ANNUAL REPORT 2024

भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान, नागपुर

ICAR- CENTRAL INSTITUTE FOR COTTON RESEARCH, NAGPUR

An ISO 9001:2015 Certified Organisation

वार्षिक प्रतिवेदन | ANNUAL REPORT

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PREFACE

Cotton is one of the oldest and most widely used natural fibers, with a history dating back thousands of years. It is known for being biodegradable and relatively inexpensive, making it a popular choice globally. Cotton is also linked to India's history, including its role in the freedom movement and the iconic Charkha (spinning wheel). Cotton plays a significant role in India's agricultural and industrial economy. It is a major cash crop, providing livelihoods to more than 6 million farmers and provides employment to more than 50 million workers engaged in ginning, processing, and trade. It is a significant source of employment across various sectors and a source of raw materials not only for the textile industry but also for several other industries. Cottonseed oil is a major vegetable oil with a significant share of approximately 28% in India's edible oil market. Cotton is the third-largest contributor to domestic edible oil production, followed by rapeseed/mustard and soybean.

India is one of the world's largest cotton producers, second only to China, accounting for approximately 24% of global cotton production. However, the cotton productivity (441 kg lint/ha during 2023-24) is among the lowest among the major cotton-producing countries, such as Australia (2140 kg lint/ha), China (1950 kg lint/ha), Brazil (1939 kg lint/ha) and USA (1008 kg lint/ha). The continued decline in cotton production and productivity in India for more than a decade is a major concern for producers, industry, and policymakers.

A decline in cotton production and productivity has been observed due to biotic and abiotic stresses. High incidences of pink bollworm in all three zones due to the breakdown of resistance of BG II cotton, incidences of whitefly and CLCuD in the north zone, and increasing infestation of sucking pests, TSV, and thrips in the central and south cotton growing zones are the major contributors to the losses in cotton yields. Abiotic stresses such as aberration in climatic conditions: high rainfall, flooding, high temperature, and drought stress, affect cotton production and productivity in rainfed cotton-growing areas. Different stakeholders are making efforts to address the issues of quality seed availability, adaption of best cotton cultivation, and protection practices throughout the crop season and after harvest, marketing, and processing.

Since 2018-19, the Institute has vigorously implemented the IRM- Pink Bollworm Management strategies program sponsored by DA&FW under NFSM-CC across eight major cotton-growing states, covering 15 districts, 76 villages, and 900 acres. Overall, a 42.3% reduction in pink bollworm infestation was observed in IRM fields compared to non-IRM fields during 2023-24. Similarly, DA&FW funded a special cotton project on 'Targeting technologies to agro-ecological zones - large scale demonstrations of best practices to enhance cotton productivity' under NFSM, which was implemented during 2023-24 with an outlay of 41.87 crores by ICAR-CICR in Public-Private Partnership (PPP) mode in the identified clusters adopting a value chain approach. The project was implemented in 61 districts of 8 states covering an area of 9064 ha, involving 10,418 farmers, with the aim of scaling up three cotton technologies: HDPS (90x15cm), closure planting (90x30 cm), and promotion of ELS. The farmers realized an increase in cotton yields from 6.6 q/acre to 8.68 q/acre in HDPS demonstrations, an increase of 30.4% over the conventional plots. Similarly, closer planting resulted in an increase of 39.15% in seed cotton yield from 7.71 to 9.91 q/acre and an increase of 6.81% in ELS from 5.73 to 6.11 q/acre.

The Institute has made several noteworthy achievements during 2024, including the identification, release, and notification of 6 varieties viz. three naturally colour-linted varieties, G. arboreum variety CICR-A NC Cotton- 67 (CNA 1092), two G. hirsutum varieties CNH 18529, CICR-H NC Cotton 58 (CNH 17395), and three Bt varieties CICR 18-Bt, CICR 20-31 Bt, and PKV 081 Bt (for South Zone). Several non-Bt and Bt entries were sponsored in ICAR-AICRP on Cotton trials. A total of 12,386 germplasm accessions were conserved, one exotic accession from Nepal and three from Meghalaya were added, and 5187 accessions were evaluated for morphological traits and biotic stress. Quality seed production of 24 CICR-released varieties was taken up to meet DAC and direct indents from various stakeholders. This includes nucleus seed (3.2q), breeder seed (52.30q), and TFL

seed (4.80 q). Putative cry1D T0 transformants for pink bollworm resistance were generated via in-planta transformation. Genome editing in cotton was initiated by targeting the GhNB, GhGalT1, GhFAD2-1, and GhPEPC genes to improve plant architecture, fiber, and seed oil traits.

The ICAR-CICR developed a 'AI Smart Trap' that enables real-time monitoring of pink bollworm in cotton, which will be useful for pest monitoring throughout the country. It was deployed in three districts of Punjab at 18 locations, and the results reveal a reduction of pesticide use by 36-38% and increase in seed cotton yield by 16-18%. The ETL has been revised based on moth trap catches corresponding to the percentage of green boll damage, providing a valuable decision-making tool for pink bollworm management in cotton.

Three ICAR-CICR Technologies were certified and certificates were issued by ICAR to the developers, including (i) Nutrient Expert, a decision support system for hybrid cotton, (ii) Novel cotton-based IFS model for rainfed dry sub-humid ecosystem, and (iii) Gap-filling technology for better cotton crop establishment. Four patents were granted to the institute for bacterial-based volatile attractants for the management of sucking pests (aphids, thrips, whitefly) and an attractant for beneficial insects. During the year, 81 research papers were published, with a higher proportion of papers (82.7%) having NAAS rating >6.0.

In continuation to the previous years, outreach activities of the Institute further strengthened under the Tribal Subplan (TSP), Scheduled Caste Sub-Plan (SCSP), and IRM Pink Bollworm Management Project by the Institute, and 67 training programs were conducted with 7413 beneficiaries. In the capacity building program. 23 staff members were trained on various aspects. The final report of Quinquennial Review Team (QRT) of the Institute and ICAR- AICRP on Cotton for the period of 2018-2023 was also submitted by Dr. B. Venkateswarlu, Chairman (QRT) to the Hon'ble Director General, ICAR, New Delhi.

I am grateful to Dr. Himanshu Pathak, Hon'ble Secretary, DARE & Director General, ICAR, for his constant encouragement and guidance in supporting the Institute. I am grateful to Dr. T.R. Sharma, Hon'ble DDG (CS), Dr. D.K. Yadava, ADG (Seeds) and Dr. P.K. Dash, ADG (CC) for their constant encouragement, guidance, and support. Contribution of Dr. G. T. Behere, Head, Crop Protection & Nodal Officer (AICRP on Cotton), Dr. A.S. Tayde, Head, Crop Production, Dr. A. H. Prakash, Head, Regional Station, Coimbatore, Dr. Rishi Kumar, Head I/c, Regional Station, Sirsa, and Dr. G.I. Ramakrushna, I/c (KVK) in the execution of research programmes and outreach activities is gratefully acknowledged. Dr. M. V. Venugopalan, Principal Scientist, and Dr. K. P. Raghavendra, Sr. Scientist & I/c PME Cell have significantly contributed in shaping up the research activities of the Institute and need special acknowledgement. We would also like to thank the members of the Editorial Committee for their sincere and dedicated efforts in preparing this Annual Report-2024. Dr. K. Velmourougane, Mrs. Vandana Satish, Shri. Paresh Bhoyar and Mrs. Rama Iyer deserve special appreciation for their strenuous efforts and commitment in preparing this beautiful Annual Report.

(V. N. Waghmare)
Director

CONTENTS

1 कार्यकारी सारांश

फसल सुधार

- जी. आर्बोरियम और जी. हिर्सुटम दोनों के लिए सरल पुनरावृत्त चयन के दो चक्र पूरे किए गए। एआईसीआरपी (आई ई टी) परीक्षणों में चार जी. आर्बोरियम जीनोटाइप और बेहतर उपज और फाइबर गुणवत्ता विशेषताओं वाले दो संकर प्रायोजित किए गए। उत्तरी क्षेत्र में कृषि विज्ञान परीक्षण के लिए एक देसी संकर सीआईएसएए १९–४ को बढ़ावा दिया गया और जी. आर्बोरियम की सीएनए १०९२ किस्म की पहचान की गई और वर्षा आधारित स्थिति के तहत मध्य क्षेत्र में व्यावसायिक खेती के लिए जारी किया गया।
- १२,३८६ एक्सेशन का संरक्षण, नेपाल से एक विदेशी एक्सेशन और मेघालय से तीन एक्सेशन को शामिल करना; ५१८७ एक्सेशन का रूपात्मक लक्षणों के लिए मूल्यांकन और जैविक तनाव सहिष्णुता के लिए जांच; दो संवर्धन (कप के आकार की पत्ती लोब के साथ घने रोएँ वाले रंजित पौधे) और सीएनएच २२२७५ (जैसिड्स प्रतिरोधी) को आनुवंशिक स्टॉक के रूप में पंजीकरण के लिए पहचाना गया और सार्वजनिक और निजी क्षेत्र के प्रजनकों को विविधता दिखाने के लिए जर्मप्लाज्म फील्ड डे का आयोजन किया गया।
- बत्तीस जंगली प्रजातियों को इन–सीटू संरक्षित किया गया, पांच (५) अंतर्वर्धित वंश (जी. आर्बोरियम x जी.लॉन्गिकैलिक्स) की पहचान की गई और उन्हें जेनेटिक स्टॉक के रूप में पंजीकरण के लिए चुना गया, और जीवीएस ८/९ से प्राप्त १० बीसी३एफ१ आबादी का सिरसा में मूल्यांकन किया गया। बेहतर फाइबर गुणवत्ता और जैसिड्स के प्रति सहनशील बीटी संकर के विकास के लिए आनुवंशिक रूप से विविध जनक रेखा का उपयोग किया गया। तीन एफ१ संकर, विशेष रूप से आईसी३५६६५५ x पी के वी ०८१ बीटी, आई सी २०४७१० x सीआईसीआर २१ बीटी और आई सी ३५७२५५ x ५०३ ने सर्वश्रेष्ठ प्रदर्शन करने वाली पैतृक वंश (सीआईसीआर २१ बीटी) से बेहतर प्रदर्शन किया।
- देसी (जी. आर्बोरियम) कपास में, संकर सीआईएसएए १९–४ को २०२४–२५ के लिए एआईसीआरपी (उत्तरी क्षेत्र) के तहत कृषि विज्ञान परीक्षण में पदोन्नत किया गया था, जबकि दो अन्य संकर– सीआईएसएए २२–३ और सीआईएसएए २२–१– को एआईसीआरपी (उत्तरी क्षेत्र) २०२४–२५ के तहत उन्नत/समन्वित परीक्षण (बीआर २५ए सीएचटी) के लिए पदोन्नत किया गया था।
- सी.एल.सी.यू.डी. प्रतिरोधी प्रजनन के लिए आयोजित स्टेशन परीक्षणों में, जीनोटाइप सी.एस.एच. एन.बी. १३, सी.एस.एच. एन.बी. १४, सी. एस.एच. एन.बी. २३, तथा सी.एस.एच. एन.बी. २८ की पहचान आशाजनक सी.एल.सी.यू.डी. प्रतिरोधी जीनोटाइप के रूप में की गई, जिनमें २% से कम पी.डी.आई. तथा सर्वश्रेष्ठ मानक किस्म एफ २२२८ की तुलना में काफी अधिक बीज कपास उपज प्रदर्शित की गई, जबकि जी.वी.एस. ९ (प्रतिरोधी) x एचएस ६ (संवेदनशील) के क्रॉस से प्राप्त एफ२ जनसंख्या के पृथक्करण विश्लेषण के दौरान सी.एल.सी.यू.डी. प्रतिरोध को नियंत्रित करने वाला एक एकल प्रभावी जीन सामने आया।
- जीईएसी–स्वीकृत संकरों के मूल्यांकन के दौरान, दोनों परीक्षणों में सीएलसीयूडी के लिए पीडीआई ०% से १८% तक थी। सामान्य परीक्षण में ८४ प्रविष्टियों में से, लगभग ५४ बीजी II संकरों ने बेहतर उपज (>२८ क्विंटल/हेक्टेयर) दर्ज की। इसी तरह, हरियाणा राज्य परीक्षण में मूल्यांकन की गई १६ प्रविष्टियों में से, १० बीजी II संकरों ने उच्च उपज प्रदर्शन (>३१ क्विंटल/हेक्टेयर) प्रदर्शित किया।
- अच्छी मजबुती वाले लंबी रेशा वाली किस्मों (१९) का मूल्यांकन जैविक स्थिति में दोहराए गए परीक्षण में किया गया, साथ ही उपज और फाइबर की गुणवत्ता के लिए एक जांच किस्म के रूप में सुरक्षा का मूल्यांकन किया गया और बहु–स्थान मूल्यांकन परीक्षणों में आगे के मूल्यांकन के लिए सर्वोत्तम कल्चर की पहचान की गई।
- पांच (एच x बी) संकरों ने लगातार तीन वर्षों तक स्थिर उपज और फाइबर गुणवत्ता दिखाई, जिसमें उपज, मानक किस्म से काफी अधिक थी। एक जी. बारबाडेंस और एक जी. हिर्सुटम लाइन क्रमशः बेहतर उपज और तना भृंग (स्टेम वीविल) प्रतिरोधी के साथ विकसित की गई थी।
- ग्लाइफोसेट प्रतिरोध/सहिष्णुता के लिए पहले से पहचानी गई सहनशील (२०) और अतिसंवेदनशील (२०) लाइनों सहित ७२४० जी. हिर्सुटम लाइनों की स्क्रीनिंग की गई। लक्षणों के आधार पर, ३९ सहनशील और २० सबसे अतिसंवेदनशील लाइनों की पहचान की गई।
- मैजिक जनसंख्या एफ६ से एफ ७ पीढ़ी तक उन्नत की गई और कोर सेट के विकास हेतु फेनोटाइपिक डेटा रिकॉर्ड किया गया है।
- तीन बीटी कपास किस्मों, सीआईसीआर एच बीटी कपास ४०, सीआईसीआर एच बीटी कपास ६६ (सीआईसीआर बीटी २०–३) और सीआईसीआर एच बीटी कपास ६५ (सीआईसीआर १८ बीटी) को अधिसूचित किया गया। कुल मिलाकर, विभिन्न एआईसीआरपी परीक्षणों के तहत ११ बीटी कपास जीनोटाइप का परीक्षण किया गया।
- सूखा–सहिष्णु लाइन की पहचान २९.५ मिमी फाइबर लंबाई, २७.३ ग्राम/टेक्स, ३४.८% जिनिंग आउट टर्न और ३.२ माइक्रोनेयर के साथ की गई और इसे जैविक कपास परीक्षण के लिए प्रायोजित किया गया।
- क्राई १डी जीन को व्यक्त करने वाले ट्रांसजेनिक तम्बाकू ने स्पोडोप्टेरा लिटुरा के विरुद्ध प्रभाव नहीं दिखाया, जो पहले के जीवाणु अभिव्यक्ति परिणामों की पुष्टि करता है। गुलाबी बॉलवर्म प्रतिरोध के लिए संभावित क्राई १डी टी० ट्रांसफॉर्मेंट को इन–प्लांटा ट्रांसफॉर्मेशन के माध्यम से उत्पन्न किया गया था, और पौधों को टी १ बीज की कटाई के लिए पॉलीहाउस में स्थानांतरित किया गया था।
- कपास में जीनोम संपादन की शुरुआत जीएचएनबी (GhNB), जीएचजीएएलटी १ (GhGalT1), जीएचएफएडी२–१(GhFAD 2-1) और जीएचपीईपीसी (GhPEPC) जैसे जीन को लक्षित करके की गई ताकि पौधे की संरचना, फाइबर और बीज तेल के लक्षणों में सुधार हो सके। उम्मीदवार जीन अनुक्रमों को कोकर ३१२ से क्लोन और अनुक्रमित किया गया, और सीआरआईएसपीआर–सीएएस९

(CRISPR-Cas9) संपादन के लिए एसजीआरएनए (sgRNA) डिज़ाइन और सत्यापन चल रहा है।

- पिंक बॉलवर्म (पी बी डब्लू) ट्रांसक्रिप्टोम को अनुक्रमित किया गया, जिसमें ३०,१२४ जीन की पहचान की गई और दो काइटिन बायोसिंथेसिस जीन (PgAGM and PUAP) को पीबीडब्लू प्रबंधन के लिए आरएनएआई (RNAi) लक्ष्य के रूप में मान्य किया गया। इसके अतिरिक्त, एक लागत प्रभावी डीएसआरएनए (dsRNA) संश्लेषण प्रोटोकॉल विकसित किया गया, और α-ट्यूबुलिन को सामान्यीकरण हेतु उपयुक्त माना गया।
- जीएचएएलएस (GhALS) प्रोटीन और उनके उत्परिवर्ती रूपों के ६x-His-टैग वाले रूप को अभिव्यक्त करने और शुद्ध करने के लिए एक मानकीकृत प्रक्रिया/प्रोटोकॉल स्थापित किया गया। कपास के छोटे आरएनए(RNA) प्रोमोटर पीयू६–२६–जीएच ६.७और पीयू६–२९–जीएच६.३ को क्लोन कर उनकी अनुक्रम की पुष्टि की गई तथा उन्हें पीजीडब्लूबी४३३ में स्थानांतरित किया गया ताकि अस्थायी जेयूएस अभिव्यक्ति परीक्षणों के माध्यम से उनके कार्यात्मक प्रमाणीकरण किया जा सके।
- अनुशंसित फसल उत्पादन तकनीक के साथ–साथ पत्तियों पर केएनओ ३ (KNO_3)और सूक्ष्म पोषक तत्वों के छिड़काव से कपास में रुई उत्पादन, रोमयुक्त बीज उत्पादन, शुद्ध बीज उत्पादन तथा शुद्ध बीज प्राप्ति के प्रतिशत में उल्लेखनीय वृद्धि दर्ज की गई।
- भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान में पादप किस्म अधिनियम, २००१ के अंतर्गत ६०० से अधिक संभावित कपास जीनोटाइप्स का डीयूएस (DUS) परीक्षण किया गया। वर्तमान में प्रचलित सभी कपास किस्मों का पूर्ण डेटाबेस भी लिखित रूप में प्रमाणित किया गया है और उसे डिजिटल रूप से संरक्षित भी किया जा रहा है
- बीज वृद्धावस्था के परीक्षण में पाया गया कि आर्बोरियम किस्म में हिर्सुटम किस्म की तुलना में तीव्र कृत्रिम वृद्धावस्था के प्रति अधिक संवेदनशीलता दिखाई दी। ४८ घंटे की वृद्धावस्था के बाद आर्बोरियम में अंकुरण ६५% से भी नीचे गिर गया, जबकि हिर्सुटम में यह स्तर ७२ घंटे बाद देखा गया।
- केन्द्रीय कपास अनुसंधान संस्थान द्वारा विकसित २४ किस्मों के गुणवत्तापूर्ण बीजों का उत्पादन किया गया ताकि कृषि सहकारिता विभाग (डीएसी) की मांग तथा विभिन्न हितधारकों से प्राप्त प्रत्यक्ष मांग को पूरा किया जा सके। इसमें न्यूक्लियस बीज (३.२ क्विंटल), ब्रीडर बीज (५२.३० क्विंटल) और टीएफएल बीज (४.८० क्विंटल) शामिल हैं।
- डीएसी की मांग पूरी करने के साथ–साथ इन किस्मों का प्रचार महाराष्ट्र, मध्य प्रदेश, तेलंगाना एवं गुजरात राज्यों में भी किया गया, तथा जैविक/प्राकृतिक खेती समूहों और कृषक किसान उत्पादक संगठनों (एफपीओ) सहित सभी की मांग पूरी की गई।

फसल संरक्षण

- भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान ने एक 'एआई स्मार्ट ट्रैप' विकसित किया है, जो कपास में गुलाबी सुंडी (पिंक बॉलवर्म) की वास्तविक समय (रियल–टाइम) में निगरानी करने में सक्षम है, जो क्षेत्र–व्यापी कीट निगरानी के लिए उपयोगी सिद्ध होगा
- कीटनाशक (इनसेक्टिसाइड + फफूंदनाशक) की खपत क्रमश: उत्तर भारत में ८३९, मध्य भारत में १४१७, दक्षिण भारत में २१२३ और पूरे भारत में औसतन १४९४ ग्राम सक्रिय तत्व प्रति हेक्टेयर दर्ज की गई। इसमें कीटनाशकों का हिस्सा ८९% और फफूंदनाशकों का हिस्सा ११% रहा।
- हेलीकोवर्पा आर्मीजेरा की खेतों में पाई जाने वाली आबादी के विरुद्ध आठ कीटनाशकों का परीक्षण किया गया, जिनमें से नवीन कीटनाशकों में इमामेक्टिन बेंजोएट और परंपरागत कीटनाशकों में प्रोफेनोफॉस को सबसे प्रभावी पाया गया। कीटनाशक और फफूंदनाशक के मिश्रण से बचना चाहिए, विशेषकर कॉपर ऑक्सी क्लोराइड के साथ, क्योंकि इसमें परतों का अलग होना (Phase Separation) स्पष्ट रूप से दिखाई देता है।
- एआई–सक्षम स्मार्ट ट्रैप में स्पोडोप्टेरा लिटुरा और हेलीकोवर्पा आर्मीजेरा पतंगों की पहचान और गिनती के लिए मशीन लर्निंग एल्गोरिद्म विकसित किए गए, जिन्होंने क्रमश: ९२.३% और ८९.१% की पहचान सटीकता हासिल की। जैसिड, थ्रिप्स, सफेद मक्खी, एफिड और गुलाबी सुंडी पतंगों की निगरानी और प्रबंधन के लिए एक बहुरंगी ग्लू–फिन ट्रैप विकसित कर फील्ड में परीक्षण किया गया, जो एक ही ट्रैप सिस्टम के माध्यम से सभी कीटों की निगरानी में सक्षम है।
- हरे बॉल (कच्चे कपास फल) को होने वाले नुकसान के प्रतिशत के आधार पर मॉथ ट्रैप में पकड़े गए कीटों की संख्या के अनुसार ईटीएल (आर्थिक क्षति स्तर) को संशोधित किया गया है, जो गुलाबी सुंडी प्रबंधन में निर्णय लेने के लिए एक मूल्यवान उपकरण प्रदान करता है।
- गैर–मौसमी जिनिंग मिल सर्वेक्षण (फरवरीदृमई २०२४) के दौरान गुलाबी सुंडी के कारण बीज क्षति का औसत २४.६८% (११.१८% से ४१.९८% तक) दर्ज किया गया। लार्वा की प्राप्ति ०.०० से १८.३३ तक रही, जबकि प्यूपा केस (कोष अवस्था) की प्राप्ति ०.०० से २५.०० तक पाई गई।
- वर्ष २०२३–२४ के दौरान गुलाबी सुंडी (पिंक बॉलवर्म) के प्रबंधन हेतु रणनीतियाँ ८ राज्यों के १५ जिलों में फैले ७६ गांवों के ९०० एकड़ क्षेत्र में लागू की गईं। कुल मिलाकर, IRM (एकीकृत प्रतिरोध प्रबंधन) क्षेत्रों में गैर–IRM क्षेत्रों की तुलना में गुलाबी सुंडी के प्रकोप में ४२.३% की कमी दर्ज की गई।
- मेटारिज़ियम एनिसोप्लिए के टीएमबीएमए १ स्ट्रेन ने डस्की कॉटन बग के विरुद्ध प्रयोगशाला स्थितियों में ९९% तक मृत्यु दर दर्शाते हुए उच्च रोगजनकता दिखाई। फील्ड परीक्षणों में इस जैव कंट्रोल एजेंट ने एफिड, गुलाबी सुंडी (पिंक बॉलवर्म) और जैसिड की आबादी को प्रभावी रूप से कम किया, जिससे यह स्पष्ट होता है कि यह कपास में सतत कीट प्रबंधन के लिए एक प्रभावी जैव कीटनाशक (बायोपेस्टीसाइड) बन सकता है
- कपास में टी मस्किटो बग हेलोपेल्टिस थिवोरा द्वारा होने वाले नुकसान का आकलन करने के लिए संपूर्ण पौधे पर आधारित एक व्यापक स्कोरिंग प्रणाली विकसित की गई। थायमेथोक्साम १२.६०% + लैम्डा–साइहैलोथ्रिन ९.५०% झेडसी तथा डिनोटेफ्यूरन २० एसजी को एच. थिवोरा के कंट्रोल में अत्यधिक प्रभावी पाया गया।
- कॉटन स्टेम वीविल (तने की सूंडी) की रासायनिक पारिस्थितिकी को समझने में आकर्षक यौगिकों, विशेष रूप से कंपाउंड सी , की पहचान से महत्वपूर्ण जानकारी प्राप्त हुई है। इन निष्कर्षों के आधार पर लक्षित कीट प्रबंधन रणनीतियाँ, जैसे कि आकर्षक–आधारित ट्रैप्स और रेपेल्लेंट (कीट भगाने वाले पदार्थ) विकसित किए जा सकते हैं, जो वीविल की आबादी को प्रभावी ढंग से नियंत्रित करने में सहायक होंगे और पर्यावरण

पर न्यूनतम प्रभाव डालेंगे।

- हरियाणा राज्य प्रायोजित परीक्षण (२०२३-२४) के अंतर्गत ४० बीटी कपास संकर किस्मों में गैर–बीटी पौधों के अनुपात का मूल्यांकन किया गया, जो ० से १८.२१% के बीच पाया गया। उल्लेखनीय रूप से, २०२२ की तुलना में २०२३ में अधिक संख्या में संकर किस्में अनुशंसित रिफ्यूजिया सीमा के भीतर पाई गईं।
- तापमान तनाव पर किए गए अध्ययन से पता चला कि अत्यधिक कम और अधिक तापमान दोनों ही सफेद मक्खी के जीवित रहने पर महत्वपूर्ण प्रभाव डालते हैं। होस्ट पौधे की उपस्थिति या अनुपस्थिति भी इसके जीवन दर को प्रभावित करती है। अल्पकालिक रूप से अत्यधिक तापमान के संपर्क में आने से सफेद मक्खी की जैविक क्रियाओं में परिवर्तन देखा गया।
- सूचना एवं संचार प्रौद्योगिकी (आय सी टी) उपकरणों का उपयोग करते हुए कपास कीट प्रबंधन की प्रभावी रणनीतियाँ लागू की गईं, और महाराष्ट्र में क्रॉपसैप (ब्ल्ब्ै।ब २०२३–२४) में एक प्रमुख भागीदार के रूप में योगदान दिया गया। २०२३–२४ के दौरान तीनों प्रकार की सुंडियाँ (बॉलवर्म्स) और चूसक कीट पूर्णत: कंट्रोल में रहे।
- कपास की फसल पर फिप्रोनिल के चार बार छिड़काव के बाद, कपास जैसिड में प्रतिरोधकता का विकास २४ घंटे बाद ३४ गुना और ४८ घंटे बाद १२ गुना पाया गया, जबकि फ्लोनिकामिड के प्रयोग के बाद २४ और ४८ घंटे पर बहुत ही कम प्रतिरोधकता दर्ज की गई।
- कपास से एकत्रित कोरीनेस्पोरा कैसिकोला जीवाणु के आनुवंशिक विविधता और रोगजनकता के अध्ययन में कैसिकोलिन जीन, विशेष रूप से सीएएस ५ (Cas 5), की अधिकता पाई गई, जो रोग की तीव्रता में इसकी प्रमुख भूमिका को दर्शाता है। फील्ड प्रयोगों से यह सिद्ध हुआ कि प्रतिरोधी किस्मों और लक्ष्यित फफूंदनाशी रणनीतियों (विशेष रूप से जैव एजेंटों के समूह का उपयोग) से टारगेट लीफ स्पॉट रोग की घटना में प्रभावी कमी लाई जा सकती है।
- बॉल रॉट रोग समूह से जुड़े रोगजनकों की व्यापकता, रोग के कारण बनने वाले कारकों तथा फाइटोपैथोजन्स (रोगजनक जीवाणुओं) की विविधता का अध्ययन किया गया और रोग के समेकित प्रबंधन (हेतु रणनीतियाँ तैयार की गईं।
- रामुलरिया एरिओला का विभिन्न कपास प्रजातियों पर क्रॉस–इनोकुलेशन (पारस्परिक संक्रमण) ग्लास हाउस और फील्ड में किया गया, लेकिन विभिन्न संकर किस्मों पर ग्रे मिल्ड्यू रोग की तीव्रता फील्ड में कम पाई गई। ग्रे मिल्ड्यू रोग के विरुद्ध सर्वश्रेष्ठ प्रबंधन पद्धति की पहचान हेतु दूसरे वर्ष का फील्ड परीक्षण किया गया। अधिकतम पीडीआई (रोग तीव्रता प्रतिशत) कंट्रोल में १३.३% दर्ज किया गया, इसके बाद ज्र (ट्राइकोडर्मा हार्ज़ियानम का फोलियर स्प्रे @ ९० और बुआई के ११० दिनों बाद) में ११.७३% रहा। कंट्रोल की तुलना में रोग में अधिकतम कमी ज५ (कॉम्बी उत्पाद दृ एज़ॉक्सीस्ट्रोबिन १८.२% + डाइफेनोकोनाज़ोल ११.४% का फोलियर स्प्रे @ ९० और ११० बुआई के ११० दिनों बाद) में दर्ज की गई।
- कपास की पत्तियों में पी. गॉसिपी (कॉटन रस्ट रोगजनक) के संक्रमण प्रक्रिया से संबंधित नवीन जानकारी प्राप्त की गई, जो कॉटन रस्ट पर कंट्रोल के लिए नई और अधिक प्रभावी प्रबंधन रणनीतियाँ विकसित करने में सहायक हो सकती है।
- ट्राइकोडर्मा वीरीडे के राइजोस्पेरिक फफूंद आइसोलेट्स सीआईसीआर–आरएफ–टीएच–११(CICR-Rf-Th-11), सीआईसीआर–आरएफ–१६ (CICR-Rf-16, सीआईसीआर–आरएफ–६०(CICR-Rf-60, सीआईसीआर–आरएफ–६३ (CICR-Rf-63), आरएफ–टीएनएयू टीवी१ (Rf-TNAUTv1) और आरएफ–सीआरएसवीपीटी टीवी १ (Rf-CRSVPT Tv 1) को बीज अंकुरण, पौधों की जीवंतता (विगर) तथा रूट रॉट रोग प्रबंधन के दृष्टिकोण से श्रेष्ठ पाया गया।
- नीम *(Azadirachta indica)* की पत्तियों से प्राप्त एक टेट्रानॉरट्राइटरपीनॉइड (लिमोनॉइड) यौगिक निम्बोलाइड के मॉलिक्यूलर डॉकिंग अध्ययन से पता चला कि इसकी निमेटोड्स (सूक्ष्म कृमियों) के प्रोटीन लक्ष्य पर सबसे अधिक बाइंडिंग एफिनिटी है। इसके बाद निमेटिसाइड्स फ्लूपायरम और फ्लुएनसल्फोन का स्थान रहा, जबकि कार्बोफ्यूरान की बाइंडिंग एफिनिटी सबसे कम पाई गई। निम्बोलाइड ने निम्नलिखित लक्षित प्रोटीनों कृ ओडीआर १ (ODR 1), कैथेप्सिन एल–प्रकार की सिस्टीन प्रोटीनेज, एचएसपी९०, न्यूरोपेप्टाइड जीपीसीआर, हीट शॉक आदि कृ पर संभावित अवरोधक के रूप में कार्य किया और निमेटोड्स में स्थायी पक्षाघात उत्पन्न किया।
- कपास में चूसक कीटों के पर्यावरण अनुकूल प्रबंधन के लिए बायोपेस्टीसाइड कंसोर्टिया (लेकेनिसिलियम लेकेनी और एसिनेटोबैक्टर लवॉफी) के तरल फार्मुलेशन का ५ मिली/लीटर की दर से १५–१५ दिनों के अंतराल पर दो बार छिड़काव करने की सिफारिश की गई है।

  टैल्क आधारित बायोनिमेटीसाइड कंसोर्शिया(पोकोनिया क्लेमाइडोस्पोरिया और स्यूडोमोनास फ्लोरेसेंस) का १ किलोग्राम प्रति एकड़ की दर से प्रयोग फील्ड स्थितियों में केंचुओं और लाभकारी सूत्रकृमियों (शिकार करने वाले एवं कीटजन्य रोग फैलाने वाले सूत्रकृमि) के लिए सुरक्षित पाया गया।

फसल उत्पादन

- गोबर खाद (५ टन/हेक्टेयर) + अन्य वैकल्पिक स्रोतों से पीकेव्हे संकुल (८.९६ क्विं/हेक्टेयर) और उर्वरक की आवश्यक मात्रा (अकार्बनिक उपचार) (११.९३ क्विं/हेक्टेयर) के साथ समान बीज कपास उपज (९.६९ क्विं/हेक्टेयर) का उत्पादन किया गया। रंगीन देसी कपास के किस्म सी.एन.ए १७५–२२ (१४.९९ क्विं/हेक्टेयर) ने सबसे अधिक बीज कपास उपज का उत्पादन किया, जिसके बाद गैर–बीटी संकर पार्टेक २९ (१३.८८ क्विं/हेक्टेयर) का स्थान रहा।
- सिंचित कपास के खेतों में औसत बीज कपास उपज (८.६ क्वि. एकड़) प्राप्त हुई, जो वर्षा आधारित खेतों की तुलना में ६८% की वृद्धि दर्शाती है। विशेष रूप से जलगांव और नंदुरबार में गंभीर गुलाबी सूंडी संक्रमण ने कम पैदावार में योगदान दिया, जिससे उत्पादकता बढ़ाने के लिए एकीकृत कीट और जल प्रबंधन की आवश्यकता पर प्रकाश डाला गया।
- २०२४–२५ के कपास के खेती के दौरान, कपास से प्रति हेक्टेयर लगभग १.१७ टन कार्बन संचयित किया गया।
- कपास के साथ इन–सीटू कवर फसल के रूप में उगाई गई और ४५ कौ। पर शामिल की गई सनहेम्प ने उच्च कार्बन डाइऑक्साइड (eCO_2) के तहत सबसे अधिक बायोमास संचयन किया। उच्च कार्बन डाइऑक्साइड (eCO_2) के तहत एकीकृत पोषक तत्व प्रबंधन (INM) ने उच्चतम बीज कपास उपज, मृदा कार्बनिक कार्बन और मृदा उपलब्ध छ दर्ज किया, और इसे उच्च कार्बन डाइऑक्साइड (eCO_2) के तहत एक स्थायी छ प्रबंधन रणनीति के रूप में समर्थित किया गया। आईएनएम प्रथाओं द्वारा

उच्च कार्बन डाइऑक्साइड (eCO_2) के तहत नायट्रोजन (N) तनुकरण प्रभाव को कम किया गया।

- जलभराव का समय पर प्रबंधन, ड्रोन स्प्रे द्वारा प्राप्त किया जा सकता है, जिसमें जलभराव के ५वें दिन सैलिसिलिक एसिड / ०.५ mM एकल स्प्रे के साथ ३७.५ लीटर/हेक्टेयर की दर उपयोग किया जाता हैद्य इसके अलावा और जलभराव के ८वें दिन २% KNO_3 का उपयोग किया जाता है और मेड़ और फ़रो भूमि विन्यास के साथ (जल निकासी के बाद) २० किग्रा/हेक्टेयर नाइट्रोजन और पोटेशियम प्रत्येक का उपयोग किया जाता है।
- जी. बारबाडेंस जीनोटाइप (सुविन, सीआईसीआर बी कॉट ४५) में पौधों की सघनता (९० x १५ सेमी की दूरी; ७४,०७४ पौधे प्रति हेक्टेयर) और पौध वृद्धि नियामक–आधारित कैनोपी प्रबंधन में वृद्धि के माध्यम से उपज में वृद्धि ने निकट भविष्य में एक्स्ट्रा–लॉन्ग स्टेपल (ईएलएस) कपास की मशीन से कटाई की संभावना का संकेत दिया है।
- उच्च घनत्व रोपण प्रणाली के तहत, कपास के छत्र प्रबंधन में रासायनिक छिड़काव ड्रोन का उपयोग कर के किया जा सकता है, जिसमें पारंपरिक उच्च मात्रा वाले स्प्रेयर (२०० लीटर स्प्रे द्रव्य/एकड़) के बजाय २० लीटर स्प्रे द्रव (पानी)/एकड़ में ए.आई. आधार पर मेपिक्वेट क्लोराइड की अनुशंसित खुराक को मिलाया जाता है।
- क्षेत्रीय स्तर पर, सर्वोत्तम योजना के तहत, वर्षा आधारित कपास के अंतर्गत आने वाले फसल क्षेत्र को ५६.४१ हेक्टेयर से बढ़ाकर ६७.१ हेक्टेयर और सिंचित कपास के अंतर्गत क्षेत्र को १०७.७६ हेक्टेयर से बढ़ाकर १३५.३८ हेक्टेयर करने का सुझाव दिया गया है। अध्ययन से पता चलता है कि उत्पादक सामग्री की समय पर उपलब्धता, सिंचाई सुविधाओं और किसानों के बीच जागरूकता पैदा करने से कोयंबटूर जिले में कपास के अंतर्गत आने वाले क्षेत्र बढ़ने की संभावना है।
- संरक्षण कृषि आधारित कपास–गेहूँ प्रणाली प्रयोग के तहत, कपास के लिए शून्य जुताई + गेहूं अवशेष प्रतिधारण + मल्चर संचालन (कपास) और हैप्पी सीडर के साथ गेहूं के लिए शून्य जुताई + कपास अवशेष प्रतिधारण + मल्चर संचालन (गेहूँ) के साथ दोनों फसलों (किसानों की प्रथा) के लिए पारंपरिक जुताई प्रथाओं की तुलना में काफी अधिक बीज कपास उपज, गेहूं अनाज उपज और कुल उत्पादकता प्राप्त की गई।
- छत्र प्रबंधन में, पौधों की दूरी (प्रथम कारक) के बीच, ६७.५ x ४५ सेमी की दूरी ६७.५ x ६० सेमी की व्यापक दूरी की तुलना में काफी अधिक बीज कपास उपज हुई। द्वितीय कारक (मोनोपोडिया हटाने, डिटॉपिंग और विकास नियामक अनुप्रयोग) के तहत, डिटॉपिंग + ईथरल अनुप्रयोग के संयोजन ने कंट्रोल की तुलना में सबसे अधिक उपज दी।
- फसल ज्यामिति प्रयोग में, अन्य फसल ज्यामिति की तुलना में २.२१ फीट पंक्ति दूरी x २.० फीट पौधे की दूरी (६७.५ x ६० सेमी) के साथ काफी अधिक बीज कपास की उपज प्राप्त की गई।
- विभिन्न कपास किस्मों (गैर–बीटी, बीटी–किस्म और बीटी–संकर) में अधिकतम उपज बीटी–संकर के साथ दर्ज की गई, उसके बाद बीटी–किस्में दर्ज की गई। ऑन–फार्म परीक्षणों की तुलना में स्टेशन परीक्षणों में उच्च बीज कपास की उपज दर्ज की गई।
- नैनो–Zn फॉर्मूलेशन वर्षा आधारित काली कैल्केरियस मिट्टी में मिट्टी और कपास के पौधे के हिस्सों में Zn सांद्रता को सकारात्मक रूप से बढ़ाते हैं।
- बढ़ी हुई जाली पानी की गहराई को प्रोफ़ाइल के निचले स्तरों में अधिक रिसने के लिए जिम्मेदार ठहराया जा सकता है।
- पादप हार्मोन जैसे आयएए, आयबीए, आइसोपेन्टाइल एडेनोसिन (साइटोकिनिन), एसए, जेए, एज़ेलिक एसिड, सक्सिनिक एसिड, टी–सिनामिक एसिड, और सिस–सिनामिक एसिड आदि का पता लगाने के लिए एक विधि को जीसी–एमएस पर स्कैन और सिम मोड का उपयोग करके सिलीलेशन (बी एसटीएफए, एमएसटीएफए, और बीएसटीएफए + टीएमसीएस) और मिथाइलेशन (एमसीएफ) द्वारा अनुकूलित और मान्य किया गया था। परीक्षण किए गए व्युत्पन्नकरण विधियों में, बीएसटीएफए +१% टीएमसीएस ने फाइटोहोर्मोन का सबसे अच्छा पता लगाने की सुविधा प्रदान की।
- माइक्रोबियल कंसोर्शिया (MC4) के बीज और मिट्टी के अनुप्रयोग ने कपास की वृद्धि, पौधे की शारीरिकी, पौधे की रक्षा/एंटीऑक्सीडेंट एंजाइम गतिविधियों, बीज कपास की उपज, मिट्टी में पोषक तत्वों की उपलब्धता और मिट्टी के जैविक गुणों को महत्वपूर्ण रूप से बढ़ाया और कपास में अजैविक तनाव (जल–जमाव और सूखा) को कम किया।
- जीवाणु–आधारित वाष्पशील: टीसी, एचडीसी, एचटीसी, पीवाई, डीबीपी, ईसी,और ईसी ने कंट्रोल की तुलना में क्रमश: अल्टरनेरिया (९८%), फ्यूजेरियम (३३%), राइज़ोक्टोनिया (७८%), मैक्रोफ़ोमिना (३०६%), कोरीनेस्पोरा (२१९%), स्क्लेरोटियम (२१५%), और मायरोथेसियम (२२%) जैसे कपास रोगजनकों में N–एसिटाइलग्लुकोसामिन (NAG) सामग्री को महत्वपूर्ण रूप से कम कर दिया। कपास रोगजनकों के N–एसिटाइलग्लुकोसामिन (NAG) सांद्रता और फंगल बायोमास के बीच एक महत्वपूर्ण सकारात्मक सहसंबंध भी देखा गया।
- तीनों कृषि–जलवायु क्षेत्रों में सर्वोत्तम विस्तार प्रथाओं (बीईपी) का उपयोग करके कपास में सर्वोत्तम कृषि प्रथाओं (बीएफपी) के प्रसार ने बीज कपास की उपज को २२५ किलोग्राम से २१०० किलोग्राम प्रति हेक्टेयर तक स्थायी रूप से बढ़ाया है, और कपास उत्पादकों के ज्ञान संवर्धन में वांछनीय परिवर्तन लाया है।
- अधिकांश उत्तरदाताओं ने महसूस किया कि कपास की किस्म सुरभि ने ग्रीष्मकालीन सिंचित परिस्थितियों में कपास उत्पादकों की आजीविका पर महत्वपूर्ण प्रभाव डाला है। ई–कपास मोबाइल सलाह ने कपास उत्पादकों के ज्ञान स्तर पर महत्वपूर्ण प्रभाव डाला।

२०१८–२०२३ की अवधि के लिए संस्थान और आईसीएआर–एआईसीआरपी की कपास पर पंचवर्षीय समीक्षा टीम की अंतिम रिपोर्ट भी डॉ. बी. वेंकटेश्वरलू, अध्यक्ष (QRT) द्वारा माननीय महानिदेशक, आईसीएआर, नई दिल्ली को सौंपी गई।

1 EXECUTIVE SUMMARY

Crop Improvement

- Two cycles of simple recurrent selection were completed for both *G. arboreum* and *G. hirsutum*. Four *G. arboreum* genotypes and two hybrids with superior yield and fibre quality traits were sponsored in the AICRP (IET) trials. A *desi* hybrid CISAA 19-4 was promoted to the Agronomy trial in the North Zone, and CNA 1092 variety of *G. arboreum* was identified and released for commercial cultivation in the Central zone under rainfed situation.
- Conservation of 12,386 accessions, addition of one exotic accession from Nepal and three accessions from Meghalaya; 5187 accessions evaluated for morphological traits and screening for Biotic stress tolerance; two cultures (Dense Hairy Pigmented Plant with Cup Shaped Leaf Lobed) & CNH 22275 (Jassids Resistant) identified for registration as Genetic Stocks and conducted Germplasm Field Day to showcase the variability to the breeders from the Public and Private Sector.
- Thirty-two wild species were conserved in-situ, five (5) introgressed lines (*G.arboreum* x *G.longicalyx*) were identified and selected for registration as Genetic Stocks, and 10 BC3F1 populations derived from GVS 8/9 were evaluated at Sirsa. Genetically diverse parents were utilized for the development of Bt hybrids with superior fibre quality and tolerant to jassids. Three F1 hybrids, particularly IC356655 x PKV081 Bt, IC204710 x CICR 21 Bt and IC357255 x 503 performed better than the best performing parental line (CICR 21 Bt).
- In *Desi* (*G. arboreum*) cotton, the hybrid CISAA 19-4 was promoted to the agronomy trial under AICRP (NZ) for 2024-25, while two other hybrids—CISAA 22-3 and CISAA 22-1—were promoted to the advanced/coordinated trial (Br 25a CHT) under AICRP (NZ) 2024-25.
- In station trials conducted for CLCuD resistance breeding, the genotypes CSH NB 13, CSH NB 14, CSH NB 23, and CSH NB 28 were identified as promising CLCuD resistant genotypes, exhibiting less than 2% PDI and significantly higher seed cotton yield compared to the best check, F 2228, whereas during segregation analysis of the F2 population derived from the cross GVS 9 (resistant) × HS 6 (susceptible) revealed a single dominant gene controlling CLCuD resistance.
- During the evaluation of the GEAC-approved hybrids, the PDI for CLCuD ranged from 0% to 18% in both trials. Among the 84 entries in the common trial, approximately 54 BG II hybrids recorded superior yields (>28 q/ha). Similarly, of the 16 entries evaluated in Haryana State trial, 10 BG II hybrids exhibited high yield performance (>31 q/ha).
- Long staple cultures (19) with good strength were evaluated in a replicated trial in organic situation along with Suraksha as a check variety for yield and fibre quality and best cultures were identified for further evaluation in multi-location evaluation trials.
- Five (H x B) hybrids showed stable yield and fibre quality for three consecutive years, with yield significantly higher than the check. One *G. barbadense* and a *G. hirsutum* line were developed with better yield and stem weevil resistant respectively.
- Screening of 7240 G. hirsutum lines, including the already identified tolerant (20) and susceptible (20) lines for glyphosate resistance/tolerance, was carried out. Based on symptoms, 39 tolerant and 20 most susceptible lines were identified.
- The MAGIC population is advanced from F6 to F7 generation and phenotypic data recorded for development of Core set.
- Three Bt cotton varieties, CICR H Bt cotton 40, CICR H Bt cotton 66 (CICR Bt 20-3) and CICR H Bt cotton 65 (CICR 18 Bt), were notified. In total, 11 Bt cotton genotypes were tested under different AICRP trials.
- The drought-tolerant line was identified with 29.5 mm fibre length, 27.3 g/tex, 34.8 Ginning out turn (%), and 3.2 Micronaire and was sponsored for the Organic Cotton Trial.
- Transgenic tobacco expressing the cry1D gene showed no efficacy against *Spodoptera litura*, confirming earlier bacterial expression results. Putative cry1D T0 transformant for pink bollworm resistance were generated via in-planta transformation, and plants were transferred to the polyhouse for T_1 seed harvest.
- Genome editing in cotton was initiated by targeting genes like GhNB, GhGalT1, GhFAD2-1, and GhPEPC for improvements in plant architecture, fiber, and seed oil traits. Candidate gene sequences were cloned and sequenced from Coker 312, and sgRNA design and validation are underway for CRISPR-Cas9 editing.
- The pink bollworm (PBW) transcriptome was sequenced, identifying 30,124 genes and validating two chitin biosynthesis genes (PgAGM and PUAP) as RNAi targets for PBW management. Additionally, a cost-effective dsRNA synthesis protocol was developed, and α-tubulin was identified as a suitable

normalizer for gene expression studies in PBW.

