ICAR Network Project	2018-2021	Identification of high trehalose -producing soybean rhizobia and their integration with AM fungi for enhanced drought tolerance in soybean	**Dr M.P. Sharma** (Rs 20.00 Lakhs)
National Agriculture Science Funds (NASF), ICAR	2018-2021	Genomics strategies for improvement of yield and seed composition traits under drought stress conditions in soybean	**Dr Milind B. Ratnaparkhe** (Rs 219.61 Lakhs)
IITM, Ministry of Earth Science, Govt. of India	2018-2021	Strategies for enhancing yield of soybean *Glycine max* L) and pigeonpea (*Cajanus cajan*, L) in India using climate variability information and crop growth simulation models	**Dr Raghavendra M** Rs 80. 94 Lakhs)

DBT, Government of India	2019-2021	Establishment of BIOTECH-KISAN Hub at Manthan Gramin Evam Smaj Seva Samiti,	**Dr Nita Khandekar** (Rs 163.20 Lakhs)
DBT, Government of India	2019-2021	Expansions of Activities of Biotech -KISAN Hub in Seven Aspirational districts in Madhya Pradesh under Biotech-KISAN Hub	**Dr Nita Khandekar** (Rs 406 Lakhs)
Science & Engineering Research Board (SERB) Govt. Of India	2019-2022	Development of Laser Biospeckle Technique for Applications in Agriculture	**DrLaxman Singh Rajput** (Rs 30 Lakhs)
DBT, Government of India	2020-2023	Accelerated development of Kunitz trypsin inhibitor free soybean genotypes with charcoal rot resistance	**Dr Vineet Kumar** (Rs 39.24 Lakhs)
SERB, DST, New Delhi	2021-2024	Genome- wide association mapping of charcoal rot resistance in soybean (*Glycine max* L.)	**Dr V. Nataraj** **(**27 Lakhs**)**

* LT: Long Term

Publications

Research papers

1. Agnihotri, R., Bharti, A., Ramesh, A., Prakash, A and Sharma, M.P. 2021. Glomalin related protein and C16:1ω5 PLFA associated with AM fungi as potential signatures for assessing the soil C sequestration under contrasting soil management practices. European Journal of Soil Biology.103:103286.https://doi.org/10.1016/j.ejsobi.2021.10328 (Press).

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 (7): 2595-2607; 10.1007/s00284-021-02532-7

3. Agnihotri, R., Sharma, M.P., Prakash, A., Ramesh, A., Bhattacharjya, S., Patra, A.K., Manna, M.C., Kurganova, I and Kuzyakov, Y. 2021. Glycoproteins of arbuscular mycorrhiza for soil carbon sequestration: Review of mechanisms and controls. Science of the Total Environment. doi: 10.1016/j.scitotenv.2021.150571.

4. Bajpai, P., Rani, A., Kumar, Anshu, A.A., Tayalkar, T., Pimpale, P and Kumar, V. 2021. Genetic Variability for the Activities of Soybean Seed Lipoxygenase-1, Lipoxygenase-2 and Lipoxygenase-3 Isozymes. Chemical Science Review Letters. 10 (38): 242-246

5. Chen, H., Kumawat, G., Yan, Y., Fan, B and Xu, D. 2021. Mapping and validation of a major QTL for primary root length of soybean seedlings grown in hydroponic conditions. BMC Genomics. 22:132. https://doi.org/10.1186/s12864-021-07445-0.

6. Chourasiya, D., Gupta, M.M., Sahni, S., Oehl, F., Agnihotri, R., Buade, R., Maheshwari, H.S., Prakash, A and Sharma, M.P. 2021. Unraveling the AM fungal community for understanding its ecosystem resilience to changed climate in agro-ecosystems. Symbiosis. 84: 295–310. https://doi.org/10.1007/s13199-021-00761-9.

7. Devi, L.S., Kumar, V., Rani, A., Tayalkar, T., Mittal, P., Kumar, Anshu, A.A and Singh, T.A. 2020. Fatty acid composition, antinutritional factors, and oligosaccharides concentration of Hawaijar, the ethnic fermented soyfood of India, as affected by genotype and Bacillus subtilis strain. Indonesian Food and Nutrition Progress. 17 (2) : 45-50

8. Dupare, B.U., Sharma, P and Billore, S.D. 2021. Determinants of adaptation practices to climate change: insights from soybean growers in Central India. Journal of Oilseeds Research. 38(3): 286-294,

9. Dupare, B.U., Sharma, P., Billore, S.D and Verma, S.K. 2020. Changes in agricultural scenario of Madhya Pradesh with special reference to soybean in changed climatic scenario: A study on farmers' perception. Journal of Oilseeds Research. 37(4): 299-308,

10. Dupare, B.U., Sharma, P., Billore, S.D and Verma, S.K. 2020. Impact of Climate Change on Soybean Cultivation in Malwa and Nimar Region of Madhya Pradesh: Farmers' Perspective. Soybean Research. 18(1): 87-97

11. Gujre, N., Agnihotri, R., Rangan, L., Sharma, M.P and Mitra, S. 2021. Deciphering the dynamics of glomalin and heavy metals in soils contaminated with hazardous municipal solid wastes.Journal of Hazardous Materials; DOI: 10.1016/j.jhazmat.2021.125869.

12. Gujre, N., Mitra, S., Agnihotri, R., Sharma, M.P and Gupta, D. 2021. Novel agrotechnological intervention for soil amendment through areca nut husk biochar in conjunction with vetiver grass. Chemosphere. doi: 10.1016/j.chemosphere.2021.132443.

13. Gupta, S., Agrawal, N., Tripathi, R., Kumawat, G., Nataraj, V., Shivakumar, M., Satpute, G.K., Ratnaparkhe, M.B., Rajesh, V., Chandra, S and Jain, M. 2021. Long juvenility trait: A vehicle for commercial utilization of soybean (*Glycine max*) in lower latitudes. Plant Breeding. DOI: 10.1111/pbr.12926.