- A standardized protocol was established for expressing and purifying 6x-His-tagged GhALS proteins and their mutants. Cotton small RNA promoters pU6-26_Gh6.7 and pU6-29_Gh6.3 were cloned, sequence-verified, and mobilized into pGWB433 for functional validation via transient GUS expression assays.
- Recommended Packages of Practices + Foliar application of KNO3 along with micronutrients significantly increased seed cotton yield, fuzzy seed yield, pure seed yield and pure seed recovery percentages in cotton.
- More than 600 candidate cotton genotypes have been tested for DUS under implementation of Protection of Plant Variety legislation, 2001 at the ICAR-CICR. The complete database of extant cotton varieties has also been documented and is being maintained digitally.
- In seed ageing responses, the arboreum genotype was found more sensitive to the accelerated ageing (AA) process than the hirsutum genotype. Germination dropped below 65% in the arboreum genotype after 48 hours of ageing, whereas in the hirsutum genotype, this threshold was observed after 72 hours.
- Quality seeds of 24 CICR-released varieties were produced to maintain and meet DAC indent as well as direct indent from various stakeholders. This includes nucleus seed (3.2q), breeder seed (52.30q), and TFL seed (4.80 q).
- In addition to meeting the DAC indent, the varieties were popularized among Maharashtra, MP, Telangana, and Gujarat States, and their demand, as well as those of organic/natural farm groups and farmer FPOs, were fully met.

Crop Protection

- ICAR-CICR developed a 'AI Smart Trap' that enables real-time monitoring of pink bollworm in cotton, which will be useful for area-wide pest monitoring.
- Pesticide (insecticide+ Fungicide) consumption was 839, 1417, 2123, and 1494 g a.i/ha in North India, Central India, South India, and overall India, respectively. The share of insecticide was recorded 89% while of fungicide 11%.
- Eight insecticides were screened against field populations of *Helicoverpa armigera*, among which emamectin benzoate in newer insecticides and profenofos in conventional insecticides were found to be most effective. Insecticide/fungicide combinations should be avoided, especially with copper oxychloride, as phase separation is very evident.
- Machine learning algorithms were developed to detect and count Spodoptera litura and Helicoverpa armigera moths in an AI-enabled smart trap, achieving detection accuracy of 92.3% and 89.1%, respectively. A multi-colored glue-fin trap was developed and field-tested for monitoring and managing jassids, thrips, whiteflies, aphids, and pink bollworm moths in cotton using a single trap system.
- The ETL has been revised based on moth trap catches corresponding to the percentage of green boll damage, providing a valuable decision-making tool for pink bollworm management in cotton.
- During off-season surveys in ginning mills (Feb–May 2024), an average of 24.68% (11.18 to 41.98%) seed damage due to PBW was recorded. The numbers of PBW larvae recovered ranged from 0.00 to 18.33, whereas pupal case recovery ranged from 0.00 to 25.00.
- During 2023-24, pink bollworm management strategies were implemented across 900 acres in 76 villages, spanning 15 districts and 8 states. Overall, a 42.3% reduction in pink bollworm infestation was observed in IRM fields compared to non-IRM fields during 2023-24.
- The *Metarhizium anisopliae* TMBMA1 strain exhibited high virulence against the dusky cotton bug, with up to 99% mortality under laboratory conditions. Field trials demonstrated the effectiveness of this biocontrol agent in reducing aphid, pink bollworm, and jassid populations, highlighting its potential as a biopesticide for sustainable pest management in cotton.
- Developed a comprehensive whole plant-based scoring system to assess the damage caused by tea mosquito bug (*Helopeltis theivora*) in cotton. Thiamethoxam 12.60% + Lambda-cyhalothrin 9.50% ZC and Dinotefuran 20 SG were highly effective in controlling *H. theivora*.
- The identification of attractant compounds, particularly Compound C, provides valuable insights into the chemical ecology of cotton stem weevils. These findings can inform the development of targeted pest management strategies, such as attractant-based traps and repellents, to effectively control weevil populations while minimizing environmental impact.
- Evaluation of proportion of non-Bt plants across 40 Bt cotton hybrids under the Haryana State-sponsored trial (2023–24) ranged from 0 to 18.21%. Notably, compared with 2022, a greater number of hybrids in 2023 were within the recommended refugia limits.
- Temperature stress studies revealed that both low and high temperatures significantly affected whitefly survival, with host plant presence/absence also influencing survival percentage. Short-term exposure to extreme temperatures altered whitefly biology.
- Implemented effective cotton pest management

strategies using Information and Communication Technology (ICT) tools, contributing as a key stakeholder in CROPSAP 2023-24 in Maharashtra. All three types of bollworms and sucking pests were under control during 2023-24.

- After 4 repeated sprays of Fipronil on cotton crop, resistance development in cotton jassid was 34 and 12-fold at 24 and 48 hrs after exposure, whereas Flonicamid showed very low resistance at both 24 and 48 hrs after exposure.
- Genetic diversity and pathogenicity study of *Corynespora cassiicola* isolates from cotton revealed a high prevalence of the *cassiicolin* gene, particularly Cas5, and emphasized its role in disease severity. Field experiments demonstrated that resistant cultivars and targeted fungicidal strategies, particularly using Bioagents consortia, effectively reduced Target Leaf Spot incidence
- Studied the prevalence of boll rot pathogens associated with the boll rot disease complex, etiological factors, and phytopathogens diversity and devised strategies for integrated management of the disease.
- Cross-inoculation of *Ramularia areola* on different cotton species was taken up in Glass house and in the field, but the severity of grey mildew disease on different hybrids was less in the field. A second-year field trial was conducted to identify the best management approach against grey mildew disease. Maximum PDI was seen in Control (13.3%) followed by T1 (Foliar spray of *Trichoderma harzianum* @ 90 and 110 DAS i.e. 11.73%). The percent disease reduction over control was highest in T5 (Foliar spray of combi product (Azoxystrobin 18.2% + Difenoconazole 11.4%) @ 90 and 110 DAS).
- Generated novel information regarding the infection process of *P. gossypii* in cotton leaves, which might be useful in the development of new and more effective management strategies to control cotton rust.
- Rhizospheric fungal isolates of *Trichoderma viride* (CICR-Rf-Th-11, CICR-Rf-16, CICR-Rf-60, CICR-Rf-63, Rf-TNAU Tv1 and Rf-CRSVPT Tv1) found superior in terms of enhancing seed germination, plant vigour, and root-rot disease management.
- Molecular docking of Nimbolide, a tetranortri-terpenoid (*limonoid*) compound isolated from the leaves of *Azadirachta indica*, revealed it to have the highest binding affinity for the protein targets of nematodes, followed by nematicides Fluopyrum and Fluensulfone. Carbofuran exhibited the lowest binding affinity. Nimbolide served as a potential inhibitor of the target proteins such as ODR1, Cathepsin L-like cysteine proteinase, HSP90, Neuropeptide GPCR, Heat Shock, and causes Irreversible paralysis of nematodes.
- Spraying liquid formulations of biopesticide consortia (*Lecanicillium lecanii* and *Acinetobacter lwoffii*) @ 5ml/L twice at 15 days intervals is recommended for the ecofriendly management of sucking pests in Cotton.
- Application of talc-based bionematicide consortia (*Pochonia chlamydosporia* and *Pseudomonas fluorescens*) at a rate of 1kg/ac was safer for earthworms and beneficial nematodes (predatory and entomopathogenic nematodes) under field conditions.

Crop Production

- FYM (5t/ha) + other alternate sources produced on par seed cotton yield (9.69 q/ha) with PKV package (8.96 q/ha) and RDF (inorganic treatment) (11.93 q/ha). Coloured desi cotton variety CNA 175-22 (14.99 q/ha) produced the highest seed cotton yield, which was closely followed by the non-Bt hybrid Partech 29 (13.88 q/ha).
- Irrigated cotton fields yielded an average seed cotton yield (8.6 q/acre), representing a 68% increase compared with rainfed fields. Severe pink bollworm infestation, particularly in Jalgaon and Nandurbar, contributed to lower yields, highlighting the need for integrated pest and water management to boost productivity.
- During the cotton-growing season of 2024-25, around 1.17 tonnes of carbon per ha were sequestered from cotton.
- Sunnhemp grown as an in-situ cover crop with cotton and incorporated at 45 DAS produced the highest biomass accumulation under elevated carbon dioxide (eCO_2). The Integrated Nutrient Management (INM) under eCO_2 recorded the highest seed cotton yield, soil organic carbon, and soil available N, and it was advocated as a sustainable N management strategy under eCO_2. The N dilution effect under eCO_2 was reduced by INM practices
- Timely management of water logging can be achieved by drone spray by adopting spray fluid @ 37.5 L/ha with salicylic acid @ 0.5mM single spray on the 5th Day after water logging and KNO_3 @ 2% on the 8th day after water logging and application of nitrogen and potassium each @ 20 kg/ha (after drainage) with ridges and furrow land configuration
- Yield enhancement through increased plant density (90 x 15cm spacing; 74,074 plants per ha) and plant growth regulator-based canopy management in G. barbadense genotypes (Suvin, CICR B Cot 45) indicated the possibility of machine harvesting of ELS cotton in the near future.
- Chemical spraying drones can be used in cotton canopy management under a High- Density Planting System by mixing the recommended dose of Mepiquat chloride on an a.i basis in 20 litre spray fluid (water)/acre instead of a conventional high-volume

sprayer (200 litre spray fluid/acre).

- At the Regional level, the optimal plan suggests an increase in the area under rainfed cotton from 56.41 ha to 67.1 ha, and under irrigated cotton from 107.76 ha to 135.38 ha, respectively. The study reveals through timely availability of inputs, irrigation facilities, creating awareness among farmers, there is a possibility to enhance the area under cotton in Coimbatore district in general.
- Under the conservation agriculture-based cotton–wheat system experiment, significantly higher seed cotton yield, wheat grain yield, and total system productivity were achieved with: Zero tillage for cotton + wheat residue retention + mulcher operation (cotton) and Zero tillage for wheat with Happy Seeder + cotton residue retention + mulcher operation (wheat), as compared to conventional tillage practices for both crops (farmer's practice).
- In the canopy management, among the plant spacing (Factor I), 67.5 × 45 cm spacing resulted in significantly higher seed cotton yield than a wider spacing of 67.5 × 60 cm. Under Factor II (monopodia removal, detopping, and growth regulator application), the combination of Detopping + Etheral application gave the highest yield compared with the control.
- In the crop geometries experiment, a significantly higher seed cotton yield was obtained with 2.21 feet row distance x 2.0 feet plant distance (67.5 x 60 cm) than with the other crop geometries.
- Among the different cotton cultivars, (Non-Bt, Bt-variety and Bt-hybrids) maximum yield was recorded with Bt-hybrids followed by Bt-varieties. Higher seed cotton yield was recorded in the station trials than the on-farm trials.
- Nano-Zn formulations positively enhance the Zn concentration in soil and cotton plant parts in rainfed black calcareous soil.
- The increased lattice water depth can be attributed to more percolation into the lower levels of the profile.
- The method for detection of plant hormones such as IAA, IBA, Isopentyl adenosine (cytokinin), SA, JA, Azelaic acid, Succinic acid, t-cinnamic acid, and Cis-cinnamic acid etc was optimized and validated by deploying silylation (BSTFA, MSTFA, and BSTFA+TMCS) and methylation (MCF) in plant samples using SCAN and SIM modes on GC-MS. Among the derivatization methods tested, BSTFA +1% TMCS provided the best detection of phytohormones.
- The seed and soil application of microbial consortia (MC4) significantly enhanced cotton growth, plant physiology, plant defense/antioxidant enzyme activities, seed cotton yield, soil nutrient availability, and soil biological properties, and alleviated abiotic stress (water-logging, and drought) in cotton.
- Bacterial-based volatiles: TC, HDC, HTC, PY, DBP, EC, and EC significantly reduced N-acetylglucosamine (NAG) content in cotton pathogens such as *Alternaria* (98%), *Fusarium* (33%), *Rhizoctonia* (78%), *Macrophomina* (306%), *Corynespora* (219%), *Sclerotium* (215%), and *Myrothecium* (22%), respectively, compared with the control. A significant positive correlation was also observed between the NAG concentration and fungal biomass of the cotton pathogens.
- The diffusion of Best Farm Practices (BFPs) in cotton using Best Extension Practices (BEPs) in all three agro-climatic zones has sustainably increased seed cotton yield from 225 kg to 2100 kg per hectare, and has brought desirable changes in the knowledge augmentation of cotton growers.
- The majority of respondents perceived that the cotton variety Surabhi had a significant impact on the livelihood of cotton growers in summer irrigated conditions. e-Kapas mobile advisory had a significant impact on the knowledge level of cotton growers.

The final report of Quinquennial Review Team (QRT) of the Institute and ICAR- AICRP on Cotton for the period of 2018-2023 was also submitted by Dr. B. Venkateswarlu, Chairman (QRT) to the Hon'ble Director General, ICAR, New Delhi.

2 INTRODUCTION

2.1: Brief History

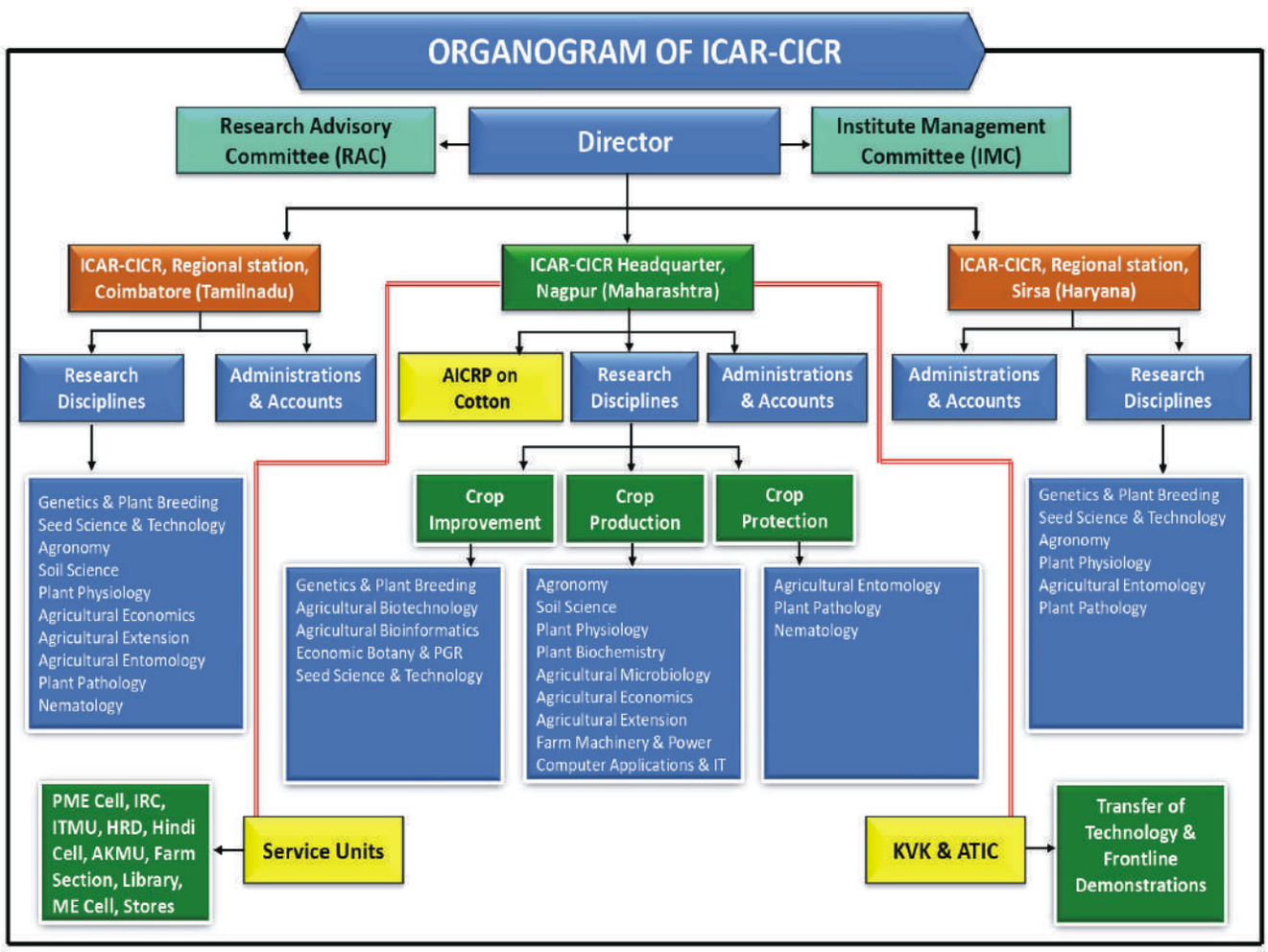
The ICAR-Central Institute for Cotton Research (CICR) was established in Nagpur, in 1976. The two regional stations of IARI located at Sirsa (Haryana) and Coimbatore (Tamil Nadu) were transferred to ICAR-CICR to cater the needs of north and south India, respectively.

2.2: Mandate

- Basic, strategic and adaptive research on production, protection, fibre quality and by-products of cotton
- Creation of new genetic variability for location-specific adoption in cotton-based cropping systems.
- Coordination and monitoring of applied research on national and regional issues to develop improved varieties and technologies
- Dissemination of technologies and capacity building

Location of the of ICAR-CICR Institute

Center	Latitude (0N)	Longitude (0E)
ICAR-CICR, Head Quarters, Nagpur, Maharashtra	21.037	79.056
ICAR-CICR, Regional Station,Coimbatore,Tamil Nadu	11.014	76.929
ICAR-CICR, Regional Station, Sirsa, Haryana	29.543	75.038



2.3: Staff Position (as on 31st Dec. 2024)

Category	Sanctioned Cadre Strength				Post Filled Up			
	NGP	CBE	Sirsa	Total	NGP	CBE	Sirsa	Total
Director (RMP)	1	--	--	1	1	-	-	1
Scientific	54	14	09	77	29	18	5	52
Technical	--	--	--	72	36	10	7	53
Administrative	--	--	--	46	20	3	3	26
Skilled Support Staff	--	--	--	44	24	3	11	38
Training Organizer	1	--	--	1	-	-	-	-
Technical	11	--	--	11	8	-	-	8
Administrative	02	--	--	02	-	-	-	-
Skilled Support Staff	02	--	--	02	1	-	-	1

NGP – Nagpur; CBE – Coimbatore

2.4: Financial Statement

The budget grant and actual expenditure for the year 2024 are furnished below: **(Rs. in Lakhs)**

	2023-24		2024(Jan-Dec 2024)	
	Sanction	Expenditure	Sanction	Expenditure
Plan Scheme	1977.74	1975.70	2427.32	1698.93
Deposit Scheme	4229.78	3300.45	4176.65	3548.86
Revolving Fund	27.31	7.96	16.27	0.00
Govt. Grants	5161.61	5161.53	5551.00	4075.66
Total (in lakhs)	11396.44	10445.64	12171.24	9323.45
Revenue Generation (Revenue Receipts)	45.00	30.63	38.00	31.83

3 RESEARCH ACHIEVEMENTS

1. CROP IMPROVEMENT DIVISION

1.1 Project Name: Development of broad-based high yielding varieties of diploid and tetraploid cotton through recurrent selection

PI : V.N. Waghmare

Importance of the study: This project involves several parental lines aimed at development of broad-based *G. arboreum* and *G. hirsutum* varieties with improved fibre traits and high seed cotton yield through repeated cycles of selection and intercrossing. It also envisages development of high yielding spinnable as well as coarse type *G. arboreum* varieties and GMS-based hybrids for the North Zone.

Salient findings

Nagpur

Evaluation of advanced cultures: During 2023-24, 171 *G. arboreum* and 72 *G. hirsutum* selections were evaluated in 9 replicated trials (4 rows plots in 2 replications). Based on the data for economic performance and fibre quality traits, 107 advanced generation selections of *G. arboreum* were retained for further evaluation in replicated trial during 2024-25. The range for seed cotton yield among the *G. arboreum* selections ranged from 16.6 to 27.9 q/ha, boll weight: 2.2-3.28 g, GOT: 30.4-38.4%, fibre length: 25.2–29.9 mm, micronaire: 4.3–6.0, UI: 79.2-82.2 %, fibre strength: 24.3-34.1 g/tex and fibre elongation: 5.4-6.3%. Similarly, for *G. hirsutum*, 38 advanced selections were retained for further evaluation. The ranges for various economic and fibre quality trait values among the upland cotton selections ranged; 2.6 -3.8 g for boll weight, 29.7 - 44.4% for GOT, 10.93 - 21.64 q/ha for seed cotton yield, 27.2-32.9 mm for fibre length, 2.4-3.9 for micronaire, 80.7-83.5 % UI, 26.5-36.5 for fibre strength and 5.3-6.2% for fibre elongation.

Evaluation of single plant selections: We evaluated 542 fertile single plant selections (347 of *G. arboreum* and 195 of *G. hirsutum*) as plant- to- row progenies. Superior single plants (604 Nos.) from the segregating progenies (117 of *G. arboreum* and 487 of *G. hirsutum*) were identified and harvested separately for further evaluation. Based on the performance and uniformity of advanced-generation plant progenies, 24 plant progenies of *G. arboreum* and 31 of *G. hirsutum* were identified for evaluation in replicated trial during 2024-25.

Evaluation of sterile plants: Sterile single plant progenies (673 nos) of *G. hirsutum* were planted as plant to row progenies. Trait-specific populations and sterile plant progenies were monitored for sterile and fertile plants at flowering and tagged. In sterile plant progenies, observations of economic traits were recorded on 3 fertile random plants of each progeny. Based on superiority for specific traits, namely boll weight, GOT, seed cotton yield and fibre traits, about 10-15% superior progenies were identified to constitute trait-specific population and to further advance the recurrent selection cycle.

Recurrent populations: Composite populations in G. hirsutum were constituted for boll wt., GOT and SCY and fibre quality traits and were and grown on large plots. Thus, two recurrent selection cycles were completed in *G. hirsutum* during 2023-24. In *G. arboreum*, trait-specific composite populations were monitored for sterile and fertile plants at flowering and tagged. Individual sterile plants from the 4 trait- specific composite populations (about 500 each) were harvested separately for evaluation and advancement of the recurrent selection cycle. From the 4 composite populations, 266 promising fertile plants were selected for evaluation as plant to row progenies.

Evaluation of BLB selections: We evaluated 79 advanced single-plant selections in two unreplicated row plots. Of these, 21 progenies were still segregating for resistance or susceptibility to BLB. About 24 uniform and BLB- resistant progenies with better fibre quality traits were identified for yield performance evaluation during 2024-25.

Entries promoted under AICRP trials: *G. arboreum* entry CNA 1085 was promoted to AVT II in the Central Zone, and entries i.e., CNA 1084 and CNA 1085 were promoted to Br. 24(a/b) AVT II in the South Zone.

Agronomy Trial: The genotypes CNA1092 and CNA 2034 of G. arboreum were evaluated in an agronomy trial in the Central and South Zones, respectively, under rainfed conditions. A variety identification proposal of CNA 1092 was submitted to the ICAR-AICRP on cotton. CNA 1092 was identified by the Varietal Identification Committee and subsequently released by CVRC vide Gazette Notification S.O. 4388(E) dated October 08, 2024.

Table 1.1.1: Yield and fibre quality parameters CNA 1092

S. No.	Characters	
1	Seed cotton yield potential	2230 kg/ha
2	Boll weight (g)	2.60
3	Ginning Outturn (%)	33.1
4	Days to maturity (days)	150-160
	Fibre characteristics	
5	Fibre length (at 2.5% SL)	24.5 mm
6	Micronaire	5.2
7	Bundle strength (g/tex)	25.2
8	Zone of cultivation	Central Zone

Plant and boll characteristics

Maintenance and multiplication of varieties: CNA1028, CNA1032. CNA1031, CNA1054, CNA1003, CNA1091, CNH1111, and CNH 1128. In the previous year, 180-200 single plants were selected from each variety and evaluated for economic and fibre quality traits during 2023-24. About 5-10 % progenies matching the varietal traits were identified and bulked to constitute nucleus seeds for each variety.

Sirsa

Evaluation of GMS-based *G. arboreum* Hybrids: Five GMS-based hybrids were evaluated for seed cotton yield using check CICR 2 and zonal check KR 64. Two GMS based hybrids i.e. CISAA 23-3 (3072 kg/ha) and CISAA 23-2 (2952 kg/ha) recorded significantly higher seed cotton yields than hybrid CICR 2 (2601 kg/ha).

Evaluation of High-yielding *G. arboreum* genotypes: Sixteen varietal cultures were evaluated using the RBD design, including two check varieties, CICR 1(CISA 310) and CICR 3 (CISA 614). Two elite lines i.e. CISA 8-1 (2846 kg/ha) and CISA 6-11 (2773 kg/ha) recorded significantly higher seed cotton yield than high yielding best check CICR 3 (2206 kg/ha).

Evaluation of spinnable *G. arboreum* genotypes: Twelve spinnable cultures were evaluated in the RBD design including two check varieties, CISA 310 and CISA 614. Two elite lines i.e. CISA 10 (2241 kg/ha) and CISA 33-2 (2197 kg/ha) recorded significantly higher seed cotton yield than the quality check PA 255 (1522 kg/ha) and numerically higher seed cotton yield than the high-yielding best check CISA 614 (2170 kg/ha). In separate trial, 20 spinnable cultures were evaluated. Four cultures, namely NA-5 (1966 kg/ha), NA-2 (1755.8 kg/ha), NA-9 (1734 kg/ha), and NA-12 (1694.8 kg/ha) recorded significantly higher seed cotton yield than quality check PA 255 (1472 kg/ha).

Maintenance, advancement, and selection: Four GMS lines DS 5, CISA 2, GAK 413A, CISG 20, and 03 newly developed GMS lines, CISG-10, CISG-13, CISG-14 and 9 combiner lines of *G. arboreum* were also maintained. *G. arboreum* selections with better spinnability (23-26 mm fibre length) were advanced.

Entries under AICRP (North Zone): One GMS-based *G. arboreum* intra-arboreum hybrid CISAA 19-4 was promoted to the Agronomy Trial. Two GMS-based *G. arboreum* intra-arboreum hybrids i.e., CISAA 22-1 and CISAA 22-3 were promoted under Coordinated trial Br 25a. Two *G. arboreum* varieties i.e., CISA 8-1 and CISA 6-11 were sponsored in Br 22a/b National trial. Two intra-arboreum hybrids i.e., CISAA 23-2 and CISAA 23-3 were sponsored in the Br 25a/b (National trial).

1.2 Project Name: Collection, conservation, evaluation, documentation and maintenance of germplasm of cultivated species of Gossypium.

PIs: Vinita Gotmare

Co-PIs: Sunil S. Mahajan, M. Saravanan, Neelakanth S. Hiremani, Manickam, A.H. Prakash, A. Manivannan, Debashis Paul, Anjali Kak

Importance of the study: The mandate of the institute is collection, conservation, evaluation, exchange, documentation of cotton germplasm in Medium-Term Storage (MTS) to ensure their availability and utilization to the public and private sector breeders and researchers of the country.

Salient findings

Conserved 12,386 accessions including cultivated and wild species of Gossypium perennials, landrace interspecific derivatives, and 52 registered Genetic stocks. One exotic germplasm was imported from Nepal. A total of 5187 germplasm accessions were evaluated in 2023-24 (780 core collection at both locations Nagpur and Sirsa) while *G. barbadense* (205) at ICAR-CICR RS Coimbatore for morphological and biotic stress. At Sirsa, IC359084, IC358473, IC359143, IC359758, IC359238, EC700049, IC357745, IC356611, and EC700514 were identified for higher seed cotton yield attributes.

Three new genotypes [*G. arboreum* race *Cernuum* (2) and *G. barbadense* (1)] were collected through survey and exploration in the West Garo Hills of Meghalaya. CMS conversion of the three identified Male Sterile lines was performed, and leaf curl viral disease resistant lines (BC3F1) were developed in Nagpur and evaluated at hot spot ICAR-CICR, RS, Sirsa. BC3F1 backcrosses of water-logging toleranace were developed and field evaluated. A germplasm field day was conducted for breeders of SAU's on 5th and 19th January, 2024 for SAU's & Pvt Seed Co. breeders, respectively,. At least 231 germplasm accessions, as indented, were shared with breeders of SAU's, 86 accessions were deposited in MTS and additional 283 accessions were processed for sharing with SAU's. Two *G. hirsutum* single plant progenies, namely CNH 2257 (dense hairy pigmented plant with cup shaped leaf lobed – Figure 1.2.1) and CNH 22275 (Jassids resistant, Figure 1.2.2), have been identified for registration as unique Genetic stocks.

Fig 1.2.1CNH 2257 (Dense Hairy Pigmented Plant with Cup Shaped Leaf Lobe

Fig 1.2.2 CNH 22275 (Jassid Resistant)

1.3 Project Name: Genetic diversity and utilization of wild germplasm for cotton improvement.

PI: Vinita Gotmare

Co-PI (s) – M Saravanan, Rachna Pande, Neelkanth Hiremani, Annie Sheeba, Sampath Kumar, K. Baghyalakshmi & Subhash Chandra

Importance of the study: Wild species are the reservoirs of many useful genes governing different economic traits, including lint yield, fibre quality and resistance to biotic and abiotic stress tolerance. In view of the narrow genetic base of cultivated cotton, the available wild species including the newly introduced tetraploid, races of cultivated species, and synthetic polyploids of *Gossypium* are conserved and utilized in introgression breeding to broaden the genetic base and their utilization in improvement of cultivated species.

Salient findings

Nagpur

More than 425 introgressed derivatives were evaluated for fibre traits, biotic and abiotic stress tolerance. A total of 32 wild species, 15 races of cultivated species, and more than 45 synthetic polyploids were conserved in the wild species garden. 21 accessions of 9 exotic wild species were imported from USDA in 2021 were established. The seeds of two wild tetraploid species, *G. mustelinum* and *G. ekmanianum*, were harvested. Total 2340 crosses using wild species namely *G. australe, G. thurberi, G. raimondii, G. barbosanum, G. anomalum, G. capitis virides, G. triphyllum, G. klotzchianum, G. longicalyx, G. somalense, G. mexicanum, G. incanum, G. mustelinum, G. ekmanianum, G. aridum, Thespesia lumpas* were attempted with cultivated species while 314 crosses were harvested. F6 generation were advanced to F7 generation for field evaluation and a total of 180 single plants were selected on the basis of yield and yield contributing characters in wild derivatives viz. *G. arboreumx G. longicalyx*, *G. arboreum* race indicum x *G. davidsonii, G. arboreum x G. thurberi* and AK 8401 x *G. davidsonii* for fibre fineness and elongation. Five (5) lines (Table 1.3.1) have been identified & selected for registration as Genetic Stocks (*G. arboreum x G. longicalyx*) namely 23335 SP82-2, 23335 SP 125-2, 23335 (R)SP 94-5, 23335 (R)SP 103-1 & 23335 (R)SP 123-1. More than 50 naturally colour cotton genotypes have been evaluated for fibre and other economic traits and one green linted genotype has been selected for further evaluation.

Table 1.3.1: Five introgressed lines selected for registration as Genetic Stocks (*G. arboreum* x *G. longicalyx*, F7)

Introgressed Line	UHML (mm)	Bundle strength (g/tex)	Mic (µg/in)	UI %	EI %
23335 SP82-2	27.2	28.1	4.0	82	5.1
23335 SP 125-2	26.5	24.1	3.8	81	5.5
23335 (R)SP 94-5	26.1	26.8	4.3	83	4.9
23335 (R)SP 103-1	26.1	26.8	4.0	82	4.7
23335 (R)SP 123-1	26.1	27.3	4.6	82	5.3

Sirsa

During 2023-24, four BC3F1 populations with cultivated genotypes (CSH 3129/ CSH3075/ HS 6) as recurrent parents involving GVS 8and GVS 9 were evaluated for yield/plant, insect-pest reactions and CLCuD resistance, wherein high-yielding CLCuD resistant segregants (N= 07; PDI=0) were identified. Six BC3F1 populations with unadapted genotypes (GVS 8/9) as recurrent parent involving cultivated genotypes were evaluated for yield/plant, insect-pest reaction and CLCuD resistance, wherein high- yielding CLCuD resistant segregants (N = 22; PDI=0) were identified at ICAR-CICR, RS, Sirsa.

1.4 Project Name: Development of Bt hybids in tetraploid cotton with high yield, superior fibre quality and tolerance to jassids.

PI:M. M. Saravanan

Co-PIs: Rahul M Phuke, Amudha J, Prabhulinga T

Importance of the study: The aim of this study is to develop elite Bt cotton hybrids along with superior fibre quality traits and tolerance to jassids. To break yield barriers, hybridization is the most important method, involving genetically diverse parents. The yield advantage is high in case of hybrids compare with varieties.

Salient findings

BG (II) advanced lines, Jassid tolerant lines (CNH2, CNH8 & CNH14) and ICAR-CICR released varieties such as Suraj Bt, PKV081 Bt, Rajat Bt, GJHV374 BT and

CICR21 Bt were used as male parents. Varieties such as Suraksha, Suchitra, Sunantha, PKV081 Non-Bt, Suraj Non-Bt and genetic stocks such as CNH204710 (above 40 % Ginning outturn) and big boll accessions of germplasm lines such as IC356655, IC359922, IC357255, IC359721, IC359084, IC356720, IC359266, and IC357449 (>5 grams) were utilized as female parents in the crossing programme. Line X Tester mating design was followed for the crossing programme, and all 98 F1s were evaluated using a randomized block design (RBD) with two replications. The F1 hybrids were compared with parental lines and check hybrids (3) for estimation of general combining ability (GCA), specific combining ability (SCA), and heterosis. Three crosses particularly IC356655 x PKV081 Bt, IC204710 x CICR 21 Bt and IC357255 x 503 performed better than the best performing parental line (CICR 21 Bt). Jassid screening of parents and F1 hybrids was carried out at 30, 60 and 90 DAS.

1.5 Project Name: Screening of germplasm and induced mutagenesis for the development of herbicide resistant cotton.

PI: M. Saravanan (PI),

Importance of the study: This study aimed to screen the cotton (*G. hirsutum*) germplasm and induced mutagenesis for developing herbicide-resistant cotton. Herbicide-resistant cotton enables more efficient weed management and maximizes cotton productivity.

Salient findings

Screening of 7240 already identified most tolerant (20) and most susceptible (20) *G. hirsutum* lines for glyphosate resistance/tolerance was carried out under field conditions during Kharif 2023-24. Glyphosate @100ml/15 litres of water was sprayed 48 days after sowing and the observation was recorded until 14 days after glyphosate spray in terms of symptoms such as chlorosis, wilting, growth response and stunting. Based on these observations, 39 most tolerant (Nos. 5,22, 25, 27, 31, 36, 101, 103, 104, 118, 165, 237, 250, 256, 265, 267, 280, 285, 290, 294, 295, 297, 298, 300, 301, 302, 310, 455, 557, 3561, 3749, 3913, 4000, 4039, 4073, 4080, 4086, 4110 and 4199) and 20 most susceptible lines (80, 87, 163, 170, 325, 490, 515, 565, 575, 594, 3507, 3527, 3537, 3578, 3693, 4176, 4296, 4326, 4403 and 4419) were identified for future research programmes.

The M2 population of gamma irradiated (200 & 300 Gy) Suraj Non-Bt cotton was established and screened against glyphosate during Kharif 2023-24. Glyphosate @100ml/15 litres of water was sprayed 48 days after sowing (Figure 1.5.1) and the observation were recorded until 14 days after spray as indicated above. Based on symptoms, 16 most tolerant lines were identified for further studies.

1.6 Project Name: Advancement of MAGIC population to develop core set for genetic mapping and identification of potential inbred lines

PI: Rahul M. Phuke

Co-PI: Y G Prasad

Importance of the study: MAGIC populations due to their complex pedigree structure offer great potential for improving the breeding population and providing better chance to break the negative linkage between yield and fibre quality traits. MAGIC population has richer diversity and recombination rate without population structure which, enable genetic dissection of complex traits to support modern plant breeding programs.

Salient findings

A total of 2,886 MAGIC lines at the F6 stage were sown in a single row of eight dibbles using an augmented design, with parents included as checks. Selfing was performed on 4-5 flowers from a randomly selected plant in each line. Data were collected on plant phenology traits, including plant height, number of bolls per plant, number of monopodia, number of sympodia, boll weight, seed cotton yield (SCY) per plant, Jassid grade, maturity score, compactness score, and boll shape (Fig1.6.1 a & b). The variations in the observed traits are summarized in Table 1.6.1. Out of the total lines, 336 exhibited segregation and were removed from the panel. A total of 106 lines were identified as promising, among which 81 showed an SCY per plant greater than 100 grams.

Table 1.6.1. Observed variation for studied traits in 2731 MAGIC RILs

S. No.	Characteristics	Mean	Range
1	Nos. of monopodia	1.9	0.5 - 8.0
2	Nos. of sympodia	16.44	2.5 -28
3	Nos. of bolls/plant	24.40	4.5 - 65.8
4	Plant height (cm)	91.58	37 -170
5	Boll weight (gm)	3.0	1.32 -4.8
6	Seed cotton yield /plant (gm)	51.6	4.0 -181

Figure 1.6. 1a: Trait variability for boll shape and leaf hairiness in MAGIC population

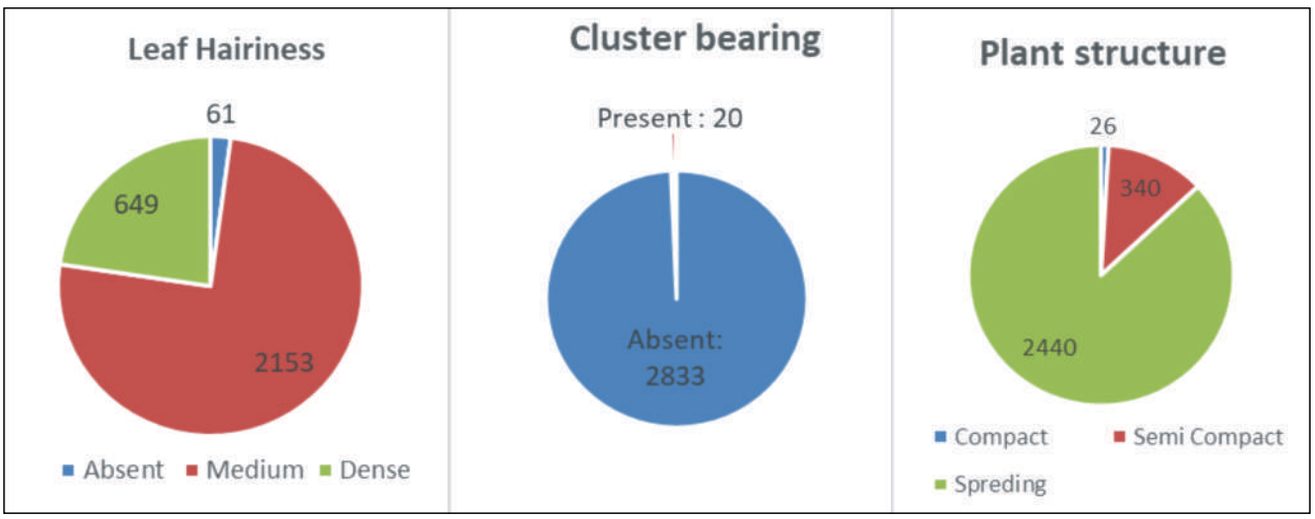


Figure 1.6. 1b: Trait variability for leaf hairiness, plant structure and cluster bearing nature in MAGIC population

1.7 Project Name: Rapid development of high-yielding Bt cotton varieties amenable for high-density planting system

PI: Rahul M. Phuke

CO-PIs: Raghavendra KP, Ramkrushna GI, Shah Vivek, Neelakanth S. Hiremani, S. Manickam, K. Baghyalakshmi, K. Ramesh, A. Sampath kumar, Subhash Chandra and Debashis Paul

Importance of the study: Cotton productivity in India can be improved by deploying early maturing, compact Bt cotton varieties in rainfed areas with the option of high-density planting to increase yields, low resource demand, and better protection from bollworms due to early maturity. This project aims to develop Bt varieties using deregulated transgenic events.

Salient findings

Nagpur:

Notification of varieties: Three Bt cotton varieties i.e., CICR H Bt cotton 40, CICR H Bt cotton 66 (CICR Bt 20-3) & CICR H Bt cotton 65 (CICR 18 Bt), were notified in the 92nd meeting of Central Sub-committee on crop standards, notification and release for Agricultural crop held on 2nd August 2024 under the chairmanship of DDG (Crop sciences), ICAR, New Delhi.

Nucleus seed production of Bt varieties: Nucleus seed production was performed for two release Bt cotton varieties viz., CICR- PKV 081 Bt and CICR 23 Bt.

Evaluation of promising cultures in AICRP: A total of 11 entries sponsored by ICAR-CICR were tested in different AICRP trials as mentioned in Table 1.7.1

Table: 1.7.1 List of Bt cotton genotypes sponsored in different AICRP trial for 2023-24

S. No.	Entries	Trial name
1	CICR Bt 211-225	Initial Evaluation Trial of Compact Hirsutum Varieties – Rainfed (CZ)
2	CICR Bt 211-246	
3	CICR Bt 2	Advanced Evaluation Trial - I of Hirsutum Varieties– Rainfed (CZ)
4	CICR Bt 4	
5	CICR Bt 22-31	
6	CICR Bt 22-32	
7	CICR Bt 22-33	
8	CICR Bt 21-31	Advanced Evaluation Trial - II of Hirsutum Varieties– Rainfed (CZ)
9	CICR Bt 21-32	
10	CICR PKV 081 Bt	Advanced Evaluation Trial of Hirsutum Varieties - II – Rainfed (SZ)
11	CICR Bt 20-31	

Evaluation of Bt genotypes in Station Trial at Nagpur: A common station trial of 20 Bt entries along with four checks (Ajeet 155 BG II, RCH 608 BG II, PKV 081 Bt, and Suraj Bt) was conducted in RBD with two replications in 90 x 30 cm spacing of 4 rows. Phenotyping for yield related and fibre quality traits was carried out along with protein expression for Cry I Ac, pest infestation, and disease incidence.

The highest yield was recorded by Ajeet 155 (22.6 q/ha), followed by CICR Bt 24-13 BG II (20.4 q/ha) CICR Bt 24-11 (16.9 q/ha) (Table 1.7.2). Based on yield, resistance

to pest and diseases and fibre quality traits, test entries, viz., CICR Bt 24-13 BG II &CICR Bt 24-11 were sponsored for the compact AICRP trial of central zones under rainfed condition and high-density planting.

Table 1.7.2. Seed cotton yield and other data of Station trial selected entries

Genotype	SCY (q/ha)	GOT (%)	Lint Index	Seed Index (gm)	UHML	Mic.	Str.
Ajeet 155 ©	22.6	37.1	5.3	9.1	26.3	3.5	33.1
CICR Bt 24 -13	20.4	34.6	5.2	10.6	28.9	3.9	29.0
CICR Bt 24-11	16.9	38.4	4.2	6.8	24.5	3.8	23.9
CICR RS Bt 31 -1	16.8	35.3	4.4	8.0	25.2	3.0	27.3
CICR Bt 24 -03	16.2	37.2	5.1	8.6	27.6	3.3	28.8
PKV-081 Bt ©	16.1	34.2	4.1	7.9	25.7	2.8	29.1
CICR Bt 24-04	15.7	38.0	4.7	7.7	27.9	2.9	28.5
Suraj Bt ©	15.4	38.2	4.4	7.2	24.3	3.5	24.3
RCH 608 ©	14.5	35.0	4.6	8.5	27.1	2.8	31.5
Avg. Mean	**14.3**	**35.1**	**4.6**	**8.5**	**27.0**	**3.0**	**28.2**
σ^2g	21.35**	13.39**	0.35*	1.87*	4.94**	0.35**	10.10**
CD @5%	1.87	2.73	0.61	1.38	1.53	0.46	2.98
C.V	6.3	3.7	6.3	7.8	2.8	7.3	5.1

Stability analysis Trial: During 2nd consecutive year, phenotyping for stability trails was performed for 22 entries involving 20 release varieties of CICR, divided into Bt and non-Bt categories, with two designated checks: Ajeet 155 BGII and Ankur 3028 BG II. The pooled analysis of two-year data showed that the highest Seed cotton yield was recorded by Ajeet 155 BG, followed by PKV081-Bt, Ankur 3028 BGII, CICR Bt 14, and CICR Bt 9 (Table 1.7.3). The most stable genotypes were CICR Bt14, CICR Bt 21, PKV 081 Bt, and PKV Rajat. The genotypes released for the South zone were found unstable in the central zone (eg: Subhiksha, Surbhi, Sunantha, Anjali).

Table 1.7.3. Location wise and pooled seed cotton yield of evaluated entries

Genotype	2022-23 TS	2022-23 LS	2023-24 TS	Pooled
Ajeet 155 BGII	17.6	16.1	17.5	17.1
PKV081 Bt	16.4	13.3	13.7	14.4
Ankur 3028 BGII	11.6	13.7	14.1	13.1
CICR Bt 14	15.4	8.6	10.7	11.5
CICR Bt 9	14.8	9.3	10.4	11.5
CICR Bt 25	15.6	9.2	8.5	10.9
PKV Rajat	14.8	4.7	12.0	10.5
CICR 23 Bt	10.1	9.3	11.9	10.4
PKV 081	11.8	8.0	8.8	9.7
CICR Bt 21	13.8	5.5	9.8	9.6
GJHV 374 Bt	11.8	5.9	10.9	9.5
CICR 16 Bt	12.9	5.9	9.3	9.3
Suraj Bt	11.5	6.7	8.6	8.9
NH615	10.2	6.8	7.2	8.2
Rajat Bt	11.4	3.8	9.1	8.1
Sunantha	8.8	6.1	6.7	7.1
Suraj (QC)	10.5	6.1	4.9	7.0
Anjali	8.4	6.1	6.2	6.8
Surabhi	7.1	6.0	4.9	5.9
LRA5166	7.5	5.0	4.8	5.7
Suraksha	6.1	4.7	4.1	4.9
Subiksha	7.0	2.9	4.3	4.7
Average	**11.6**	**7.4**	**9.0**	**9.3**
CD @ 5%	**3.9**	**3.2**	**2.6**	**1.78**
CV	**16.0**	**18.7**	**13.7**	**16.4**

HDPS (Agronomy) Trial:

A spacing trial with three different configurations (60 × 15 cm, 60 × 30 cm, and 90 × 15 cm) was conducted for five compact Bt cotton varieties alongside the hybrid check, Ajeet 155 BG II. The analysis of variance revealed significant differences among genotypes, spacing, and their interactions. The pooled analysis showed that Ajeet 155 BG II had the highest seed cotton yield (26.71 q/ha), followed by Samrat Bt (19.73 q/ha), Tejas Bt (19.53 q/ha), and Yugank Bt (19.02 q/ha). Among the spacing treatments, the highest average seed cotton yield was observed at 60 × 15 cm (20.77 q/ha), followed by 60 × 30 cm (20.15 q/ha) and 90 × 15 cm (18.71 q/ha), indicating the suitability of these varieties for high-density planting.

Advanced *Bt* Breeding material:

The *Bt* breeding material (BG I & BG II) from the F2 to F7 generation comprising of total 185 families was advanced through the pedigree method. Among the higher generation, 22 bulks were produced based on yield and stability. High-yielding bulk with better fibre quality will be advanced to station trail. From early generations, 215 single plants were selected. Bacterial blight is a major disease during the season, and the maximum PDI of Bacterial blight was observed in entry ID 23-130 (22.0%).

Selected Bulk Material:

Fifteen F2 populations were grown in large plot sizes (~600 plants per F2). Single plant selection was performed based on phenotypic scores (compact, sucking resistance and vigorous flowering), and the first burst boll was selected for each selected plant. The family bulk for all 15 F2 families has been advanced as an F3 generation crop in the off-season (2024) in large plot size in lieu of fast-track variety development.

Phenotypic expression of off-season crop

Crossing program: In total, 38 parental lines were maintained in the crossing block, and 35 single-way and 05 three-way crosses were attempted. Two female lines with GMS backgrounds underwent conversion through backcross breeding and BC5 generation is harvested.

Sirsa: Two entries i.e. CICRS Bt 58 (BG I) and CICRS Bt 50 (BG II), were sponsored in the ICAR Bt cotton Trials under AICRP (NZ) during 2024-25. In station trials (33 BG II entries + 2 checks), the BG II genotypes i.e., CICRS 50 BG II, CICRS 55 BG II, CICRS 81 BG II, and CICRS 88 BG II were found to be significantly high-yielding than best check PAU Bt 3. In other station trials (35 BG I entries + 2 checks), the BG I genotype i.e. CICRS Bt-58, CICRS Bt-63 and CICRS Bt-57 were found to be significantly high-yielding than best Check PAU Bt 3 (Table 1.7.4). BG I Entry CICRS Bt 31-1 ranked 3rd (Seed cotton yield: 16.8 q/ha) during Common Institute Trials 2023-24 at ICAR-CICR, Nagpur. Eight fresh crosses involving BG II cultures, compact cultures, and CLCuD-resistant genotypes were attempted.

Table: 1.7.4: Details of prominent *Bt* and BG II genotypes evaluated at ICAR-CICR, RS, Sirsa during 2023-24

Station Trial (BG II)		Station Trial (BG I)	
Entry	**Seed Cotton Yield (Kg/ha)**	**Entry**	**Seed Cotton Yield (Kg/ha)**
CICRS 55 BG II	2553	CICRS *Bt* 56	2259
CICRS 59 BG II	2324	CICRS *Bt* 58	2424
CICRS 39 BG II	2143	CICRS *Bt* 62	1975
CICRS 50 BG II	2572	CICRS *Bt* 63	2405
CICRS 61 BG II	1924	CICRS *Bt* 31	2259
CICRS 81 BG II	2440	CICRS *Bt* 51	1949
CICRS 88 BG II	2395	CICRS *Bt* 52	2088
CICR *Bt* 6 (LC)	1661	CICRS *Bt* 57	2592
PAU *Bt 3* (ZC)	2158	CICR *Bt* 6(LC)	1626
RCH 773 (BG II Hybrid)	2617	PAU *Bt* 3 (ZC)	2179
Range (Kg/ha)	955 - 2617	Range	984 - 2591
CD (5%)	235.15	CD (5%)	276.24
CV	8.90	CV	9.94

A total of 11.07 kg seeds of seven elite Bt- cotton lines viz. CICR Bt 46, CICR Bt 58, CICR Bt 48, CICR Bt 57, CICR Bt 50, CICR Bt 88 and CICR Bt 92, were produced at ICAR-CICR, Regional Station, Sirsa during 2023-24 for sponsoring under AICRP. Qualitative ELISA testing of each plant was performed to determine the Bt-seed purity.

1.8: Project Name : AICRP on Seeds (Crops)

PI: V. Santhy

Co-PIs: S. Manickam, S. Mahajan and Debashis Paul

Importance of the study: Seed is the basic fundamental medium for technology dissemination, and the supply of quality seeds is essential to popularize newly developed cotton varieties. This project aims to produce sufficient quantities of quality seed in the form of breeder seed and truthfully labelled seeds of released and notified crop varieties of cotton developed by CICR. These include Bt and non-Bt cotton varieties, thereby catering to the needs of all types of cotton farmers, FPOs and various schemes including FLDs, NFSM, organic cotton producers and researchers. Additionally, to utilize unutilized land as improve its soil properties, the project also includes the production of other crop varieties such as red-gram, chickpea and linseed during the kharif and rabi seasons.

Salient findings

Quality seed (nucleus, breeder and TFL) production of CICR released and notified cotton varieties suitable for each zone was taken up as per DAC indent as well as direct indents received, at Nagpur (Figure 1.8.1), Sirsa and Coimbatore. A total of 52.30q breeder seed was produced for 24 released and notified cotton varieties at all three locations. This includes 7.1 q seed of 7 Bt varieties, 26.82 q seed of 7 non Bt hirsutum varieties, 4.50q seed of 3 ELS cotton varieties and 14.0q of 6 desi cotton varieties (Table 1.8.1). Nucleus seed of 3.2q was produced at all three stations for the released and notified CICR cotton varieties belonging to three cultivated species *G. hirsutum, G. arboreum* and *G. barbadense.*

Table 1.8.1: Breeder seed production of released and notified varieties

Name of the Variety	Breeder seed produced (q)
Non Bt *G. hirsutum* varieties	
Suraksha	13.77
Nano	2.30
Suraj	6.25
Sunanda	1.10
CCH-2623	1.10
CSH 3129	0.90
CSH 3075	1.40
Bt varieties	
Yogank Bt	1.25
PKV-081 Bt	3.30
CICR Bt 6	1.50
CICR 16 Bt, 21Bt, 23Bt and 25 Bt	1.02
G.barbadense varieties (CICR B Cot.37, B Cot.45 and B Cot. 55)	4.50
Desi Cotton Varieties (CICR-1, CICR-3, CNA 1028, CNA-1032, CNA-1003 and CNA 1054)	14.00

In addition, 4.80q TFL seeds of Suraksha non-Bt cotton varieties were produced under farmer participatory mode at Nagpur. Other Crops (Kharif and rabi crops) mainly for crop rotation as well as utilization of cotton non-arable land produced at Nagpur include 15.5q red gram, variety Ankur 555; 30.96q Gram variety Jackie 9218; 10q wheat variety Purna 444; 2.06q linseed variety NL-260 and 0.45q mustard variety TAM-108.

Experiment on nano- seed priming at 200 ppm using chitosan nanoparticles synthesized using ionic gelation method with TTP as cross-linker in cotton variety, Suraksha showed higher germination and root length than hydro primed seeds and untreated seeds

Visit by Central Zone Breeder Seed Production Monitoring Team to the fields of ICAR-CICR, Nagpur

Breeder seed production of CICR non Bt cotton, Suraksha, an ELS variety

1.9.Project Name: Development of Quality Seed Production Protocol in Cotton

PI: Sunil S. Mahajan

Co-PIs: Santhy Venoor

Importance of the study: Seed production in cotton is the lengthy process. It include removal of lint from the seed followed by delinting with acid, cleaning, grading, seed treatment and packaging. It was found that the seed- to- lint ratios varied among different species and varieties of cotton. Very low recovery of pure seed and wastage of undesired materials are the major issues that need to be resolved in cotton seed production. Package of practices developed for crop production are available, but proper seed production protocols for cotton seed production in India are not available. To find

appropriate seed production methods, present work was initiated to explore different available treatments with interventions under the resource-constrained conditions to enhance quality seed recovery per unit area in cotton.

Salient findings

The experiment was conducted using the existing seed production plots in three replications (RBD). Bt variety PKV 081 (90 x 30 cm, spacing) and non-Bt variety, Suraj (90 x 30 cm and 120 x 30 cm, spacing) were used for the experiment. All the recommended package of practices (RPP) for seed cotton yield were followed and treated as control (T1). The other five additional interventions to enhance the quality seed production in cotton employed were RPP + Additional KNO3 @2% at 80-85 days (T2), RPP + Detopping at 80-85 days (T3), RPP + Micronutrients (MN) available in the market @60, 80 and 100 days (T4), RPP + T2 + T4 (T5) and RPP + T2 + T3 + T4 (T6). The results obtained from the experiment are a under:

- Foliar application of RPP + MN + KNO3 influenced the plant height, number of sympodia and significantly increased the Seed Cotton Yield, Fuzzy Seed Yield, Pure Seed Yield and Pure Seed Recovery percentages in Suraj at wider spacing (120 x 30 cm).
- Foliar application of RPP + KNO3 and RPP + MN + KNO3 significantly increased Seed Cotton and Fuzzy Seed Yield in Suraj at closer spacing (90 x 30 cm)
- Pure seed yield and pure seed recovery percentages were significantly highest with RPP + KNO3 and RPP + MN + KNO3 + detopping in PKV 081 Bt at closer spacing.
- Seed germination, seedling length, seedling vigour index, 100 seed weight, boll numbers, boll weight and monopodia were non-significant.

1.10 Project Name: Blindfold testing of RIB practice in Bt cotton

PI: G. Balsubramani

Importance of the study: The poor compliance of structured refugia in India is considered one of the major reasons for the development of resistance against Bt proteins in the pink bollworm. The Government of India introduced an alternate strategy of blending non-Bt seeds with Bt seeds so that there is an automatic compliance of refuge planting which can help to extend longevity of Bt technology. Accordingly, a gazette notification [S.O. 4215(E) dated 27 December 2016)] on 'refuge-in-bag' (RIB) in Bt cotton was brought out which mandates blending of 5-10% non-Bt seeds with 90-95% Bt seeds in each Bt seed packet being sold in the market from June 2020. With Bt and non-Bt seeds becoming indistinguishable, ascertaining compliance of RIB was a national concern.

Salient findings

The minimum seed sample size for RIB compliance testing was determined earlier through a multi-phase study that proposed a minimum sample size of 180 seeds with each seed tested individually for transgenes. The said protocol was validated through testing of commercial seed packets of Bt cotton purchased from open market for RIB compliance as well as validation on the field.

Following the protocol, 44 commercial seed packets of Bt cotton purchased from open markets were tested and sampled completely randomly for the presence of refugia using the standardized sample size. Out of the 44 seed packets of various companies tested, 28 only were found to adhere to the RIB requirement with 5-10% refugia for both Cry1Ac and Cry2Ab.Those company seed packets which did not adhere to the requirement showed only 2-3% refugia within them. This was reconfirmed by repeating the test following the same protocol.

1.11 Project Name: Validation of molecular markers and genes linked to drought tolerance in cotton.

PI: .J Amudha

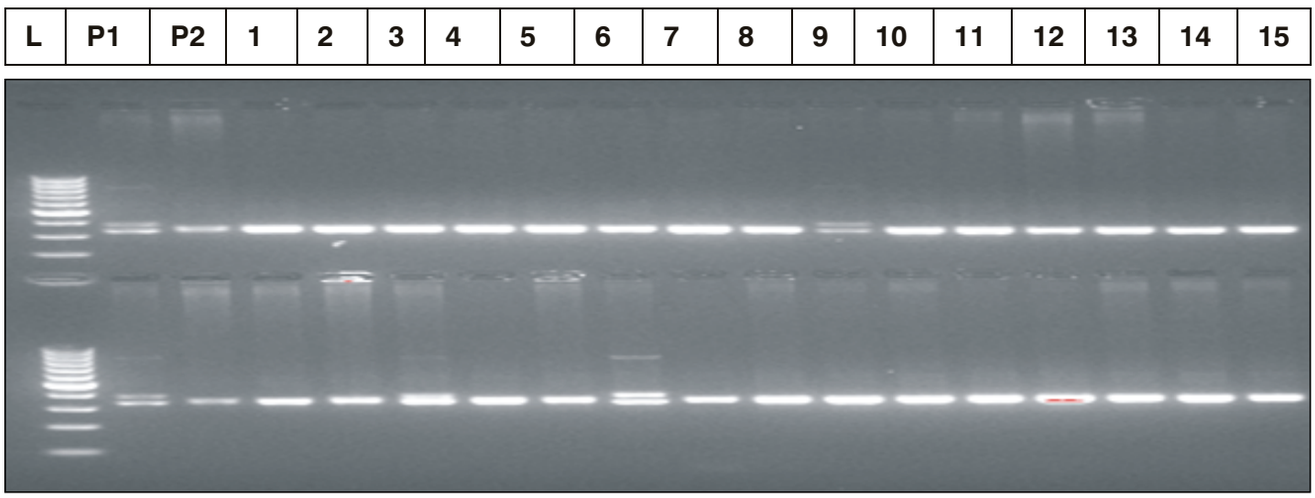
Co-PI (s) - Jayant Meshram; M.Saravanan

Importance of the study: This study aimed to investigate stress situation,-focused research needed specifically for developing genotypes with tolerance to abiotic stresses. Identification/Validation of molecular markers and genes linked to drought tolerance traits is being undertaken in this project.

Salient findings

Interspecific cross between *G. hirsutum* X *G. barbadense* (CNH 28 I X Suvin) derived recombinant inbred lines (RIL) (129 F11 lines) were used for validation of drought-linked markers. QTL markers mapped and linked with osmotic potential, carbon isotope ratio, chlorophyll a, chlorophyll b, relative water content, canopy temperature, root length, and root volume were selected from the cotton database (http://www.cottonqtldb.org). The selected 157 QTLs were screened using genomic DNA samples from both parents produced 16 polymorphic markers, namely NAU 2557, CIR 143b, MUSB 0818c, JESPR 0205, BNL 1053, NAU 2474, BNL 3594b, BNL 2884, BNL 3259, BNL 3259, BNL 1153b, BNL 3173b, JESPR 230c, BNL 3347, MUSS 096a, CIR 061b, and BNL 1705 (Table 1.11.1). 5 QTLs each linked to the carbon isotope ratio and osmotic pressure, 4 QTLs linked to root volume, and 1 QTL each linked to relative water content and root length. The drought-tolerant parent and the drought tolerant recombinant inbred line population produced the same banding pattern with the polymorphic SSR markers showing the introgression of drought trait in the progenies (Fig 1.11.1).The RIL population was phenotyped for physiological parameters like canopy temperature, chlorophyll content (SPAD value), relative water content, and proline content. Phenotyping data with high relative water content, proline content, chlorophyll content, and lower canopy temperature are good indicators of drought tolerance in cotton. These

phenotypic and genotypic data will be transferred to the development of drought-tolerant varieties to enhance yield and its components in cotton genotypes under water stress conditions.



1 Lane 1L-100bp ladder 2)P1-SUVIN, 3)P2- CNH28I, Samples from 1-15:F 11 progenies
2 Lane1)L-100bp er 2)P1-SUVIN, 3)P2- CNH 28I, Samples from 16-32:F 11 progenies

Figure 1.11.1: SSR Marker BNL1153 on chromosome 25 linked to Osmotic Potential (OP)

Table 1.11.1: Parental Polymorphic survey with SSR markers linked to drought tolerant traits

SN.	Name of Primer	Chromosome No.	Character	Forward Sequence	Reverse Sequence	Polymorphism	Band Size (bp)	
							P1 Suvin	P2 CNH-28 I
1.	NAU2557	C15	CIR	F: CAACCATTCAGCTTCTTGTG	R: CGAGGACTCCTTTCATGTCT	P	50	60
2.	CIR143b	C15	CIR	F:AAGAAAGAAGAAACTTCCC	R:GCCATTAAGAAGGACAAA	P	120, 290	120
3.	MUSB0818c	C15	CIR	F:ACTCCGCGAACCACAGTG	R:GTCGCCAGGCCGTGTAAC	P	260,350	260, 400
4.	JESPR0205	C15	CIR	F:CCCAACTCTTTCCAAACTTGAG	R:GTACATATAGATGCCCTCGTG	P	110	90
5.	BNL1053	C21	CIR	F:AGGGTCTGTCATGGTTGGAG	R:CATGCATGCGTACGTGTGTA	P	180	180,200
6.	NAU2474	C1	OP	F:CTATTACCTCCGCCGTAGTG	R:CTGAGCTAATGCAAGAAGCA	P	190	200,230
7.	BNL3594b	C6	OP	F:AGGGATTTTGATTGTTGTGC	R:TGAATTCAAAACAAATGTTAGCC	P	200	190,230
8.	BNL2884	C6	OP	F:TCAACTCATACCAAATCAATTCC	R:CCCTGTTTTGTTCAATGGGT	P	190	180
9.	BNL3259	C14	OP	F:TTTTGAAATTCCAGCGAAGG	R:GTCAATACCTGCTTCTCCACG	P	240	200
10.	BNL1153b	C25	OP	F:CTTTATCCGGAGACGGAACA	R:CTAACTTTTGCTCACCCCCA	P	340,395	350
11.	BNL3173b	C1	RWC	F:AAGCTATAAAGAGAAGATGCAACG	R:TTTAACCATTGCGTGCAAAA	P	150	150,180
12.	JESPR230c	C19	RV	F:GGGACTAAAGAAGTAATTATGCC	R:GAAACCCTTGGCCATGAG	P	290	320
13.	BNL3347	C19	RV	F:AGACTGACATGCAGCTTCCA	R:ATCTTAATTTTGAGTATAGGATAGGGG	P	190	150
14.	MUSS096a	C20	RV	F:TCTGATAAACAGCGACAAAAGG	R:AAGAAATGAACTCTCACATGGC	P	250,320	255
15.	CIR061b	C24	RV	F:TTAGTCCTCTACATACCGAA	R:TCATAATAAAGGCGTGG	P	140	170

CIR-Carbon Isotope Ratio, OP-Osmotic Pressure, RWC-Relative Water Content, RL-Root Length, RV-Root Volume

1.12 Project Name: Exploration of genomic resources for identification of candidate genes and promoters for cotton improvement.

PI: Raghavendra KP

Co-PI: Pooja Verma, Joy Das, Rakesh Kumar

Salient findings

Transgenic tobacco plants carrying the cry1D gene were established in a contained facility, and the protein was isolated from cry1D-positive transgenic tobacco plants. The bio-efficacy of study of extracted protein against Spodoptera litura through the diet incorporation method revealed that the truncated Cry1D protein was not effective against the *Spodoptera litura*. The results confirmed the preliminary test results obtained using the heterologously expressed recombinant Cry1D protein isolated from bacterial cells. Transformation of the cry1Da gene construct to develop transgenic events for pink bollworm resistance through the In-planta method generated a cry1D positive putative T0 transformants, and the hardened plants were transferred to a polyhouse to harvest T1 seeds for further analysis.

1.13 Project: Enhancing climate resilience and ensuring food security with genome editing tools-Genome editing in Cotton

PI: Raghavendra KP

Co-PIs: Rakesh Kumar, Joy Das, Pooja verma, Rahul Phuke and Jayant Meshram

Importance of the project: Genome editing has significantly advanced crop improvement by enabling precise modifications in plant genomes. In cotton, recent high-throughput omics techniques have identified key genes related to stress resistance, fiber quality, seed development, and plant architecture, which can be targeted with greater accuracy using CRISPR/Cas genome editing tools to develop agronomically superior genotypes / varieties with improved traits of economic significance in cotton.

Salient findings

Initial strides were made in augmenting cotton (*Gossypium hirsutum* L.) via genome editing for desired traits. Target genes, including GhNB associated with compact architecture and determinate sympodial shoots, GhGalT1 for fibre quality and yield, GhFAD2-1 for seed oil quality enhancement, and GhPEPC for seed oil content augmentation, were identified for genome editing in cotton. CRISPR cas9 vectors for genome editing in cotton were procured from Addgene, USA. The targeted coding sequence of the candidate genes (GhFAD2-1, GhGalT1, GhNB, and GhPEPC) were PCR amplified from the Coker 312 genotype, cloned, and subjected to sanger sequencing for confirmation of the allelic status. The identified sequences were utilized to design the sgRNAs. In-vitro sgRNAs validation, selection, and construction of target gene specific sgRNAs cassettes is in progress.

1.14 Project Name: Identification, cloning, and functional validation of genes/enzymes involved in chitin biosynthesis pathway of Cotton Pink Bollworm (*Pectinophora gossypiella*)

PI: Joy Das

CO-PIs: Rakesh Kumar, Raghavendra K P

Salient findings

Identification and validation of suitable House-Keeping Genes for gene expression studies at all developmental stages of Pink Bollworm

Nine house-keeping genes were identified from the PBW transcriptome, which are essential for accurate gene expression studies. Among these, the α-tubulin gene (α-tub) demonstrated consistent expression across all developmental stages of PBW, making it a reliable candidate for normalization in quantitative gene expression analyses (Figure 1.14.1).

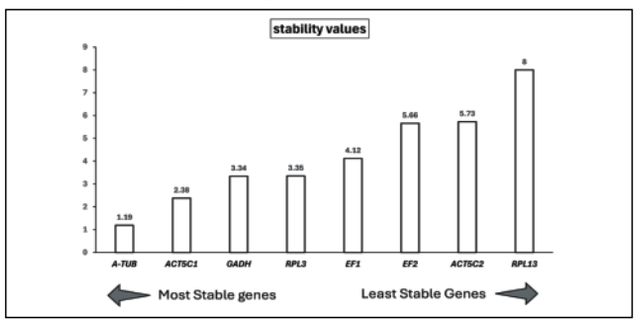


Figure 1.14.1: Identification and validation of α-tubulin as the most suitable normaliser reference gene for gene expression studies in PBW.

Optimization of In-House Protocol for dsRNA Synthesis:

An in-house, low-cost protocol for synthesizing in vitro dsRNA with high yield and quality was successfully optimized. This protocol provides a cost-effective method for producing dsRNA, a critical component for RNA interference (RNAi) experiments.

RNAi-Mediated Targeting of Chitin Synthesis Genes:

The chitin synthesis genes PgAGM and PgUAP, which were targeted by RNAi in PBW, led to approximately 30% and 40% mortality rates, respectively. Additionally, various detrimental phenotypes were observed, including molting defects, poor growth, and significant weight loss (Figure 1.14.2).

These results functionally validate the roles of PgAGM and PgUAP in PBW development, confirming their potential as targets for RNAi-based pest management strategies.

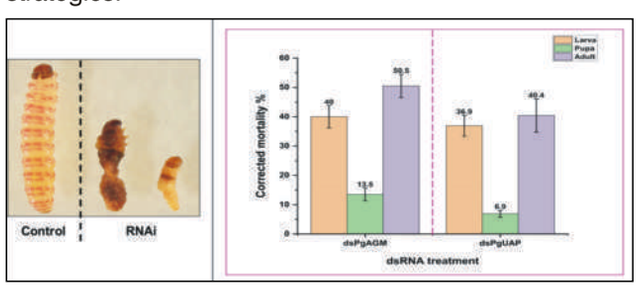


Figure 1.14.2: Effects of RNAi mediated silencing of targeted chitin biosynthesis genes (dsAGM and dsUAP) on pink bollworm

Recombinant Expression and Purification of PgAGM and PgUAP: The recombinant expression of both PgAGM and PgUAP proteins was successfully performed, followed by purification to homogeneity using Ni-NTA affinity chromatography and gel filtration techniques, exhibiting approximate sizes of ~60 kDa for PgAGM and ~55 kDa for PgUAP (Figure 1.14.3). Successful expression and purification of these proteins are critical steps toward functional characterization and further biochemical studies.

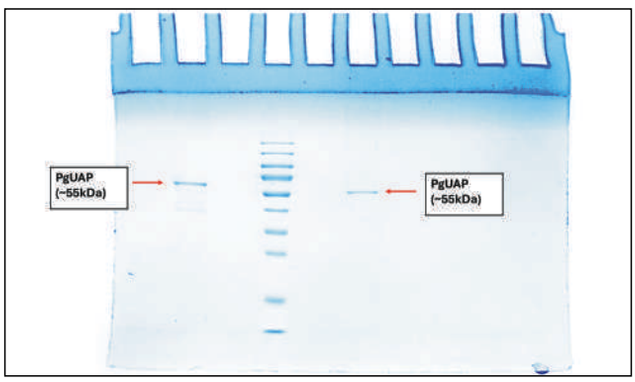


Figure 1.14.3: SDS-PAGE for purified recombinant proteins (PgAGM and PgUAP)

1.15 Project Name: Precise base editing in Acetolactate synthase (ALS) gene for herbicide tolerance in Cotton

PI: Rakesh Kumar

Co-PI (s): Joy Das , KA Molla (ICAR-NRRI Cuttack)

Importance of the study: The objective of the study is to develop a CRISPR/Cas-mediated genome editing protocol in cotton.

Salient findings

A standardized protocol was established for the expression and purification of 6x-His-tagged recombinant GhALS protein and its mutants (Fig 1.15.1). Amplification, cloning, and sequence confirmation of cotton small RNA promoter sequences for pU6-26_Gh6.7 and pU6-29_Gh6.3 were completed in the pENTR™/D-TOPO™ vector, and mobilization into the promoter-less gus expression vector pGWB433 vector for their functional validation through transient expression assay (Fig 1.15.2)

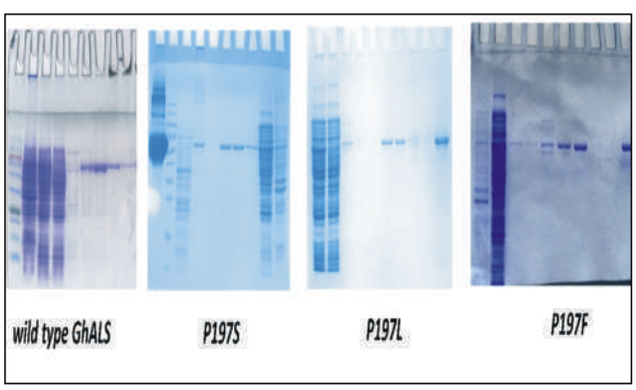


Figure 1.15.1: 6X-His tag-basedNi-NTA Affinity purification of wild-type GhALS and its various mutants

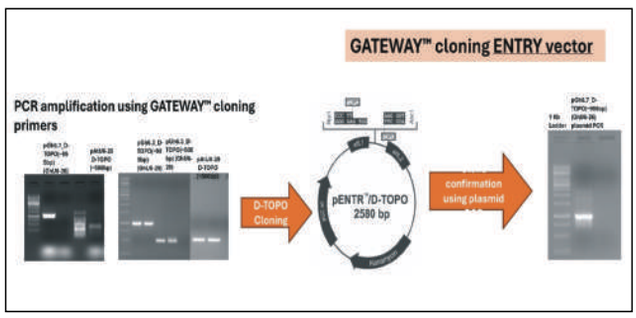


Figure 1.15.2. Cloning of cotton small RNA promoter sequences into pENTER/D-TOPO vector

1.16 Project Name: Implementation of PVP legislation 2001 and DUS testing of cotton under ICAR-SAU system

PI: V. Santhy (PI),

Co- PI: A. Manivannan

Importance of the study: The project aims for the establishment and maintenance of database on extant cotton varieties, conduct DUS testing of new, varieties under common knowledge, and characterize farmers' varieties for morphological characteristics based on National DUS test guidelines as a part of providing variety registration and protection. The database will be maintained primarily in digital format. In addition, maintenance breeding of reference cotton varieties is undertaken for their regular use in DUS testing of candidate genotypes.

Salient findings

The trial at Nagpur consisted of 4 entries under the first year and 98 entries under second year testing, while, at Coimbatore consisted of 15 under first year and 113 entries under second year testing along with 50 gazette notified varieties since 2017, grown as reference genotypes. A few unique traits such as full plant pigmentation, loose flower opening, chain boll bearing, blunt boll tip, bigger sized seeds with more than 14.0 g seed index were observed during the season. More reference varieties under maintenance include example varieties also and a total of 31 such G. hirsutum varieties and 3 G. barbadense varieties are being maintained and multiplied.

Monitoring of DUS trials was done on 20th November 2023 at Nagpur and 2nd February 2024 at Coimbatore centre. Among the 18 CICR varieties submitted for plant variety registration with PPV&FRA, DUS testing of 13 were completed and certificates issued.

1.17 Project Name: Development of high strength cotton genotypes by reducing the short fibre content

PI: S. Manickam

Co-PI: A. H. Prakash, J. Gulsar Banu

Importance of the study: The identification and development of high-strength culture will be useful for further breeding programmes. By developing suitable geometry and agronomy, yield maximization can be achieved in high strength cultivars that may be released as variety for the benefit of both farmers and end users.

Salient findings:

Long staple cultures (19) with good strength were evaluated in a replicated trial in organic situation along with Suraksha as a check variety for yield and fibre quality. Analysis of data indicated significant differences among the cultures for most of the studied characters. The highest seed cotton yield of 2845 kg/ha was recorded in culture BB 16-1-1 as compared to 1302 kg/ha yield recorded in check variety, Suraksha (Table 1.17.1). For fibre quality, the culture YLS 19-2 was the best for fibre length with 32.1 mm of UHML, whereas, the culture YLS 21-2 was the best for tenacity with 29.5 g/tex. These cultures were also assayed for physiological and biochemical parameters viz., nitrate reductase, total soluble protein, proline content, total soluble sugars, chlorophyll contents, and carotenoid content at 30, 60 and 90 days after sowing. The perusal of data indicated that the best culture for yield also recorded the highest nitrate reductase activity at 30, 60 and 90 DAS. Different cultures showed variable responses for total soluble protein (ug/g), proline (ug/g), total soluble sugar content (ug/g) and chlorophyll content in at different stages of data recording.

Comparison of fibre quality of these cultures evaluated under conventional growing conditions (2020-21) and organic conditions (2023-24) indicated that there was not much variation in the fibre quality traits because of the growing conditions.

Table 1.17.1 Per se performance of long staple cultures for yield and quality grown under organic conditions

ENTRY	Boll Weight (g/boll)	Seed Cotton Yield (kg/ha)	Upper Half Mean Length (mm)	Uniformity Index	Micronaire (µg/inch)	Tenacity (g/tex)
BB 1-1-1	4.3	2116	28.5	84.5	4.3	24.7
BB 1-2-1	4.0	1664	30.7	84.3	4.3	27.1
BB 2-2-1	4.5	2191	30.3	83.9	4.6	26.8
BB 4-2-1	3.6	1213	29.6	84.3	4.6	26.6
BB 4-2-2	4.1	1587	30.8	84.7	4.3	27.2
BB 5-2-1	4.1	1268	29.8	83.2	4.3	26.9
BB 10-1-2	4.0	1102	30.6	84.1	4.3	26.9
BB 13-1-2	4.1	2204	29.1	84.4	4.0	24.8
BB 16-1-1	4.8	2845	31.8	84.2	4.5	27.4
BB 18-1-1	4.5	2244	31.3	83.8	4.3	27.0
BB 18-1-2	3.9	1830	27.9	82.5	4.7	24.8
BB 18-2-1	4.6	2263	29.8	84.1	4.7	26.6
YLS 3-1	4.0	1759	30.1	84.1	4.1	26.8
YLS 15-1	4.5	1526	31.1	81.7	4.8	27.7
YLS 19-2	3.7	1009	32.1	84.1	3.8	27.5
YLS 21-2	4.2	1866	31.4	84.1	4.4	29.5
YLS 25-1	3.9	1292	30.6	84.1	4.0	26.9
YLS 33-1	4.1	1542	28.9	84.5	4.0	26.0
YLS 70-2	4.5	1611	28.7	82.7	4.0	24.8
Suraksha	3.8	1302	31.0	83.2	3.5	29.0
Mean	4.2	1722	30.2	84.0	4.4	26.9
CD	0.5	664				
CV	7.9	24				

1.18 Project Name: Induced mutagenesis for improvement of ELS cotton (*G. barbadense*)

PI: A. Manivannan

Co-PIs: K. Rathinavel, K. Shankarganesh, A. Sampath kumar

Importance of the study: Fast Neutron (FN) mutagenesis of cotton could aid in developing improved fibre quality varieties. Induced mutations increase the variability and broaden the genetic base of crop plants. Hence, the objective of the study was to optimize the mutagenic dosage of FN to induce higher variability for desired traits, measure the extent of variability among mutagenic population, and identify the mutants with

high yield, ginning out turn (GoT) and fibre quality traits.

Salient findings

- The LD50 was fixed to the dose of 30 Gy based on probit analysis. Among these doses of FN, 30 Gy dose showed the highest effectiveness (1.51%) and efficiency (2.99%) compared with the other doses.
- Spectrum of mutant like Variegated, Chlorina, Glandless, Brown linted, Big boll, and Dwarf were identified in M2 generations.
- Mutants were screened for higher yield, GoT and fibre traits in M2 generations and advanced to M4 generations.
- Twenty-five mutants for yield and GoT along with fibre quality traits were selected from the M3 generation. These mutants were performing better than control in terms of GoT and other fibre quality traits. The majority of the selected M3 mutants also performed better than control variety (Suvin) for single plant yield.
- Five mutants were identified in the M4 generations, namely S M6(S 30-4785-2-14-6), S M9(S 30-4423-6-4), S M10(S 30-1012-5-15), S M15(S 30-589-6-6), and S M25(S 30-3411-5-8), and they showed higher GoT (>35%), single plant yield, and fibre quality traits.

1.19 Project Name: Breeding for high yielding, early maturing sucking pest tolerant extra-long stable *G. barbadense* genotypes with improved fibre properties

PI: A. Manivannan

Co-PIs: K. Ramaesh

Importance of the study: Extra-long-staple (ELS) cotton is known for its high staple length, strength, and fineness. Fabrics made of ELS cottons fray less, pill less, wrinkle less, and even fade less than fabrics made with their short-staple counterparts. Despite the virtues of supreme fibre traits, ELS cotton *(G.barbadense)* is low in yield. To meet the ever-increasing demand for ELS cotton in India, this project was developed to increase the yield of *G.barbadense* along with superior fibre properties.

Salient findings

Product profiling of ELS cotton (*G. barbadense*) varieties ELS Cotton (*G. barbadense*) released varieties, namely CICR B Cotton 37, CICR B Cotton 45, and CICR B Cotton 55 varieties were profiled for their unique advantage under premium fibre category. CICR B cotton 37 with a length of 34.8 mm, strength of 38.45 and micronaire of 3.65; CICR B cotton 45 with a length of 34.65 mm, strength of 36.75 and micronaire of 3.3; CICR B cotton 55 with a length of 34.3 mm, strength of 38.3 and micronaire of 3.6. Among them CICR B Cotton 45 showed highest yield (1334 kg/ha), CICR B cotton 37 of 1321 kg/ha and CICR B Cotton 55 with yield of 1320 kg/ha. (Table 1.19.1). These varieties had a higher yield advantage.

Table 1.19.1 Product profiling of ELS cotton (*G. barbadense*) varieties

Attribute	CICR B Cotton 37	CICR B Cotton 45	CICR B Cotton 55	Suvin
UHML (mm)	34.80	34.65	34.30	37.5
Strength (g/tex)	38.45	36.75	38.30	39.5
Micronaire	3.65	3.30	3.6	3.7
GoT(%)	32.1	33.0	32.7	32.1
SCY (Kg/ha)	1321	1334	1320	1062

Promising ELS genotypes in AICRP trials during 2023-24: CCB24-1 and CCB 24-2 (IET); CCB22-1, CCB22- 2. and CCB23- 1 (IET Br14a)

Insect resistant lines: CCB-25 and CCB-28 for Aphids; CCB-28 for both Aphid and Jassid- tolerant were identified for sucking pest tolerance.

Evaluation of Advanced Progenies for sucking pest tolerance: BC2F10 generation of high yielding and sucking pest tolerance were evaluated, namely H1 Suvin × (ICB-241 × CCB-29), H2 Suvin × (EC-18 x CCB-3), H3 Suvin × (ICB85 ×CCB-29), H5 Suvin × (ICB126 × CCB-29), H6 Suvin × (ICB124 × CCB-29), H7 Suvin × (ICB124 × CCB-6), H8 Suvin × (ICB-124 × CCB-5), H9 Suvin × (ICB-27 × CCB-12), H10 Suvin × (ICB-214 ×CCB-6), H11 Suvin × (EC18 × CCB-29).

Identification of sucking pest-tolerant genotypes in *G. barbadense*: Among the hairy lines screened for various sucking pests, lines H1, H5, H6, and H8 were found to be moderately tolerant. SEM leaf anatomy of these lines showed, hirsute-type trichomes in H1, pilose-type trichomes in H5 compared with glabrescent leaves of susceptible lines. This leaf anatomical structure provides resistance against sucking pest.

Evaluation of Early Advanced lines for yield : BC1F6 generation of high-yielding namely, EA line derivatives Suvin × (EA241 ×CCB-29) (A1), Suvin × (EA118 × CCB-3) (A2), Suvin × (ICB85 × EA154)(A3), Suvin × (EA155 × Suvin) (A4), Suvin × (ICB124 × EA113) (A5), Suvin × (EA30 × CCB-6) (A6), Suvin × (ICB-124 × EA10) (A7), Suvin × (EA209 × Suvin) (A8), and Suvin × (EA118 ×

CCB-29) (A9). Among them five entires were shown promising yield viz., A8 (1679 kg/ha), A4 (1546 kg/ha), A9 (1541 kg/ha), A1 (1423 kg/ha), and A7 (1411 kg/ha)

Germplasm: A set of 327 *G. barbadense* germplasm is being maintained at CICR, Regional Station, Coimbatore.

Mutants: Brown linted mutant identified from the EA 203, Big boll mutant from EA159 were evaluated for the past three years (2021-2023) and found to be stable.