14. Jha, P., Kumar, V., Rani, A and Kumar, A. 2021. Investigation on the Genetic Variability of Soybean Seed Sucrose Contentin Germplasm Accessions from Different Countries of Origin. Bioscience Biotech Research Communication. 14(2). http://dx.doi.org/10.21786/brc/14.2.40

15. Jha, P., Kumar, V., Rani, A and Kumar, A. 2021. Mapping QTLs controlling the biosynthesis of maltose in soybean. Romanian Journal of Biotechnology. 26 (5):2937-2942

17. Kolhe, S., Dupare, B.U and Mundankar, K. 2020. Soybean Gyan - a mobile application for effective soybean knowledge dissemination. Journal of Oilseeds Research. 37(3): 215-220

18. Kuchlan, P and Kuchlan, M. 2021. Intrinsic factors of soybean seed quality loss and practical approach to tackle the problem. Agro Science Today. 2(2) page 49-55

19. Kuchlan, P and Kuchlan, M. 2021. Effect of Salicylic Acid on Plant Physiological and Yield Traits of Soybean. Legume Research. DOI: 10.18805/LR-4527

20. Kumar, S., Rajput, L.S., Ramteke, R.H., Nataraj V., Ratnaparkhe, M., Maheshwari, H.S and Shivakumar, M. 2021. First report of root rot and damping off disease in soybean (*Glycine max*) caused by Pythium deliense in India. Plant Disease. Doi:10.1094/PDIS-01-21-0059-PDN

21. Kumar, V., Rani, A and Rawal, R. 2021. First Indian soybean variety free from off-flavour generating lipoxygenase-2 gene identified for release for commercial purpose. National Academy Science Letters. 1-4. https://doi.org/10.1007/s40009-021-01046-x

22. Kumar, V., Rani, A., Anshu, A.A and Tayalkar, T. 2021. Marker assisted stacking of null Kunitz trypsin inhibitor and off-flavour generating lipoxygenase-2 in soybean. The Journal of Agriculture Science. 159:272-280

23. Kumawat, G., and Xu, D. 2021. A major and stable quantitative trait locus *qSS2* for seed size and shape traits in soybean RIL population. Frontiers in Genetics. 12:646102. https://doi.org/10.3389/fgene.2021.646102

24. Maranna, S., Nataraj, V., Kumawat, G., Chandra, S., Rajesh, V., Ramteke, R., Patel, R.M., Ratnaparkhe, M.B., Husain, S.M., Gupta, S and Khandekar, N. 2021. Breeding for higher yield, early maturity, wider adaptability and water-logging tolerance in soybean (*Glycine max* L.)- A case study. Scientific Reports. 10.1038/s41598-021-02064-x.

25. Mathew, L., Pandey, N., Kumar, S., Khandekar, N and Vasudevan, J. 2021. Effect of using sugar substitute and egg replacers on organoleptic properties of cake. Soybean Research. 19 (1): 70-79.

26. Mathur, S., Agnihotri, R., Sharma, M.P., Reddy, V.R and Jajoo, A. 2021. Effect of High-Temperature Stress on Plant Physiological Traits and Mycorrhizal Symbiosis in Maize Plants. Journal of Fungi. 7: 867. https://doi.org/10.3390/jof7100867

27. Meena, L.K., Rajesh, V. and Sharma, A.N. 2021. Effects of Genotypic Diversity on Insect-pests of Soybean. Legume Research. LR-4625 [1-5].

28. Mittal, P., Kumar, V., Rani, A and Gokhale, S.M. 2021. Bowman-Birk inhibitor in soybean: Genetic variability in relation to total trypsin inhibitor activity and elimination of Kunitz trypsin inhibitor.Notulae Scientia Biologicae. 13 (1): 10836 https://doi.org/10.15835/nsb13110836

29. Nataraj, V., Bhartiya, A., Singh, C.P., Devi, H.N., Deshmukh, M.P., Verghese, P., Singh, K., Mehtre, S.P., Kumari, V., Maranna, S., Kumawat, G., Ratnaparkhe, M.B., Satpute, G.K., Rajesh, V., Chandra, S., Ramteke, R., Khandekar, N and Gupta, S. 2021. WAASB-based stability analysis and simultaneous selection for grain yield and early maturity in soybean. Agronomy Journal. 113, 3089–3099.

30. Nataraj, V., Pandey, N., Ramteke, R., Verghese, P., Reddy, R., Onkarappa, T., Mehtre, S.P., Gupta, S., Satpute, G.K., Mohan, Y. Shivakumar, M., Chandra, S and Rajesh, V. 2021.

GGE biplot analysis of vegetable type soybean genotypes under multi-environmental conditions in India. Journal of Environmental Biology. 42, 247-253.

31. Pandey, N and Ramteke, R. 2020. Effect of Aloe vera on keeping quality of soy lassi. Soybean Research. 18 (2): 58-65

32. Pandey, N., Wadikar, D.D., Manjunath, S.S., Patki, P.E. 2021. Optimization of Mango Soy Shrikhand by Response Surface Methodology and its nutritional evaluation. Soybean Research. 19 (1): 125-135.

33. Patel, R.M., Sharma, A.N and Purushottam Sharma. 2021. GIS based pest-weather model to predict the incidence of Girdle beetle (*Oberiopsis brevis*) in Soybean crop. Journal of Agrometeorology. 23(2): 183-188.

34. Rajput, L.S., Kumar, S., Bhati, H., Nair, K., Akhtar, J., Kumar, P and Dubey, S.C. 2021. Morphological and Cultural Characterization of Quarantine Concerned spp. Associated with Oilseed Crops. Journal of Mycology and Plant Pathology. 51: 48-58.

35. Rajput, L.S., Kumar, S., Bhati, H., Nair, K., Akhtar, J., Kumar P. and Dubey S.C. 2021. Diversity assessment of indigenous and exotic Diaporthe species associated with various crops using ISSR, URP and SRAP markers. Indian Phytopathology https://doi.org/10.1007/s42360-020-00313-z

36. Rani, A., Kumar, V., Shukla, S and Manjaya, J.G. 2021. Molecular Characterization of Novel Mutation in *E1* Flowering Gene Induced by Gamma Irradiation in Soybean. Genome. doi: 10.1139/gen-2020-0137

37. Rani, A., Kumar, V., Tayalkar, T and Anshu, A.A. 2021. Genomic regions controlling seed weight, water absorption ratio, sprout yield, and storage protein fractions in soybean. Journal of Crop Improvement. 35(3):346-60. https://doi.org/10.1080/15427528.2020.1823921

38. Sharma, M.P. 2021. Appraisal of native AM fungi in improving the plant productivity, soil health and sequestering soil carbon in agro-ecosystems. Kavaka 56:13-21. doi: 10.36460/Kavaka/56/2021/13-21.

39. Sharma, P., Dupare, B.U and Patel, R.M. 2021. Crop management and socio-economic determinants of soybean yield variability in Central India: a regression tree approach. Journal of Oilseeds Research. 38(1): 68-83.