Seed multiplication: Mass multiplication of seeds of released varieties, CICR B Cotton 37, CICR B Cotton 45, and CICR B Cotton 55; cultures sponsored in AICRP trials (CCB 22-1, CCB 22-2, CCB 23-2, CCB 24-1, and CCB 24-2) and advance cultures (CCB 3, CCB 4, CCB 5, CCB 7, CCB 8, CCB 12, CCB 13, CCB 28, CCB 64, CCB 64B, CCB 129, CCB 141, CCB 142)

1.20 Project Name: Unraveling the Differential Expressed Proteins (DEP) in cotton genotypes with contrasting resistance to leafhopper and development of the protein biomarkers/functional markers for leafhopper resistance

PI: A. Manivannan

Co-PI: K. Shankarganesh

Importance of the study: Cotton insect resistance and its molecular mechanism involved in plant defense against pests is not well elucidated. The Global proteome analysis of Gossypium spp. in relevance to leafhopper resistance is expected to aid in developing resistant cotton varieties. Insights from plant-insect interaction molecular studies will be valuable in devising resistance strategies against leafhopper attacks in cotton.

Salient Findings

Putative proteins involved in cotton-based resistance to leaf hoppers

- Our combined KEGG pathway and GO enrichment analyses identified a diverse group of defense-related DEPs that may be involved in resistance of cotton plants to leaf hopper infestation.
- A total of 88 DEPs were shared between resistant and hybrid cotton.
- The majority of proteins associated with stress response, including polyphenol oxidase (A0A1U8MR36), carboxypeptidase (A0A1U8PDJ2), probable cinnamyl alcohol dehydrogenase 1 (A0A1U8LPT0), heat shock 70 kDa protein 15-like (A0A1U8HYA9), and subtilisin-like protease SBT1.9 (A0A1U8MSB0), were highly expressed in resistant and hybrid cotton.
- Proteins involved in photosynthesis were down-regulated in all genotypes after leafhopper infestation.
- Photosynthesis-related proteins such as sedoheptulose-1, 7-bisphosphatase (A0A1U8M9I6), malate dehydrogenase [NADP] chloroplastic (A0A1U8JCZ1), ATP synthase subunit beta (Q2L917), and ribulose bisphosphate carboxylase/oxygenase activase 2, chloroplastic (A0A1U8MWN6) were down-regulated.

Protein markers for breeding leaf hopper resistant cotton

- Comparison of proteome profiles among cotton genotypes revealed that heat shock 70- kDa protein 15-like (A0A1U8HYA9), carboxypeptidase (A0A1U8PDJ2), and probable cinnamyl alcohol dehydrogenase 1 (A0A1U8LPT0) are candidate proteins. In particular, these proteins were expressed in resistant genotypes, but not in susceptible.
- We found only one (uncharacterized protein LOC107904777, A0A1U8J8U7) that was significantly up-regulated (FC - 26.929) in the resistant genotype upon leafhopper infestation.
- Structural and functional annotations of particular uncharacterized proteins may result in the identification of new structures, facilitating the introduction of new functions and interactions.
- We hypothesize that this uncharacterized protein contributes to a physiologically advantageous againstleaf hopper infestation response.

Validation of proteins by qRT- PCR analysis

- Five candidate proteins were randomly selected, and their expression was confirmed by qRT-PCR analysis.
- The transcripts of BTR1-like isoform X2, 60S ribosomal protein L7-4, heat shock 70 kDa protein 6, and chaperone protein ClpB1 were highly expressed in resistant and hybrid after leaf hopper infestation.
- Malate dehydrogenase protein genes have minimal expression patterns in both resistant and susceptible genotypes.
- The results were consistent with the proteomics analysis and confirmed a positive correlation between protein abundances and transcripts for all tested genes.

1.21 Project Name: Development and evaluation of ELS interspecific hybrids with better yield and fibre quality

PI: K. Baghyalakshmi,

Co-PI: M. Amutha, A. Sampath Kumar

Importance of the study: The demand for Extra Long Staple (ELS) cotton in India is far more than the production. As a result, a significant amount of imports is needed to meet the demand. H × B hybrids act as an alternate to G barbadense varieties in the supply of Extra Long Staple Cotton. Hence, there is an urgent need to promote these cottons, whose quality is closer to that of modern textile mills demand.

Salient findings

The H × B hybrids, namely CCH15-1 × ICB284 (Fig 1.21.1), CCH15-1 × CCB 29, Suraj × ICB 99, MCUVT5 × ICB 284, and MCUVT5 × CCB 143 B, were stable for three years of testing, and the average yield was around 4000-4500 kg/ha. They combined better fiber quality with more than 39mm fiber length and 38 g/tex fiber strength. The GOT of all five hybrids were >34%. The hybrid Suraj × ICB29 and Suraj × ICB258 were found to be free of all

diseases. All the hybrids were showing resistance to moderate resistance to sucking pests and bollworms. While developing parental lines for H × B hybrids, 7 barbadense lines outperformed Suvin in fibre and yield trails (Table 1.21.1). These *G. barbadense* lines were early maturing and compact when compared with Suvin. A light brown colored lint line from the *G. barbadense* line was identified (GbAL7-CC) (Fig 1.21.2). The line will be further evaluated for stability and registered for colour lint. A stem weevil resistance *G hirsutum* line (Gh-STR-1) was identified in a segregating population. This line showed no gall formation for two consecutive years under field conditions which will be evaluated further.

Table 1.21.1 Yield and Fiber Properties of Advanced *barbadense* lines

S.No	Advanced Bt Lines (F8)	SBW (g)	SCY(kg/ ha)	GOT (%)	FL (mm)	FS (g/tex)	Mic (μ)
1.	GbAL1	3.1	999	32	34.8	34.1	3.0
2.	GbAL 2 (semi compact)	3.2	980	35	36.0	34.0	4.0
3.	GbAL 3	3.1	971	31	36.1	36.2	3.1
4.	GbAL4	3.0	900	32	37.0	34.8	3.0
4.	GbAL5 (double cross)	3.0	899	30	37.2	36.0	4.0
6.	GbAL6 (Semi dwarf)	3.2	1010	32	36.0	36.0	3.1
7.	GbAL7 (Three-way cross)	3.3	1015	33	36.1	34.8	3.4
8.	GbAL7 CC (Light brown lint)	3.0	905	32	34.2	34.2	3.4

Fig 1.21.1 HxB hybrid CCH15-1XICB284 plant, flower boll and fiber

Fig 1.21.2 H x B Light brown lint (GbAL7-CC) selected from segregating line GbAL7

1.22 Project Name: Development of varieties of upland cotton having better fiber traits and tolerance to CLCuD

PI: Subhash Chandra

Co-PIs:V. N. Waghmare

The importance of the study: The study aims at the development of *G. hirsutum* genotypes having better fibre traits and tolerance to CLCuD.

Salient findings

- In two station field trials conducted during 2023-24, each comprising 16 (total of 32 advanced cultures derived from 14 different crosses), 28 cultures were found to be resistant to CLCuD (PDI < 2%). In contrast, high-yielding check F 2228 and susceptible check HS 6 recorded PDI values of 4.85% and 7.26%, respectively. Among these, the genotypes CSH NB 13, CSH NB 14, CSH NB 23, and CSH NB 28 were found to be promising, showing seed cotton yields superior to the best check F 2228 (Fig. 1.22.1).

Additionally, the genotypes CSH NB 5, CSH NB 6, CSH NB 8, CSH NB 9, CSH NB 10, CSH NB 24, and CSH NB 27 were found better for fibre length (25.9 mm to 28.80 mm) than best check CSH 3129 (25.7 mm UHML).

- The Non-Bt cotton genotype CSH NB 101 (CSH NB 31-2) was found promising with SCY 18.2 q/ha in comparison with the best check NH 615 (SCY 17.3 q) in the Common Institute Trial 2023-24 which was subsequently sponsored in organic trial (Br 02 c) under AICRP (CZ) 2024-25.
- A single dominant gene reaction was observed for CLCuD resistance during segregation analysis in F2 Populations (N: 260; R: 192; S: 68) derived from cross, i.e., GVS 9 (R) × HS 6 (S).
- The trichome length (μm) and trichome density (cm2) were less in CLCuD-resistant sources (GVS 8 and GVS 9) than in susceptible check HS 5.
- Segregation/distribution pattern for yield attributes i.e., Plant height, Boll Nos, Boll Wt., Monopods, Sympods and Morphological traits i.e. Leaf hairiness, Stem hairiness, Pollen colour, Petal Colour, stem pigmentation etc. was studied.
- A total of four fresh crosses were attempted for pyramiding CLCuD resistance, high-yielding traits, and fiber quality traits using the Bt genes.
- Single plant selections (~30 Nos) with CLCuD resistance (PDI = 0) were identified from several early segregating generations (F2/F3/BC1F1/ BC1F2/BC1F3) derived from crosses involving unadapted exotic CLCuD resistant resources, i.e., GVS 8/GVS 9 with cultivated adapted backgrounds.

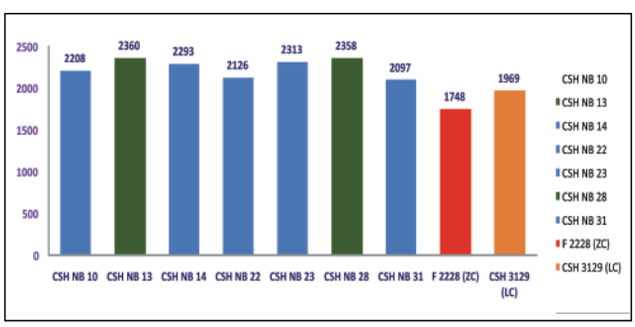


Fig. 1.22.1: Performance of promising cultures for seed cotton yield (kg/ha)

1.23 Project Name: Common research trials on evaluation of GEAC approved Bt cotton hybrids in North Zone

PI: Subhash Chandra

Co-PIs: Rishi Kumar, S. K. Sain and Amarpreet Singh

The importance of the study: The study aims to evaluate GEAC approved Bt cotton hybrids for yield attributes, fibre traits, insect-pest reactions and CLCuD resistance reactions for the North zone/Haryana state for further recommendations. Studies on sources of PBW carryover and management at various plant growth stages are also important in Northern states of India.

Salient findings

- In the Common GEAC Trial for the North Zone conducted at ICAR-CICR, RS, Sirsa, seed cotton yields ranged from 20.22 to 39.18 q/ha. Out of 84 entries, 54 BG II hybrids were identified as high-yielding (>28 q/ha) hybrids with favorable agronomic and pest resistance parameters. The CLCuD PDI ranged from 0%-18%. The whitefly population varied from 7.80 to 15.75, jassid from 2.40 to 7.55, and thrips from 15.40 to 28.50 per 3 leaves. Entry 954 recorded the lowest green boll damage (7.50%), while entry 902 had the least open boll damage (4.62%). In the Haryana State Trial conducted at ICAR-CICR, RS, Sirsa, the seed cotton yield ranged from 21.16 q/ha to 35.33 q/ha and out of 16 entries (Haryana state only), about 10 BG II hybrids were identified for seed cotton yield (>31 q/ha) and related parameters. CLCuD PDI ranged from 0 to 18%. Whitefly populations were ranged between 13.90-15.27, Jassid populations varied from 4.54-5.70 and thrips populations ranged between 27.74-33.37 per 3 leaves. Green boll damage due to PBW was the lowest in entry 614 (15.0 %), and open boll damage was the minimum in entry 614 (7.85%).
- The off-season carryover of PBW was studied during 2023-24. The PBW incidence in the unopened bolls collected from cotton stalks at different farmer fields ranged from 5.33%-94.67 % from January to June, 2024. Similarly, PBW larval recovery (Nos.) ranged between 0.00-20.00 and pupal case recovery ranged between 0.00-34.00 based on the average recorded from 50 unopened bolls from stacked cotton stalks.
- Pink bollworm management through insecticide sprays was evaluated with applications initiated at 10%, 20%, 30% and 40% square initiation stages, and also applied based on ETL (5–10% incidence on flowers or bolls) and moth trap activity (≥8 moths/trap for consecutive nights). The lowest PBW incidence (10.03%) was recorded in the treatment where sprays started at 10% square initiation, which also recorded the highest yield (8.53 q/ha) and the highest number of sprays (7). Bioassay of PBW (2nd instar larvae) using the topical application method showed the highest mortality with Profenophos 50 EC (83.33%), followed by Bifenthrin 10 EC (80.00%). The lowest mortality was observed with Deltamethrin 2.8 EC, while only 10% mortality was recorded in the untreated control.

1.24 Project Name: Development of high yielding varieties & hybrids of diploid cotton (*G. arboreum*) (Station activity)

PI: Subhash Chandra

Importance of the study: This study aimed to develop the GMS-based *desi* cotton hybrids (*G. arboreum*) and *desi* cotton varieties (*G. arboreum*) amenable to cultivation in North Zone Situations.

Salient findings

- GMS-based desi cotton hybrid development: One hybrid i.e., CISAA 19-4, was promoted to agronomy trial under AICRP (NZ) 2024-25. Two hybrids (CISAA 22-3 and CISAA 22-1) were promoted to advanced/coordinated trial (Br 25a CHT) under AICRP (NZ) 2024-25.Two hybrids (CISAA 23-3 and CISAA 23-1) were sponsored in National Trial (Br 25a/b) under AICRP (NZ) during 2024-25 after identification under station trial conducted at Sirsa during 2023-24. Seven GMS-based maintainer lines were maintained through sib mating.
- Desi cotton variety development: Two desi varietal cultures (CISA 6-11 and CISA 8-1) were sponsored under the National Trial (Br 22 a) under AICRP (NZ) 2024-25 after identification under station trial conducted at Sirsa during 2023-24. Four fresh crosses were attempted to develop varietal cultures with improved boll weight. A total of 20 Single plant selections were made for better boll weight (2.4 to 2.9 g) and other promising yield attributes. Promising G. arboreum entries i.e. CISA 6-350, CISA 6-295, NA 10, NA 14, NA 16, NA 17, and NA 19 were identified for better spinnability (fibre length > 25 mm).

1.25 Project Name: Physiochemical traits determining genotypic response towards accelerated ageing process in cotton

PI: Debashis Paul

Co-PIs: V Santhy, Sunil Mahajan

The importance of the study: Standardization of accelerated ageing in cotton to assess the biochemical changes associated with accelerated ageing process.

Salient findings

- The seeds harvested (at 140 DAS) from middle stratum of the plants showed the least response to accelerated ageing (AA) test.
- The arboreum genotypes were more responsive to the AA process compared to hirsutum genotypes. After 48 hours of ageing, germination (%) was recorded below 65% for the arboreum genotypes whereas it was 72 hours in case of hirsutum genotypes. This result was attributed to the higher seed oil content (%), smaller seed size, and lower seed index (g) of the arboreum genotypes (Figure 1.25.1)
- The biochemical indicators of seed ageing like lipid peroxidation and volatile aldehyde emission showed an increasing trend with ageing duration in both arboreum (Figure 1.25.2) and hirsutum genotypes (Figure 1.25.3); however, the magnitude was higher in arboreum genotypes
- Six months of ambient storage was equivalent to 72 hours AA test at 450C and 90 (%) RH.

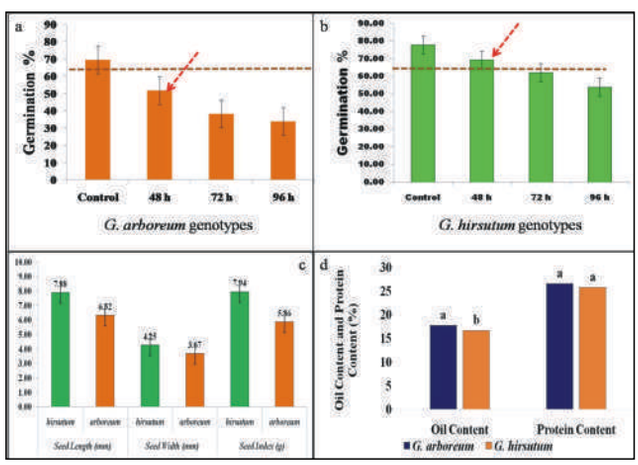


Figure 1.25.1:Response of Accelerated ageing conditions for 48, 72 and 96 hours on cotton genotypes; a: *G. arboreum*; b: *G.hirsutum*; Comparison between *G. arboreum* and *G.hirsutum* genotypes for seed size (mm) and seed index (c) and for Seed protein % and oil content % (d) in untreated seeds

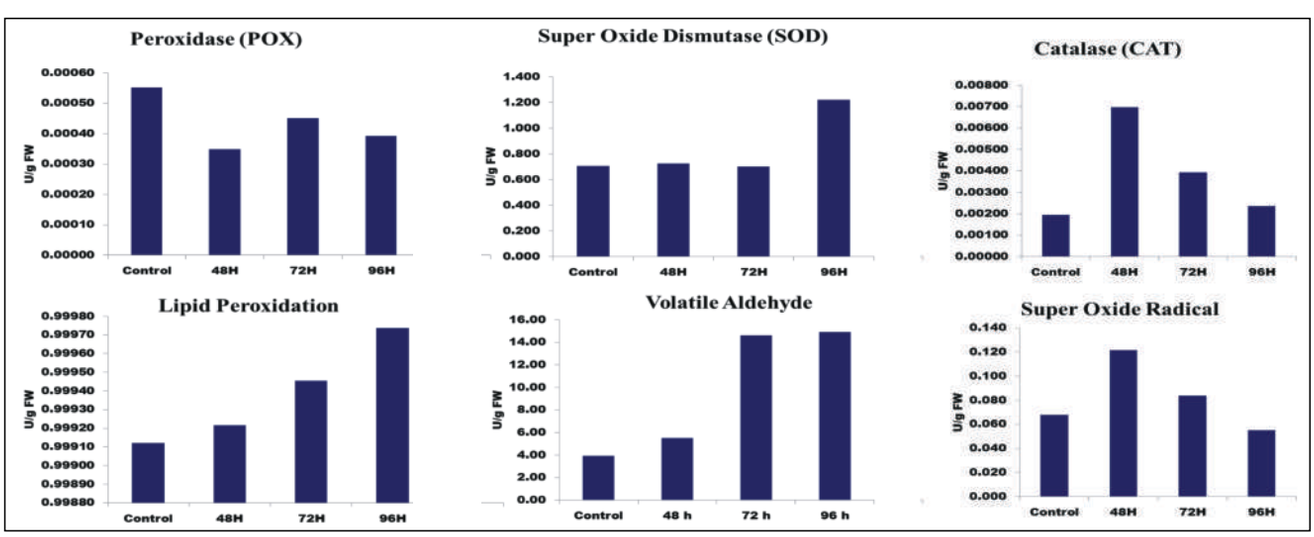


Figure 1.25.2: Response of accelerated ageing condition for 48, 72 and 96 hours on biochemical changes in *G. arboreum* genotypes

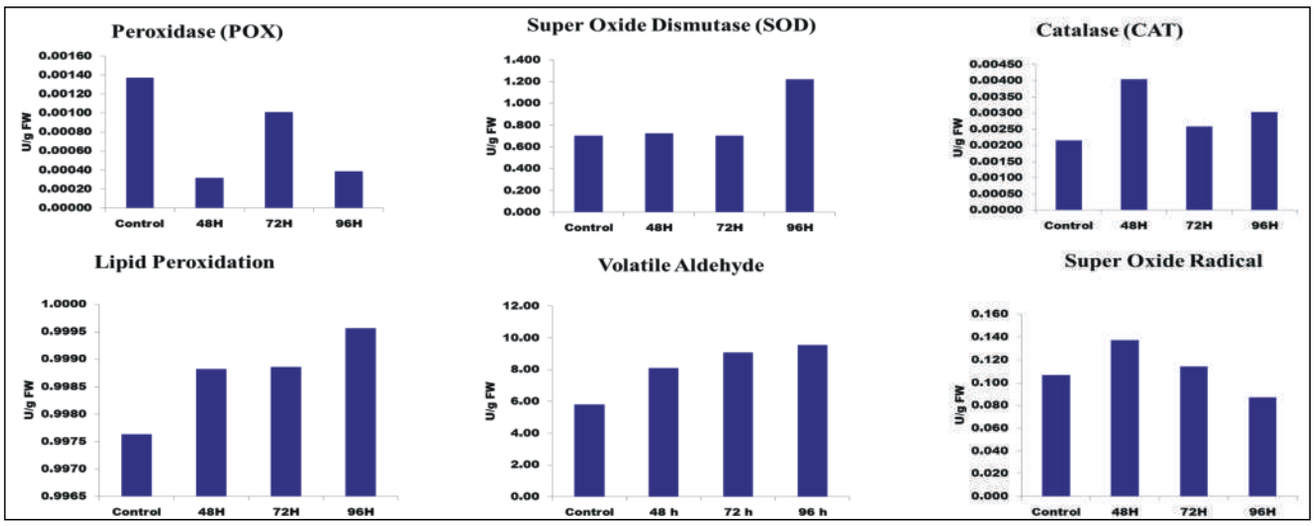


Figure 1.25.3:Response of accelerated ageing for 48, 72 and 96 hours on biochemical changes in *G. hirsutum* genotypes

1.26 Project Name: Combating seedling burning in cotton through induction of early heat tolerance in North Zone

PI: Debashis Paul

Co-PIs: Amarpreet Singh, Subhash Chandra, K. Velmourougane

The importance of the study: This study aimed to determine the extent of early seedling burning in cotton and to identify possible seed treatment combination options for early heat tolerance.

Salient findings

- A comprehensive farmers' field survey was conducted across multiple locations in all three North Zone states i.e., Punjab, Haryana, and Rajasthan to assess the extent of seedling mortality. The findings revealed a significant reduction in the plant population due to seedling burning, which can be attributed to adverse climatic or soil conditions. The extent of damage was categorized as follows:12 locations reported more than 50% seedling burning; 26 locations recorded 41–50% seedling burning; 32 locations showed 31–40% seedling burning; and only 4 locations had seedling burning limited to up to 10%(Figure 1.26.1).

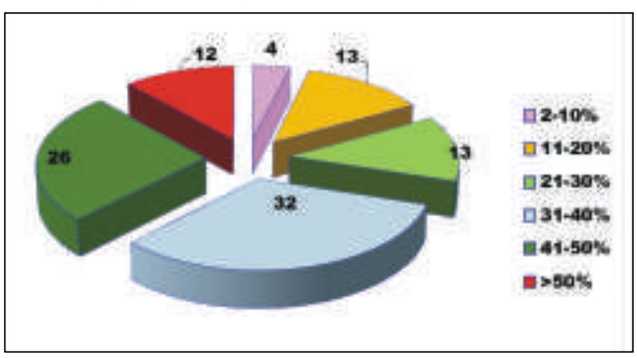


Figure 1.26.1: Percentage of farmer's field location under various categories of plant population reduction

1.27 Project Name: Evaluation of commercially available Bt cotton hybrids for the state of Haryana

PI: Debashis Paul

Co-PIs: Rishi Kumar, Amarpreet Singh

The importance of the study: To evaluate the commercially available BG-II hybrids with respect to the proportion of non-Bt seeds present as 'refugia' in seed packets.

Salient findings

- The percent of non-Bt plants ranged from 0% to 18.21 % among the 40 hybrids evaluated during 2023-24.
- Among the hybrids evaluated, 45% hybrids were within the recommended limit of 'refugia' (5-10%), 40% hybrids were below the recommended limit of 'refugia' (<5%) and 15% hybrids were above the recommended limit (>10%).
- As compared to 2022; the higher number of hybrids were within the recommended limit of refugia in 2023 (Figure 1.27.1).

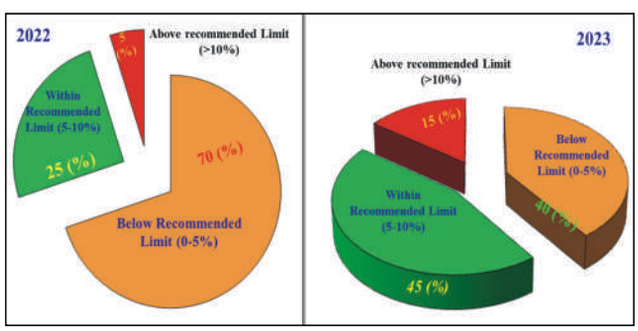


Figure 1.27.1: Refugia in Bag (RIB) status of the hybrids evaluated in 2022 and 2023

2.CROP PROTECTION DIVISION

2.1 Project Name: Monitoring insecticide resistance in American bollworm, *Helicoverpa armigera* (Hubner) populations from cotton growing regions of Maharashtra and Gujarat (2021-26)

PI: Shah Vivek

Co-PI: Rachna Pande

Importance of the study: Insecticide applications under field conditions are subjected to various environmental factors that lead to sub-lethal dose exposure of insects. The continuous use of the recommended insecticides under field conditions over a period of time has led to the development of resistance. Hence, field efficacy of recommended insecticides should be periodically monitored. In this context, the present study aimed to determine the status of resistance in American bollworm to recommended newer insecticides and selected conventional insecticides under laboratory conditions.

Salient findings

- The American bollworm, *Helicoverpa armigera* population was screened against five newer (Chlorantraniliprole, flubendiamide, indoxacarb, spinosad, emamectin benzoate) and three conventional (Cypermethrin, novaluron, profenofos) insecticides using the diet incorporation method.
- Among the different insecticides evaluated using newer molecules, emamectin benzoate had the best efficacy against Helicoverpa armigera, whereas, indoxacarb was the least effective. Comparing the relative resistance in terms of lethal concentrations, the values were range bound across years 2021-22, 2022-23, and 2023-24 (Fig. 2.1.1, 2.1.2 and 2.1.3).
- Among the different conventional insecticides evaluated, profenofos was found to be the best, followed by novaluron and cypermethrin. Comparing the relative resistance in terms of lethal concentrations, an increase was noted across years 2021-22, 2022-23, and 2023-24 (Fig. 2.1.4, 2.1.5 and 2.1.6).
- In case of insecticide compatibility studies, most insecticides and fungicides dissolve easily in water when added singly, except for flonicamid, emamectin benzoate, pyraclostrobin, and thiamethoxam.
- The pH change was in the alkaline range for most insecticides and fungicides in the range of 0.1- 0.4 except for monocrotophos, which was in the acidic range of 0.8- 0.9 when added singly.
- Sedimentation was observed in all combinations involving diafenthiuron, carbendazim, propineb, pyraclostrobin, and copper-oxichloride as a component.
- Combinations should be avoided, especially with copper oxychloride, because phase separation is very evident in such combinations.

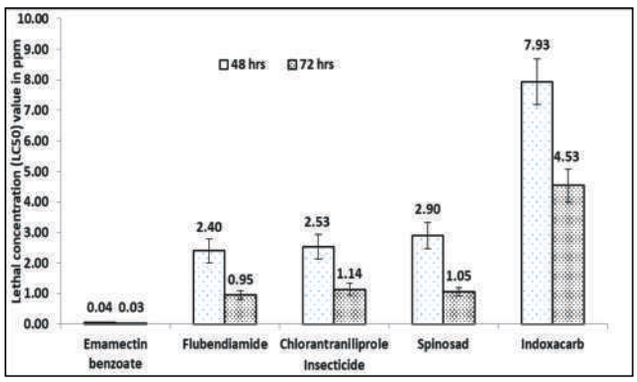


Fig 2.1.1. Mean lethal concentration (ppm) of populations screened against newer insecticides (2021-22)

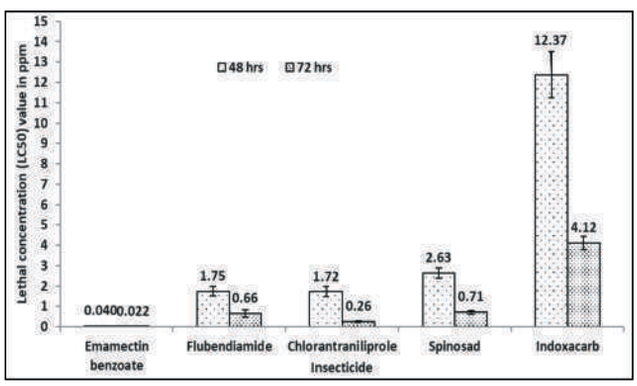


Fig 2.1.2. Mean lethal concentration (ppm) of populations screened against newer insecticides (2022-23)

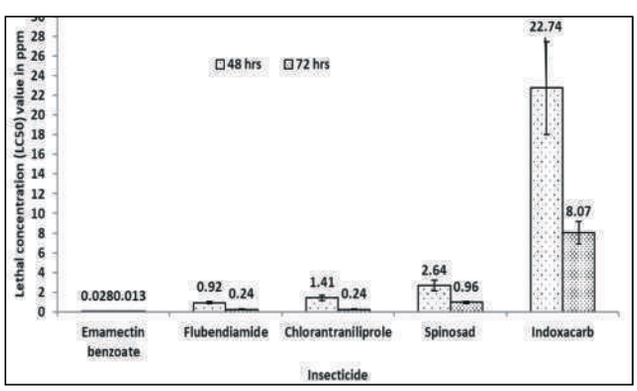


Fig 2.1.3. Mean lethal concentration (ppm) of populations screened against newer insecticides (2023-24)

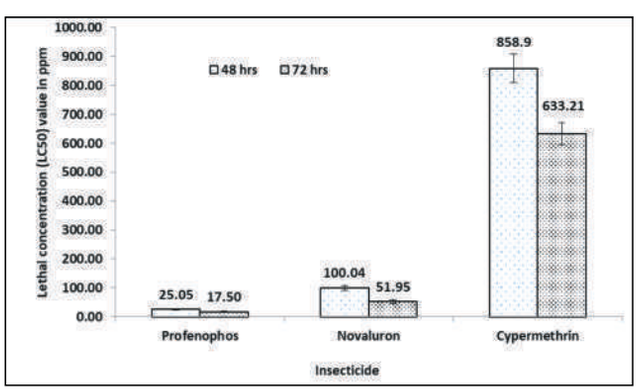


Fig 2.1.4. Mean lethal concentration (ppm) of populations screened against conventional insecticides (2021-22)

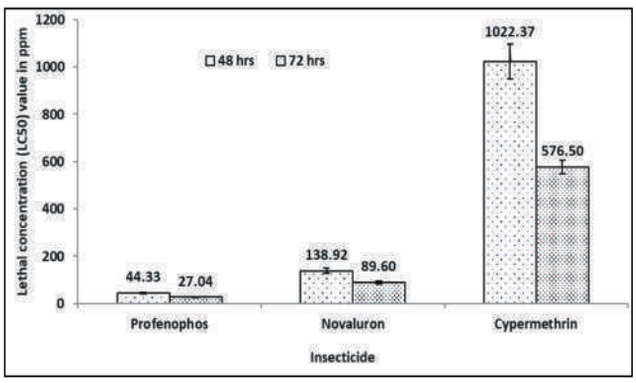


Fig 2.1.5. Mean lethal concentration (ppm) of populations screened against conventional insecticides (2022-23)

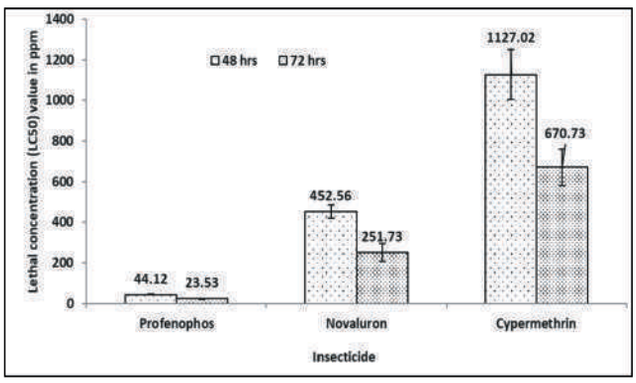


Fig 2.1.6. Mean lethal concentration (ppm) of populations screened against conventional insecticides (2023-24)

2.2 Project Name: Revisiting the ETLs and yield loss assessment for pink bollworm and boll rot in cotton

PI: Babasaheb B Fand

Co-PI: Vivek Shah, Dipak T Nagrale

Importance of the study: Pink bollworm (PBW) and boll rot (BR) cause significant yield loss in cotton due to deterioration of lint quality and seed damage. The present research was prompted by a paucity of precise methods for yield loss assessment due to damage caused by the two entities. Objectives of study were: i) To develop a reliable and robust method for yield loss assessment in cotton due to PBW and BR, ii) To study the effect of climate change on future invasiveness of PBW, and iii) To predict future trends of yield loss due to PBW by linking the phenology model with field-level damage.

Salient findings

- A linear relationship was determined between pheromone trap catches (independent variable) and crop damage parameters (dependent variables: pink bollworm larvae per boll and percent green boll infestation) using the equation y = a + bx.
- The moth catch number (X) was estimated using inverse regression based on the regression equation parameters (a, b) and green boll damage or larvae per boll (Y), as shown in the equation: X = (Y - a) / b.
- Data from published Annual reports of AICRP on Cotton for the period 2009-24 for four different cotton growing locations were used to validate the results.
- The regression model provided the best fit to the data (R2> 0.74, p <0.01).
- The revised ETL was estimated to be 2.5 and 5.7 moths per trap per night for crop stages <120 DAS and >120 DAS, respectively, compared to the existing ETL of 8 moths per trap per night (Fig. 2.2.1; Table 2.2.1).

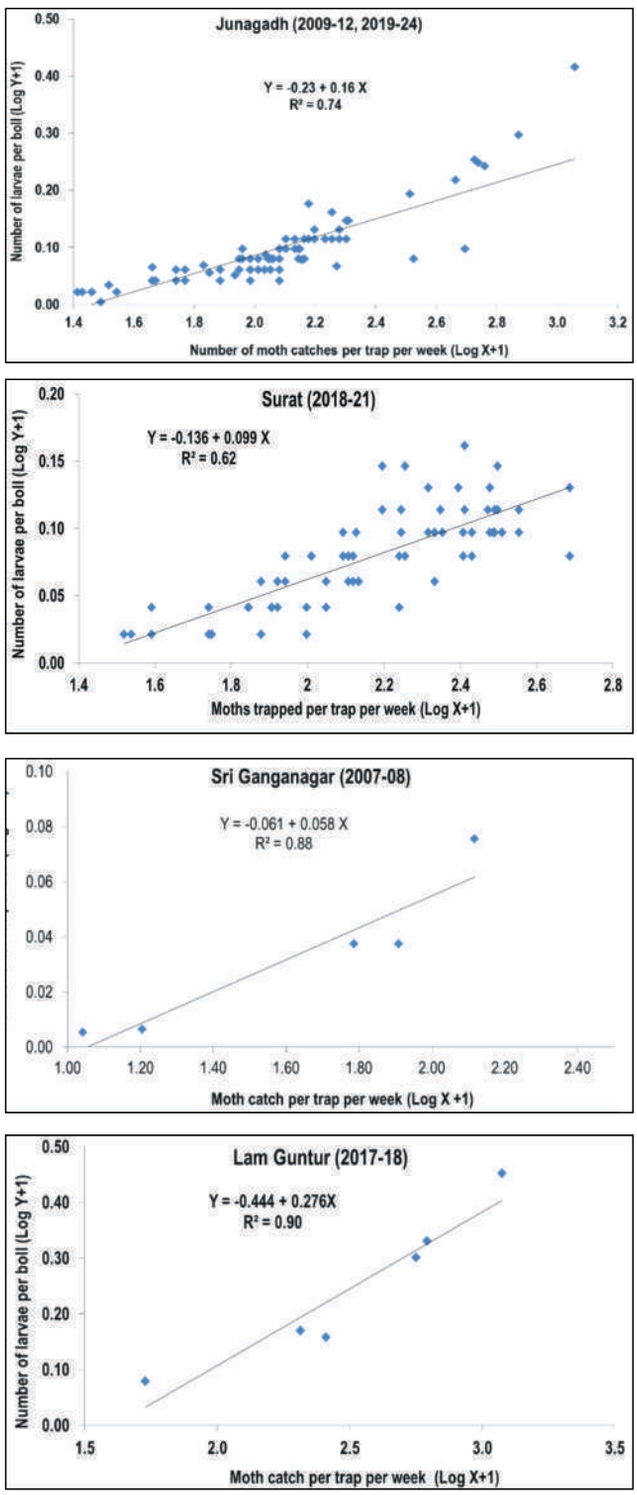


Figure 2.2.1. Multilocation validation of pink bollworm ETL based on moth trap catches

Table 2.2.1. Pink bollworm ETLs based on moth trap catches estimated for four different cotton growing locations of India

ETL based on green boll infestation (%)	Mean weekly moths trapped (Nos.)				Mean daily moths trapped (Nos.)			
	Junagadh	Surat	Sri Ganganagar	Lam Guntur	Junagadh	Surat	Sri Ganganagar	Lam Guntur
5	39.1	38.5	26.1	48.7	5.6	5.5	3.7	7.0
6	41.5	42.4	30.8	50.4	5.9	6.1	2.4	7.2
7	42.1	46.6	36.2	52.2	6.3	6.7	5.2	7.5
8	46.7	51.1	42.5	53.4	6.7	7.3	6.1	7.7
9	49.5	56.1	49.8	55.8	7.1	8.0	7.1	8.0
10	52.4	61.5	58.3	57.7	7.5	8.8	8.3	8.2

2.3 Project Name: Identification of Host Cues from Cotton (*Gossypium hirsutum*) to elicit behaviour of female Pink bollworm (*Pectinophora gossypiella*)

PI: Rachna Pande

Co-PI: Pooja Verma

Importance of the study: This project aims to conduct a comprehensive volatile profiling of the cotton plant, analyzing different plant parts at various stages. The proposed method generates comparative data on volatiles between and within species. This study will enhance our understanding of chemical cues by evaluating the role of identified volatiles as host attractants. In addition, this project will identify the key volatiles that influence female pink bollworm behavior.

Salient findings

- For confirmation of protocol and volatile profile, the identification of compounds from different plant parts at different crop stages was repeated using Gas chromatography–mass spectrometry (GC-MS).
- *Gossypium hirsutum, G. raimondii,* and *G. indicum* were the targeted plant species, Plant parts, viz., leaves (tender, fully developed), squares, buds, flowers (yellow and pink), and bolls, were collected and analyzed using GCMS. For the preparation of comparative volatile profiling, comparative tables were prepared under different categories, viz., plant part-wise comparison between the species, comparison of compounds within the species (comparison of different stages and individual stage at different days after sowing),).
- The potential fecundity of the pink bollworm was also calculated. In this experiment, 1 male + 1 female were included as treatment (3 replications), and potential fecundity was recorded. The average potential fecundity of the female pink bollworm was 148.33 eggs.
- Volatiles were also collected from whole potted plant (var. Suraj) using a customized air entrainment system (BIOLABS, Hyderabad-India) for Y tube Olfactometer bioassay. The bioassay responses of mated female pink bollworm (*Pectinophora gossypiella*) moths toward plant volatiles collected on different days after sowing were recorded.

2.4 Project Name: Development of EPF (*Beauveria bassiana* and *Metarhizium anisopliae*) and EPN based bio-formulation for sustainable management of pink bollworm and sucking pest complex in cotton

PI: Shivaji Thube

Co-PI: Y.G. Prasad, G. T. Behere

Importance of the study: Cotton insect pests inflict severe damage to cotton crops, leading to significant yield losses and economic setbacks for farmers. In addition, the extensive use of chemical pesticides to control these pests has raised concerns about environmental pollution, human health hazards, and the development of pesticide-resistant populations. Given the urgency to find sustainable and eco-friendly alternatives to chemical pesticides, this project aims to address these important issues.

Salient findings

- Field evaluation of the *Metarhizium anisopliae* TMBMA1-based formulation demonstrated its effectiveness against aphids, with the lowest mean population recorded at 8.7 aphids per three leaves compared with 45 aphids per three leaves in the control (Fig. 2.4.1).
- The incidence of pink bollworm (PBW) was significantly lower in the TMBMA1-treated plots, with only 10% green boll damage, compared to 40% in the control (Fig. 2.4.2).
- Similarly, the jassid incidence was the lowest among all tested biopesticide, with a mean of 1.5 jassids per three leaves, compared with 2.4 jassids per three leaves in the control.
- The virulence of TMBMA1 against adult dusky cotton

bugs was evaluated under laboratory conditions. The highest mortality rate (99%) was observed at the highest fungal concentration (1×10^{10} spores/ml), whereas the lowest mortality rate (13.33%) was recorded at the lowest concentration (1×10^{4} spores/ml).

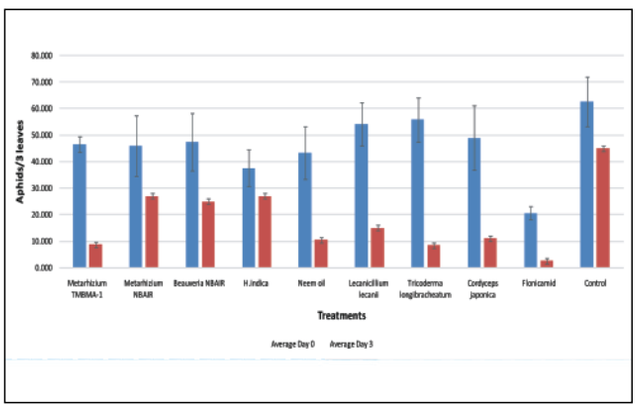


Figure 2.4.1. Bio-efficacy of biopesticides against cotton aphid

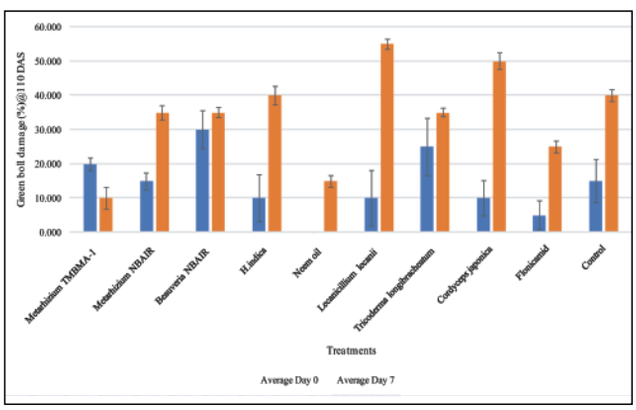


Figure 2.4.2. Bio-efficacy of biopesticides against pink bollworm at 110 days after sowing

2.5 Project Name: Insecticide Resistance Management: Dissemination of Pink Bollworm Management Strategies

PI: V. S. Nagrare

Co-PI: S.P. Gawande, B.B. Fand, D.T. Nagrale, S.S. Patil, K. Rameash, Rishi Kumar, Rachna Pande, Neelkanth Hiremani, S. K. Sain, J. H. Meshram, K. Shankarganesh, Shivaji Thube

Importance of the study: The widespread adoption of single-gene (Cry1Ac) Bt cotton hybrids from 2002, followed by dual-gene (Cry1Ac+Cry2Ab) Bollgard II hybrids from 2006, which now cover over 95% of India's cotton cultivation area, initially resulted in a significant shift in pest dynamics. Specifically, bollworm infestations were effectively suppressed, whereas sucking pests remained a concern. However, the initial success against cotton bollworm (*Helicoverpa armigera*), spotted bollworm (*Earias* spp.), and pink bollworm (*Pectinophora gossypiella*) was compromised by the emergence of pink bollworm resistance to Cry1Ac in Gujarat in 2008. This resistance subsequently led to severe pink bollworm infestations across central and southern India from 2014, and in northern India from 2018. The resurgence of pink bollworm across all major cotton-growing regions of India poses a substantial threat to cotton production, affecting farmers' livelihoods and the national economy. Over the past 8-9 years, this pest has become a critical challenge, causing widespread damage and yield losses estimated at 20-30%. In contrast, cotton bollworm and spotted bollworm have been effectively controlled due to the broad host range and sustained toxicity of the Cry1Ac and Cry2Ab genes in Bollgard II cotton. Therefore, the primary objective of this project is to disseminate effective pink bollworm management strategies. This initiative was crucial for mitigating the immediate threat to cotton crops, ensuring the long-term sustainability of cotton farming, and safeguarding cotton farmers' economic well-being and theresilience of the Indian economy.