41. Sharma, P., Dupare, B.U., Gupta, S., Basavaraja, G.T and Sharma, M.P. 2021. Economic impact assessment of soybean rust (*Phakopsora pachyrhizi*) resistance breeding in India: An ex-ante analysis. Indian Journal of Agricultural Sciences. 91 (12): 1723–6

42. Shruti, S., Rani, A., Jain, M and Kumar, V. 2021. Genotypic Variability in Soybean [*Glycine max* (L.) Merrill] through Agrobacterium-Mediated Transformation. Plant Tissue Culture and Biotechnology. 30: 2: 231-242 https://doi.org/10.3329/ptcb.v30i2.50693

43. Singh, P., Chatterjee, A., Rajput, L.S., Kumar, S., Nataraj, V., Bhatia, V and Prakash, S. 2021. Biospeckle-based sensor for characterization of charcoal rot (*Macrophomina phaseolina* (Tassi) Goid) disease in soybean (*Glycine max* (L.) Merr.) crop. IEEE Access. 9: 31562-31574. Doi: 10.1109/ACCESS.2021.3059868

44. Singh, P., Chatterjee, A., Rajput, L.S., Rana, S., Kumar, S., Nataraj, V., Bhatia, V and Prakash, S. 2021. Development of an intelligent laser biospeckle system for early detection and classification of soybean seeds infected with seed-borne fungal pathogen (*Colletotrichum truncatum*), Biosystems Engineering. 212: 442-457.

45. Tripathi, R., Agrawal, N., Kumawat, G., Gupta, S., Kuchlan, M., Shivakumar M., Nataraj, V., Kuchlan , P., Satpute, G.K., Ratnaparkhe , M.B., Rajesh, V., Chandra, S., Bhatia, V.S and Chand, S. 2021. Novel role of photoinsensitive alleles in adaptation of soybean [*Glycine max* (L.) Merr.] to rainfed short growing seasons of lower latitudes. Genetic Resources and Crop Evolution. https://doi.org/10.1007/s10722-021-01142-3.

46. Vasudevan, J., Pandey, N., Khandekar, N., Rajput, H and Mathew, L . 2021. Formulation and optimization of soy based eggless mayonnaise. Soybean Research. 19 (1): 80-89.

47. Wani, S.H., Lin, F., Nataraj, V., Shivakumar, M., Wang, D. 2021. Screening of soybean (*Glycine max*, L. (Merr.)) germplasm for tolerance to Pythium irregulare. SKUAST Journal of Research. 23(2): 135-139.

Books & book chapters

1. Billore, S.D., Dupare, B.U., Raghavendra, M., Verma, R.K., Gupta, S and Khandekar, N. 2021. Frontline demonstrations under AICRP system: An effective tool for transfer of soybean production technology. E-Book published by ICAR-Indian Institute of Soybean Research, Khandwa road, Indore, Madhya Pradesh, India, PP 1-79

2. Dupare, B.U., Kolhe, S and Balasubramani, N. 2021. e-Book on "Climate smart technologies and practices for increasing the soybean productivity. Jointly published by ICAR-Indian Institute of Soybean Research, Indore and National Institute of Agricultural Extension Management, Hyderabad. Pp:140

3. Giri, B and Sharma, M.P. 2021. Plant Stress Biology: Strategy and Trends In Giri B, SharmaMP(ed.), ISBN 978-981-15-9379-6 ISBN 978-981-15-9380-2 (eBook) https://doi.org/10.1007/978-981-15-9380-2;SpringerNature SingaporePte Ltd.2020

4. Maheshwari, H.S., Agnihotri, R., Bharti, A., Chourasiya, D., Pratibha, L., Dukare, A., Prabina, J.B., Sharma, M.P and Sharma, S.K, 2020. Signaling in the rhizosphere for better plant and soil health. In: Sharma S.K., Singh U.B., Sahu P.K., Singh H.V., Sharma P.K. (eds.), Rhizosphere Microbes. Microorganisms for Sustainabilityvol 23. Springer, Singapore. https://doi.org/10.1007/978-981-15-9154-9_6 Pages 149-174

5. Maheshwari, H.S., Bharti, A., Agnihotri, R., Dukare, A., Prabina, J.B., Gangola, S and Sharma, M.P. 2021. Combating the abiotic stress through phytomicrobiome studies pages 45-60 In Verma, A., Saini, J.K., Singh, H.B., El-Latif, A and Hesham (eds.), Phytomicrobiome Interactions and Sustainable Agriculture. John Wiley & Sons Ltd; DOI: 10.1002/9781119644798; ISBN: 978-1-119-64462-0, 320 pp.

6. Rani, A and Kumar, V. 2020. Translational genomics and breeding in soybean. In Gosal, S.S and Wani S.H (ed.), Accelerated Plant Breeding. Vol 3, Springer Publisherpp 343-367

7. Sahil, R.K., Mehta., Abdelmotelb, K.F., Aggarwal, S.K., Lavale, S.A., Jat, B.S., Tripathi, A and Rajput, L.S. 2021. Salicylic Acid for Vigorous Plant Growth and Enhanced Yield Under Harsh Environment. In: Hussain A (ed.), Plant Performance Under Environmental Stress: Hormones, Biostimulants and Sustainable Plant Growth Management Springer, Singapore

8. Satpute, G.K., Ratnaparkhe, M.B., Chandra, S., Kamble, V.G., Kavishwar, R., Singh, A.K., Gupta, S., Devdas, R., Arya, M., Singh, M., Sharma, M.P., Kumawat, G., Shivakumar, M., Nataraj, V., Kuchlan, M.K., Rajesh, V., Srivastava, M.K., Chitikineni, C., Varshney, R.K and Nguyen, H.T. 2021. In B. Giri, M. P. Sharma (eds.), Breeding and Molecular Approaches for Evolving Drought-Tolerant Soybeans. Plant Stress Biology: Strategies and Trends. Springer Nature Singapore Pte Ltd. 2020; DOI https://doi.org/10.1007/978-981-15-9380-2_4.

9. पुनम कुचलान, सुभाष चन्द्र, लक्ष्मण सिंह राजपूत, संजय कुमार पाण्डेय एवं विकास कुमार केशरी. 2020. सोयावार्तिका 1-120:1,

Popular articles

1. Khandekar, N., Kumawat, G., and Kumar V. (2021) Soybean varieties for yield enhancement and niche-needs. In Souvenir of International Soy Conclave organized between Oct. 09-10, 2021, at Indore pp 14-16.

Technical/Extension bulletins/folders

1. Patel, R.M and Sharma, P. 2021. Soybean Market Monitor - Apr-Sept 2021. https://iisrindore.icar.gov.in/pdfdoc/soybeanmonitorsept2021.pdf

Dupare, B.U. and Billore, S.D. 2021. Soybean Production: Package of practices and Technical Recommendations. Extension Bulletin No. 16. ICAR-Indian Institute of Soybean Research Publication. Pp: 50

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

4. मृणाल कुचलान एवं पुनम कुचलान (2021). किसानों के स्तर पर सोयाबीन बीज के अंकुरण की जांच, विस्तार फोल्डर क्रमां 24 (2021) भा.कृअनु.प. भारतीय सोयाबीन अनुसंधान संस्थान, इन्दौ,

5. मृणाल कुचलान एवं पुनम कुचलान (2021) किसान सोयाबीन बीज को इस तरह से भंडारित करें । भा. कृ. अनु. प. भारतीय सोयाबीन अनुसंधान संस्थान, इन्दौर, विस्तार फोल्डर क्रमांक 23 (2021)।

6. सुभाष चन्द्र जी के सातपुते, संयज गुप्ता, गिरिराज कुमावत, राकेश वर्मा, विराज कांबले, मिलिंद रत्नपारखे एवं एम. के. श्रीवास्तव (2021) सोयाबीन में अजैविक तनावों का प्रबंधन विस्तार फोल्डर भारतीय सोयाबीन अनुसंधान संस्थान, इन्दौर।

Training manual

1. Dupare, B.U., Kolhe, S and Balasubramani, N. 2021. Training Manual of Online Collaborative Training Programme on "Climate smart technologies and practices for increasing the soybean productivity" jointly organized by ICAR-Indian Institute of Soybean Research, Indore and National Institute of Agricultural Extension Management, Hyderabad during 18-21 May 2021. Pp:140

Awards and Recognitions

Awards

i. Dr Nita Khandekar, Director(A), received special award from SOPA for her "Significant contribution to research and development of soybean cultivation in India" in the International SOYCONCLAVE, held on 10th Oct., 2021, at Indore (MP).

ii. Dr M.P. Sharma, Pri. Scientist, received National Level Senior Scientist Award-2021 for outstanding contribution in Agri Microbiology by Microbiologists Society, India, Maharashtra.

iii. Dr Raghavendra, M, Scientist,received ISA Best Doctoral Thesis award for the year 2017 from Indian Society of Agronomy at 5th International Agronomy Congress held at PJTSAU, Hyderabad (TS) from 23-28th November 2021.

iv. Dr M.P. Sharma, Pri. Scientist, was awarded best paper 2020 (Impact of Agrochemicals on "Soil Microbiota and Management: A Review (NAAS Rating 9.39)awarded by MDPI Open access publishing, Basel for highly cited paper in "Land" Journal. https://doi.org/10.3390/land9020034.

Recognitions

i. Dr M.P. Sharma, Pri. Scientist, got selected as member of 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).

ii. Dr Giriraj Kumawat, Sr. Scientist (Agri. Biotechnology), successfully completed JIRCAS visiting research fellowship program at Japan International Research Centre for Agricultural Sciences, Tsukuba, Japan (from 1st Oct 2019 to 25th March 2021).

Conferences attended

1. Pandey, N (2021) International Conference on "Alternate Cropping Systems for Climate Change and Resource Conservation" from 29 September to 01 October 2021.

2. Pandey, N (2021) attended online seminar in Hindi on "कोविड-जनित परिस्थितियों में देश 19 के आर्थिक विकास एवं आत्मनिर्भरता में कृषि अभियांत्रिकी की भूमिका" on 28 – 29 July 2021

3. Verma, R.K., Kumawat, G., Satpute, G.K., (2021) Exhibition stall in 15th Agricultural Science Congress and ASC Expo 2021 organized during Nov 13-16, 2021 at BHU, Varanasi, U.P.

4. Raghavendra M (2021) 5th International Agronomy Congress and presented on Grain yield of soybean as influenced by agronomic biofortification under conservation and conventional tillage practices. Extended Summaries on November 23-27, 2021, PJTSAU, Hyderabad (TS), India

5. Patel R.M(2021) Machine Learning based Geospatial Forewarning of Tobacco Caterpillar severity in Soybean at VIth International Conference in Hybrid Mode on Global Research Initiatives for Sustainable Agriculture & Allied Sciences (GRISAAS-2021), SKRAU Bikaner, Rajasthan, India, pp. 123-124.

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DR. NITA KHANDEKAR
Director (Acting)
ICAR – Indian Institute of Soybean Research
10 October 2021


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"Impact of Agrochemicals on Soil Microbiota and Management: A Review"
Land 2020, 9(2), 34; https://doi.org/10.3390/land9020034

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Invited talks in conferences/meetings :

1. Sharma MP (2021) Arbuscular Mycorrhizal Fungi: An ancient symbiosis sustaining the plant productivity and environment- A facet of Traditional Science and Technology presented during Azadi Ka Amrit Mahotsav, under Madhya Pradesh Vigyan Bharti conference on Traditional Science and Technology in Higher Educational Institutes organized by Institute of Science and Research (ISR), IPS Academy, Indore in collaboration with IIT Indore on December 24, 2021.

2. Sharma MP and Chourasiya D (2021) Culturing AM fungi for Inoculum Production & Application in Agriculture. In workshop on "Microbes for Sustainable and Resilient Future" organized online by the Department of Botany, University of Delhi and Delhi Botanical Society from 6th -11th December, 2021.

3. Sharma MP (2021) AM fungi: A new generation fungal biofertilizer for sustainable agriculture and environment presentation made on August 22, 2021 during expert lecture series organized jointly by RK University, Rajkot and Microbiologists Society, India.

4. Sharma MP (2021) Appraisal of native AM fungi in improving the plant productivity, soil health and sequestering soil carbon in agro-ecosystems" delivered during the virtual National Conference on "Biodiversity and Biotechnology of Fungi" & 47th Annual Meeting of Mycological Society of India held at Punjabi University Patiala from February 22nd to 24th, 2021.

Deputation Seminars :

1. Dr Giriraj Kumawat, Sr. Scientist (Agri. Biotechnology), "Identification and function analysis genes controlling root development in soybean" for study conducted during JIRCAS visiting research fellowship program at Japan International Research Centre for Agricultural Sciences, Tsukuba, Japan, on 6th May 2021.