Salient findings

- The project, "Insecticide Resistance Management: Dissemination of Pink Bollworm Management Strategies (IRM-PBW)," was implemented during 2023-24 season across 900 acres in 76 villages spanning 15 districts and 8 states: Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, and Haryana.
- The ICAR-Central Institute for Cotton Research (CICR) served as the nodal institute, collaborated with 10 State Agricultural Universities. This initiative employed a comprehensive pink bollworm management strategy that integrated cultural practices, biological controls, and need-based, judicious pesticide application.
- Outreach activities carried out in IRM villages were: Field visits-275, Farmer's trainings-26, Sensitization workshop to ginning mill owners and input dealers-6, Mobile text /voice Messages sent-205, Exhibitions arranged-8, Training/ workshop conducted-22, TV Programs-13, Radio talks-41, Farmers' queries replied-4763, Lectures delivered in trainings-79, Visit of farmer to station /personal contact-2521.
- IRM fields received an average of 5.82 sprays as compared to 8.37 sprays in non-IRM fields.
- IRM fields recorded average seed cotton yield of 1971 kg/ha compared to 1671 kg/ha in non-IRM fields, with a yield advantage of 18%. The accrued Benefit: Cost ratio was 1.91:1.
- The reduction in pesticide usage in IRM vs. non-IRM fields was 33.4% in terms of cost and 37.4% in terms of volume. The average pink bollworm infestation in North India was 36.2% in IRM fields and 68.6% in non-IRM fields. Similarly, pink bollworm infestations were 12.9% and 22.8% in central India and 13.9% and 21.3% in southern India in IRM and non-IRM fields, respectively. Overall, a 42.3% reduction in pink bollworm infestation was recorded in IRM fields over non-IRM fields during 2023-24.

2.6 Project Name: Crop pest surveillance and advisory project (CROPSAP) in Maharashtra

PI: V. S. Nagrare

Co-PI: B.B. Fand

Importance of the study: The state of Maharashtra, covering about one-third of India' s total cotton cultivation, is crucial for cotton production and is often intercropped with soybean and pigeon pea. However, biotic stresses like pests and diseases pose threats to yields. To address this, the State Agriculture Department initiated the e-Crop pest surveillance and advisory project (CROPSAP) in 2009-10, employing Information and Communication Technology (ICT). In collaboration with ICAR Institutes, State Agriculture Universities, and government agencies, including NIPHM and MAIDC, the project focuses on major crops like Cotton, Soybean, Rice, pigeon pea, sugarcane, and chickpea. CROPSAP utilizes real-time monitoring and timely advisories, especially when pest populations exceed Economic Threshold Levels (ETL). ICAR-CICR plays a pivotal role, formulating Integrated Pest Management (IPM) strategies tailored for cotton and providing pest-specific advisory capsules. This project establishes a model for sustainable and technology-driven agricultural practices in Maharashtra, safeguarding crops, and fostering collaboration among various stakeholders.

Salient findings

- Disseminated cotton pest management strategies through ICT tools as a stakeholders in CROPSAP 2023-24 in Maharashtra.
- Issued 38 growth-stage-wise advisories on pest and disease management. Conducted 1 Training/Lectures on pest and disease management, and 11 random field visits in 8 districts of Maharashtra.
- Analyzed pest infestation scenario. Pink bollworm infestation in green bolls was observed from the 31st standard week (SW) (30 July-05 Aug) in 3 villages and increased to 31 villages till 36 SW (03-09 Sep). Subsequently, infestation came down to 6 villages and crossed the ETL in 31 villages during 41 (08-14 Oct). Infestation crossed the ETL in more than 20 villages from 43 SW (22-28 Oct) to 51 SW (Dec 17-23) (Fig 2.6.1). The infestation increased from August to December. The month-wise villages that crossed ETL by pink bollworm were 39, 74, 104, 97 and 138 during August, September, October, November and December, respectively (Fig 2.6.2).
- The Amravati, Jalgaon, and Yavatmal districts showed maximum number of villages crossed ETL (Fig 2.6.3). Jassid infestation crossed ETL in 16 villages during the 31st SW (30 July-05 Aug) and was seen fluctuating till mid-September and subsequently, decreased thereafter. Highest number of villages where ETL crossed was recorded during August (49) followed by September (33), October (29), November (4) and December (5). Maximum no. of villages crossing ETL by cotton jassid was seen in Amravati and Nanded. The overall whitefly and thrips data shows negligible infestation in most of the districts under observations.

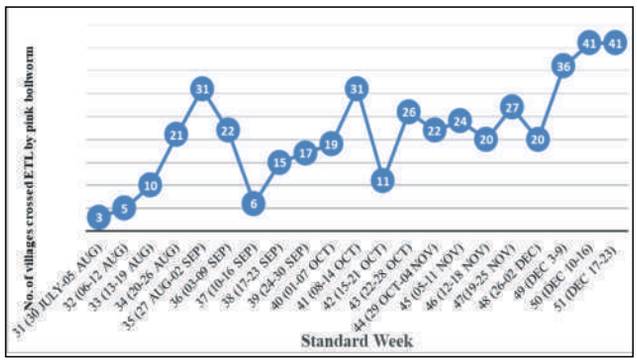


Fig 2.6.1. Pink bollworm infestation crossed ETL in a number of villages over the season 2023-24 in Maharashtra

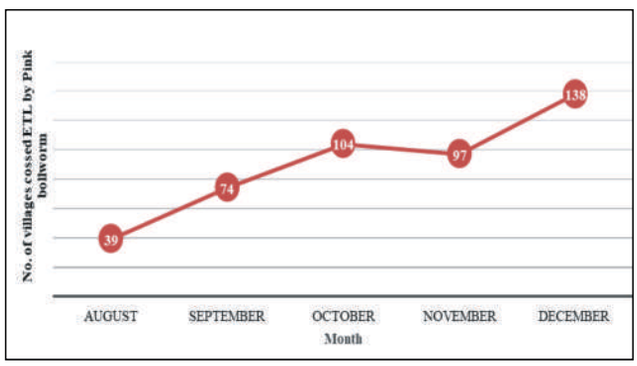


Fig 2.6.2. Month wise pink bollworm infestation crossed ETL in a number of villages in Maharashtra (2023-24) over the season

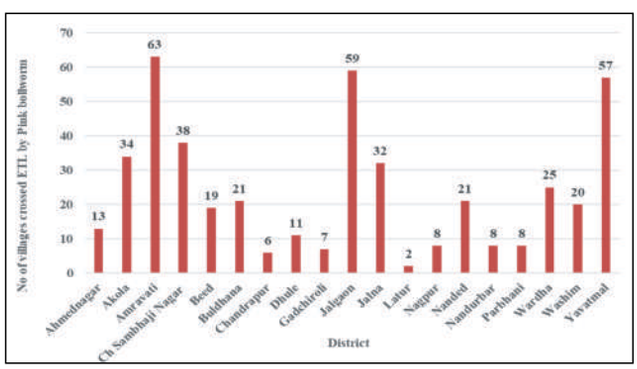


Fig 2.6.3. District wise Pink bollworm infestation crossed ETL in Maharashtra (2023-24) over the season

2.7 Project Name: Neonicotinoid and pyridine carboxamide insecticides resistance monitoring in cotton Jassid (*Amrasca biguttutla biguttutla* Ishida)

PI: V. S. Nagrare

Co-PI: Rishi Kumar, K. Shanakarganesh, Joy Das

Importance of the study: The resurgence of pink bollworm in three cotton-growing regions of India poses a significant threat to cotton cultivation and the nation's economy. The larvae of the pink bollworm are internal feeders, residing within the green bolls and consuming

developing seeds, rendering conventional chemical control methods less effective. To address this challenge, a range of pest management strategies are being explored, with particular attention to the potential of entomopathogen as biological control agents. These include bacteria, fungi, viruses, and entomopathogenic nematodes (EPNs). This project focuses on the comprehensive characterization of entomopathogen associated with pink bollworm larval infections across diverse geographic locations. The bioefficacy of these entomopathogens against pink bollworm populations was also investigated under laboratory and field conditions. By elucidating the traits and effectiveness of these natural control agents, this research project aims to contribute to the development of sustainable and environmental friendly approaches for managing pink bollworm infestations in cotton fields.

Salient findings

- Seven technical-grade insecticides were used for bioassays. The mean LC50s at 24 and 48 hrs after exposure to the insecticides recorded were 195.0 and 8.4 ppm for Acetamiprid, 62.4 and11.8 ppm for Clothianidin, 91.2 and 32.4 ppm for Fipronil, 92.2 and 47.9 ppm for Flonicamid, 117.5 and 62.1 ppm for Imidacloprid, 87.9 and 32.1 ppm for Thiamethoxam and 102.1 and 52.7 ppm for Dinotefuron, respectively.
- After 4 repeated sprays of Fipronil on cotton crop, resistance development in cotton jassid was 34 and 12-fold at 24 and 48 h respectively, while Flonicamid showed very low resistance at both 24 and 48 h after exposure. The relative susceptibility of cotton jassid across insecticides was recorded as Clothianidin > Thiamethoxam > Fipronil > Flonicamid > Dinotefuron > Imidacloprid > Acetamiprid at 24hrs after exposure. A survey on the pesticide use pattern in cotton was carried out at 24 locations of 18 districts across 3 cotton growing zones.
- At each location, 25 farmers were interviewed; thus, data from 600 farmers were collected. Farmers applied average 6.11, 5.87, 6.72, and 6.09 pesticide sprays in North India, Central India, South India and overall, India for the control of both sucking pests and bollworms. Pesticide (insecticide+ Fungicide) consumption was 839, 1417, 2123, and 1494 g a.i/ha in North India, Central India, South India and overall, India, respectively. The share of insecticide was recorded 89% while of fungicide was 11%.

2.8 Project Name: Studies on target leaf spot of cotton caused by *Corynespora cassiicola*

PI: Shailesh P. Gawande

Co-PI: S. K. Sain, Babasaheb B. Fand, Rakesh Kumar

Importance of the study: This study aims to gather crucial data on Target Leaf Spot, an emerging cotton disease, for location-specific management, which is currently lacking. Comprehensive information on cotton distribution across Indian cotton acreage, disease onset, and diversity is essential. Understanding these factors will help analyze disease progression and its potential impact on yield, thereby aiding in better disease control and management strategies.

Salient findings

Classification and detection of the cassiicolin gene cascade in the studied isolates

A survey of 22 districts in eight Indian states assessed the diversity of *Corynespora cassiicola* isolates from diseased cotton leaves. The study analyzed the cassiicolin-encoding gene in 48 isolates using PCR with primers targeting all known Cas sequences (Fig.2.8.1). Isolates were cultured in PDA broth, and conidia were inoculated onto the susceptible cotton cultivar Yugank-Bt. Symptoms appeared five days post-inoculation (Fig.2.8.2). The cassiicolin gene, which encodes host-selective toxins (HSTs), was found in 79% of the isolates, with Cas5 in 65%, which correlates with higher virulence. Findings highlight cassiicolin's role in disease severity.

Regression analysis using a Logistic Model for estimation of Disease progression for Target Leaf Spot

A field experiment using a split-plot design with two hybrids, four replications, and varying fungicide applications showed that Ajeet-155 (BG-II) had a lower disease incidence than the Crystal First Class, indicating resistance (Fig.2.8.3). Disease peaked at 85–120 DAS, highlighting a critical window for management. Increasing the number of fungicidal sprays reduced disease incidence, with three most sprays, being most effective. Findings underscore the importance of resistant cultivars and optimized spray schedules for sustainable cotton disease control.

Field evaluation of label-claimed fungicides and bio agents against Target leaf spot

Table 2.8.1 summarizes a cotton field experiment on disease incidence (PDI), , and yield. T10 (water spray) had the highest PDI (16.93) while T9 (culture consortia) had the lowest PDI (2.47), with 73.6% disease reduction. T1 yielded showed highest seed cotton yield (28.88 q/ha), highlighting the impact of treatments on disease control and productivity.

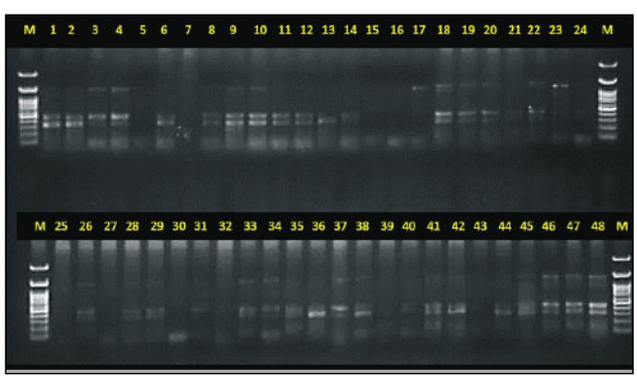


Fig.2.8.1 PCR amplification of Corynespora samples from different geographic locations using Cas 5 cascade gene where M-Marker 100bp, Samples 1-48= Corynespora isolates from North, Central and South India

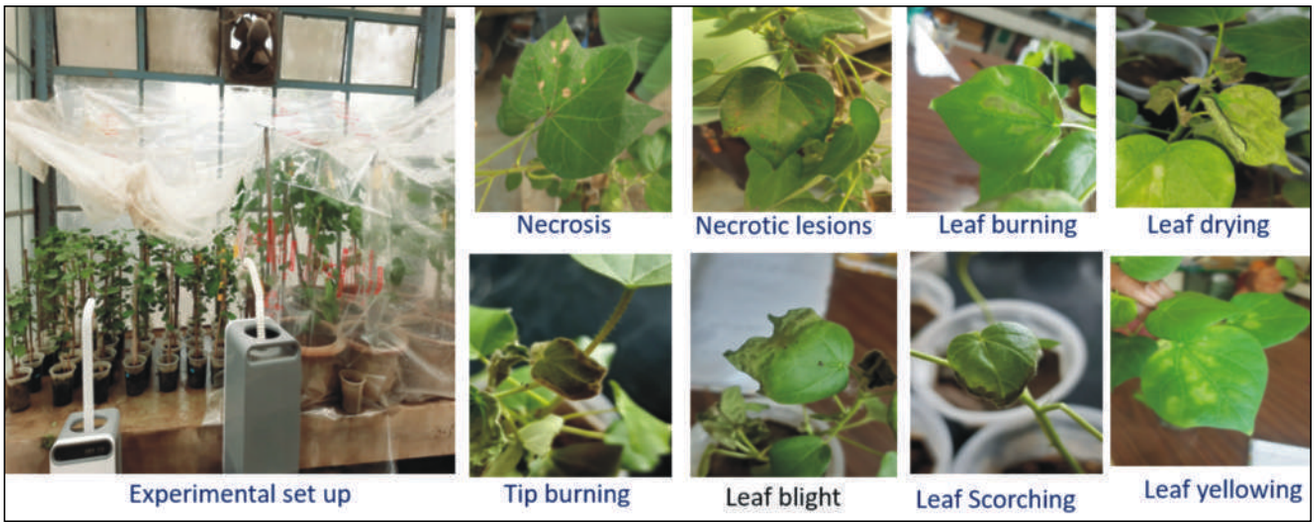


Fig.2.8.2. Symptoms appeared on the susceptible cultivar (Yugank Bt) five days after Inoculation with conidial suspensions from different *Corynespora cassiicola* isolates

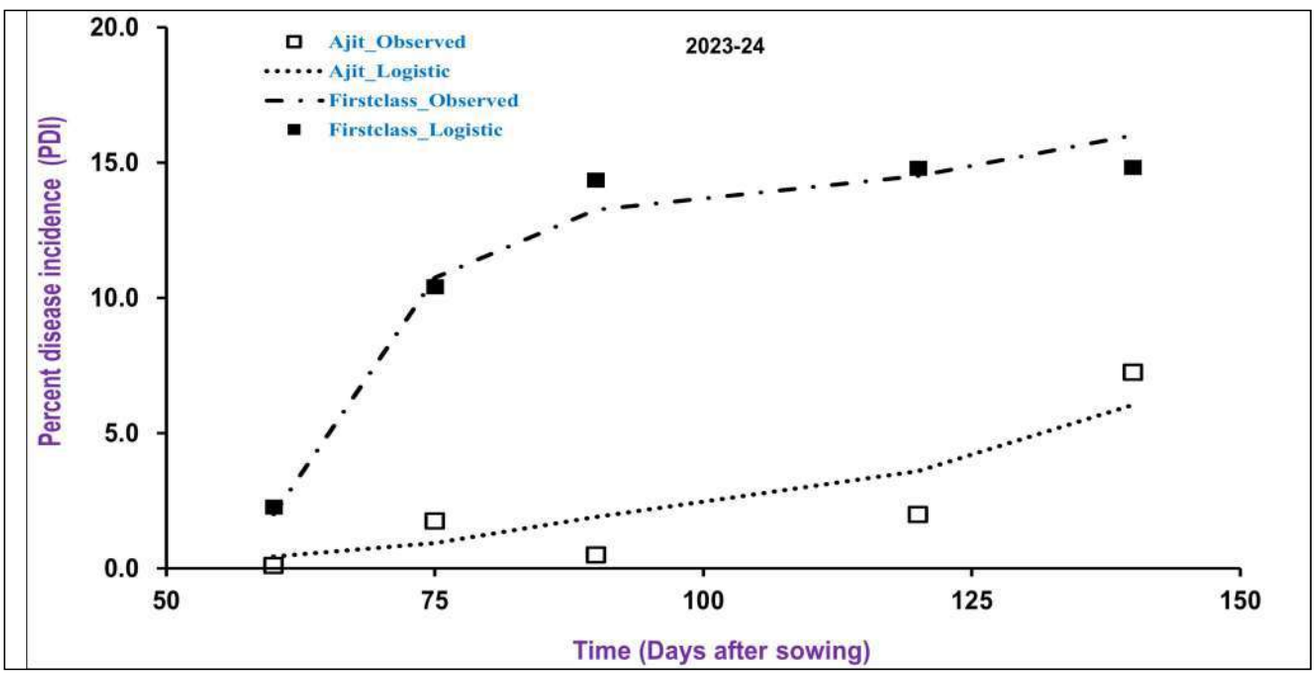


Fig.2.8.3 The Percent Disease Incidence (PDI) over Time (Days After Sowing - DAS) for two cotton BG-II hybrids: Ajeet-155 and Crystal First Class. The graph compares observed disease incidence with a logistic model-based prediction.

Table 2.8.1. Field evaluation of label claim fungicides and bio agents against Target leaf spot.

Treatments	Avg. PDI at 110 DAS	% Reduction over control	Avg. Yield q/ha
T1-Fluxapyroxad 167 g/l + Pyraclostrobin 333 g/l SC	7.00	58.65	28.88
T-2 Carbendazim 50 WP	6.10	63.97	26.24
T3-Propiconazole 25% EC	5.13	69.70	26.14
T4-Propineb70%WP	5.43	67.93	28.48
T5-Trichoderma asperellum 1% WP	9.90	41.52	26.23
T6-Trichoderma longibrachiatum 1% WP	5.33	68.52	27.53
T7-Bacillus tequellencis 1% WP	7.90	53.34	27.50
T8- Trichoderma harzianum 1% WP	6.77	60.01	28.09
T9- Consortia of all the cultures 1% WP	2.47	73.60	28.64

Treatments	Avg. PDI at 110 DAS	% Reduction over control	Avg. Yield q/ha
T10- Control (Water spray)	16.93	0.00	23.74
C.D.	2.041		N/A
SE(m)	0.682		1.801

2.9. Project Name: Studies on boll rot in cotton- Etiology and Management

PI: Dipak T. Nagrale

Co-PI: Babasaheb B. Fand

Importance of the study: The boll rot disease complex in cotton has emerged as a significant threat in major cotton-growing regions, impacting both fiber and seed quality while reducing overall seed cotton yield. A diverse group of pathogens contribute to the disease, varying across agroclimatic zones and cultivation practices. With climate change intensifying the problems, addressing boll rot has become increasingly challenging. Understanding etiological factors, insect-pathogen interactions, and effective management strategies are crucial for sustainable cotton production and fibre quality.

Salient findings

- The multilocation survey, sampling, and diagnostics of boll rot disease complex were performed from northern, central and southern zones of India.
- The detailed polyphasic characterization, symptomatology, and pathogenicity of the BG-II cotton hybrid and non-Bt variety were performed for the isolated pathogens associated with the boll rot disease complex (Fig. 2.9.1 and 2.9.2).
- Among the pathogens, *Pantoea* spp., *Xanthomonas citri* pv. *malvacearum, Enterobacter cloacae, Fusarium* spp., *Alternaria macrospora, Corynespora cassiicola, Lasiodiplodia theobromae, Colletotrichum gossypii,* etc. were dominant across zones.
- Erect to semi-erect plant type, medium height, sucking pests tolerant, and medium crop duration for BG-II hybrids, along with timely prophylactic sprays with suitable and better field drainage condition were observed with less severity of disease complex in medium to medium-heavy soil condition at farmers' fields.
- Vectoring of the bacterial boll rot pathogen *Pantoea dispersa* in healthy green bolls were observed using a sucking pest (Thrips sp.), thereby intensifying internal bacterial boll rot disease.
- In late season stages, red cotton bugs and brown/green stink bugs carries bacterial pathogens (*Pantoea* spp.) in the proboscis, which can stain and deform seeds and reduce lint quality in developing and opening bolls.
- Thiram 37.5% + Carboxin 37.5% WS@ 0.35% was the best seed treatment fungicide for managing bacterial and fungal boll rot pathogens under in vitro and field conditions.
- Under field conditions, Carbendazim 12% + Mancozeb 63% WP @0.25%, Carbendazim 50 WP (0.04%), Propiconazole 25 EC (0.1%), Propineb 70 WP (0.25%), and Copper oxychloride 50 WG (0.25%) were comparatively effective against the boll rot disease complex.

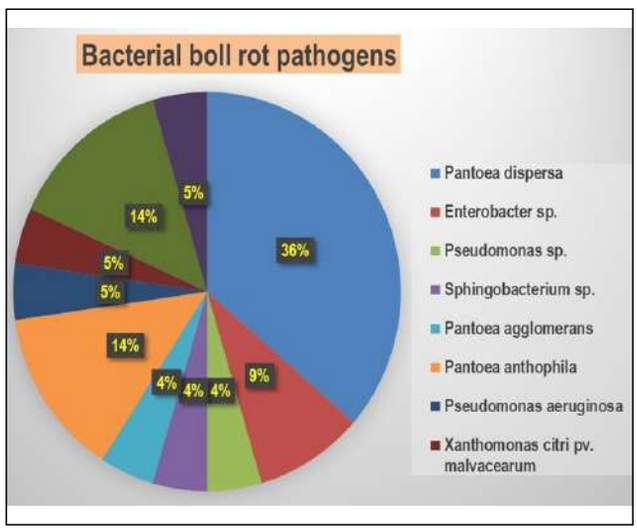


Fig. 2.9.1 Bacterial boll rot pathogens from cotton growing zones

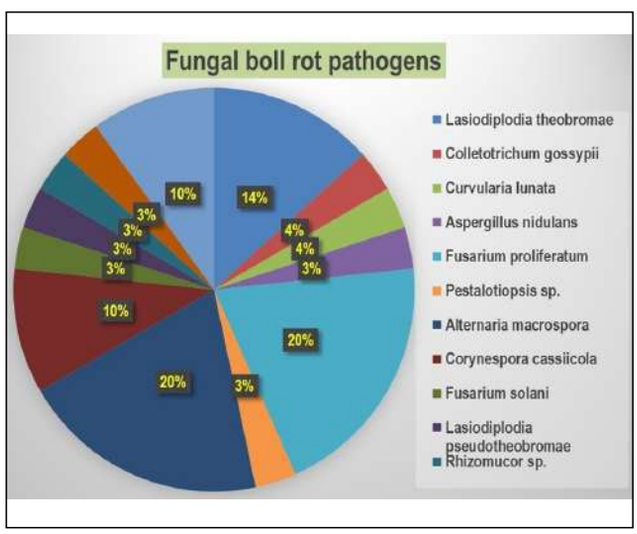


Fig. 2.9.2 Fungal boll rot pathogens from cotton growing zones

2.10. Project Name: Studies on grey mildew disease of cotton caused by *Ramularia areola*

PI: Neelakanth S. Hiremani

Co-PI: P. Valarmathi

Importance of the study: Grey mildew disease was first reported in upland cotton, and it then spread to all cultivated cotton species. The constant shift in this disease over the years may be due to the variability existing among the pathogen. Very limited information is available regarding the pathogenic and genetic variability of *R. areola*, making it difficult to manage either through resistant cultivars or through fungicides.

Salient findings

- The pathogenicity of *Ramularia areola* was tested on LRA-5166 by spraying spore suspension, prepared by scraping conidia from diseased leaves. Optimum leaf wetness and humidity were maintained after spraying. Small necrotic spots were noticed on the leaves.
- Cross-inoculation of *Ramularia areola* on different cotton species was performed in a glass house and in the field. In the field experiment, 10 different cotton hybrids were grown, and PA-810 was used as an infector row/border crop. We found that the severity of grey mildew disease on different hybrids was less.
- Evaluation of bioagents and fungicides for the management of grey mildew disease in the field: A second-year field trial was conducted to identify the best management approach against Grey mildew disease. Bt hybrid RCH-797 was sown along with two infector rows- PA-740 and PA-810. The severity of grey mildew disease was less during the season. Maximum PDI was seen in the control (13.3%), followed by T1 (Foliar spray of *Trichoderma harzianum* @ 90 and 110 DAS i.e., 11.73%) and T2 (11.47%). The percent disease reduction over the control was highest in T5 (Foliar spray of combi product (Azoxystrobin 18.2% + Difenoconazole 11.4%) @ 90 and 110 DAS), followed by T6 (Foliar spray of T. harzianum @ 90 DAS + Propineb @110 DAS). (Fig. 2.10.1).

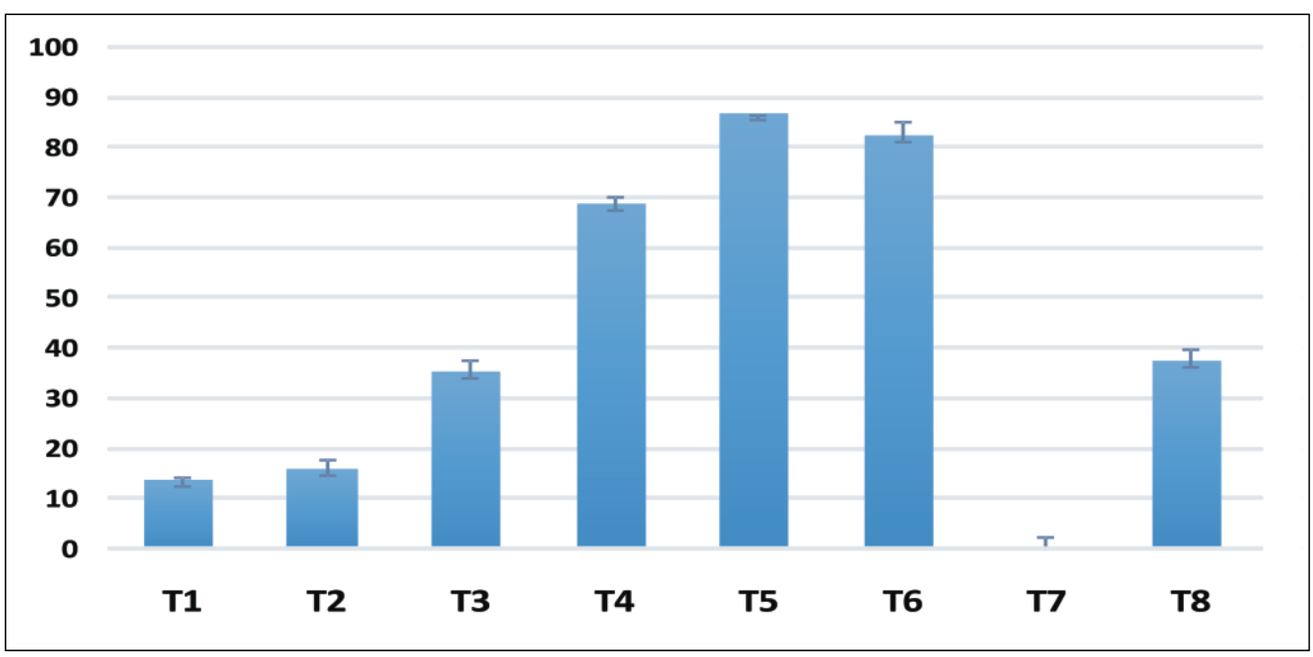


Fig. 2.10.1. Percent disease reduction of Grey mildew disease in different treatments over control at 120 DAS, where T1= Foliar spray of *Trichoderma harzianum* @ 90 and 110 DAS, T2= Foliar spray of *Pseudomonas fluorescens* @ 90 and 110 DAS, T3= (T1 + T2), T4= Foliar spray of Kresoxim methyl @ 90 and 110 DAS, T5= Foliar spray of combi product Azoxystrobin 18.2% + Difenoconazole 11.4% @ 90 and 110 DAS, T6= Foliar spray of *T. harzianum* @ 90 DAS and Propineb @110 DAS, T7= Untreated control and T8= Foliar spray of Kresoxim methyl @110 DAS.

2.11 Project Name: Development of AI enabled pheromone trap for lepidopteran pests and Multi-fin glue trap for sucking pests on cotton

PI: K. Rameash

Co-PI: M. Sabesh

Importance of the study: Pheromone traps assist in monitoring the population of key lepidopterous pests on cotton viz., *Spodoptera litura* and *Helicoverpa armigera,* that helps to decide the appropriate time for insecticide application. However, conventional traps have many limitations; as the data collection is labour-intensive, error-prone, costly, and inefficient for large-scale monitoring. Manual surveys fail to capture real-time pest dynamics over a wider area, leading to delayed and ineffective pest management. To circumvent the limitations of conventional pheromone traps, research has been undertaken to develop an artificial intelligence (AI) enabled pheromone trap to transmit the count of insect catches directly to the user with additional

information like location of the trap and weather data. The AI-enabled pheromone trap addresses these challenges, offering a more efficient and precise solution for cotton pest monitoring.

Sticky traps, that leverage insect color preferences have for long been used for pest monitoring and management in cotton fields. Yellow sticky traps are commonly used to monitor sucking pests such as jassids, aphids, and whiteflies, whereas blue sticky traps are effective for thrips monitoring and their control. This research aimed to develop a multi-colored glue-fin trap designed to monitor and manage multiple cotton pests—including jassids, thrips, whiteflies, aphids, and pink bollworm—using a single, integrated trapping system.

Salient findings

A real-time insect detection system based on YOLO Machine learning algorithm was developed to detect and count the trapped adult moths of Spodoptera litura and Helicoverpa armigera. The fabricated AI smart trap was field tested during 2023-24 for monitoring , and it was found that the trained algorithm achieved a detection accuracy of 92.3% for S. litura and 89.1% for H. armigera (Fig.2.11.1).

Two field experiments were conducted during 2023-24 to evaluate the multi coloured glue-fin trap for the monitoring and management of jassids, thrips, whitefly aphids, and pink bollworm adults on cotton (T1. yellow + blue + white + gossyplure; T2. yellow + blue + green+ gossyplure; T3. yellow + blue + red+ gossyplure; T4. fluorescent yellow + fl. green + Fl. white + gossyplure; T4. florescent yellow + fl. blue + fl. green + gossyplure; T6. fluorescent yellow + fl. blue + fl. red + gossyplure; T7. yellow + yellow + yellow + gossyplure; T8. yellow cylinder trap; T9. standard funnel trap with gossyplure) in RBD with three replications. The mean trap catch data showed that yellow + blue + white + gossyplure combination recorded maximum trap catch of sucking pests viz., jassids, aphids, and thrips, and pink bollworm adults. Occurrence of whiteflies was low throughout the season. There were no differences among the colour traps in attracting pink bollworm adults. However, the colour sticky trap catches were significantly low (0.7-16.3/week) than the catches in standard funnel trap (21.2/week).

Figure 2.11.1: Detection and counting of Spodoptera litura and Helicoverpa armigera by machine learning algorithm

2.12 Project Name: Biology and holistic management strategies for emerging pest tea mosquito bug (*Helopeltis* sp.) in cotton

PI: M. Amutha

Importance of the study: Tea mosquito bug (TMB) *Helopeltis* sp. has emerged as a significant pest of cotton causing severe damage to the crop. The impact of *H. theivora* on cotton productivity necessitates detailed studies on the efficacy of various insecticide groups used for its control. This information is crucial for recommending effective chemical control measures for cotton ecosystem. Development of an efficient damage scoring system is crucial for accurately assessing the level of damage caused by *Helopeltis* sp. and is essential for timely pest management decision.

Salient findings

- The population dynamics of the tea mosquito bug (TMB) (*Helopeltis* sp.) indicated that the incidence of TMB began in December and persisted until March. The occurrence during 2023-24 was lower than previous three years. Temperature exhibited a highly significant negative correlation with the incidence of TMB. Furthermore, sunshine hours and solar radiation showed negative correlation with TMB population levels, while relative humidity, rainfall, and number of rainy days demonstrated positive correlations with pest incidence (Fig 2.12.1 and Table 2.12.1).

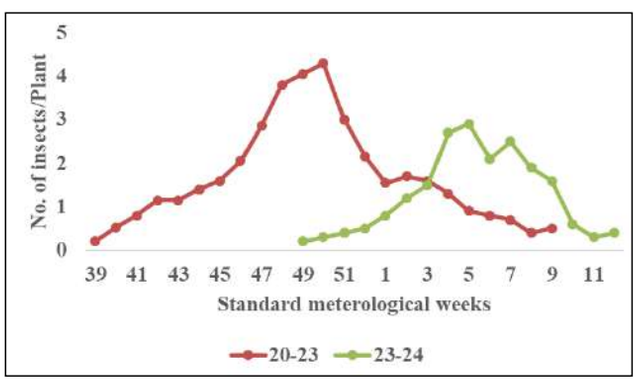


Fig 2.12.1. Population dynamics of *H. theivora* in cotton

- A total of eleven insecticides were tested in field trials to evaluate their efficacy against the tea mosquito bug (*Helopeltis* sp.). Among the tested insecticides, Thiamethoxam12.60% + Lambda-cyhalothrin 9.50% ZC and Dinotefuran 20 SG demonstrated the highest effectiveness, achieving a 92% corrected reduction in the number of insects per plant (Fig. 2.12.2).
- The order of efficacy of insecticides was classified as follows: Thiamethoxam + Lambda-cyhalothrin > Dinotefuran > Bifenthrin> Lambda-cyhalothrin> Cypermethrin> Fibronil> Thiamethoxam> Thiacloprid>Flonicamide > Imidacloprid >Azadiractin.
- Developed a comprehensive whole plant-based scoring system to assess the damage caused by the

tea mosquito bug in cotton, replacing the method of evaluating damage separately on shoots and bolls (Table 2.12.2).

- In total, 25 alternate hosts were recorded for tea mosquito bug during the off season.

Table 2.12.1. Correlation between *H. theivora* incidence and weather factors

Max. Temp	Min. Temp	RH Morn	RH Even	Rainfall	Sunshine hours
-0.382*	-1.157*	-0.085	0.048	0.004	0.154

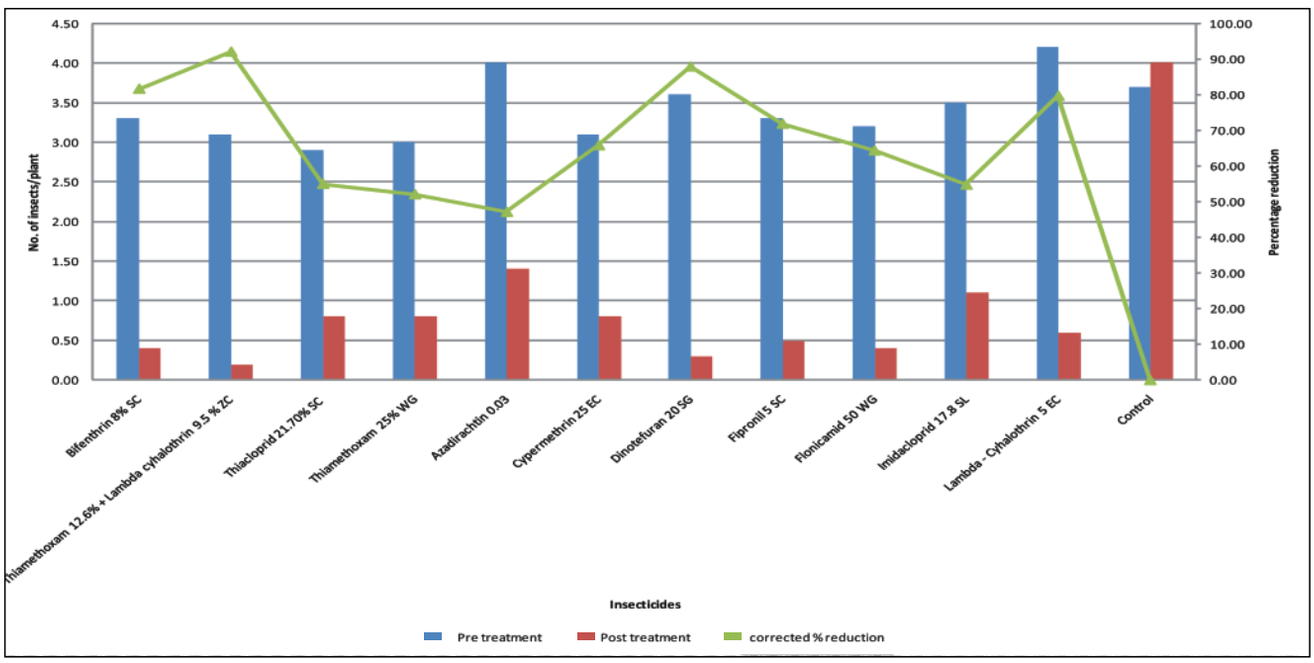


Fig 2.12.2. Evaluation of efficacy of different insecticides against *H. theivora* under field conditions

Table 2.12.2. Whole plant-based damage scoring system for *H. theivora* damage

Scale	Damage Symptoms	
	Shoot	Boll
0	No damage	No damage
1	1-10 necrotic lesions in stem or 25% damage in leaf area	Few lesions on 10% of bolls
2	10-20 necrotic lesions in stem or 50% damage in leaf surface area	1/4 of the surface area canker in 25% of bolls
3	damage in leaf area	1/2 of the surface area canker in 50% of bolls
4	Lesions confluent or bunching or drying of affected shoots or more than 75% leaf area damaged	¾ or more of the boll surface cankered in more than 50% bolls

2.13 Project Name: Development of Semio-chemical based attractants for sustainable management of cotton stem weevil *Pempherulus affinis* (Faust) Curculionidae: Coleoptera)

PI: K. Shankarganesh

Importance of the study: Cotton stem weevil is one of the key insect pests in south India especially in Tamil Nadu. If infestation occurs on 12-15 days of seedlings, it can cause up to 90% of mortality. Control with insecticides targeted at the adult stage is becoming increasingly difficult as more effective insecticides were banned and non-availability or limited availability of new chemistry insecticides. Farmers struggled to control this pest because of the invisibility of its life stages. Susceptibility of the most promising Bt and non-Bt varieties to stem weevils is unknown. In addition, the

existing management strategies were ineffective in controlling this pest. Studies on the influence of plant-derived volatiles on the behavior of stem weevils in cotton were less studied. The initial phase of stem weevil infestation is associated with the volatiles emitted by cotton seedlings that attract this pest. In susceptible varieties, this phenomenon leads to the death of young seedlings. Hence, an understanding of host plant interactions mediated by semio-chemicals would offer clues for deciphering the weak links in the biology of stem weevil. It is imperative to study the chemo profiling of resistant and susceptible genotypes/varieties/hybrids (Bt and non-Bt) against stem weevil. Hence, the characterization of semio-chemicals can help identifying attractants and repellents for stem weevil infestation. Based on the differential profiles of semio-chemicals, promising compounds can be synthesized and validated for their efficacy on the behavior of stem weevils. The outcome of this study will help develop chemo lures for managing stem weevils.

Salient findings

Comparison of volatile profiles between 10-day-old cotton plants with and without herbivore interaction

Plants vs. plant with insects

The compounds in this group (13) appeared across both plants and plants with insect conditions, indicating that they may serve as baseline chemicals present regardless of insect interaction. This group includes a mix of hydrocarbons (e.g., Dodecane, Undecane), siloxanes (e.g., Cyclotrisiloxane, hexamethyl-, Cyclohexasiloxane, dodecamethyl-), and aromatic compounds (e.g., o-Xylene, 4-(2-Aminoethyl) benzenesulfonyl fluoride). The presence of these baseline compounds suggests roles in the structural or metabolic processes of plant that are unaffected by insect presence.

Comparison of volatile profiles between 20-day-old cotton plants with and without herbivore interaction

Plants and plants with insect

The plant and plant with insect groups consistently contains nine compounds under both plant-only and plant-with-insect conditions. This suggests that these compounds play essential baseline roles in plant's chemistry, likely contributing to general defense or resilience. Notable compounds in this group include non-anal, an aldehyde commonly involved in plant signaling that may help deter herbivores or attract beneficial insects for natural pest control. Disulfide, dimethyl, a sulfur compound, is also present and is known for its strong defensive properties against pests. Benzene, a simple aromatic hydrocarbon, has structural or mild defensive functions, enhancing plant stability and deterring herbivores. Several volatile compounds identified in this analysis function as attractants for cotton stem weevil adults. These attractants were confirmed in controlled laboratory experiments using a Y-arm olfactometer, and their behavioral effects were validated. Compound C emerged as a key component that was consistently observed under multiple conditions and experiments. Its significant presence in both plant-insect and insect-only treatments suggests a critical role in mediating insect-plant interactions.

Cotton stem weevil behavioral study

The responses of cotton stem weevil adults to cotton reference pheromone compounds were determined using an olfactometer. The reference pheromone compounds viz., Compound C and Compound B showed a positive response to adult weevil at 2000 ppm among the 10 tested compounds. The significance level was P< 0.04. There is a highly significant difference between the two sample means. Reference compounds viz., A, B, C, and E showed positive responses to adult weevil at 2000 ppm among the 10 tested compounds. Compounds C and B were highly effective attractants against cotton stem weevil adults.

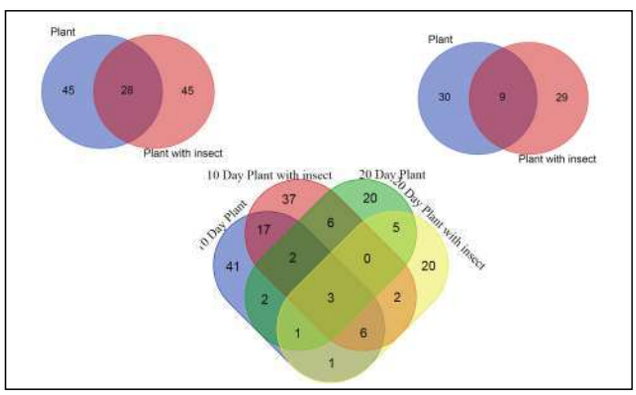


Fig 2.13.1. Comparison of volatile profiles between and 20-day-old cotton plants with and without herbivore interaction

2.14 Project Name: Survey, molecular characterization, vector transmission and exploiting host plant resistance for tobacco streak virus (TSV) in cotton

PI: A. Sampathkumar

Co-PIs: P. Valarmathi, Shailesh P. Gawande, Shivaji Thube, Sivaramakrishna (RARS, Nandyal – ANGRAU)

Importance of the study: Cotton necrosis disease caused by tobacco streak virus (TSV) is an emerging threat in India. The initial symptom include chlorotic lesions and purplish brown spots, followed by necrosis. In the advanced stages of drying of squares, stems and stunting of plants are observed. The tobacco streak virus (TSV) belongs to the genus ilarvirus of the family bromoviridae and is a multipartite, single-stranded, positive-sense, RNA virus. The host range comprises 200 plant species, including agricultural, horticultural crops, and weeds. In cotton, tobacco streak virus causes a maximum of 62.7% yield loss (Rageshwari et al., 2017). The TSV incidence of cotton is increasing day by day specifically in the southern parts of India in the last few years. During 2022-23 crop season, the Kurnool and Nandyal districts of Andhra Pradesh witnessed a

severe disease incidence ranging from 4.5 to 44.0 PDI.