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

राजभाषा– कार्यान्वयन

संस्थान में जनवरी–दिसम्बर 2021 के दौरान राजभाषा कार्यान्वयन संबंधी विभिन्न गतिविधियाँ

भारतीय संविधान में हिन्दी को संघ राजभाषा के रूप में स्थापित किया गया है एवं संविधान के भाग सत्रह, अनुच्छेद तीन सौ इक्यावन में वर्णित है कि राजभाषा हिन्दी को इस तरह से विकसित किया जाए ताकि वह भारत की विविध संस्कृति को व्यक्त करने में समर्थवान हो। अतः राजभाषा के रूप में हिन्दी की भूमिक अत्यंत महत्वपूर्ण तथा दायित्वपूर्ण है। इस उद्देश्य का वहन करते हुए भा.कृ.अनु.प.- भारतीय सोयाबीन अनुसंधान संस्थान, इन्दौर में राजभाषा हिन्दी के प्रसार-प्रसार हेतु अनेकानेक कार्यक्रम किए जा रहे है। जिनका स्वरूप भारतीय सोयाबीन अनुसंधान संस्थान में राजभाषा के क्षेत्र में उत्तरोत्तर प्रगति के साथ दृष्टिगोचर होते है, जो राजभाषा के प्रगामी प्रयोग में अत्यंत सार्थक सिद्ध हो रहे हैं। इस क्षेत्र में किए जा रहे क्रियाकलापों का संक्षिप्त विवरण निम्नानुसार है :

क) राजभाषा निमय, 1976 के नियम 8 का अनुपालन : संस्थान के अधिकारी एवं कर्मचारी शासकीय कार्यों हेतु राजभाषा नियम, 1976 के नियम 8 के उपनियम (1) तथा (4) के अनुसार लिखे जाने वाली टिप्पणियाँ एवं अन्य कार्य हिन्दी में करते हैं।

ख) राजभाषा कार्यान्वयन समिति की तिमाही बैठक

प्रथम बैठक	:	दिनांक 06 जनवरी 2021
द्वितीय बैठक	:	दिनांक 15 जून 2021
तृतीय बैठक	:	दिनांक 07 जुलाई 2021
चतुर्थ बैठक	:	दिनांक 05 अक्टूबर 2021

ग) प्रशिक्षण : संस्थान में राजभाषा के प्रचार-प्रसार हेतु कृषकों एवं प्रशिक्षणार्थियों को प्रशिक्षण संबंधित सारी सामग्रियाँ हिन्दी में प्रदान की जा रही है।

घ) शब्दकोश में वृद्धि : संस्थान में प्रतिदिन एक शब्द हिन्दी एवं अग्रेंजी को द्विभाषी रूप में ''आज का शब्द'' नाम से प्रदर्शित किया जा रहा है, जिससे कर्मचारियों, अधिकारियों एवं वैज्ञानिकों के हिन्दी शब्द ज्ञान में वृद्धि करने के साथ ही साथ हिन्दी के कार्यालयीन उपयोग में भी सहायता प्रदान कर सके।

ङ) अनुवाद द्विभाषी प्रपत्र : संस्थान में कार्यालयीन कार्य में प्रयुक्त होने वाले विभिन्न पत्रों, प्रपत्रों आदि का अनुवाद कार्य भी प्रगति पर है, जिससे दैनिदिन 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।

च) राजभाषा तिमाही रिपोर्ट का प्रेषण : संस्थान में राजभाषा हिन्दी से संबंधित समस्त कार्यो का विवरण तिमाही हिन्दी रिपोर्ट के माध्यम से संबंधित विभागों को ऑनलाईन एवं द्रुतगामी 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।

छ) मौलिक लेखन कार्य का प्रादुर्भाव : संस्थान में राजभाषा विभिन्न क्रियाकलापों के साथ मौलिक लेखन काय को द्रुतगामी आयाम प्रदान करने में अधिकारियों एवं कर्मचारियों की रुचि अद्वितीय है। संस्थान राजभाषा गृह पत्रिका ''सोयवृतिका'' तथा विभिन्न प्रतिष्ठित संस्थानों द्वारा इनकी लेखनी को स्थान प्राप्त होते हैं।

ज) हिन्दी कार्यशालाएं : संस्थान के अधिकारियों एवं कर्मचारियों की हिन्दी में कार्य करने के दौरान होने वाली समस्याओं के निराकरण हेतु संस्थान में हिन्दी कार्यशालाओं का आयोजन किया जाता है। इसके अतिरिक्त कार्यशालाओं के अ ायोजन का मुख्य ध्येय यह भी होता है कि हिन्दी का प्रयोग किस प्रकार सरल से सरलत्तम् की और बढ़ाया जा सकता है। इसलिए प्रत्येक तिमाही में कम से कम एक हिन्दी कार्यशाला का आयोजन किया जा रहा है। ताकि संस्थान के सभी सवंर्गों में हिन्दी में कार्य संपन्न करने का रुझान में उत्तरोत्तर प्रगति हो सके। इस उद्देश्य हेतु संबंधित विषयानुसार कार्यशालाएं सम्पन्न की जाती है। जनवरी–दिसम्बर 2021 में अब तक 04 कार्यशालाओं का आयोजन किया गया, जिसकी सूचि इस प्रकार से हैं : -

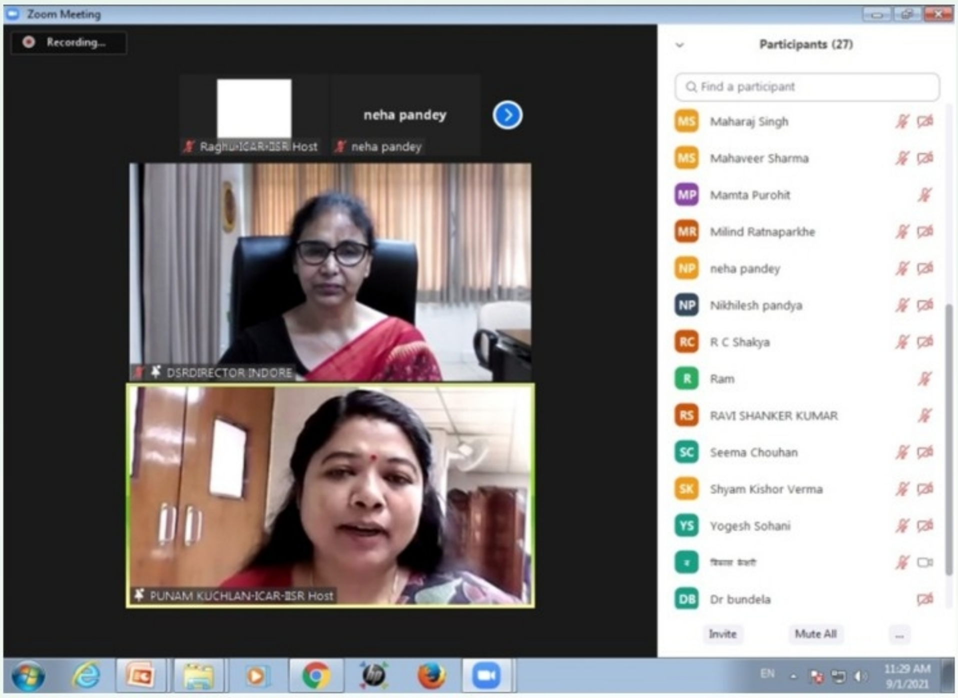
दिनांक	विषय	अतिथि वक्ता
04 मार्च 2021	हिन्दी के सरलतम् प्रयोग द्वारा राजभाषा के कार्य को सम्पन्न करना	श्री राम दयाल शर्मा, उप-निदेशक (राजभाषा), उत्तर-पूर्वी पर्वतीय क्षेत्र अनुसंधान परिसर, मेघालय
08 जून 2021	कार्यालय में व्यवहारिक हिन्दी का प्रयोग	श्री जयनाथ यादव, राजभाषा अधिकारी, भारतीय प्रबंध संस्थान, इन्दौर
07 सितम्बर 2021	हम, हिन्दी, हिंदुस्तान और विश्व	डॉ. राजीव शर्मा, विभागाध्यक्ष- पत्रिकारिता, श्री अटल बिहारी वाजपेयी शासकीय कला एवं वाणिज्य म.वि. इन्दौर
01 दिसम्बर 2021	हिन्दी भाषा के सरल स्वरूप के प्रयोग का व्यापक प्रभाव	श्री मधुकर पवार, सहायक निर्देशक (राजभाषा) क्षेत्रीय लोक सम्पर्क ब्यूरो, सूचना एवं प्रसारण मंत्रालय, इन्दौर

झ) राजभाषा अधिनियम, 1963 की धारा 3 (3) : संस्थान में राजभाषा अधिनियम, 1963 की धारा 3 (3) से संबंधित दस्तावेजों जैसे : सामान्य आदेश, अधिसूचनाएं, प्रेस विज्ञप्तियाँ, संविदाएँ, करार, लाइसेंस, परमिट, टेंडर के फार्म और नोटिस, संकल्प, नियम, संसद के एक सदन में या दोनों सदनों में प्रस्तुत सरकारी कागज - पत्र (रिपोर्टों के अलावा) इत्यादि को द्विभाषी (हिन्दी और अंग्रेजी) में निकाला जाता है, ताकि राजभाषा संबंधित दिशा-निर्देशों का पालन होता रहे।

ञ) मध्य एवं पश्चिम क्षेत्र का राजभाषा कार्यान्वयन संबंधी पुरस्कार : भारत सरकार, गृह मंत्रालय, गृह मंत्रालय, राजभाषा विभाग द्वारा मध्य एवं पश्चिम क्षेत्र के राजभाषा कार्यान्वयन में उत्कृष्ट कार्य करने हेतु संस्थान को वर्ष 2018-19 एवं 2019-20 संबंधित प्रथम पुरस्कार रविंद्र भवन, कल्चरल सेण्टर, मडगाँव, फटरोड़ा, स्टेट हाइवे के पास गोवा में प्रदान किया गया।

ट) प्रोत्साहन योजना : संस्थान के अधिकारियों और कर्मचारियों में राजभाषा के प्रचार-प्रसार तथा हिन्दी में उनके द्वारा किए गए कार्य को बढ़ावा देने हेतु प्रोत्साहन योजना प्रतियोगिता किया गया, जिसमें संस्थान के अधिकारियों और कर्मचारियों द्वारा प्रतियोगिता में भाग लिया गया।

ट) हिन्दी पखवाड़ा : संस्थान में दिनांक 01 सितम्बर से 14 सितम्बर के दौरान हिन्दी पखवाड़ा का आयोजन किया गया, जिसमें संस्थान के सभी वर्गों के लिए प्रतियोगिता को आयोजित किया गया । सभी प्रतियोगिता के विजेता प्रतिभागियों को 14 सितम्बर अर्थात् हिन्दी-दिवस को पुरस्कृत किया गया।



ठ) राजभाषा पत्रिका : संस्थान के स्थापना दिवस के दौरान हिन्दी राजभाषा पत्रिका ''सोयवृतिका'' के द्वितीय अंक का विमोचन किया गया। इस पत्रिका में संस्थान के अतिरिक्त भा. कृ. अनु. प. के अन्य संस्थानों के लेखकों ने अपने आलेख प्रदान कर पत्रिका के प्रकाशन में सहयोग प्रदान किए।

ड) यूनिकोड की सुविधा : संस्थान के अधिकारियों तथा कर्मचारियों की हिन्दी में कार्य करने की रूचि में वृद्धि करने हेतु समस्त कम्प्यूटर में हिन्दी यूनिकोड की व्यवस्था प्रदान की गई है, जिससे एक समान फॉन्ट के माध्यम से पूरा संस्थान एक ही दिशा की ओर अग्रसर हो सके।

उपरोक्त गतिविधियों पर यदि दृष्टिपात करें तो ज्ञात होता है कि संस्थान में राजभाषा कार्यान्वियन की दिशा में एक सकारात्मक एवं सार्थक कार्य हो रहा है, जो संस्थान में हिन्दी के सुनहरे भविष्य का आभास प्रदान करता है।

Women Empowerment

International Womens'day celebration

Womens' day celebration at IISR-Indore were commenced with full of enthusiasm and joy on 8th March, 2021. The day was designated by U.N. as International day for womens' right and international peace. To cherish the efforts and struggle of women for the equality and justice various programs were organized at the institute especially for the women and girl's students such as poster making and slogan writing competitions. The titles for poster making and slogan making were "Women leadership in agriculture" and "Women Empowerment" respectively. This was to give platform to the incredible skills and innovative talent vested at women from agricultural background. The program gota huge response from the girl students and women staff of the institute. Dr Nita Khandekar, acting Director, ICAR-IISR, Indore appreciated the work done by the women employees in institute. She emphasized on gender equality in work place, as well as,at household level. She specifically mentioned the role of education, enterpreneurship and economical independence of women in achieving their goal. Dr Anita Rani, Women cell in-charge elaborated the events organized for celebration of women's day at institute. The prize distribution ceremony was convened by Dr Punam Kuchlan and program ended with vote of thanks from Mrs. Priyanka Sawan.

Training programs for women

Training on “Soy processing and by-product utilization”

In alignment with the scheme “Atmanirbhar Bharat Abhiyan” launched by the honorable Prime Minister to give stimulus to the skill development ecosystem, a training program was held at ICAR-IISR Indore on 6th March, 2021 for women laborers on "Soy processing and By-product utilization". The training was organized by Mrs. Neha Pandey, Scientist Food Technology. The training aimed at providing information to the laborers related to soy based products being made at the institute. The participants were demonstrated the production of tofu at the tofu plant of the institute.

Training on “Hands on training on small tools for drudgery reduction”

A training program was held at ICAR-IISR Indore on 8th March, 2021 for women laborers on "Hands on training on small tools for drudgery reduction". The program aimed at equipping women technologically for reducing their work load in agricultural work and also increase the efficiency of work.Training was organized by Dr Punam Kuchlan, Pri. Scientist, Seed Technology.