Salient findings

- A survey on TSV in the Kurnool (10 mandals, 17 villages), Nandyal (2 mandals, 7 villages) and Anantapur (1 mandal, 2 villages) districts of Andhra Pradesh was carried out. Kurnool had a disease incidence of 4.0 – 42.0 % disease incidence (average 10.26%). Three fields had >20% incidence (Fig. 2.14.1 & 2.14.2), and three fields were disease-free. Madhavaram village in Nandavaram mandal recorded 42.0% TSV incidence in Khiladi and Ranadheera BG II hybrids. All four stages of TSV recorded (Grade I to IV) and mostly Grade II and III.
- In Nandyal, 4.0–12.0% incidence (average 7.14%) was recorded, including sunflower necrosis (Fig. 2.14.3) in the RARS farm. Anantapur recorded 0.0-3.0% incidence. Cotton area was reduced in both districts and replaced by Bhendi, Red gram, Tobacco, Chilli, Onion, Sunflower, Maize and Soybean.
- Swift (Rasi Seeds), US 7067 (Seed Works), and Ankur 888 were found to be tolerant to TSV, as per the farmers' and seed distributors. Less thrips population was observed in the visited fields.
- The incidence of TSV was higher in rainfed cotton compared irrigated fields wherein, most fields were surrounded by other crops like chilli, onion, soybean, red gram, and sunflower, which were infected by TSV. Bunds of the fields were filled with weeds - parthenium and others - a source of inoculum for TSV. Due to delayed monsoon, lot of variations were observed in the sowing date. Many farmers took up late sowing with a reduced area at the end of July 2023.
- Cotton fields were also visited in Adilabad (0.5 -1.0%), Nirmal (0.5 -1.0%), Warangal (3.0 to 19.0%), Siddipet (4.0 to 12.0%), Ranga Reddy (9.0 to 14.0%), and Medak (4.0 to 12.0%) districts of Telangana.
- Coimbatore district had an incidence of 0.5%-40.0% (Fig. 2.14.4) (average 11.0%). RCH659 BGII hybrid had the highest incidence of 40.0% with all types of symptoms (Fig. 2.14.5).
- Sixty-five cotton cultivars were screened under field conditions against TSV in CICR RS Coimbatore (Fig.2.14.6) and RARS, Nandyal. In Coimbatore, TSV varied from 1.25 to 8.33 PDI among 18 cultivars. In Nandyal, TSV was not recorded in cultivars. However, entries like KCH707, SMP1836, CICR 23 and 25 Bt were found to be tolerant to thrips as well as other sucking pests.

Fig,2.14.1. TSV Symptoms (purple ring spot, mosaic observed during survey in Kurnool district, Andhra Pradesh

Fig. 2.14.2. TSV Symptoms (mosaic,purple ring spot and necrosis observed during survey in Kurnool district, Andhra Pradesh

Fig. 2.14.3. TSV Symptoms – Sunflower necrosis observed in RARS, Nandyal

Fig. 2.14.4. TSV Symptoms (mosaic, purple spot, necrosis observed in New Area Farm, CICR, RS, Coimbatore

Fig. 2.14.5 TSV Symptoms (tip and square drying) observed in New Area Farm, CICR, RS,Coimbatore

Fig. 2.14.6. Screening of cotton cultivars against TSV under field conditions at, CICR,RS,Coimbatore

2.15 Project Name: Studies on rust disease of cotton caused by *Phakopsora gossypii* and cotton necrosis disease caused by TSV and its management

PI: Dr. P. Valarmathi

Importance of the study: *Phakopsora gossypii*, an emerging cotton disease, has led to substantial yield losses. Considering the current importance of rust disease and the need to obtain additional basic information about its causal agent for the development of new and effective control strategies, this study aimed to determine the infection process of *P. gossypii* in cotton leaves using scanning electron microscopy (SEM).

Salient findings:

SEM microscopic evidence of the infection process of *Phakopsora gossypii* in the leaves of cotton plants showed that at 42 hai (hours after inoculation), the uredospores germinated, producing a germ tube and an appressorium, a pivotal event that might directly allow the fungus to penetrate the leaf cuticle. At 20 dai (days after inoculation), closed uredia containing uredospores were observed on the abaxial leaf surface (Fig.2.15.1 to Fig.2.15.4). The findings of this study suggest that managing rust through fungicides should be initiated within 20 days after infection, as after this period, the uredia begin to open, releasing airborne uredospores which can then spread to healthy cotton leaves. P. gossypii forms asexual uredospores on short stalks within a uredium 5-8 days after inoculation on colonized leaves. Germinating uredospores (Sp) produce a single germ tube (Gt) under suitable conditions terminated with the formation of a globose, appressorium (App), and continue into a penetration hypha (Penh), which traverses epidermal cells (Epi). In the intercellular space of the mesophyll, a primary hypha (Ph) is separated from the penetration hypha by a septum and then branches into several secondary hyphae (Sh).

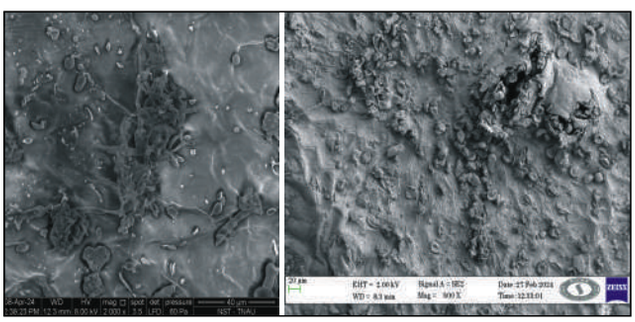


Fig. 2.15.1 Scanning electron micrographs of the abaxial leaf surface of cotton plants at 42 h (A) after inoculation with Phakopsora gossypii.(A) A uredospore (arrow) germinated, formed a germ tube (arrowhead) and produced an appressorium on the cotton leaf surface (arrows). Uredospores (us), Germ tube (gt), Abaxial epidermis (abep), appressorium (app), stomata (st). Scale bars = 40 μm.

Finally, the pathogen invades a mesophyll cell (Meso), forming the first haustorium (Hau) to establish in the host interaction. Field evaluation for TSV in 14 resistant lines of *G. barbadense*: Sowing of 14 resistance lines- ICB 84, 85, 86, 87, 90, 91, 122, 124, 125,127,153,161, 162,163, Suvin, and ICB 260S were - carried out. The in situ Parthenium population was maintained to monitor the occurrence of TSV disease symptoms.

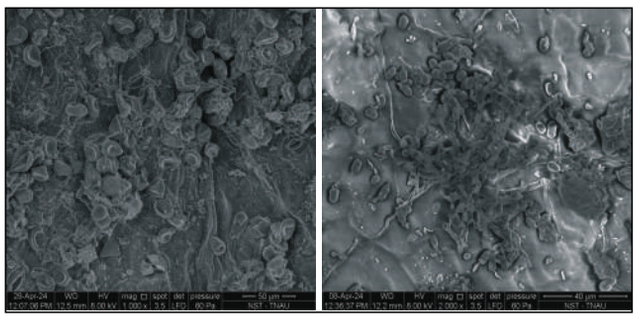


Fig. 2.15.2 Scanning electron micrographs of the abaxial leaf surface of cotton plants at 35 days after inoculation with Phakopsora gossypii. Fungal hyphae grew abundantly (arrowheads) in the mesophyll next to the uredia. Arrows indicate uredospores in the uredia. Scale bars= 40 μm

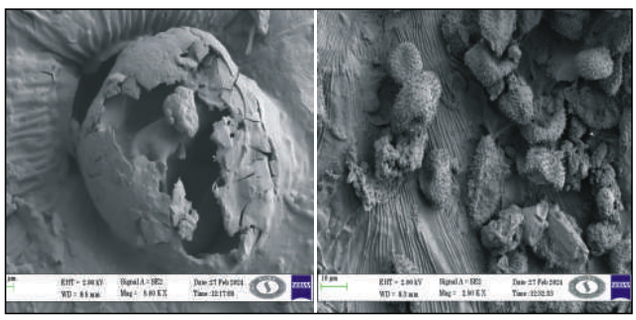


Fig. 2.15.3. 20 days after inoculation with *Phakopsora gossypii* (A) A closed uredium with uredospores on the abaxial leaf surface, (B)Many uredospores (arrow) in an open uredium. Scale bars = 2 μm and 10 μm

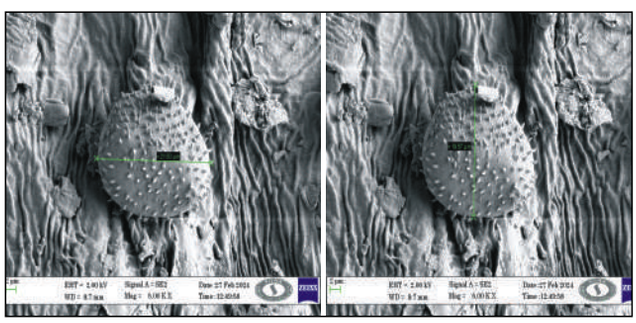


Fig. 2.15.4. Measurement of uredospore size: Width-21.63 μm and Length-19.57 μm. Scale bars= 2 μm

2.16 Project Name: Studies on plant parasitic nematodes of cotton

PI: J. Gulsar Banu

Importance of the study: Plant-parasitic nematodes are considered hidden enemy of Cotton in India. When they interact with fungi and bacteria, yield loss is increased by several folds. Increased awareness about the harmful effects of chemical nematicides on non-target organisms, human beings and the environment,

in addition to phytotoxicity necessitates safer approaches for nematode management in cropping systems. To develop eco-friendly alternatives, a wide spectrum of plant metabolites with nematostatic and nematicidal action has been extensively reported. This study aims to identify novel photochemistry by in silico analysis and in vitro studies and to develop an integrated nematode management strategy to combat losses due to nematodes in Cotton.

Salient findings

The nematicidal activity of Nimbolide, a tetranortriterpenoid (limonoid) compound isolated from the leaves of *Azadirachta indica*, against the nematode pests of Cotton was proved by in silico analysis and in vitro studies. Docking analysis revealed that Nimbolide had the highest binding affinity for the protein targets, followed by the nematicide, Fluopyrum and Fluensulfone. Carbofuran exhibited the lowest binding affinity fortarget proteins. Nimbolide served as a potential inhibitor of the target proteins like ODR1, Cathepsin L-like cysteine proteinase, HSP90, Neuropeptide GPCR, and Heat Shock and causes irreversible paralysis of nematodes.

A novel nematode pathogenic bacterium *Enterobacter cloacae* was isolated from reniform nematodes and its molecular characterization was performed. Infected juveniles become sluggish, stick to wall, internal content oozes out, vacuole formation, crowded, and finally dead within 24 hours. Cell free extract of *E. cloacae* significantly reduced egg hatching and juvenile survival of *Rotylenchulus reniformis* and *Meloidogyne incognita* under in vitro condition.

Soil application of talc based formulation of *Pochonia chlamydosporia* @ 1Kkg/ac or Soil drenching of liquid formulation of *P. chlamydosporia* @ 2.50 l/ac was effective against reniform nematode and found to be safer to earthworms and beneficial nematodes under field condition. Talc based formulation mixed with vermicompost supported longer persistence of spores under field condition.

2.17 Project Name: Development of biocontrol consortia with multifaceted fungi for the management of important pests and nematodes of cotton

PI: J. Gulsar Banu

Co-PI: Shivaji Thube

Importance of the study: The biocontrol ability of bio agents to manage pests and nematodes has been well documented, but the variability of results is often recorded under field conditions. Originally, biocontrol research focused on the application of a single microorganism, and the inconsistent and ineffectiveness of a single organism is often related to limited competitiveness with native microbes and the environment. Under such circumstances, microbial consortia that exhibit diverse modes of action and synergistic effects that enhancing biocontrol efficacy is need of hour. This study focused on the development of safer biocontrol consortia for managing sucking pests and nematodes in cotton.

Salient findings

- A liquid-based bioconsortia formulation of the native entomopathogenic fungus *Lecanicillium lecanii* and the bacterium *Acenitobacteri lofii* was developed and evaluated under field conditions. Spraying of liquid formulation biopesticide consortia @ 5 ml/l twice at 15 days interval causes significant reduction in jassids and aphids. Spraying biopesticide consortia is more effective than *L. lecanii* and *A. ilofii* alone. Biopesticide consortia were ranked next to insecticide in terms of efficacy. This consortium is safer for Coccinellid beetles and spiders in field conditions.
- A talc-based bionematicide consortia with the native nematode antagonistic fungus *Pochonia chlamydosporia* and the bacterium *Pseudomonas flourescens* was developed and evaluated against the Reniform nematode *Rotylenchulus reniformis* infesting cotton. Soil application of this bionematicide consortia @ 5g/kg soil significantly reduced reniform nematodes. Significant reductions in soil and root populations, number of egg masses and number of eggs/egg mass was recorded. This consortium was safer to earthworms and beneficial nematodes (predatory and entomopathogenic nematodes) under field conditions.
- The molecular characterization of 24 endophytic fungi from cotton root identified them as *Amesiani gricolor, Aspergillus* sp., *Aspergillus sydowii, Aspergillus versicolor, Fusarium solani, Fusarium verticillioides, Paecilomyces tenuis, Talaromyces albobi verticillius, Talaromyces* sp., and *Talaromyces trachyspermus.*

2.18 Project Name: Thermal stress induced effect on insecticide susceptibility and fitness traits in whitefly, *Bamesia tabaci*, a serious pest of worldwide concern

PI: Rishi Kumar

Co-PIs: Debashis Paul, B.S. Fand

The importance of the study: This study aims to investigate the effects of basal and induced thermal stress on the fitness traits of whitefly. This research also enumerated the stress- induced effects on the efficacy of insecticides on fitness traits in whitefly and associated biochemical changes in host plants and insects under basal and induced thermal stress.

Salient findings

- Whitefly mortality increased significantly at extreme temperatures, with higher mortality observed under no-host conditions.
- Fecundity, nymphal development, and adult emergence were adversely affected by exposure to high and low temperatures.
- In the experiment on the effect of temperature on the

egg stage was studied. The eggs were subjected to six different temperatures for two hours duration at: 37, 39, 41, 43, 45, and 26˚C on a potted plant. Egg hatching percentage declined progressively with increasing temperature, with the lowest at 45°C.

- Field-collected whiteflies exhibited greater thermal tolerance compared to those reared under controlled polyhouse conditions (Figure 2.18.1 & 2) (Table 2.18.1).

Table 2.18.1: Comparison of mortality (%) after basal exposure in adult whitefly reared in ambient conditions to temperature stress under Host and No-host environment.

Temp (˚C)	Dead Adults (%) after basal exposure		Difference in Dead adults (No-Host & with host)	Temp (˚C)	Dead Adults (%) after basal exposure		Difference in dead adults (No - host & with host)
	High temperature				Low temperature		
	No-Host	With Host			No-Host	With Host	
49	100	90.88	9.12	26	18.43	9.28	9.15
47	100	89.47	10.53	25	21.00	10.33	10.67
45	100	70.45	29.55	24	21.66	12.33	9.33
44	93.58	58.89	34.69	23	29.58	12.17	17.41
43	80.16	52.00	28.16	21	32.57	15.00	17.57
41	68.93	41.18	27.75	19	34.00	19.00	15.00
39	47.20	27.36	19.84	17	32.20	25.26	5.94
37	37.14	18.75	18.39	15	34.68	27.52	7.16
35	35.83	18.33	17.50	13	42.93	27.94	14.99
34	34.16	16.49	17.67	11	44.63	29.63	15.00
33	32.71	16.46	15.25	9	47.97	32.56	15.41
31	30.00	15.00	15	7	53.06	34.68	18.38
29	27.50	12.50	15	5	73.39	48.54	24.85
27	23.33	10.83	12.5	3	75.55	51.04	24.51
Range	23.33-100	10.83-90.88	9.12-34.69	Range	18.43-75.55	9.28-51.04	9.15-24.85

Figure 2.18.1 Field Collected Population during experimentation

Figure 2.18.2 Population reared in Poly-house during experimentation

2.19 Project Name: Season-long monitoring & management of pink bollworm in cotton crop in North Zone (RASI-ICAR-CICR-CSR-Project)

PI: Rishi Kumar

Co-PIs: Y.G. Prasad, S.K.Sain

The importance of the study: This study aimed to perform season-long monitoring of prominent carryover sources of pink bollworm i.e., cotton stalks, cotton seed, and management of pink bollworm in the North Zone.

Salient findings

- Surveys were conducted (Figure 2.19.1) in ginning-cum-oil extraction mills to study off-season sources of pink bollworm (PBW) carryover. A total of 30 cotton seed samples (each 500 grams) were collected from various locations in Haryana. On an average, 24.68% of seeds were damaged by PBW, with the damage ranging from 11.18% to 41.98% during February to May 2024. PBW larval recovery ranged from 0.00 to 18.33, and pupal case recovery ranged from 0.00 to 25.00 per sample.

a: Collection of Seed Sample

b: Examination of Collected Seed Sample

Figure 2.19.1:Surveys for Off-season sources of carryover of Pink Bollworm in Cotton (a to b)

2.20 Project Name: Collection, characterization and evaluation of beneficial fungal microorganisms from North, Central and South cotton growing zones

PI: S.K. Sain

Co-PIs: S.P. Gawande, P. Valarmathi,

Importance of the study: This study aimed to isolate, characterize, and screen beneficial rhizosphere fungi in cultivated cotton for disease management, plant growth, and productivity enhancement in an integrated and organic farming system.

Salient findings

- Among 100 cotton rhizospheric fungi (Rfs), seven isolates showed promise based on their antagonism against root rot pathogens and plant vigour index (PVI). Under root rot sick conditions at the ICAR-CICR, RS Sirsa (2022–23 and 2023–24), Rf-Th-11 (*Trichoderma asperellum*) recorded the lowest AUDPC, followed by Rf-60 and Rf-63 (*Actinomortierella* spp.). The highest seed cotton yield (cv. RCH-926) was observed with Rf-60 (38.2 q/ha), followed by Rf-Th-11 (35.8 q/ha) and Rf-63 (35.2 q/ha) (Figure 2.20.1).
- In pot culture experiments, consortia of top-performing Rf fungi were used for seed treatments (cv. Bayer First Class) the highest PVI with Rf-11+Rf-16+Rf-60+Rf-63 (4806%), followed by Rf-16+Rf-60 (4414%), Rf-16+Rf-63 (4358%), Rf-Th-11+Rf-60 (4167%), and Rf-Th-11+Rf-63 (4140%), compared to the control (2753%) (Figure 2.20.2).
- Rf-TNAU Tv1 and Rf-CRSVPT Tv1 (T. viride) performed better in terms of PVI and root rot control in Bt Suraj and Suraksha. Under pot conditions in Suraksha, Rf-TNAU Tv1 exhibited the highest root colonization (9.4 × 10^4 cfu/g soil), PVI (5974%), and the lowest disease incidence at 60 DAS, followed by Rf-CRSVPT Tv1 (Figure 2.20.3).

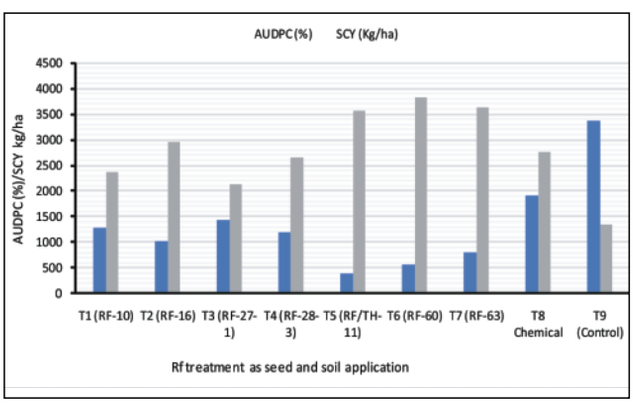


Figure 2.20.1:Evaluation of selected Rhizospheric fungi on cotton root-rot control and yield under root rot-sick-field conditions (Pooled 2022-23 and 2023-24)

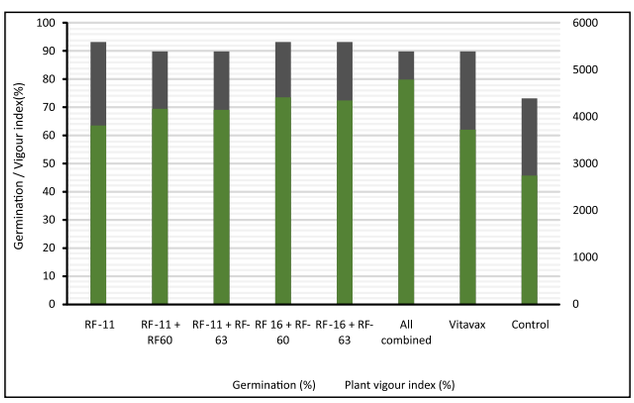


Figure 2.20.2: Effect of combined application of rhizospheric fungi on seed germination and plant vigour index under pot-culture conditions (Pooled 2022-23 and 2023-24)

Figure 2.20.3: Evaluation of selected Rhizospheric fungi for disease control and vigour index under Pot Conditions in variety Suraksha (60 DAS)

3. CROP PRODUCTION DIVISION

3.1 Project Name: Long-term impacts of sub-soiling and cover crop rotation on soil properties and N requirement of cotton

PI: D. Blaise

Co-PIs: R. K. Singh (IISS, Bhopal)

Importance of the study: Poor root growth in cotton may be either due to hard pan or natural causes. Mechanical (sub-soiling) and biological methods (crop rotation) are possible means to improve crop root growth and seed cotton yields.

Salient findings

Field experiments were conducted for the sixth year in a row with all treatments on a fixed layout. Among the application of fertilizer-N (75%, 100% and 125% of the recommended dose), seed cotton yields were significantly lower with the 75% application rate than the recommended and 1.25 times the recommended dose of N. Crop rotation resulted in yields significantly greater than deep sub-soiling and control plot at 75% and 100% of the recommended dose. At 1.25 times the recommended doses, the seed cotton yield did not differ between crop rotation and sub-soiling treatments. The increase in seed cotton yields with greater N rate was due to a significant increase in the number of bolls. Averaged over treatments, application of 1.25 times the recommended dose of N had the maximum number of bolls (80.9 bolls/m^2) compared with 63.4 bolls/m^2 with the recommended dose and the least with 75% of the recommended dose of N (49.2 bolls/m^2). Boll weight did not differ significantly between treatments (3.56 to 3.69 g). Among the treatments, rotation treatment plots had a significantly greater seed cotton yield than the control, cotton after a fallow, and sub-soiling treatments (Fig. 3.1.1).

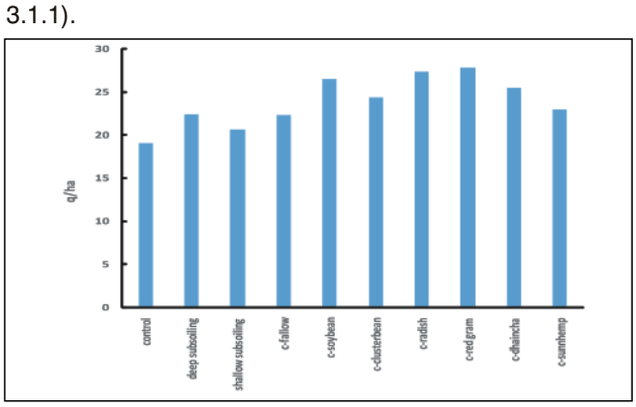


Fig. 3.1.1. Seed cotton yield as influenced by sub-soiling and crop rotation

Among the rotation treatments, cotton following red gram had the highest seed cotton yield, but did not differ with the soybean, radish, daincha, and cluster bean treatments. However, yields were greater than those of sunnhemp treatment. Soil penetration resistance was recorded during the crop growing season using a penetrometer at regular depth intervals. In general, penetration resistance increased with decreasing soil moisture. During the crop growing season, soil strength values were in the range of 0.75 to 1.2 MPa in the top soil. Higher soil strength was observed at later crop growth stages when the soils began to dry following the cessation of rain.

3.2 Project Name: Network Programme on Precision Agriculture (NePPA)

PI: Y.G. Prasad

Co-PIs: Blaise Desouza, R. Raja, K. Rameash, Shailesh Gawande, Dipak Nagrale, B. B. Fand, N. S. Hiremani, P. Nalayini, Amarpreet Singh, D. Kanjana, A. Manikandan, J. H. Meshram, Pooja Verma

Importance of the study: As a partner of the ICAR-NePPA project, ICAR-Central Institute for Cotton Research, Nagpur has conducted research on precision farming technologies in cotton with defined objectives, viz., (i) Quantitative assessment of crop health using sensors and data analytics, (ii) Developing Decision Support Systems (DSS) for precision agriculture, and (iii) Developing Variable Rate Technologies (VRTs) for site specific input management and carried out different activities

Salient findings

ICAR-CICR developed an 'AI Smart Trap' that enables real-time monitoring of the pink bollworm. By integrating the traditional trapping method with modern communication technology, the smart trap system provides real-time information on the dynamics of the pest population with the corresponding weather parameters. This technology is useful for area-wide pest monitoring, which is a major obstacle to traditional monitoring methods using pheromone trap in cotton. Pilot testing of the Smart trap developed by ICAR-CICR under NePPA was undertaken for Real-time Monitoring of 'Pink bollworm' in Punjab with the financial assistance from the Department of Agriculture & Farmers Welfare, Govt. of India. Pheromone traps were installed at 18 locations in three major cotton growing districts of Punjab, viz., Mansa, Bathinda, and Sri Muktsar Sahib, at the identified farmers' fields. At these locations, conventional pheromone traps were also installed, and weekly trap catch data were recorded for comparison. A dedicated web portal https://cicr.indianmark.com/ was developed for real-time information on the pink bollworm trap catch and corresponding weather data.

An infrared (IR) sensor trap was developed for the automated monitoring of lepidopteran pests in cotton. The IR sensor system, consisting of a transmitter and a receiver, was installed at the narrow end of a pheromone-based funnel trap to count the number of insects captured. The transmitter emits a continuous beam of infrared light across the funnel exit, which is precisely aligned with the receiver. When an insect passed through the funnel and disrupted the IR beam, the interruption was detected and recorded as a single count. Each beam break corresponds to the entry of an individual insect, thereby enabling accurate and real-time quantification of trap catches. The data generated by the IR sensor is

processed by a control unit mounted on the support pole. This unit is powered by a 10-W solar panel and comprises a rechargeable battery, a processing circuit, and a GSM module. The GSM module transmits recorded insect counts as SMS text messages to designated mobile numbers at hourly intervals. This IR-based monitoring system offers several advantages, including non-contact and precise insect detection, energy-efficient operation via solar power, and suitability for deployment in remote agricultural fields. Moreover, it enhances integrated pest management (IPM) strategies by facilitating timely, evidence-based decisions on pest control interventions.

Traditional disease identification methods, such as manual field inspections, heavily rely on expert knowledge and often miss early-stage infections due to subtle symptoms. Although laboratory tests offer precise results, they are costly and time-consuming, making them impractical for large-scale or real-time monitoring. To address this, machine learning-based disease detection was attempted. Convolutional Neural Networks (CNN) were employed for RGB image processing and classification with a dataset of 954 images from ICAR-CICR, Nagpur, for detecting and classifying cotton boll rot disease. A dataset of 654 diseased and 300 healthy boll images was prepared using a digital camera and converted to grayscale via GLCM for segmentation. The combined CNN and YOLO for real-time detection provided high accuracy with minimal background errors. The model was tested using Google Colab, and a Python-based user interface (UI) was developed for real-time disease identification- to enhance cotton disease management. The model accurately identified early-stage infections, supporting timely disease management. The system automatically identified the distinguishing features of infected bolls and distinguished them from healthy ones based on visual patterns. Optimized over multiple epochs, the model achieved the highest validation accuracy of 92% in 21st epoch. This study marks a significant advancement as the first to apply CNN techniques specifically for boll rot detection in cotton, thereby enhancing the precision of disease identification and management.

Managing within-field variability of soil for precision nitrogen (N) management is challenging. The advent of unmanned aerial systems based on multispectral sensorscombined with data analytics provides an option to address this issue. Field experiment were conducted with graded levels of applied N involving 7 levels (25%, 50%, 75%, 100%, 125%, 150%, and 200% of ICAR-CICR prescribed dose of N (80 kg ha-1) along with a control (No N). UAS-based multispectral crop imaging data were collected to develop an algorithm for calculating N dose for its in-season variable rate application. The multispectral imagery was processed for different crop growth stages, and treatment-wise mean Normalized Difference Red-edge Index (NDRE) values were calculated. The 95th percentile NDRE values and spatial Nitrogen Adequacy Index (NAI) maps were generated. NAI-based nitrogen sufficiency response curve was generated and parameterized by the N rate that maximized cotton yield. The best fits were obtained using a quadratic model with a coefficient of determination (R2) value of 0.84. The algorithm is being further refined and validated for different genotypes.

Sensor-based irrigation in cotton was carried out during kharif 2023. The moisture sensor used in the experiment was dielectric soil moisture sensor type. The moisture content at the field capacity was 45%, and whenever the soil moisture reached 34% and 23% in the sensor, irrigation was scheduled for 25 % DASM (depletion of available soil moisture) and 50 % DASM, respectively. The 'sensor-based' irrigation resulted in higher seed cotton yield, lesser water consumption and higher water use efficiency in cotton than the ET based drip irrigation and the traditional flood irrigation method (Table 3.2.1).

Sh. Manoj Ahuja IAS, Secretary (DoA&FW) inspecting AI Smart Trap

Infrared Sensor Trap for monitoring of lepidopteran pests in cotton

Table 3.2.1: Effect of sensor-based Irrigation on seed cotton yield (kg/ha) and water use efficiency in cotton during *kharif* 2023

Irrigation Treatments	Seed Cotton yield (kg/ha)	Water used (ha cm)	Water use efficiency (kg seed cotton/ha cm)
ET based Irrigation (Drip at 1.0 ET)	2634	57.95	43.5

Irrigation Treatments	Seed Cotton yield (kg/ha)	Water used (ha cm)	Water use efficiency (kg seed cotton/ha cm)
Sensor based Irrigation (Drip at 25 % DASM)	3092	53.55	57.7
Sensor based Irrigation (Drip at 50 % DASM)	2790	53.55	52.1
Conventional Irrigation	1978	78.80	23.1
CD (P=0.05)	**354**	-	-

3.3 Project Name: Land diagnostic Survey (LDS) of cotton production practices and crop performance in Maharashtra

PL: Y.G. Prasad

PI: Ramkrushna G.I.

Co-PIs: A.R. Reddy, M.V. Venugopalan, Shailesh P. Gawande, M. Sabesh, Rahul M. Phuke, Ranjit Kumar Paul, Soumen Pal and R. Jaya Kumaravaradan

Importance of the study: To understand possible factors responsible for low productivity in Maharashtra, a study was conducted through a project entitled "Landscape Diagnostic Survey (LDS) of cotton production practices and crop performance in Maharashtra" which was funded by the Rajiv Gandhi Science and Technology Commission, Government of Maharashtra.

Salient findings

The data showed that the average seed cotton yield (SCY) under irrigated conditions was 8.6 quintals per acre, while under rainfed conditions it was 3.1 quintals per acre. This indicated a clear advantage of irrigation, with a yield difference of 3.5 quintals per acre on average. Among the districts, Amravati recorded the highest yield under irrigation at 10.0 q/acre, followed by Ahilya Nagar (9.8 q/acre) and Jalna (9.4 q/acre). Under rainfed conditions, Akola performed the best with 6.4 q/acre, while Wardha (3.8 q/acre) and Beed (3.6 q/acre) also showed relatively better yields (Fig 3.3.1). Jalgaon had the lowest yield at 3.3 q/acre under irrigated conditions followed by Nandurbar with 3.9 q/acre. Poor yields of Jalgaon and Nandurbar were mainly due to severe infestation of pink bollworm. In rainfed areas, Nandurbar (4.3 q/acre) and Ahilya Nagar (4.4 q/acre) had the lowest yields. The yield gap between irrigated and rainfed conditions was the highest in Ahilya Nagar (3.4 q/acre) and Amravati (3.0 q/acre), indicating the strong impact of irrigation in those areas. Irrigated fields yielded 68% more seed cotton over rainfed fields. Overall, the findings highlighted the importance of improving irrigation access and technology adoption in rainfed areas to enhance cotton productivity.

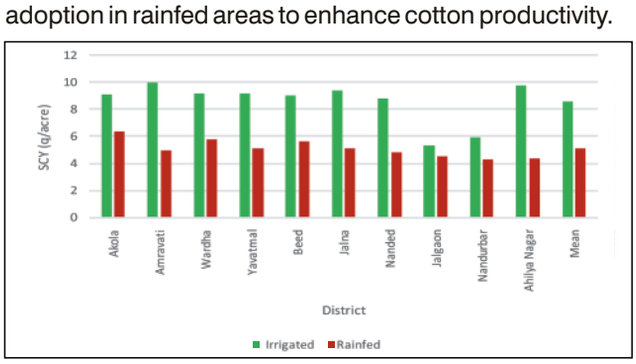


Fig 3.3.1 Seed cotton yield (q/acre)

3.4 Project Name: Effects of varied canopy management and mulching on growth, productivity and profitability of cotton

PI: AS Tayade

Co-PIs: P. Nalayini, Ramkrushna GI, K. Velmourougane, A. Manikandan, Pooja Verma

Importance of Study: The deployment of varied plant densities and canopy management practices is of paramount importance in order to enhance the cotton growth and seed cotton yield. Canopy management influences the cotton morphological and biochemical parameters immensely. Changes in weed dynamics and soil moisture regimes can substantially affect cotton crop growth and the physical, chemical, and biological properties of cotton soil.

Salient findings

During the crop season 2024-25, an experiment with 24 treatment combinations was conducted to standardize the use of Jute Agro Textile (JAT) bio-mulches and canopy management in the High-density planting system (HDPS) and Closer Spacing (CS) in split- split plot experimental design with three replications in Rasi swift, a cotton hybrid, in shallow and medium soils. Among the planting systems, yield under closer spacing (37.86 q/ha) was comparable to that under HDPS cotton planting system (33.0 q/ha). Manual canopy management in cotton recorded significantly higher yield (38.63 q/ha) than chemical canopy management (33.41 q/ha). Five hundred GSM JAT bio-mulch was found comparable with polyethylene mulching, wherein, polyethylene mulching (31.93 q/ha) in cotton recorded significantly higher seed cotton yield over control. Medium deep soils had higher soil biological activity (microbial biomass carbon, glomalin content, soil polysaccharides, soil protein, soil enzyme activities) than shallow soils. HDPS and jute mulching practices enhanced soil biological activities. Except phosphatase activity, other soil biological parameters were higher under manual canopy management. The performance of different mulches in cotton was also evaluated at ICAR-CICR, Regional Station, and Coimbatore, where polyethylene mulching recorded the highest seed cotton yield of 3978 kg /ha, which was 62.4% over no mulching. Jute mulches recorded 23%, 44%, and 36.8% higher seed cotton yields at 500,600 and 700 GSM than conventional no mulching. Among the jute mulches, 600 GSM recorded the highest seed cotton yield (3527 kg/ha} and was on par with 700 GSM, and was superior to 500 GSM.

3.5 Project Name: Quantitative estimation of carbon and moisture fluxes over the cotton based agro-ecosystem: Integrating ground observation, satellite

data and modeling (in collaboration with ISRO-NRSC)

PI: Ramkrushna G.I.

Co-PI: A Manikandan

Importance of the study: Ecosystem-level carbon fluxes serve as crucial indicators of the functioning and sustainability of crop production systems. Their quantification provides valuable insights into the long-term impacts of current management practices. In this study, the eddy covariance (EC) technique was used to measure CO2 fluxes from a rainfed cotton production system in Central India during the 2024-2025 cropping season.

Salient findings

The ecosystem was found to be a net CO2 source for about two weeks from the date of sowing, as the crop stand was meager and ecosystem respiration exceeded photosynthetic processes. This is reflected in the relatively low mean CO2 flux of 1.061 g cm^2 d^{-1} in May and 2.553 g cm^2 d-1 in June. However, the ecosystem transitioned into a net CO2 sink thereafter, as crop growth improved and photosynthetic activity began to dominate. The peak net CO2 influx was observed during the flowering initiation to the first boll opening stage, particularly in October, which is consistent with the high meanCO2 flux of 1.865 g C m^2 d^{-1} on October 10, 2024 and 3.899 g cm^2 d^{-1} on October 24, 2024, indicating continued photosynthetic activity and carbon sequestration by the crop (Fig 3.5.1). Soil moisture content varied temporally and with depth from May to October. From May to July, all treatments (Mini, Opt, Maxi at 20 cm and 40 cm) produced low moisture levels (0.2–0.4 m^3/m^3). In August, moisture improved, especially in Opt and Maxi at 40 cm, reaching 0.4–0.6 m^3/m^3, with Maxi even hitting 0.6-0.8 m^3/m^3 coinciding with peak crop growth. During September and October, higher moisture was sustained in Opt and Maxi at 40 cm, while Mini at 20 cm remained lower. This indicates that deeper soil placement and higher inputs enhance moisture retention, supporting better crop performance and CO2 uptake. The mean Net Ecosystem CO2 Exchange (NEE) was 1.12 g C m2 d-1 during sowing to germination, -0.22 g C m^2 d-1 germination to squaring, -1.32 g C m^2 d-1 during squaring to flowering initiation, -2.1 g C m^2 d-1 flowering initiation to first boll opening. It declined after that during the boll bursting stage and was -0.9 g C m^2 d-1 during the period from second to last picking.

3.6 Project Name: Validation and refinement of organic cotton production technology

PI: Ramkrushna G.I.

Co-PIs: Rachna Pande, Neelakanth S. Hiremani

The importance of the study: Hazardous synthetic pesticides used in non-organic farming can damage ecosystems, poison waterways, and endanger workers who cannot always afford the necessary safety equipment. Organic cotton is a great eco-friendly cotton production system. Cotton is grown without the use of pesticides, herbicides, or other chemical fertilizers, that is simply better for human health and the environment. By encouraging biological diversity, it create conditions that reduce the likelihood of any insect, bird or mammal doing any major damage to their crop. Keeping this in view, this project aimed to validate and refine available organic cotton production practices.

Salient findings

Identifying optimum nutrient supply combination to organic cotton

An experiment was undertaken using different combinations of organic sources viz,. 5 t/ha FYM + Other alternate sources (300 kg/ha vermicompost, 200 kg/ha neem cake, two sprays of vermiwash, two sprays of Panchgavya + Biomulching (Sunhemp) + Biofilm), 2.5 t/ha FYM + other alternate sources (300 kg/ha vermicompost, 200 kg/ha neem cake, two sprays of vermiwash, two sprays of Panchgavya + Biomulching (Sunhemp) + Biofilm), PKV organic package (10 t/ha FYM + Biofertilizer + Intercrop (Mung) + Biomulching), RDF (inorganic treatment) and compared with control (No nutrients) and available farmers' practice. Among the different treatments, no significant variation was found in terms of boll weight, number of bolls per plant and tur grain yield (Table 3.6.1). Five tones/ha FYM + Other alternate sources produced on par seed cotton yield (9.69 q/ha) with PKV package (8.96 q/ha) and RDF (inorganic treatment) (11.93 q/ha). The control had the lowest seed cotton yield (3.88 q/ha).

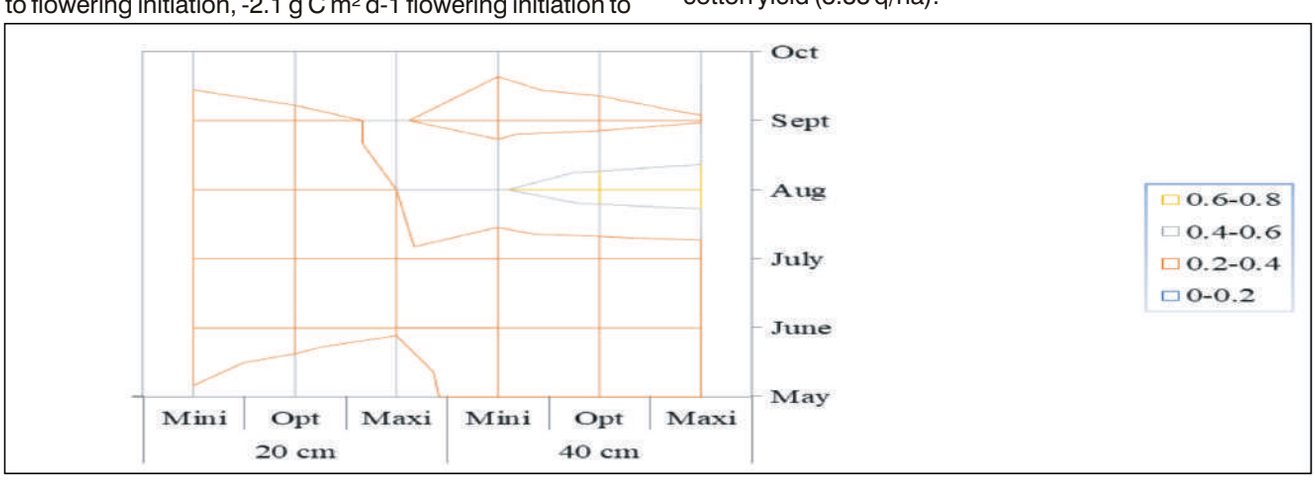


Fig 3.5.1 Depth wise soil moisture content (20 cm and 40 cm) during cotton growing season

Table 3.6.1 Effect of different organic treatments on yield attributes and yield.

Treatment Details	SCY (q/ha)	Boll weight (g)	Bolls / plant	Nodes	Mono pods	Sympods
Control	3.88	3.17	10	20	0.72	15
Farmer's Practice	7.25	3.47	10	21	0.56	15
Natural Farming	7.77	3.50	9	20	0.72	15
3.0 T/ha FYM + other*	9.69	3.57	12	22	1.33	16
2.5t/ha FYM + Other*	8.80	3.80	11	22	0.56	15
PKV Package#	8.96	3.47	12	22	1.06	17
RDF inorganic	11.93	3.60	13	26	2.22	19
CD (p=0.05)	3.09	NS	NS	2.61	0.58	1.75

Other: 300 kg/ha vermicompost, 200 kg/ha neem cake, two sprays of vermiwash, two sprays of Panchgavya + Biomulching (Sunhemp) + Biofilm, #PKV package: 10 t/ha FYM + Biofertilizer + Intercrop (Mung) + Biomulching

Evaluation of cotton cultivars grown under organic cultivation

Ten *G. hirsutum* cultivars CNH 1128, CNH 1111, Partech 29, Partech 30, Suraj, Anjali (LRK 516), NH 615, Vaidehi (colour), Suraksha, BB 7 and five G. arboreum varieties CNA 175-22 (colour), PA 812, PA 810, CNA 1054 and CNA 1032 were evaluated under organic conditions. Among the different varieties, the highest number of open bolls per plant was observed in CNH 1111 (16), followed by PA 810 and CNA 1054. The highest boll weight (4.15) was recorded with Non Bt hybrid Partech 30 followed by another non Bt hybrid Partech 29 (4.10). Colour desi cotton variety CNA 175-22 (14.99 q/ha) produced the highest seed cotton yield, which was closely followed by Non Bt hybrid Partech 29 (13.88 q/ha). Among the G. hirsutum varieties, CNH 1128 produced the higher seed cotton yield (10.06 q/ha).

Pink bollworm damage ranges from 0 -45%. At approximately 120 DAS (5-35%) minimum (%) damage was in CNA 1032, 140 DAS (0-25%) minimum (%) damage was in BB7 (60×30) and CNA 175-22, 150 DAS (5-45%) minimum damage was in PA 810, 170 DAS (5-55%) minimum damage was in BB7 (60×15), BB7 (60×30), CNA 1032, CNA 175-22, PA 812 and 185 DAS (0-45%) minimum damage was in CNH 1128 at 10 days interval. Bacterial blight was the major disease whereas; Grey mildew and *Corynespora* leaf spot were comparatively less severe during the season. Bacterial blight was found in all the nine cultivars screened wherein the PDI was ranging from 1.4 to 22.8%. However, highest mean PDI was seen Suraksha (12.6%) followed by CNH-1128 and NH-613. Lowest mean PDI was seen in Vaidehi (2.05%) followed by Partech-29.

Evaluation of microbials

Microbial culture viz., *Diaporthe longicolla* (CEL-48), *Trichoderma harzianum, Bacillus tequilensis, Trichoderma longibrachiatum, Diaporthe longicolla* (CEL-41), *Daldinia eschscholtzii* (M1- 4), *Diaporthe* sp. (CFL-34) were evaluated against cotton insect pests. Inorganic insecticides and neem oil were used as positive control. Against the aphid, *D. longicolla, T. harzianum, T. longibrachiatum, D. eschscholtzii* were the microbials at par with the positive control. No incidence of pink bollworm was observed in *D. longicolla, D. eschscholtzii, Diaporthe* sp. (CFL-34), *B. tequilensis* treatments after 120 DAS (days after sowing). During the 140 DAS and 150 DAS, the population was below the ETL for some microbials, however, after 170 DAS in all treatments including positive check PBW incidence was above ETL.