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
66(a)9	Senior Administrative Officer, ICAR-IISR, Indore	Member- Secretary	09.01.2022

Research Advisory Committee(w. e. f.07.06.2020 to 06.06.2023)

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, Barrackpore, 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 Delhi -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	Dr Nita Khandekar, Director
Official side	
Member	Dr Savita Kolhe, Principal Scientist
Member	Dr G.K.Sat pute, 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 Devendra Pratap, Technical Officer
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 of the Institute

1.	**Official Language Implementation Committee** Director, ICAR-IISR (Chairman) Dr Punam Kuchlan Mrs Neha Pandey Dr S.K. Pandey Dr D.N. Baraskar Shri Ravi Shanker Kumar Administrative Officer Finance & Accounts Officer Shri Vikas Kumar Keshari	2.	**Institute Technology Management Committee (ITMC)** Director, ICAR-IISR (Chairman) Dr M.P. Sharma Dr Sai Prasad Dr B U Dupare Dr Sanjay Gupta Dr D V Singh Dr M K Srivastava Dr Mrinal Kuchlan
3.	**Priority Setting Monitoring and Evaluation (PME) Cell** Dr Anita Rani(Chairman) Dr B.U. Dupare Dr M. K. Srivastava Dr Milind Ratnaparkhe Dr Mrinal Kuchlan Dr Rakesh Kumar Verma	4.	**Purchase Advisory Committee (PAC)** Dr Savita Kolhe (Chairman) Dr G K Satpute Dr Laxman Singh Rajput Dr Rakesh Kumar Verma Dr Giriraj Kumawat Administrative Officer Finance & Accounts Officer
5.	**Human Resource Development Committee** DrRajkumar Ramteke (Chairman) Dr Milind Ratnaparkhe Dr Giriraj Kumawat Dr Nikhlesh Pandya Ms. Avinash Kalanke Administrative Officer	6.	**Consultancy Processing Cell (CPC)** Dr M.P. Sharma (Chairman) Dr Mrinal Kuchlan Dr LokeshMeena Dr Raghvendra Madar Finance & Accts. Officer Administrative Officer
7.	**Student Affairs Committee & Higher Study Committee** Dr Shivakumar M. (Chairman) Dr Subhash Chandra Dr Vangala Rajesh Dr Laxman Singh Rajput	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 Punam Kuchlan (Nodal officer SCSP) Dr Subhas Chandra (Nodal officer TSP) Dr Mrinal Kuchlan (Nodal officer NEH) Dr M. K. Srivastava Dr Rakesh Kumar Verma Dr Laxman Singh Rajput Mrs. Neha Pandey Administrative Officer Finance& Accounts Officer
9.	**Estate and Guest House Management Committee** Mrs. Neha Pandey (Chairman) Dr Subhash Chandra Shri S. P. Singh Shri R.N. Shrivastava Sh. R.C. Sakya Dr D.N. Barasakar Administrative Officer	10.	**Publication Committee (Annual Report/Newsletter)** Dr A. Ramesh (Chairman- Annual Report) Dr G. K. Satpute Dr V Nataraj Dr M. K. Srivastava (Chairman-Newsletter) Dr Vangala Rajesh Dr Raghvendra Madar Dr Surendra Kumar

11.	**Library Advisory Committee** Shri Ram Manohar Patel(Chairman) Dr V. Nat araj Shri Shyam Kishore Verma Finance & Accounts Officer Administrative Officer Dr Surendra Kumar	12.	**Foreign Deputation and Higher Study Committee** Dr Milind B. Ratnaparkhe (Chairman) Dr Savita Kolhe Dr Giriraj Kumawat Representative from PME Administrative Officer
13.	**Works Committee** Dr G. K. Satpute (Chairman) Dr Viraj Kamble Dr Vangla Rajesh Dr Raghvendra Madar Administrative Officer Finance & Accounts Officer Estate Officer	14.	**Agriculture Knowledge Management Unit** Dr Savita Kolhe (Chairman) Dr B.U. Dupare Shei Ram Manohar Patel Dr V. Nataraj Dr Raghvendra Madar Dr Avinash Kalanke
15.	**Public Information Officer** Administrative Officer/ Head of Office Shri Ajay Kumar, AAO	16.	**Nodal Scientist SSCNARS, IASRI-NAIP Statistics Project** Shri Ram Manohar Patel
17.	**Women Complaint Committee on Sexual Harassment** Dr Anita Rani (Chairman) Dr Punam Kuchlan Dr Neha Pandey Ms. Priyanka Sawan Third Party Representative (To be nominated as & when required) Administrative Officer	18.	**House Allotment Committee** Dr Rajesh Vangla (Chairman) Dr Raghvendra Madar Shri Vikas Keshari Mrs. Jyoti Meena Secretary, IJSC Administrative Officer
19.	**Centralized Public Grievance Cell and Monitoring Systems (CPGCMS)** Dr Vineet Kumar	20.	**Soybean Market Intelligence Cell** Dr Ram Manohar Patel
21.	**Liaison Officer (SC/ST/OBC)** Dr Viraj Kamle (Chairman)	22.	**Institute Technical Management Unit (ITMU)** Dr M.P.Sharma (Nodal Officer)
23.	**Swachh Bharat Abhiyaan Committee** Administrative Officer/ Head of Office (Chairman) Dr D.N. Baraskar Shri S.K. Verma Mrs. Jyoti Meena Shri I.R.Khan Shri R. C. Shakaya Anil Crasco Finance & Accounts Officer Sh. Surla	24.	**Institute Publication /Printing, Press & Media Committee (General)** Dr B.U. Dupare (Chairman) Dr Savita Kohle Dr Viraj Kamble Dr Lokesh Meena Dr D.N. Baraskar Shri S.K. Verma
25.	**Vehicle Management Committee** Dr Maharaj Singh (Chairman) Dr Lokesh Meena Dr Sanjay Pandey	26.	**Physical Verification and Condemnation Committee** DrG.K Satpute (Chairman) Dr Rakesh Kumar Verma Dr S. K. Pandey Shri R. N. Shrivastava Shri I.R. Khan Shri Balbir Singh Store Officer Shri Ajay Kumar Shrivastava