A field trial was conducted to test the efficacy of different microbial biocontrol agents against cotton diseases. Bacterial blight was the major disease, whereas, fungal leaf spots were found in traces. Bacterial blight disease severity (PDI) ranged from 1.6% to 22.13% (Fig.). The disease severity (mean PDI) was maximum in control (17.28%), whereas reduction in disease severity over control was maximum in T8 (inorganic treatment), followed by T1 (*Diaporthe longicolla*- 51.54%) and T6 (*Daldinia eschscholtzii*- 51.23%).

Field evaluation of plant extracts against insect pests and diseases in cotton

Based on the previous year's results, a total of 4 botanicals viz., Neem seed kernel extract 5%, Dashparni 10%, Pongamia 5%, and Panchgavya 10%, were evaluated against inorganic insecticides and neem oil. All botanicals were effective against the aphids as no incidence was observed during different period after sowing and varied time of sowing. Damage of *H. armigera* was effectively managed by botanicals at 60 and 90 days after sowing. In addition, significantly higher yield was recorded in all the treatments.

3.7 Project Name: Nutrient Profile based fertilizer management in cotton

PI: A. Manikandan

Co-PI: K. Sankaranarayanan

Importance of the study: Sigmoidal growth indicate that day-to-day nutrient and water requirement demands varied in critical stages of cotton under rainfed conditions. However, present inadvertent nutrient

management partially fulfills the needs, resulting in low yield with inferior quality fiber. Therefore, pre-plant nutrient testing (PPNT), pre-side-dress nutrient testing (PSNT), pre-flowering nutrient testing (PFNT), pre-harvest nutrient testing (PHNT) status of cotton-growing soils as well as plant analysis (petiole, tissue testing, nutrient partitioning in different parts) from on-farm and on-station experiments are essential during the critical growth stages of cotton.

Salient findings

Soil analysis (PPNT-Pre plant nutrient testing; PSNT-Pre side dress nutrient testing; PFNT-Pre flowering nutrient testing; PHNT-Post harvest nutrient testing) revealed that cotton growing soils are slightly alkaline, normal electrical conductivity and low in organic carbon concentration under rainfed conditions. Similarly, rainfed cotton soils are low in nitrogen with low (on-station) to medium (on-farm) phosphorus and high potassium content. Further, the micronutrients ranged from deficient to sufficient during the experimental period (2023-2024). Soil fertility maps of panjari farm revealed the importance of balanced nutrition (Figure 3.7.1). Further, cotton plant petiole analysis (two stages i.e., germination and seedling), plant nutrient analysis (vegetative, flowering and reproductive) during reproductive stage (90-120 days after sowing) revealed that the availability of soil nutrients (macronutrients) is low attributing to fewer bolls under rainfed conditions. Subtending leaves nutrient analysis explained that lower sympodial branch had higher concentration of macronutrients than top and middle sympodial branches at 120 DAS. Overall, nutrient uptake and accumulation were maximum during reproductive stage than vegetative and flowering. Seed cotton yield results varied between on-station and on-farm experiments suggested that on-farm mid-season nutrient management with split application based on soil and cotton plant analysis is essential for higher yields and sustainability (Table 3.7.1).

Table 3.7.1. Seed cotton yield (kg ha^{-1}) in on-station and on-farm experiments (2023-2024)

Cotton	Spacing (cm)	SCY (kg/ha)		Cotton	Spacing (cm)	SCY (kg/ha)	
American cotton					Bt-Hybrid (<10% $CaCO_3$)		
		On-station	On-farm			On-station	On-farm
NH615	90 x 10	2328	1654	Ajeet-155	90 x60	3281	2861
Suraksha - Inorganic	90 x 30	1865	1649	Ankur-3028		3124	2770
Suraksha -Organic		1641	1517	Dhandev +		2705	2766
Bt- variety				RCH 779		2691	2593
PKV-081 Bt	90 x15	3009	1929	Bt-Hybrid (>20% $CaCO_3$)			
Rajat Bt		2774	1876	Ankur Kirti	90 x60	2825	2680
Suraj Bt		2037	2135	Dhandev +		2361	2766
Desi cotton							
CNA1032	90 x10	1933	1388				
PA-740		1807	1545				
Phule Dhanwantary		1965	1238				

3.8 Project Name: Efficacy evaluation of ICAR-CIRCOT nano-ZnO as nanofertilizer in field crops

PI: N. Vigneshwaran, ICAR-CIRCOT, Mumbai

CC-PIs: A. Manikandan

Importance of the study: In order to understand the efficacy of seed treatment (ST), foliar spray (FS), and ST+FS of nano Zn formulations (nano particles, nano suspension) on growth, yield, and nutrient accumulation in rainfed cotton under black calcareous soils. Conventional soil application (SA) of zinc sulphate (ZnSO4) compared along with nano Zn formulations.

Salient findings

Based on the pot and field studies, either seed treatment or foliar spray of zinc sources, viz., Zn nanoparticles or Nano Zn suspension did not affect the Bt-cotton, although it improved the plant height during the boll development stage. Although soil had Zn deficiency, Zn deficiency symptoms (Interveinal Chlorosis) were not visible during 2023-24. Cotton plant parts (root, stalk, leaf), Zn concentration is within the sufficiency range, viz., 20-200 mgkg-1 (Vegetative) & 20-100 mgkg-1 (reproductive). Soil Zn levels were medium (0.5-1.0 mgkg-1) during the experimental period. Among the

nano Zn formulations (Zn nano particles or Nano Zn Suspension) tested, no significant differences were observed in cotton morphology, Seed Cotton Yield (Table 3.8.1) and Fibre quality. However, significant Zn accumulation was observed in soil and cotton plant was observed during 2023-24.

Table 3.8.1. Effect of Nano Zinc formulations on seed cotton yield (kg ha^{-1}) during 2023-24

Treatments	Calcareous soil
T1-Control (RDF+12.5 kg of ZnSO4)	1719 ±298
T2-ST-ZnO NP's @ 20 mg kg-1	1841 ±239
T3-ST-ZnO NP's @ 50 mg kg-1	1752 ±329
T4-FS -ZnO NP's @ 200 mg kg-1 (45,60 DAS)	1790 ±333
T5-ST-ZnO NP's @ 20 mg kg-1 + FS ZnO NP's @ 200 mg kg-1 (45,60 DAS)	1738 ±292
T6-ST -ZnO NP's @ 50 mg kg-1 + FS ZnO NP's @ 200 mg kg-1 (45,60 DAS)	1807 ±210
T7-ST-Nano Zn Suspension(NZnS)@ 50 mg kg-1	1820 ±324
T8-FS-Nano Zn Suspension@ 200 mg kg-1 (45 DAS)	1779 ±104
T9-ST-Nano Zn Suspension@ 50 mg kg-1 + FS-NZnS @ 200 mg kg-1	2182 ±456
T10-FS-Nano Zn Suspension@ 200 mg kg-1 (45,60 DAS)	2082 ±259
C.D.(0.05)	NS
SE(m)	177.01
SE(d)	250.33
C.V. (%)	16.56

3.9 Project Name: Establishment of Cosmic Ray Soil Moisture Instrument for Validation of Model Computed Soil Moisture under National Hydrology Project (NHP) -NRSC (2024)

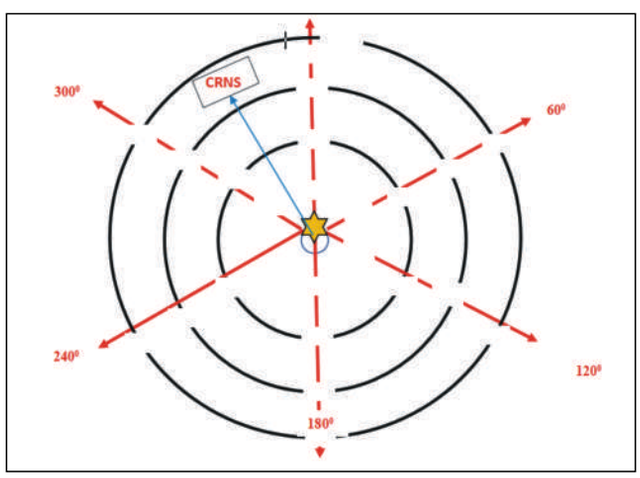
PI: A. Manikandan

Co-PIs: YG Prasad, Ramkrushna GI

Importance of the study: Cotton water requirement is 700-800 mm during the whole growth period, and its use is varied from 2 to 8 mm per day from germination to boll development. However, changes in environmental conditions have adverse effects on soil moisture availability. Therefore, it is essential to know the soil moisture in cotton growing areas. Alhough different point source methods are available, they are time-consuming. Moreover, these data are not available for predicting and forecasting for a large area. Under national hydrology project (NHP), the novel COSMOS (Cosmic ray Soil Moisture Observing System) estimates root zone soil moisture within 200 m radius in horizontal space and 05-30 cm depth by measuring natural neutron radiation above the ground. Continuous monitoring of soil moisture using different sensors and dataset collection is essential for validation of hydrological model developed for cotton cropping systems.

Salient findings

Cosmic ray probes, soil, weather, and rainfall sensors were established at CICR, Nagpur in 2023 and calibrated during 2024. Air pressure, air temperature, relative humidity, rainfall, soil temperature, and soil moisture (5, 15, and 50 cm depth) data were collected at 15-minute intervals and retrieved once a fortnight (15 days) during kharif season 2024. The cosmic probe was calibrated using a soil sampling strategy, and and the physical and hydraulic properties of the soil were estimated during May and June 2024. Undisturbed soil samples were collected at 24 sampling points located at radii of 5, 25, 50 and 75 meters from the Probe, with 6 depths at intervals of 5 cm each. A total of 144 samples are necessary for estimating the parameters required for COSMOS calibration. During the calibration of the soil samples, the average lattice water content was 1.18 - 1.39 % and soil organic carbon storage was 2882 to 3568 g m-2 (Fig 3.9.1)



Cosmic-ray Soil Moisture Observation System (COSMOS) standard soil sampling diagram

A cosmic ray probe component parts (CICR, Nagpur)

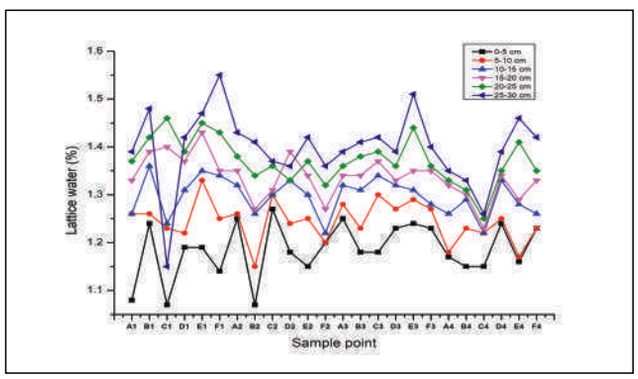


Fig 3.9.1 Study area lattice water (%) of upto 30 cm soil depth

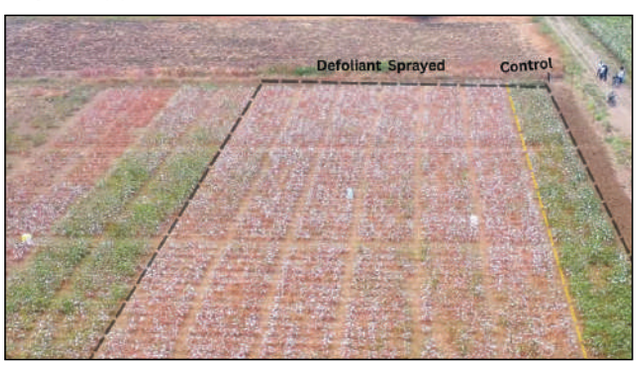
3.10 Project Name: Evaluation of chemical defoliants augmenting leaf senescence for mechanical picking in Bt Cotton (DST-SERB Project)

PI: J.H. Meshram

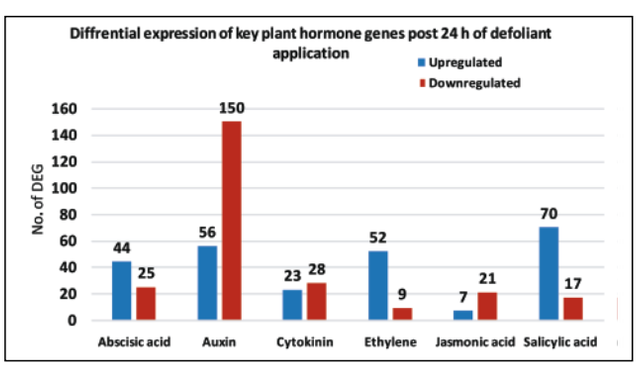
Importance of the study: The elevated impurity in machine-harvested cotton is a serious bottleneck in enhancing the efficiency of cotton cultivation. Chemical defoliation is the passive abscission of leaves at the petiole of metabolically active functional leaves under the action of defoliants to facilitate a clean mechanical harvest. The defoliants used in production mainly consist of ethylene and thidiazuron, having the role of defoliation and boll opening. Defoliation in cotton involves a hormone-driven mechanism upsetting the balance between auxin and ethylene contents in the leaf. The possible cross-talk between growth hormones such as cytokinin and ethylene regulates cotton defoliation and may provide new insights into the molecular mechanisms underlying the mode of action of defoliants in cotton. However, the underlying molecular mechanism that triggers leaf abscission through defoliant remains unresolved. Molecular screening (RNA sequencing) of the abscission zone (AZ) of cotton petioles from abscission cells was performed after defoliant treatment. This molecular approach offers a new strategy for the chemical defoliation of machine-harvested cotton, ensuring stable production and reducing leaf trash in harvested cotton, thereby enhancing environmental sustainability.

Salient findings

The current study standardized the the effective leaf defoliation rate and dose without negatively impacting fibre quality. Results showed a shift in the internal hormonal balance within the plant. The abscission zone or layer forms across the petiole near its junction with stem. SEM analysis clearly showed abscission zone formation after application of CICR Defoliant within 1 or 2 days of application. The cross–talk between hormones (Cytokinin and ethylene) was established in leaf abscission tissues induced by the chemical defoliant. The involvement of ABA hormone was validated in promoting abscission. The CICR defoliant simultaneously helps with boll opening and leaf defoliation. RNA Seq analysis study indicated up-regulation of abscission-related Genes/TFs associated with defoliation, such as SAG-39, ERF113, and Cytokinin dehydrogenase 3 etc. Defoliating leaf metabolite profiles had the presence of Caryophyllene, Cycloundecatriene, Diethyl Phthalate, Neophytadiene, Hexadecanoic Acid, Phytol, Squalene, Octadecatrienoic Acid etc. which may be involved in the induction of leaf senescence process. Defoliant treatment resulted in more than 90% boll opening after 7 days of application and more than 95 % opening after 14 days of application.



Field view of CICR defoliant foliar application on Bt cotton plants



Differentially expressed genes of key plant hormone post 24 Hrs of defoliant application.

3.11 Project Name: Phytohormone profiling by targeted metabolomics in Cotton (IXX15681)

PI: Pooja Verma

Co-PI: Joy Das

Importance of the study: The physiology of phytohormones has been a key emphasis for the advancement of agriculture since a plant hormone can affect crop output directly or indirectly by functioning as a plant-development controller or plant-environment mediator. Plant hormonomics; an approach for the collective estimation of major phytohormones with advanced LC-MS, HPLC, or GC combined with mass spectrometry (MS) has been successful in the targeted profiling of more than 100 phytohormones altogether in model plants like Arabidopsis. Building on this background, this study aims to develop a methodology for the rapid, sensitive, and simultaneous profiling of phytohormones in cotton. It will not only provide the quantitative snapshot of the physiological status of cotton tissues under stress and facilitate the correlation of fibre traits with the interplay of phytohormones in cotton.

Salient findings

A method was optimized for silylation (BSTFA, MSTFA and BSTFA+TMCS) and methylation (with MCF) in plant samples using SCAN as well as SIM mode of acquisition. Phytohormone profiling was performed using an optimized method in different cotton tissues (seedling, leaf, flower bud and flowers). Indole acetic acid (IAA), Indole Butyric acid (IBA), Isopentyl adenosine (cytokinin), Salicylic Acid (SA), Jasmonic acid (JA), Azelaic acid, Succinic acid, t-cinnamic acid, and Cis-cinnamic acid could be detected in cotton samples. More than 15 direct and indirect precursors and intermediates were also detected, such as ethyne, and Cyclopentane, 1- carboxylic acid, Benzoic acid (precursor of Salicylic acid), Hydroxy-benzoic acid (precursor of Salicylic acid), 2,4 Naphthalene/2,4 Naphthalinone, Phenoxy acetic acid, Decane, Undecane, Dodecane, Nonadecane etc., in different cotton tissues on GC-MS analysis with the method optimized under this study. On comparing the different methods of derivatization tested, BSTFA+1% TMCS was found to be better than others for detecting phytohormones (Table 3.11.1).

Table 3.11.1: Comparison of different silylating and methylating agents for best detection of phytohormones

BSTFA	BSTFA+TMCS	Methyl chloroformate
Indole-3 acetic acid Methyl salicylate Succinic acid	Indole-3 acetic acid Indole butyric acid (IBA) L-Tryptophan	Indole-3 acetic acid Succinic acid L-Tryptophan
Linolenic acid---Jasmonic acid	Isopentyl adenosine (iPR) --Cytokinin	Azelaic acid
Linoleic acid---Jasmonic acid	Salicylic acid	t-cinnamic acid, Hydroxy cinnamic acid
Ephedrine, ephinephrine	Azelaic acid t-cinnamic acid Linoleic acid---Jasmonic acid Linolenic acid---Jasmonic acid Xanthoxin….ABA Nitric oxide	Linolenic acid---Jasmonic acid Linoleic acid---Jasmonic acid Salicylic acid Xanthoxin….ABA

3.12 Project Name: Microbially mediated abiotic stress tolerance in cotton (IXX17720)

PI: K. Velmourougane

Co-PIs: J.H. Meshram, Raghavendra K.P, J. Annie Sheeba

Importance of the study: Abiotic stress is the most important factor affecting cotton production because cotton is highly sensitive to moisture. Since Bt cotton hybrids occupy 98% of the total cotton cultivated, the problem of abiotic stress and its effects on cotton has become more serious as the root systems of Bt cotton are generally shallow, creating a moisture deficit compared to native cotton species. Abiotic stress causes nutrient deficiencies and physiological disorders and demands chemical osmo-protectants to protect cotton from stress. Although several cotton growing countries are in the process of developing drought-tolerant cotton through conventional breeding and transgenic technologies, public acceptance of GM crops is still under question. Although bioinoculants are being explored for abiotic stress alleviation in crops, no studies are available on the use of native microbial consortia with relation to abiotic stress alleviation in cotton.

Salient findings

Based on the replicated field experiments with 7 treatments [Control, 75% STCR (soil test and crop response), 100% STCR, B4+B7+CSB (MC1)+75% STCR, B4+B7+310 (MC2) +75% STCR, B7+CSB+310 (MC3)+75% STCR, B4+B7+CSB+310 (MC4)+75%

STCR, and Salicylic acid + 100% STCR], the microbial consortia (MC4) significantly ($p<0.05$) enhanced cotton growth, plant physiological parameters, plant defense and antioxidant enzyme activities, yield contributing attributes, soil nutrient availability, and soil biological properties under normal (N, water-logging (WL), and drought (DR) conditions compared with other treatments. The microbial inoculation also decreased CO2 and C2H4 release and increased O2 release compared with the control.

Table 3.12.1 Abiotic stress and microbial treatments on yield and yield contributing parameters

Treatments	Bolls (Nos.)			Boll weight (g)			SCY (kg/ha)			Seed index (g)			Lint index (g)		
	N	W	D	N	W	D	N	W	D	N	W	D	N	W	D
Control	28.7^{f}	22.7^{d}	10.7^{e}	3.96^{d}	3.85^{d}	2.78^{d}	14.3^{d}	11.4^{d}	5.30^{d}	7.96^{f}	8.05^{f}	7.86^{f}	5.11^{d}	5.24^{c}	4.83^{c}
75% STCR	37.7^{e}	32.7^{c}	16.0^{d}	4.42^{c}	4.37^{c}	3.27^{c}	30.8^{c}	25.2^{c}	9.10^{c}	8.53^{e}	8.86^{e}	8.46^{e}	5.57^{c}	5.60^{b}	5.40^{bc}
100% STCR	45.7^{bc}	37.8^{bc}	21.0^{bc}	4.75^{bc}	4.70^{b}	3.40^{b}	34.7^{b}	28.7^{bc}	10.5^{b}	9.01^{bc}	9.06^{bc}	8.69^{bc}	5.74^{c}	5.91^{b}	5.61^{b}
B4+B7+CSB+75% STCR	42.3^{cd}	39.0^{b}	20.7^{bc}	4.70^{b}	4.62^{b}	3.54^{b}	34.4^{b}	31.8^{b}	10.2^{bc}	9.04^{cd}	8.91^{cd}	8.66^{cd}	5.65^{c}	5.67^{b}	5.58^{b}
B4+B7+310+75% STCR	40.2^{de}	37.1^{bc}	19.7^{c}	4.79^{b}	4.65^{b}	3.44^{b}	33.9^{bc}	31.7^{b}	10.1^{bc}	8.88^{de}	8.84^{de}	8.68^{de}	5.80^{b}	5.69^{b}	5.49^{bc}
B7+CSB+310+75% STCR	40.8^{de}	38.1^{bc}	20.3^{bc}	4.76^{bc}	4.63^{b}	3.47^{b}	34.2^{b}	31.4^{b}	10.3^{b}	8.87^{de}	8.84^{de}	8.67^{de}	6.03^{b}	5.59^{b}	5.61^{b}
B4+B7+CSB+310+75% STCR	54.0^{a}	44.7^{a}	26.7^{a}	5.36^{a}	4.84^{a}	3.91^{a}	41.2^{a}	38.5^{a}	14.7^{a}	9.24^{a}	9.07^{a}	8.86^{a}	6.57^{a}	6.27^{a}	6.04^{a}
SA + 100% STCR	47.0^{b}	40.0^{ab}	23.0^{b}	4.89^{b}	4.74^{b}	3.59^{b}	35.4^{b}	31.6^{b}	10.8^{b}	8.99^{b}	8.83^{b}	8.66^{b}	6.02^{b}	5.86^{b}	5.73^{b}

STCR, Soil test crop response-based fertilizer recommendation; N, Normal rainfed condition; W, Waterlogging, D, Drought

3.13 Project Name: Bioprospecting microbial volatiles for the management of major foliar and root diseases of cotton (IXX17719)

PI: K. Velmourougane

Co-PIs: S.P. Gawande, D.T. Nagrale

Importance of the study: Cotton is vulnerable to several foliar and root diseases. Cotton farmers largely depended on conventional fungicides for managing these diseases along with a few biologicals and organic amendments. However, continuous and irrational and of these chemicals has resulted in resistance development in cotton pathogens. Microbial volatile organic compounds (mVOCs) represent a new frontier in bioprospecting, where they produce several complex and dynamic volatile compounds, which help in plant growth promotion and induct induced systemic resistance in crop plants. Although substantial advancement has been made in our understanding of mVOCs and their multifunctional roles in crop growth promotion, including biocontrol, we remain far from implementing that knowledge under field conditions. Based on the above knowledge gap, we hypothesize that microbial volatiles may serve as a sustainable, cheaper, efficient, and ecofriendly alternative to synthetic fungicides to manage cotton foliar and root diseases.

Salient findings

Based on the replicated lab experiments with 12 bacterial-based volatiles (BHT, DBP, DCT, EC, HC, HDC, HTC, PD, PY, TC, TD, TPC) at 5 ppm concentration on N-acetylglucosamine (NAG) content (cell wall component of fungi) of major cotton pathogens, TC, HDC, HTC, PY, DBP, EC, and EC significantly ($p<0.05$) reduced the NAG content of *Alternaria* (98%), *Fusarium* (33%), *Rhizoctonia* (78%), *Macrophomina* (306%), *Corynespora* (219%), *Sclerotium* (215%) and *Myrothecium* (22%), respectively, compared with the control. A significant positive correlation was also observed between the NAG concentration and fungal biomass of the evaluated cotton pathogens.

Table 3.13.1 Bacterial-based volatiles on N-acetylglucosamine and fungal biomass

	Control		BHT		DBP		DCT		EC		HC		HDC	
Pathogens	N	F	N	F	N	F	N	F	N	F	N	F	N	F
Alternaria	178	4.35	163	4.18	123	3.97	158	4.27	136	4.05	157	4.2	126	3.86
Fusarium	220	4.26	209	4.08	186	3.87	196	4.12	162	3.76	216	3.92	162	3.62
Rhizoctonia	195	5.02	186	4.35	172	4.15	176	4.56	153	4.68	182	4.67	146	3.43
Macrophomina	245	5.36	232	5.12	72	2.34	213	5.17	56	2.13	223	5.19	79	2.09
Corynespora	224	5.73	217	5.28	68	2.17	196	4.23	186	5.27	203	5.43	73	2.12
Sclerotium	268	5.68	146	5.27	86	2.39	227	5.27	72	2.23	221	5.32	149	5.17
Myrothecium	236	5.27	224	4.89	194	4.27	215	4.86	176	4.93	206	4.76	186	4.69
	Control		**HTC**		**PD**		**PY**		**TC**		**TD**		**TPC**	
Pathogens	N	F	N	F	N	F	N	F	N	F	N	F	N	F
Alternaria	178	4.35	143	3.23	168	4.03	162	4.12	82	2.42	156	4.09	149	3.52
Fusarium	220	4.26	186	3.48	203	3.95	193	3.85	183	3.72	178	3.89	176	3.23
Rhizoctonia	195	5.02	82	2.56	172	4.86	172	4.23	156	4.23	165	3.43	163	3.92
Macrophomina	245	5.36	93	2.48	211	4.82	52	2.07	206	4.53	63	2.19	79	2.32
Corynespora	224	5.73	192	3.57	203	5.16	186	5.12	182	5.14	204	5.19	182	5.23
Sclerotium	268	5.68	213	4.23	223	5.14	206	5.09	217	5.23	206	5.34	84	2.48
Myrothecium	236	5.27	193	4.64	205	4.82	193	4.87	192	4.67	176	4.27	203	5.04

N, N-acetylglucosamine content in mg g-1 dry weight basis; F, Fungal biomass in g dry weight basis

3.14 Project name: Targeting technologies to agro-ecological zones- large scale demonstrations of best practices to enhance cotton productivity

PL: Y.G. Prasad

PI: AS. Tayade

Co-PIs: Team of Scientists form ICAR-CICR, Nagpur, and two regional stations, Coimbatore and Sirsa

Importance of Study: With the objectives of increasing cotton productivity, three scalable technologies have been identified for technology targeting in identified agro-ecological zones:1) High-density planting system in low-productivity areas with shallow soils with canopy, nutrient, and soil health management; 2) Closer Spacing planting system in medium productivity areas with medium deep soils under rainfed cotton ecosystem with canopy, nutrient and soil health management; and 3) Production technology for ELS cotton in niche areas under rainfed/irrigated farming situation.

Salient findings

The Ministry of Agriculture and Farmers welfare, New Delhi, a project entitled "Targeting Technologies to Agro-Ecological Zones: Large-Scale Demonstrations of Best Practices to Enhance Cotton Productivity," under the National Food Security Mission (NFSM) that was implemented in different cotton growing districts across the 8 major cotton growing state in Public-Private Partnership (PPP) mode. The project covered 65 districts across eight states, spanning 14,741.65 hectares and involving 17,251 farmers. Technological interventions such as HDPS (5777.12 ha and 5664 farmers), closer planting (7018.15 ha and 8937 farmers), and ELS cotton (1943.2 ha and 2650 farmers) were demonstrated. The outreach activities included 280 farmer trainings (21152 farmers), 145 field days (12453 farmers), 43 workshops (5180 farmers), and 13 Kisan Melas (10034 farmers). The project significantly increased cotton productivity in HDPS (50.71 to 73.00 %), CS (19.02 to70.29%), and ELS (11.64-31.44%) over farmer's practice.

3.15 Project Name: Impact of denser planting systems on cotton productivity and farmers income under rainfed conditions in India

PI: Jaya Kumaravaradan, R

Co-PIs: Y.G. Prasad, Ramkrushna, G.I., A.S. Tayade, K. Sankaranarayanan

Importance of the study: ICAR-CICR promotes HDPS and Closer Spacing in cotton cultivation across India to improve cotton productivity. Hence, it is necessary to study the adoption patterns of these technologies among the farmers to reveal the advantages and constraints in adoption and to determinehow far these two technologies have increased the productivity of cotton and income of farmers.

Salient findings

Traditionally, rainfed cotton farmers in the Siddipet district of Telangana adopted a Square Planting System (SPS) with a spacing of 90×90 cm, sowing 2 seeds per hill, resulting in 10,000 plants/acre and a yield of 8 q/acre. During the kharif 2024 season, 266 rainfed cotton farmers adopted HDPS. A survey was conducted among 50 respondents. HDPS adoption tripled the seed rate from 2 packets to 6 packets per acre. As a result, expenditure on seed increased by Rs.3456 and on labour for sowing by Rs.600 (Table 3.15.1). At the same time, the expenditure on row marking by bullocks decreased by Rs.1000, as there is no need for two-way marking in HDPS as in SPS. The number of bullock-drawn hoeing was halved from 8 times to 4 times as there is no scope for two-way hoeing in HDPS as done in SPS. This saved Rs.4000. Since PGR must be applied in HDPS to regulate vegetative growth, farmers incurred an additional expenditure of Rs.1200. On average, HDPS increased the yield of rainfed cotton by 4 q/acre from 8 q to 12 q. In order to harvest the additional 50% seed cotton yield, farmers must incur an additional expenditure of Rs.6000 on labour picking. Although farmers incurred an additional cost of Rs.11, 256/acre in HDPS, this reduced the cost by Rs.5000 and resulted in an increased income of Rs.30, 084. Thus, farmers have realized an additional return of more than Rs.3.00 for every rupee of added cost incurred in shifting from SPS to HDPS.

Interaction with a HDPS farmer

Table 3.15.1. Partial budgeting of shifting from SPS to HDPS in rainfed cotton cultivation (Rs./acre)

Item	Added cost (1)	Reduced cost (2)	Added return (3)
Seed	3,456	-	-
Labour cost for sowing	600	-	-
Row marking	-	1,000	-
Hoeing	-	4,000	-
PGR	1,200	-	-
Labour for harvesting	6,000	-	-
Yield	-	-	30,084
Total	11,256	5,000	30,084
Incremental income (4) = [(2)+(3)] - (1)	23,828		
MBCR (5) = [(2)+(3)]/(1)	3.12		

3.16 Project Name: Crop-weed interactions under ambient and elevated CO2

PI : Dr. P. Nalayini,

Co-PI: Dr AH. Prakash, Dr. M. Amutha, Dr. K. Sankaranarayanan

Importance of the Study : The global atmospheric CO_2 is already at 419 ppm and is projected to cross 550 and 700 ppm, respectively, by the middle and end of the twenty first century. Nitrogen management is cumbersome because of its high reactivity and mobility in soil. To avoid economic losses and environmental risks, N fertilizers should be utilized more efficiently in agriculture. Enhanced biomass and crop yield under eCO2 results in inadequate N availability to sustain growth and needs to be addressed through integrated approach like split application of N, use of biologically fixed N (via legume N_2 fixation) by growing leguminous in situ cover crops, and direct application of N to crop through foliar nutrition for easy absorption by cotton crop. In the current climate change scenario, the sequestration of carbon in soils is imperative to increase the soil carbon pool and combat GHG emission.

Salient Findings

The open-top chamber (OTC) experiment was conducted at CICR regional station, Coimbatore in RBD with six treatments viz, soil application of recommended dose of N (RDN) at 0, 30, 60 and, 90 DAS under elevated CO_2 (eCO_2), Integrated Nitrogen Management (INM) under eCO_2 with two splits as soil application at 0, 30 DAS with sun hemp grown in situ and incorporated (45-60 DAS) plus foliar N (as nano urea at 60 and 90 DAS). These two soils and INM treatments were compared under ambient OTC conditions and in an open field. The cotton crop cultivar, Suraksha responded positively to e.CO2 (550 ppm), with an average yield enhancement of 24 % over ambient. The INM under eCO_2 recorded the highest (3639 kg/ha) seed cotton yield (Fig 3.16.1) and was on par with soil application under eCO_2. The enhanced dry matter accumulation of cotton crop under eCO2 is evidenced from the crop growth rate of 17.2 - 20.9 g/m2 /day during 90-120 DAS as against 9.9–10.5 g/m2 /day under ambient condition. The growth of sunnhemp also was proliferous due to eCO2 and accumulated the highest dry matter of 8.51 t/ha as against 4.7 t/ha under ambient. The sunnhemp grown under eCO_2 produced more nodules than under ambient conditions. Soil under eCO_2 could sequester more carbon than ambient soils, as revealed by the higher soil organic carbon content with eCO_2. The organic carbon in soil was higher (0.63 %) under integrated N management than under soil application (0.50%). The N content in cotton plants on 95 DAS was 1.75 % under soil application and improved to 2.25 % in INM under eCO_2(Table 3.16.1); thus, the N dilution effect could be addressed with INM under e CO_2. The INM recorded higher soil available N in post-harvest soil besides enhanced seed cotton yield and hence advocated as a sustainable practice for cotton crops for yield enhancement, soil, and environmental health. Pest observation revealed that the aphids population was more under INM conditions, whereas the thrips were more under soil application.

Table 3.16.1 Crop growth rate, plant N, root CEC, soil organic C and available N due to INM and e. CO_2

Treatments	CGR (g/m^2 /day)	% Nitrogen in cotton (95 DAS)	Root CEC (m.e/100g roots)	% organic carbon in soil	Soil Available N(kg/ha)
RDN soil application (eCO_2) under OTC	17.2	1.75	11.12	0.50	177.8

Treatments	CGR (g/m^2 /day)	% Nitrogen in cotton (95 DAS)	Root CEC (m.e/100g roots)	% organic carbon in soil	Soil Available N(kg/ha)
INM (e CO_2 under OTC	20.9	2.25	14.63	0.63	189.7
RDN as soil application (Ambient) under OTC	9.9	2.28	10.73	0.40	177.3
INM(Ambient)under OTC	10.5	2.31	12.87	0.53	186.7
RDN as soil application (open field)	9.1	2.11	10.34	0.44	174.7
INM (open field)	13.2	2.18	12.87	0.52	186.2
CD (P= 0.05)	7.02	0.49	1.97	0.097	NS

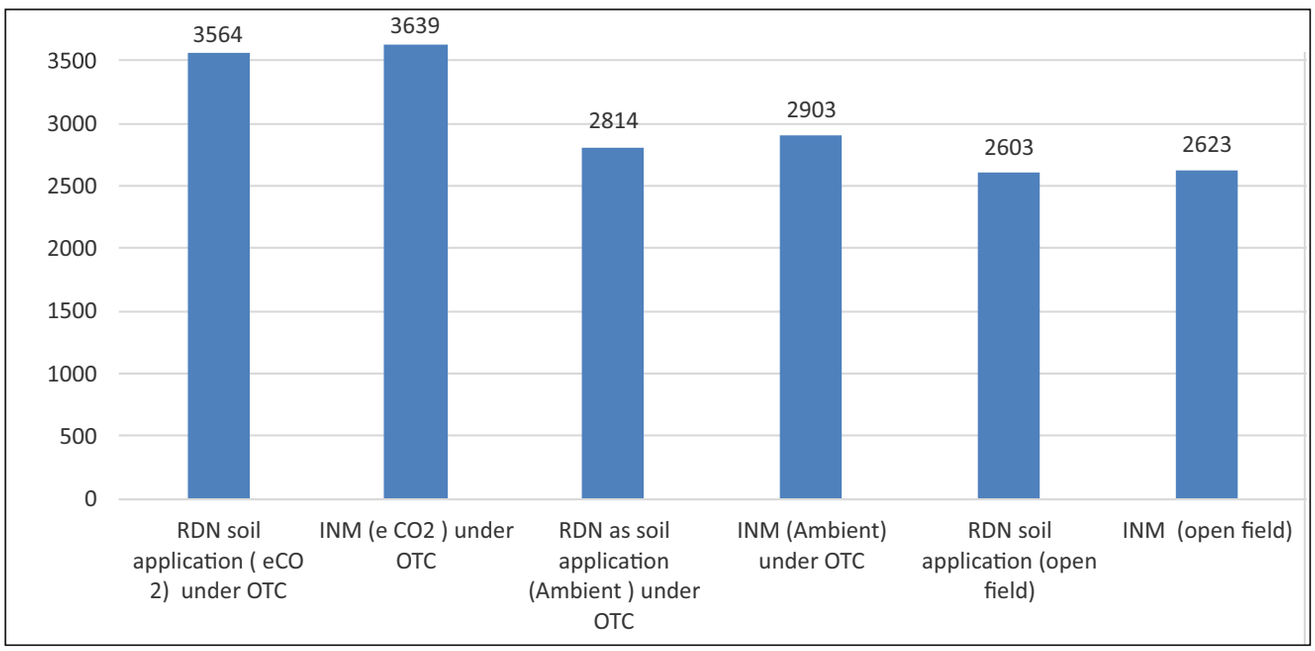


Fig 3.16.1 Seed cotton yield due to INM and eCO_2

Fig.3.16.2 Cotton with sunhemp under eCO_2

Fig.3.16.3 Efficient weed control under IWM (eCO_2)

Fig.3.16.4 Sunnhemp with clusters of nodules under eCO_2

Fig.3.16.5 Integrated Nitrogen Management under eCO_2

3.17 Project Name: Evaluating agro techniques for overcoming weather aberration of drought and water logging in cotton

PI: K. Sankaranarayanan

Co PIs: P. Valarmathi, J.H. Meshram

Importance of the study: Climate change has changed the rainfall pattern dramatically. The irregular and erratic distribution of rainfall is the result of climate change, resulting in wet and dry spells. Excess rainfall leads to water stagnation; however, in low-laying areas, drainage is not possible, leading to continuous water logging, which affects crop growth. Excess water in the rooting zone of plants due to flooding or seasonal heavy rainfall negatively affects their growth and development.

Salient Findings

- Drone spray using spray fluid @ 50 l/ha with salicylic acid @ 0.5mM single spray on the 5th Day after water logging and KNO3 @ 2% on the 8th day after water logging and application of nitrogen and potassium each @ 20 kg/ha (after drainage) with ridges and furrow land configuration performed better, which was on par with the same package with drone spray using spray fluid @ 37.5 l/ha
- Water logging of continuous 15 days (Fig.3.17.1) significantly reduced 22.8 percent mean seed cotton yield (1290 kg/ha) as compared to control (1671 kg/ha)
- Less seed cotton yield reduction was reported with Sunanda by 15 days of water logging compared with other genotypes
- Plots receiving drone spray, treatments with @ 0.5mM single spray on the 5th Day after water logging and KNO3 @ 2% on the 8th day after water logging with application of nitrogen and potassium each @ 20 kg/ha (after drainage) with ridges and furrow land configuration recorded less PDI for ALS is 8.4 (disease grade 1), Cercospora leaf spot with PDI of 4.3 (disease grade 1) and boll rot with 4.1 PDI (disease grade 1), higher total gossypol (0.27%), total soluble sugar (2.33%) and phenolics (1.23%) and less number of Jassid and jassid injury index .

Fig. No. 3.17.1 Field View of Water logging Stress

3.18 Project Name: Sustainable Intensification of Extra Long Staple Cotton Production in South Zone

PI: R. Raja

Importance of the study

Farmers preference of cultivating, high-yielding intra-hirsutum Bt Hybrids in recent times has marginalized the cultivation of other cotton species, including extra long staple (ELS) cotton, in the Subcontinent. Despite of ELS cotton's considerable economic significance in the domestic and international markets, the low productivity of pure-line barbadense cultivars coupled with relatively higher susceptibility to pests and diseases and limited availability of H × B Bt hybrids led to a huge shortage in the domestic production of ELS cotton in our country. Hence, there is a felt need to increase the production and productivity of domestic ELS cotton through agronomic management practices in a sustainable manner in order to make it remunerative to ELS farmers as well as to increase the availability of ELS cotton fibre to the domestic textile industry. Field experiments are being conducted at the ICAR-CICR, Regional Station, Coimbatore, to study the effect of increased plant density and growth regulator use on the productivity of ELS cotton under the drip fertigation system.

Salient Findings

Improving ELS Cotton productivity through increased plant density, Canopy management and drip fertigation system

Increased plant density (90 x 15 cm; 74,074 plants/ ha) combined with drip fertigation and canopy management (Mepiquat Chloride application @ 60 ppm when height to node ratio (HNR) reached 1.5 followed by 30 ppm twice at 15 days interval after first spray) significantly enhanced the seed cotton yield of Suvin (1361 kg/ha) vis-a-vis farmers' practice (90 x 60 cm; 18,518 plants/ha; 874 kg/ha). Similarly, in the case of CICR B Cot 45, increased plant density (90 x 15cm; 74,074 plants/ ha) combined with drip fertigation and canopy management has produced higher seed cotton yield (1152 kg/ha) compared to farmers' practices (90 x 60 cm; 18,518 plants/ha; 832 kg/ha). The yield increase at higher plant density (90 x 15cm) was attributed to a significantly higher number of bolls per unit area vis-à-vis farmers practice (Table 3.18.1). Yield enhancement through increased plant density and plant growth regulator-based canopy management in G. barbadense genotypes indicated the possibility of machine harvesting of ELS cotton in near future.

Technology demonstration in farmer's field

The potential for yield enhancement through increased plant density (90 x 30 cm; 37,037 plants/ ha) combined with canopy management (Mepiquat Chloride application @ 60 ppm when height to node ratio (HNR) reached 1.5 followed by 30 ppm twice at 15 days interval after first spray) was demonstrated using the Suraksha variety at farmer's field (Sh. M. Manickam and Sh. V. Ponnusamy) at Kallampalayam village in Coimbatore

during kharif 2023 season. Adoption of the technology helped Sh. M. Manickam and Sh. V. Ponnusamy to achieve seed cotton yields of 27.7 and 34.3 q/ha, respectively.

Table 3.18.1 Effect of plant density, canopy management and drip fertigation on seed cotton yield of ELS varieties during *Kharif* 2023

Treatment	Plant height (cm) at 150 DAS		No. of bolls m^{-2} at harvest		Boll weight (g)		Seed cotton yield (kg ha^{-1})	
	Suvin	B Cot 45	Suvin	B Cot 45	Suvin	B Cot 45	Suvin	B Cot 45
T_1: 90 × 60 cm + Fertigation	103.5	93.2	23.7	17.2	2.7	2.3	874	832
T_2: 90 ×30 cm + Fertigation	98.1	96.9	40.5	48.1	2.9	2.9	1191	981
T_3: 90 × 15 cm + Fertigation	96.9	111.9	89.4	72.1	2.8	2.6	1361	1152
T_4: 120 × 25cm + Fertigation	90	93.9	40.7	54.4	2.8	2.2	713	851
T_5: 120 × 15 cm + Fertigation	86.4	94.4	63.7	79.3	3.1	2.5	725	700
T_6: 120 × 10 cm + Fertigation	84.4	86.5	83.3	87.1	2.6	2.3	813	863
T_7: Farmer's practice (90 × 60 cm in R & F)	112.1	109	29.9	42	3.2	2.1	690	534
S Ed	11.23	7.81	14.68	11.44	0.38	0.54	273.6	237.8
CD (P=0.05)	NS	NS	31.99	24.92	NS	NS	NS	NS

3.19 Project Name: Active Optical Sensors based Yield Prediction in Cotton and Crop Canopy Management using Unmanned Aerial System

PI: R. Raja

Co-PIs: D Kanjana and T. Arumuganathan, PS (FMP), ICAR-SBI, Coimbatore

Importance of the study: The advent of Unmanned Aerial Vehicle (UAV) technology combined with image data analytics provides promising precision agriculture solutions like creation of spatial maps of fields, operational monitoring of crop conditions, evaluation of germination, spraying of agrochemicals, and prediction of crop yields, etc. An attempt was made (a) to use the vegetative indices derived from drone-based multispectral imaging for seed cotton yield prediction and (b) to evaluate the usefulness of chemical spraying UAV for application of plant growth regulating chemical like mepiquat chloride (MC) for canopy management in cotton under HDPS.