27.	**Farm Management , Price Fixation , Farm item Disposal Committee** Dr Maharaj Singh (Chairman) Dr Rajkumar Ramtake Dr M.K. Kuchlan Dr V.P.S. Bundela Store Officer Finance & Accts. Officer Administrative Officer	28.	**Sport and Staff Welfare Committee** Dr Subhash Chandra (Chairman) Dr Laxman Singh Rajput Dr Ram Manohar Patel Sh. R. N. Shrivastava Sh. S. P. Singh Sh. Balbir Singh Ms. Seema Chauhan Sh. Sanjeev Mishra Administrative Officer Finance & Accts. Officer
29.	**Laboratory In Charges** Dr L. S Rajput - Pathology Dr Manoj Kumar Srivastava - Central/ Physiology Dr Sanjay Gupta - Plant Breeding, Germplasm Dr M.K.Kuchalan - DUS Testing, Seed Technology, Dr Milind B. Ratnaparkhe - Biotechnology DrDr Lokesh Kumar Meena - Entomology Dr Anita Rani - Transgenics Dr M. P. Sharma - Microbiology Dr Vineet Kumar – Biochemistry Dr S. D. Billore - Agronomy Dr Savita Kolhe - Computer Dr B. U. Dupare - Extension	30.	**Security Cell** Dr Rakesh Kumar Verma (Chairman) Dr Laxman Singh Rajput Shri S. P. Singh Shri O.P. Vishwakarma Shri R. C. Shakya
		31.	**Estate Officer** Shri R.C.Sakya
			Record Officer Shri Ajay Kumar, AAO
			Vehicle In charge Shri Sanjay Kumar Pandey
			Store management committee Dr Nikhlesh Pandya (Chairman) Mr I R Khan Shri Vikas Keshari
			Tofu Plant In charge Ms. Neha Pandy Shri S.N.Verma

Personnel

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

Administrative Staff		
31.	Mr. Saurabh Meena	SAO
32.	Mr. Ravindra Kumar	SF&AO
33.	Mr. Ajay Shrivastava	AAO
34.	Ms. Priyanka Sawan	AAO
35.	Mr. SP Singh	P.S.
36.	Mr. Ravi Shankar	Assistant
37.	Mr. Avinash Kalanke	Assistant
38.	Mr. Anil Carrasco	UDC
Technical Staff		
39.	Mr. RN Singh	T-9 (CTO)
40.	Dr N. Pandya	T-9 (CTO)
41.	Dr VPS Bundela	T-9 (CTO)
42.	Mr. SK Pandey	T-9 (CTO)
43.	Mr. RN Shrivastava	T-9 (CTO)
44.	Mr. DN Baraskar	T-9 (CTO)
45.	Mr. SK Verma	T-6 (Sr. TO)
46.	Mr. OP Vishwakarma	T-5 (T.O.)
47.	Mr. RC Shakya	T-5 (T.O.)
48.	Mr. IR Khan	T-5 (T.O.)
49.	Mr. Francis Yunis	T-5 (T.O.)
50.	Mr. Vikas Keshari	T-4
51.	Ms. Jyoti Meena	T-3
52.	Mr. Bilbar Singh	T-2 (Sr. Tech.)
53.	Ms. Seema Chouhan	T-1
Skilled Supporting Staff		
54.	Mr. Sanjiv Mishra	Duplicating Officer
55.	Mr. Nirbhay Singh	Skilled Supporting Staff
56.	Mr. Balbir Singh	Skilled Supporting Staff
57.	Mr. Janglia	Skilled Supporting Staff
58.	Mr. Surla	Skilled Supporting Staff
59.	Mr. Sur Singh	Skilled Supporting Staff
60.	Smt. Fulki Bai	Skilled Supporting Staff

61.	Smt. Raida Bai	Skilled Supporting Staff
62.	Shri Mangilal	Skilled Supporting Staff
63.	Smt. Kamli Bai	Skilled Supporting Staff
64.	Shri Deepak	Skilled Supporting Staff
65.	Smt. Chunki Bai	Skilled Supporting Staff
66.	Smt. Sagri Bai	Skilled Supporting Staff
67.	Smt. Sagar Bai	Skilled Supporting Staff
68.	Smt. Rekha Bai	Skilled Supporting Staff
69.	Smt. Meera Bai	Skilled Supporting Staff
70.	Smt. Parvati Bai	Skilled Supporting Staff
71.	Smt. Romu Bai	Skilled Supporting Staff
72.	Smt. Teju Bai	Skilled Supporting Staff
73.	Smt. Surja Bai	Skilled Supporting Staff
74.	Smt. Rumli Bai	Skilled Supporting Staff
75.	Smt. Sarita Bai	Skilled Supporting Staff
76.	Smt. Sangeeta Bai	Skilled Supporting Staff
77.	Smt. Hira Bai	Skilled Supporting Staff
78.	Smt. Antar Bai	Skilled Supporting Staff
79.	Smt. Mangi Bai	Skilled Supporting Staff
80.	Smt. Naki Bai	Skilled Supporting Staff

Joining, Promotions, Transfer, Retirement

Promotions

Name	Promoted to the post of	W. E. F.
Dr M.B. Ratnaparkhe	Principal Scientist	07.06.2019
Dr G.K. Satpute	Principal Scientist	15.06.2020
Dr Punam Kuchlan	Principal Scientist	16.02.2021
Dr Giriraj Kumawat	Sr. Scientist	01.09.2019
Dr Shiva Kumar M.	Sr. Scientist	02.07.2021
Dr Rakesh Kumar Verma	Scientist (SS)	05.07.2020
Dr V. Nataraj	Scientist (SS)	05.01.2021
Dr Subhash Chandra	Scientist (SS)	05.07.2021
Dr Vangala Rajesh	Scientist (SS)	05.07.2021
Dr Raghavendra Madar	Scientist (SS)	05.07.2021
Smt. Neha Pandey	Scientist (SS)	01.01.2020
Dr Laxman Singh Rajput	Scientist (SS)	05.07.2021
Dr Lokesh Kumar Meena	Scientist (SS)	01.01.2020
Shri Ravindra Kumar	Sr. Finance & Accounts Officer	20.07.2021
Shri Ram Manhohar Patel	Scientist SS	15.12.2016
Shri Ramendra Nath Shrivastava	Chief Technical Officer (T-9)	16.10.2020
Smt. Priyanka Sawan	Assistant Administrative Officer	22.06.2021
Shri Francis Damasus	Technical Officer (T-5)	29.06.2021

Joining

Shri Saurabh Meena, Senior Administrative Officer, from 16th Oct. 2021.

Transfer

Dr Maharaj Singh, Principal Scientist (Plant Physiology)

Retirements

S.No.	Name of the employee	Post	Date of Retirement
1	Dr Yogendra Mohan	CTO	31.03.2021
2	Dr Surendra Kumar	CDO	31.08.2021
3	Smt. Rami Bai,	SSS	31.08.2021
4	Shri Gorelal Chouhan	Technical Officer	31.12.2021

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

ICAR-Indian Institute of Soybean Research

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