Salient Findings

The multispectral images obtained from gradient level nitrogen experimental plots using a Mica Sense Red Edge multispectral camera mounted on a DJI Inspire-I drone and a DJI Phantom 4 Multispectral imaging system during kharif seasons were processed using Agisoft Metashape Professional Software, and vegetation indices like Normalized Difference Vegetation Index (NDVI) and Normalized Difference Red Edge Index (NDRE), were worked out. QGIS 3.18 software was used to extract plot-wise NDVI and NDRE data in tabular format. A seed cotton yield prediction model was developed using multiple regression analysis:

$$YP = -510.92 + 9551.34\,X1 + 10614.17\,X2$$

where, YP = Predicted yield; X1= NDRE at 60 days after emergence and X2= NDRE at 90 days after emergence. The derived model exhibited a coefficient of determination (R2) value of 0.82 and coefficient of multiple correlation (R) value of 0.91, indicating a very strong correlation between the predicted and observed seed cotton yields.

Cotton Canopy Management using an Unmanned Aerial System

An attempt was made to evaluate MC application for canopy management in cotton using chemical spraying UAV in cotton cv Suraksha planted with 90 x 10cm spacing during kharif 2023 at ICAR-CICR Regional Station, Coimbatore. The treatments involved were application of the recommended dose of MC on an a.i. basis using a Knapsack sprayer (T1) and Boom sprayer (T2- Fig 3.19.1), respectively, application of the recommended dose of MC on an a.i. basis mixed in 20 (Fig 3.19.2) and 30 litre spray fluid (water)/ acre, respectively, using chemical spraying UAV (T3 & T4), and no MC spray (Control - T5). The recommended dose of MC application of 60 ppm when the height-to-node ratio reaches 1.5 followed by 30 ppm twice at 15-day intervals (need based) after the first spray. The results indicated that application of the recommended dose of MC mixed in 20 litre spray fluid/acre using chemical spraying UAV produced an optimal plant architecture with an 87.9 cm plant height, 17 sympodial branches, 71.7 bolls m-2, and 3.5g boll weight at harvest. No significant difference in seed cotton yield was observed among the treatment groups. The results indicate that the UAV system can be used in cotton for

the application of a chemical topping agent under HDPS for canopy management.

Fig no. 3.19.1 : Application of mepiquat chloride using Boom sprayer

Fig no. 3.19.2 : Application of mepiquat chloride using chemical spraying drone

3.20 Project Name: Effect of longterm application of organic and inorganic sources of nutrients on continuous cultivation of Bt and non Bt cotton cropping system under irrigated conditions

PI: D. Kanjana

Co PI: K. Sankaranarayanan, Amarpreet Singh

Importance of the study: Nutrient balance study has significant role in adopting appropriate fertilizer management strategies for sustaining the production and productivity of cotton-maize cropping system under irrigated conditions.

Salient Findings

Soil nutrient balance was calculated after five years continuous adoption of cottonmaize cropping system under irrigated conditions. Among the cotton–maize cropping systems, the expected nutrient balance (ENB) of all major nutrients like N, P, and K, was positive, which ranged from 211.7 to 278.2 kg ha-1 of N, 44.9 to 62.0 kg ha-1 of P and 487.1 to 752.3 kg ha-1 of K but the apparent nutrient balance (ANB) of N (-21.8 to -88.2 kg ha-1) and P (-14.3 to -24.2 kg ha-1) was negative, except for K (143.7 to 351.3 kg ha-1). This means the availability of N and P nutrient content in the soil was decreased after completion of the cotton – maize cropping sequence due to higher yields and biomass of cotton and maize crops, and the nutrient uptake rate was also higher under continuous cotton – maize cropping system.

Among the different fertilization, the expected nitrogen balance showed a positive sign (124.5 to 353.6 kg ha-1) but the apparent nitrogen balance was negative (-72.3 to -151.6 kg ha-1) except control (51.4 kg ha-1) and the higher negative value was noticed in organic source of nutrients application (-151.6 kg ha-1) compared to other treatments. This indicates that total nitrogen uptake by cotton and maize crop was lesser than nutrient applied in organic nutrient treatments. Regarding the phosphorous balance in the soil, a positive sign was present in the expected phosphorus balance for all the treatments (60.8 to 78.2 kg ha-1) except control (-10.1 kg ha-1) and the negative sign was present in the apparent phosphorus balance for all the treatments (-23.4 to - 37.8 kg ha-1) except control (33.5 kg ha-1). In the control treatment, the expected phosphorus balance was negative because there was no external source of phosphorus application, but the positive clear phosphorus balance might be due to a negative expected P balance.

The potassium balance under the cotton–maize cropping system was positive for both the expected (544.7 to 684.5 kg ha-1) and apparent balance (149.5 to 337.4kg ha-1) but the only difference was the reduction of apparent potassium balance due to the higher available potassium nutrient content of the soil.

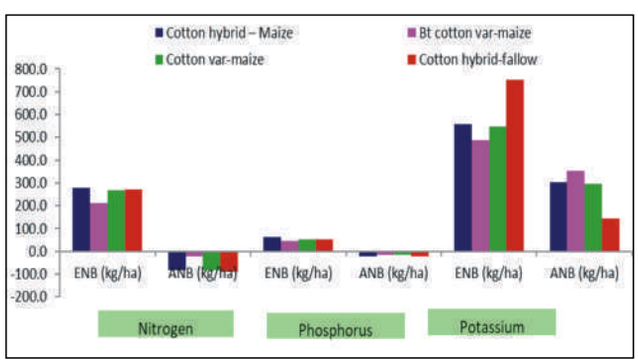


Fig 3.20.1 Expected nutrient balance (ENB) and Apparent nutrient balance (ANB) under different types of cotton–maize cropping system

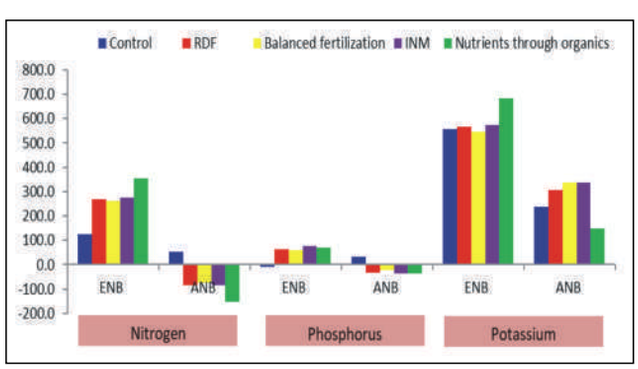


Fig 3.20.2. Expected nutrient balance (ENB) and Apparent nutrient balance (ANB) of cotton–maize cropping system under different sources of nutrients

3.21 Project Name: Formulation of customized fertilizers for cotton

PI: D. Kanjana

Co PI: R. Raja, Usha rani

Importance of the study: To achieve balanced nutrition, enhance fertilizer use efficiency, realize the full yield potential in crops, and sustain farm profitability under different soil conditions, custom made fertilizers ie., customized fertilizers / multi nutrient-carriers are needed by cotton growers.

Salient Findings

A smooth and uniform surfaced fertilizer pellet was produced based on a soil test crop response approach for basal fertilizer application that contained macro, secondary, and micronutrients along with microorganisms. Similarly, smooth and glossy-surfaced fertilizer pellets were developed for top dressing application. Good compatibility was found between the binding material and combined form of macro, secondary, and micronutrients along with bio fertilizer by observing the positive impact on cotton growth and yield parameters. Seed cotton yield increased by 24.6 per cent due to application of fertilizer in pellet form based on the STCR approach as compared to normally recommended fertilizer in powder form.

3.22 Project Name Efficacy evaluation of nano-ZnO as nano-fertilizer in cotton (ICAR –CIRCOT Project)

PI: N. Vigneshwaran, Principal Scientist (CIRCOT)

Co PI: D. Kanjana

Importance of the study: The most essential micronutrient for cotton production is zinc, which can be used to increase cotton productivity by enhancing the efficiency of zinc use via seed treatment and foliar application rather than through soil. Hence, the newly synthesized (ICAR-CIRCOT) ZnO NP's and their optimum dosage will be evaluated in cotton under field experiments along with commonly used zinc fertilizers like zinc sulphate and chelated Zn.

Salient Findings

The highest number of sympodial branches per plant (31.3), number of opened bolls per plant (34.3), boll weight (3.5 g/boll), and seed cotton yield (3582 kg/ha) were achieved by foliar application of chelated Zn (Zn EDTA) @ 0.2 % at two different critical stages of cotton (45 & 60 DAS), followed by generally sprayed ZnSO4 @ 0.5 %. Similarly, seed treatment of ZnO NP's @ 20 ppm and combined application of seed treatment of ZnO NP's @ 20 ppm + Foliar spray of ZnO NP's @ 200 ppm at two stages (45 & 60 DAS) significantly increased the seed cotton yield (2481 and 2422 kg/ha respectively) which was more or less on par with generally sprayed ZnSO4 @ 0.5 % (2735 kg/ha) and Nano Zn Suspension @ 200 ppm (2197 kg/ha). Performance of seed treatment of ZnO NP's @ 20 ppm and combination of seed treatment of ZnO NP's @ 20 ppm + Foliar spray of ZnO NP's @ 200 ppm were almost equal with foliar application of ZnSO4 @ 0.5 % and Zn EDTA@ 0.2 % on improving the shoot parameters viz., plant height, leaf area index, SPAD chlorophyll value, shoot fresh weight, root parameters like root length, root volume and root fresh weight, physiological parameters viz., total chlorophyll, total nitrogen, nitrate reductase activity and biochemical parameters viz., total phenol and total soluble protein content and yield parameters of cotton. The seed treatment of ZnO nanoparticle @ 20 ppm was more efficient for increasing the cotton productivity as compared to other Zn sources and application methods.

Table 3.22.1 : Effect of Nano Zn on seed cotton yield

T.No	Treatments	No. of sympodial branches /plant	No. of Opened bolls /plant	Boll wt (g/boll)	Seed cotton yield (kg/ha)
T_1	Control (Water spray)	23.0	21.9	2.5	1637
T_2	Seed treatment of ZnO NP's @ 20 ppm	26.0	24.7	3.4	2481
T_3	Seed treatment of ZnO NP's @ 20 ppm + Foliar application of ZnO NP's @ 200 ppm at two stages (45 & 60 DAS)	27.6	27.3	3.0	2422
T_4	Foliar application of Nano Zn Suspension@ 200 ppm (45 & 60 DAS)	24.3	23.7	3.1	2197
T_5	Foliar application of $ZnSO_4$ @ 0.5 % (45 & 60 DAS)	30.6	30.8	3.0	2735
T_6	Foliar application of chelated Zn (Zn EDTA) @ 0.2 % (45 & 60 DAS)	31.3	34.3	3.5	3582
	CD (0.05)	**NS**	**NS**	**0.49***	**1043.2***

3.23 Project Name: Development of a nutrient and plant hormone- enriched foliar formulation for cotton

PI: J. Annie Sheeba

Co-PIs: D. Kanjana

Importance of the study: A large percentage (66 to 75 %) of the yield is produced on first-position fruiting sites. Hence, the retention and maturation of these bolls are critical. The use of PGRs may increase boll retention at the first fruiting site, enhance and accelerate crop

maturity, promote an earlier harvest, improve lint quality, and potentially alter membrane properties associated with enhanced tolerance to deviation in temperature. With this background, this project aims to develop a foliar formulation of nutrients and hormones that combine nutrients and plant hormones.

Salient Findings:

Fifteen treatment combinations were tested in cotton variety to determine the effective combination of hormones and nutrients for improving the productivity of cotton variety Suraksha under field conditions. Among the different treatments, higher N and chlorophyll contents were recorded by T11: Urea (1 %) + MAP (0.5 %) + KCl (0.5%) + Mg SO4 (0.5 %)+ Ferrous Sulphate (0.25 %) + Zinc Sulphate (0.25 %) + Boric Acid (0.1 %) +NAA (20 ppm) + CuSO4 (0.05 %) + Sodium molybdate (0.01%) + Na-EDTA 0.02 mM + Salicylic acid (50 ppm) + Ascorbic acid (100 ppm) +Kinetin (20 ppm) + APSA 80. Higher yield of 2114 kg/ha was recorded by a combination of DAP (1% , micronutrients, and hormones + Triton X 100.

3.24 Project Name: Identification and characterization of germplasm lines and advanced breeding lines with higher photo synthetic efficiency and harvest index for better yield in cotton

PI: J. Annie Sheeba

Co-PIs: D. Kanjana

Importance of the study: The source sink relationship between main stem leaf, subtending leaf and developing boll plays an important role in determining the yield of cotton, advanced breeding lines with high photosynthetic efficiency and harvest index helps in increasing the productivity of cotton.

Salient Findings:

In order to assess the source-sink relationship in cotton, an experiment was conducted to assess the effect of removal of subtending leaves at flowering and 15, 30, and 45 DAF on boll weight and other quality parameters of Advanced Breeding Lines (ABL) of cotton. The results revealed that the influence of subtending leaf removal on boll weight is varied between Advanced Breeding Lines. The boll weights of Suraksha and 15 7-6-9-4 were least affected by subtending leaf removal. In another experiment, the main stem leaves were removed to assess the cotton yield. The removal of main stem leaves at 45 DAS did not affect the yield of Suraksha, but did affect the yield of Suvin and RCH659.

3.25 Project Name: Efficient resource allocation patterns for cotton farms in Tamilnadu – Fuzzy goal programming approach

PI: Isabella Agarwal

Co PI: R. Vasanthi, TNAU, Coimbatore

Importance of the Study: A critical examination from a scientific point of view is necessary to evolve optimal agricultural production patterns. Certainly, there is need to change the crop cafeteria to suit the ecology and the consumers' preference before initiating a shift in the crop. An effort was made in this study to suggest optimum cropping plans with minimum cost for cotton-based cropping systems in Tamil Nadu, where cotton is the main crop along with other subsidiary crops. Plans are being developed for average small, medium, and large farms, with the objective of minimization of the cost of cultivation from the available resources of land, labour (male, female, bullock pair), irrigation and capital. This study is based on farmers' data on cost of cultivation of prevalent crops in the region. It would be worthwhile to evaluate the relationship between acreage and value and use this to plan future actions and make the most of agricultural assets, outputs and markets.

Salient Findings

- Eight districts from five agroclimatic zones were selected for the study. A two-way classification was performed by considering farm size and irrigation status. During 2023-24, Coimbatore district was taken up for the study. Through purposive stratified sampling, 68 rainfed farmers, 32 partially irrigated farmers, and 20 irrigated farmers were considered for the study.
- Rainfed cotton in the optimal plan derived through the fuzzy goal programming model has registered an increase of 101.92%, 53.09%area in small and medium rainfed farms, respectively, over the existing plan.
- Among the large rainfed farms, the rainfed cotton has registered an increase of 28.75% and 51.13%, respectively, among the irrigated farms.
- Cotton, Bhendi, Chillies, Brinjal, Maize, Sorghum, Sugarcane, Tomato, Banana were the major crops grown in the sample blocks under the study in Coimbatore district under irrigated conditions and Cotton, Sorghum, Blackgram, Greengram, Redgram, Groundnut, Gingelly, and Bengal gram under rainfed conditions.
- The optimal plan derived from the fuzzy goal programming model registered an increase in the area under rainfed and irrigated cotton to the tune of 18.95% and 24.63 %, respectively.
- At the block level, an increase of 27 to 36% under rainfed conditions and 6.1 to 65 % of cotton area underirrigated conditions and at the regional level as a whole, 18.95 %area under the rainfed cotton and 24.63 %area increase under irrigated conditions were derived from the optimal plan through fuzzy goal programming approach.
- Among the blocks under study, there is a possibility of enhancing the cotton area under irrigated and rained conditions, except in Annur, where an irrigated cotton area is not suggested as per the optimal plan.

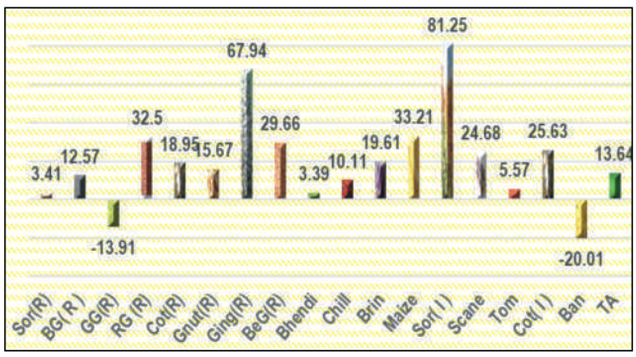


Fig 3.25.1 Change in allocation of crop area under optimal plan Vs Existing Plan (%)

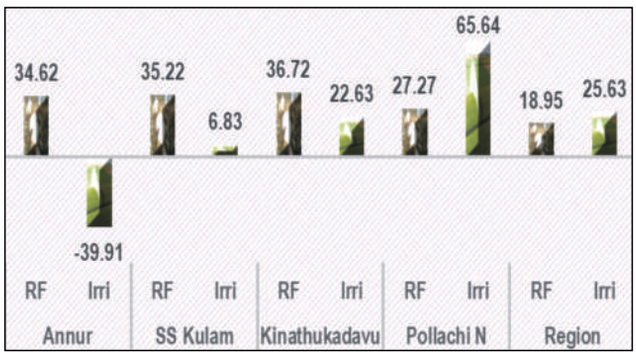


Fig 3.25.2. Block-wise allocation of cotton area and profitability under optimal Vs Existing Plan (%)

3.26 Project Name: Awareness and extension services on best farm practices for cotton farmers to improve quality, yield and sustainability

PI: Y. G. Prasad (Project Leader), S. Usha Rani (PI)

Co-PIs: A. Sampath kumar, A.H. Prakash, M. Sabesh, Arjun S Tayade, G I Ramakrushna, A Manikandan, Jaya Kumara Varadan, S.K. Sain and Amarpreet Singh

Importance of the Study: Low cotton production disrupted the supply chain and led to an unprecedented increase in the sale price of raw cotton and its cascading adverse effect on the cotton value chain. Several location-specific best practices and technologies and sound advisories/extension services are available with the research and development system that should reach a large number of smallholder cotton farmers in the country. Efforts to transform climate-sensitive cotton production to a climate-resilient production system is an immediate priority to prevent the recurrence of such disruption in cotton supply and make available quality cotton for domestic consumption by the cotton-based textile sector. Hence, an attempt has been made as a pilot study sponsored by Cotton Corporation of India with a budget outlay of 2.53 crore Indian rupees to improve the yield sustainability through demonstration of the Best Farm Practices (BFPs), establishment of action learning field sites and field demonstrations with appropriate extension backstopping by Best Extension Practices (BEPs) through the development of Information Education and Communication (IEC) products and dissemination through personalized extension services through ICAR-CICR, ICAR-AICRP centres. ICAR-CIRCOT, ICAR-CIAE and CCI.

Salient findings

To demonstrate the BFPs, a total of 421 demonstrations on BFPs were conducted in 632 farmers' fields on CLCuV-tolerant Bt hybrids, drip fertigation, desi varieties/hybrids, crop establishment, BFPs on processing, IPM, IDM, H x B ELS cotton varieties/hybrids, High Density Planting System, Intercropping, Nutrient Expert, Poly mulching + canopy management, Integrated Crop Management, and Organic Cotton. A total of 81 stakeholder consultation and interface meetings were conducted with 3507 beneficiaries in convergence mode, involving various stakeholders. 13731 farmers benefited from the training programs (178) conducted in 11 cotton-growing states on cotton production technologies. 24 Special programs on cotton post-harvest technologies were organized by ICAR-CIRCOT, Mumbai, and ICAR-CIAE, Bhopal to 1184 farmers. 14 Farm Field Schools (FFS) and one FFS on All India Radio were conducted with 93 technical sessions for 520 beneficiaries. To develop IEC products and disseminate them to farmers and stakeholders, a total of 135 knowledge products in the form of leaflets, folders, pamphlets, booklets, technical bulletins, technical brochures, books, Gingles, podcasts, and 31 video clippings were developed in English and vernacular languages. To facilitate personalized extension services, 517 contents were developed for sending voice advisories on cotton. A total of 9713016 voice advisories were sent to 587582 beneficiaries during the project period. Eighty-two success stories were documented for replication of the project activities shortly in the non-project areas. Diffusion of BFP in cotton using BEP in all three agroclimatic zones sustainably increased the seed cotton yield from 225 kg to 2100 kg per hectare in a sustainable manner and brought desirable changes in the knowledge augmentation of cotton growers.

Table 3.26.1 Details on state/district-wise technologies and BFPs demonstrated and their performance in terms of yield

S. No	State	Centres	Districts	Area ha	Technologies demonstrated (number of demonstrations)	Performance of the technologies in terms ofyield		Yield advantage in terms of kg/ha percentage in parenthesis
						Average SCY in the Demonstration	Average SCY obtained with local practices	
1	Punjab	PAU, Faridkot & Bathinda and CCI	Bathinda, Faridkot	35	CLCuV toleran t Bt Hybrids (35)	1825	1600	225 (14.06)
2	Haryana	ICAR-CICR RS Sirsa, ICAR-CIRCOT, Mumbai & CCI	Sirsa, Hisar	35	Desi varieties / hybrids (15)	2470	1710	760 (44.44)
					Drip Fertigation (5)	2310	1160	1150 (99.13)
					Crop establishment (gap filling using the existing moisture) (10)	1930	980	950 (96.93)
3	Rajasthan	MPUAT, Banswara	Banswara	10	Integrated pest and disease management (10)	2953	2286	667 (29.17)
4	Gujarat	NAU, Surat and CCI	Surat	09	HDPS (6)	1965	1700	265 (14.58)
					Drip Fertigation (3)	2505	1700	805 (47.35)
		NAU, Bharuch	Bharuch	08	HDPS (6)	2371	1870	501 (26.79)
					Drip Fertigation (2)	3415	1870	1545(82.62)
5	Maharashtra	ICAR-CICR, Nagpur ICAR-CIRCOT, Mumbai & CCI	Nagpur, Panjari and Wardha	25	HDPS (10)	2135	1450	685 (47.24)
					Intercropping (5)	1580	1385	195 (14.07)
					Nutrient Expert (5)	3022	2545	477 (18.74)
				12	Poly Mulching+ canopy management (12)	2704	2131	573 (26.88)
		PDKV, Akola & CCI	Akola	20	HDPS (12)	2578	1954	678 (34.69)
					ICM (8)	2297	1924	373 (19.38)
		VNMKV, Nanded & CCI	Nanded	20	HDPS (10)	1335	1061	274 (24.82)
					Intercropping (10)	1312	1114	198 (17.77)
6	Madhya Pradesh	JNKVV, Khandwa and CCI	Mandla, Khandwa	20	Organic Cotton (2)	1660	1115	545 (48.87)
					ELS cotton H x B (10)	1520	1165	375 (32.18)
					ICM Cotton (8)	1515	1161	354 (30.49)

S. No	State	Centres	Districts	Area ha	Technologies demonstrated (number of demonstrations)	Performance of the technologies in terms of yield		Yield advantage in terms of kg/ha percentage in parenthesis
						Average SCY in the Demonstration	Average SCY obtained with local practices	
7	Orissa	OUAT, Bhawanipatna and CCI	Kalahandi Bhawanipatna	50	ICM on Cotton (20)	1623	1366	257 (18.81)
					Intercropping (25)	1678	1423	255 (18.00)
					Organic Cotton (5)	1264	1028	236 (23.00)
8	Andhra Pradesh	ANGRAU, Guntur & CCI	Guntur	20	HDPS (20)	2667	2310	357 (14.45)
		AGNRAU, Nandyal	Nandyal	20	HDPS (20)	1750	1500	250 (16.6)
9	Telangana	PJTSAU Warangal & CCI PJTSAU, Adilabad	Warangal	15	Closer Spacing demo in medium soils (15)	2450	1900	550 (29.00)
			Adilabad	20	HDPS in light soils (10)	2125	1750	375 (21.42)
					ICM (10)	3550	1450	2100 (1.4-fold)
10	Karnataka	UAS, Dharwad & CCI	Dharwad	22	ICM in Cotton (12)	2923	2358	565 (24)
		UAS, Bangalore & CCI	Chamarajanagar	25	ELS cotton H x B (25)	1860	1602	198 (12.35)
11	Tamil Nadu	ICAR-CICR, Coimbatore & CCI ICAR-CIRCOT,	Coimbatore Virudhunagar	45	ELS cotton H x B (10)	2050	1641	409 (24.00)
					HDPS (20) Rainfed	1850	1480	370 (24.00)

3.27 Project Name: Technology impact and need assessment to address productivity, sustainability and climate change

PI: S. Usha Rani

Co-PIs: J. Annie Sheeba, M. Amutha

Importance of the study: Production, processing, technology transfer, value addition, and marketing technologies play a vital role in sustaining a nation's cotton production scenario in terms of area and production at the world level. The global cotton sector faces top three challenges related to climate change, sustainability, and productivity and the Indian cotton sector is no exception. Sustainability-related issues like usage of water, labour, agrochemicals, soil nutrients, and gender in Indian cotton cultivation and attaining sustainable development goals call for responsive cotton production in our country. Negative effects of climate change like water shortage, rise in temperature, heat waves, drought/heavy rains, insect pest outbreaks, rising ocean levels, shrinking glaciers, and loss of biodiversity impacts cotton production. Despite these challenges, Indian cotton production sectors face another major challenge, namely low productivity, which is around 500 kg lint/ha and less than the world average for many years. Assessing the impact of available technologies with Indian Cotton Research and Development sectors that significantly address all these challenges and the exact technological needs of end users to addrethese challenges in the cotton sector is need of hour. Since new technology and technological changes offer possibilities for any sector, an attempt has been planned to understand the technological needs of Indian cotton sector through the technology impact and need assessment.

Salient findings

The project has the objectives of assessing the impact created by promising technologies of ICAR-CICR and analyzing various factors responsible for full, partial, and non-adoption of these technologies and identifying the prospective and prioritized future technologies to be invented/imported for sustainable, climate-resilient, and high yielding cotton farming. During the year, the technologies available in ICAR-CICR and ICAR-AICRP on Cotton were documented using secondary sources. Technologies such as Cotton Variety `Surabhi', HDPS, IPM, and e-Kapas were selected based on the experts' opinions and reviews. Historical track of the selected technologies was documented. The data collection tools viz., semi-structured interview schedules/case study templates for assessing the adoption pattern and impact of the selected technologies, and data are being collected using the semi-constructed interview schedules and case study templates.

3.28 Project Name: Development of web-based cotton data query system

PI: M. Sabesh

Co PI: Isabella Agrwal, Sunil Mahjan

Importance of the study: Data, information, and knowledge being the pivotal elements for making decisions and policies, here there is no centralized data collation and diffusion system for cotton as a commodity. In gist, different aspects of cotton related data is maintained and scattered across different agencies. In the emerging information and communication technology, development of data query system which is web enabled could be a better option for the users to access the data across the globe.

Salient findings

During 2023-24, thirty-two data sets were collected and digitized and the necessary database was created. Further, seventeen datasets have been updated with the latest data collected. Besides, twenty-five data query modules developed were created and tested. These query modules were created using Java-script and Python-based program coding, and MySQL was used as a backend database support. Some query module and their output are described below. Query module for cotton genetic resources (Fig 3.28.1) and its output is shown in Fig 3.28.2. In another query, fertilizer consumption per hectare for cotton cultivation in Maharashtra, along with its output, is presented in Fig 3.28.3. The database includes datasets from 1996-97 to 2021-22 for all states. Similarly, the query module for export of raw cotton from India to different countries in Fig. 3.28.4 depicts the export of raw cotton from India to Bangladesh (query and output)

In addition, under this project, the ICAR-CICR website (Fig.3.28.5) and ICAR-AICRP on Cotton website (Fig 3.28.6) is being maintained and upgraded. The ICAR-CICR website was fully revamped with in-house expertise using open-source WordPress- CMS software. The site was created following the Guidelines for Indian Government Websites (GIGW). The content of the site can be read in six Indian languages along with English, and a better accessibility tool bar was incorporated. The ICAR-AICRP on Cotton website was developed using HTML codes.

Fig 3.28.1: Query module of cotton genetic resources

IC No	Plant Type	Stem Hairyness	Stem Colour	Internode Length	Leaf Size	Leaf Shape	Leaf Lobing	Leaf Colour	Leaf Surface	Leaf Glands	Days First Flowering	Bracts	Petal Colour	Petal Spot	Pollen Colour	Boll Bearing Habit	Boll Size	Boll Shape	Boll Surface	Boll Glands	Days First Boll Bursting	Boll Opening	Loculi /Boll	Seed Cottor Yield/Pl
356518	Lanky	Densely Hairy	GP	Medium	Normal	Normal	Broad	Light Green	Densely Hairy	Dense	71	Normal	Light Yellow	Absent	Cream	Normal	Medium	Elongated	SP	Dense	126	Normal	4	62.3
356519	Compact	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	70	Normal	Cream	Absent	Cream	Normal	Medium	Tapering	SP	Dense	130	Normal	4	30.3
356520	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	70	Normal	Cream	Absent	Cream	Normal	Large	Oval	SP	Dense	126	Normal	4	39.3
356522	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	74	Normal	Cream	Absent	Cream	Normal	Medium	Elongated	SP	Dense	126	Normal	4	21.3
356531	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	70	Normal	Cream	Absent	Cream	Normal	Medium	Oval	SP	Dense	126	Normal	4	45.3
356532	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	72	Normal	Cream	Absent	Cream	Normal	Medium	Elongated	SP	Dense	130	Normal	4	26.3
356541	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	62	Normal	Cream	Absent	Cream	Normal	Medium	Oval	SP	Dense	139	Normal	4	19
356549	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	62	Normal	Cream	Absent	Yellow	Normal	Medium	Round	SP	Dense	130	Normal	4	34.1
356556	Lanky	Hairy	GP	Medium	Small	Normal	Broad	Green	Hairy	Dense	65	Normal	Cream	Absent	Cream	Normal	Medium	Tapering	SP	Dense	128	Normal	4	31.3
356562	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	71	Normal	Cream	Absent	Cream	Normal	Medium	Oval	SP	Dense	136	Normal	4	35.7
356571	Lanky	Densely Hairy	GP	Medium	Normal	Normal	Broad	Light Green	Densely Hairy	Dense	64	Normal	Cream	Absent	Cream	Normal	Medium	Tapering	SP	Dense	124	Normal	4	28.9
356586	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	58	Normal	Cream	Absent	Cream	Normal	Medium	Elongated	SP	Dense	121	Normal	4	23.3
356593	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	64	Normal	Cream	Absent	Yellow	Normal	Medium	Oval	SP	Dense	129	Normal	4	19.7
356594	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	64	Normal	Cream	Absent	Yellow	Normal	Medium	Elongated	SP	Dense	129	Normal	4	16.3
356601	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	71	Normal	Light Yellow	Absent	Cream	Normal	Medium	Elongated	SP	Dense	134	Normal	4	33.7
356607	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	62	Normal	Cream	Absent	Cream	Normal	Medium	Oval	SP	Dense	129	Normal	4	31.3
356617	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	60	Normal	Cream	Absent	Yellow	Normal	Medium	Elongated	SP	Dense	134	Normal	4	22.3
356618	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	71	Normal	Cream	Absent	Yellow	Normal	Medium	Elongated	SP	Dense	124	Normal	4	44.7
356624	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	75	Normal	Cream	Absent	Cream	Normal	Medium	Conical	SP	Dense	130	Normal	4	32.3
356638	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	70	Normal	Cream	Absent	Cream	Normal	Medium	Oval	SP	Dense	133	Normal	4	38.7
356639	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	73	Normal	Cream	Absent	Yellow	Normal	Medium	Oval	SP	Dense	132	Normal	4	35.7
356649	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	70	Normal	Cream	Absent	Cream	Normal	Medium	Elongated	SP	Dense	122	Normal	4	39.3
356650	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	70	Normal	Cream	Absent	Cream	Normal	Medium	Elongated	SP	Dense	126	Normal	4	31.7
356658	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	65	Normal	Light Yellow	Absent	Cream	Normal	Medium	Oval	SP	Dense	126	Normal	4	23.7
356667	Lanky	Hairy	GP	Medium	Normal	Normal	Broad	Green	Hairy	Dense	60	Normal	Cream	Absent	Yellow	Normal	Medium	Tapering	SP	Dense	132	Normal	4	22.5

Fig 3.28.2: Output of query module of cotton genetic resources

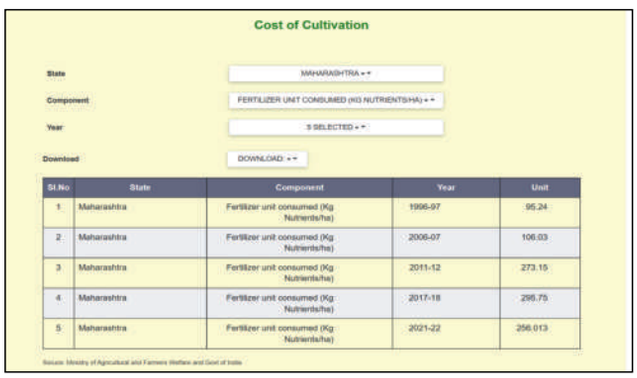


Fig 3.28.3: Fertilizer consumed in Maharashtra (query and output)

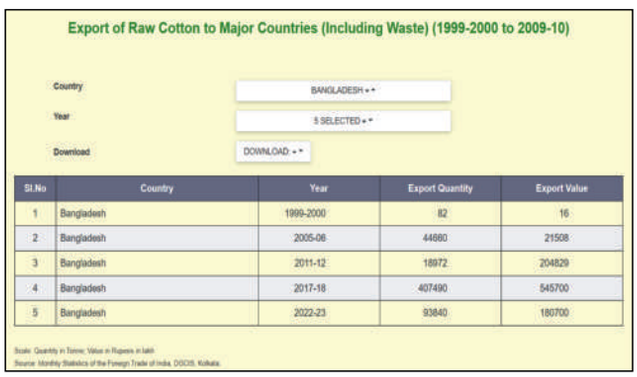


Fig 3.28.4: Export of raw cotton from India to Bangladesh (query and output)

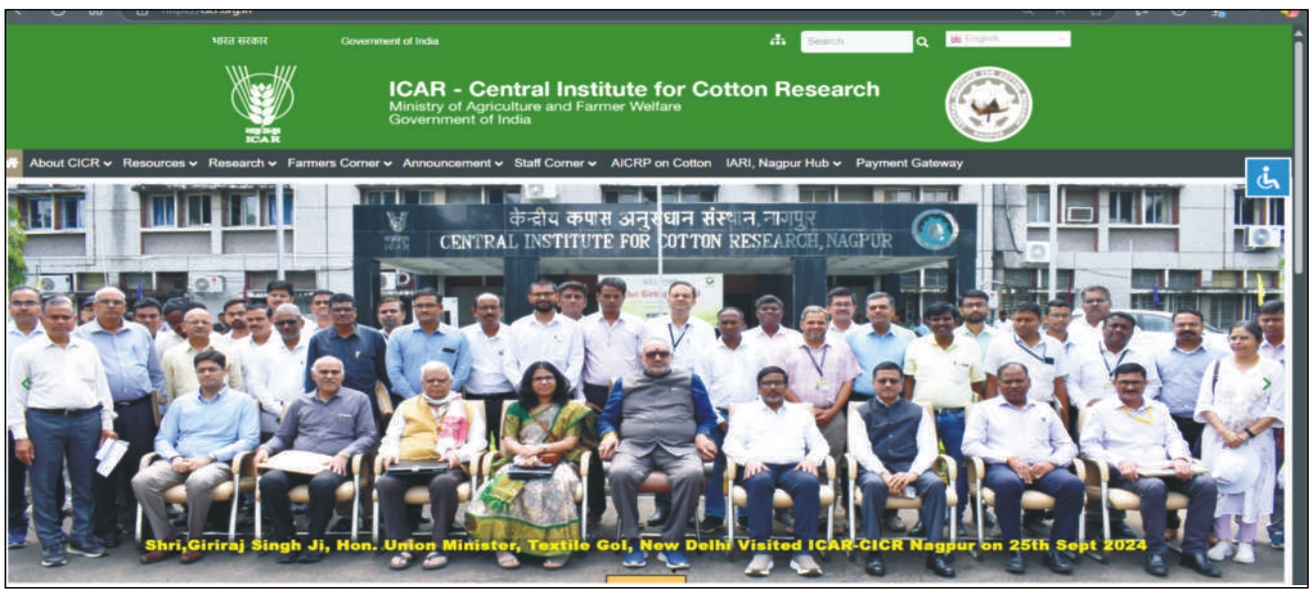


Fig 3.28.5: Home page of ICAR-CICR website (www.cicr.org.in)

Fig 3.28.6: Home page of ICAR-AICRP on Cotton website (www.aiccip.cicr.org.in)

3.29 Project Name: Conservation agriculture practices for cotton-wheat system

PI: Amarpreet Singh

The importance of the study: The study aimed to understand the effects of conservation agriculture practices under cotton-wheat cropping system with components like residue retention / incorporation and removal; zero / minimum and strip tillage; and conventional tillage practices.

Salient findings

- Under the conservation agriculture based cotton-wheat system experiment (Figure 3.29.1), seed cotton yield was significantly higher with T5-Zero Tillage for cotton sowing + Wheat residue retention + Mulcher (2,975.4 kg/ha) than with T1- Conventional tillage for cotton sowing (Farmers' practice) (2,205.4 Kg/ha) and T2- Zero tillage for cotton sowing + No wheat residue retention (removal of wheat straw) (2,008.7 kg/ha), but was at par with T3- Zero tillage for cotton sowing + Wheat residue retention (2,824.0 kg/ha).
- Wheat grain yield was significantly higher with T5-Zero tillage for wheat sowing with Happy Seeder + Cotton residue retention + Mulcher (5,172.3 Kg/ha) than with T1-Conventional tillage for wheat sowing with normal seed-cum-fertilizer drill (Farmers' practice) (4,174.0 Kg/ha) and (T-2) Zero tillage for wheat sowing with Zero till fertilizer seed drill + No Cotton residue retention (Removal of cotton stalks) (3,835.0 kg/ha), but was at par with T3-Zero Tillage for wheat sowing with Happy Seeder + Cotton residue retention (5,064.3 Kg/ha).
- The total system productivity was higher under T5-Zero Tillage for cotton sowing + Wheat residue retention + Mulcher (for cotton) and Zero Tillage for wheat sowing with Happy Seeder + With Cotton residue retention + Mulcher (for wheat), and the second best total system productivity was under T3-Zero tillage for cotton sowing + Wheat residue retention (for cotton) and Zero tillage for wheat sowing with Happy Seeder + Cotton residue retention (for wheat). etc., under north-western Indian conditions.

Figure 3.29.1 Plates1a: Mulching of cotton stalks with tractor operated Mulcher before wheat sowing; 1b: Cotton stalk shredding with tractor operated Cotton Stalk Shredder before wheat sowing; 1c: Wheat sowing with Happy Seeder in standing cotton stalks; 1d: Wheat sowing with Supper Seeder in standing cotton stalks; 1e: Happy seeder sown wheat in standing cotton stalks (after operating mulcher); 1f: Happy seeder sown wheat in standing cotton stalks (No mulcher); 1g: Supper seeder sown wheat in standing cotton stalks (incorporation of cotton stalks) at ICAR-CICR, Regional Station, Sirsa

3.30 Project Name: Effect of canopy management options on productivity of hybrid Bt cotton in North India

PI: Amarpreet Singh

The importance of the study: This study aimed to evaluate the effects of different crop canopy management options with different crop geometries on sustainable seed cotton yield.

Salient findings

- Among the plant spacing options (Factor-I), a significantly higher seed cotton yield was obtained with 67.5 x 45 cm (2,671.7 kg/ha) over the wider spacing of 67.5 x 60 cm (2,454.8 kg/ha) but was at par with the closer spacing of 67.5 x 30 cm (2,559.4 kg/ha) in North India with cotton genotype RCH 926 BG II.
- Among Factor-II (Monopodia removal, detoping & growth regulators application), significantly higher seed cotton yield was obtained with Detoping + Etheral application (2,707.5 kg/ha) than with control (2,262.6 kg/ha). All treatments applied w.r.t. with Factor-II resulted in significantly higher seed cotton yield than the control (Figure 3.30.1).
- The yield due to monopodia removal alone was 2,655.4 kg/ha, which was on par (2,541.8 kg/ha) with Detoping (at 90 -100 DAS) alone but was significantly higher than the control.
- Monopodia removal + Detoping resulted in significantly higher seed cotton yield (2,448.3 kg/ha) over control, but was at par with Detoping (at 90 -100 DAS) alone (2,541.8 kg/ha) and Monopodia removal + Detoping + Etheral application (2,489.6 kg/ha).

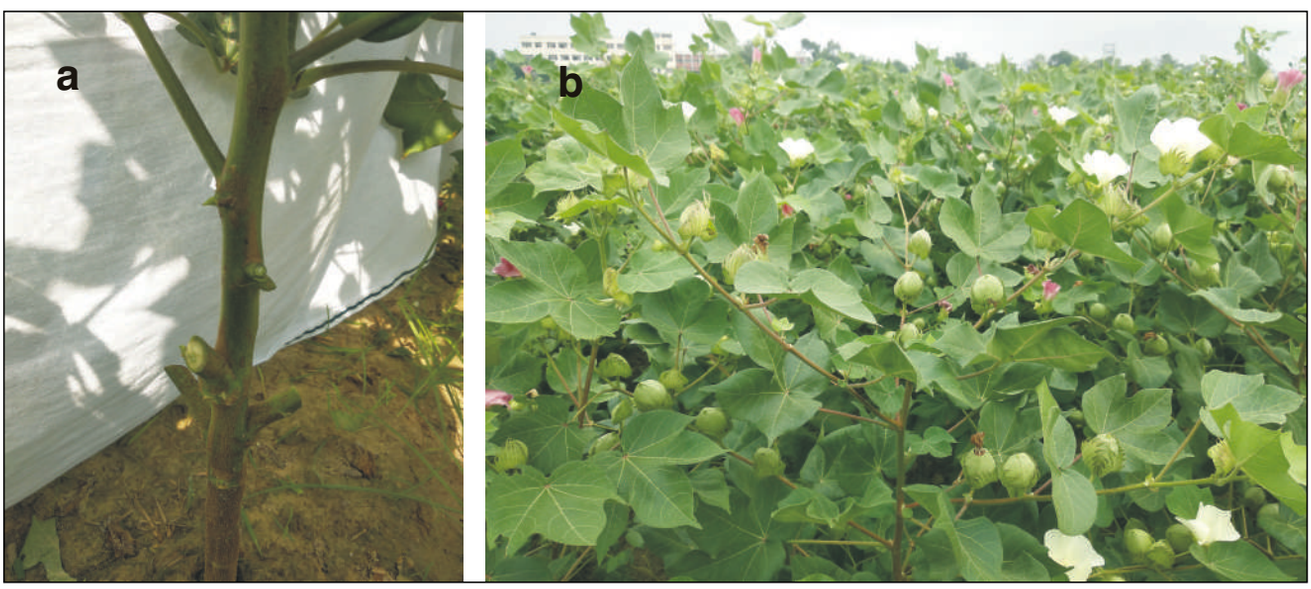


Figure 3.30.1:a: Monopodia removal of cotton; b: Detoping of cotton at ICAR-CICR, Regional Station, Sirsa

3.31 Project Name: Evaluation of different crop geometries in cotton(Ad-Hoc experiment)]

PI: Amarpreet Singh

The importance of the study: This study aims to study the cotton crop geometries to determine the efficacy and performance of robotic picking machinery, which can enable mechanized picking in the future.

Salient findings

- A field experiment to evaluate the effect of various crop geometries (row-to-row distances and plant-to-plant distances) in cotton was conducted with the RCH 773 BG II hybrid cotton genotype for the field evaluation of the robotic picker developed by CNHi (Figure 3.31.1).
- The agronomic performance of cotton crop planted under various crop geometries was evaluated at the ICAR-CICR, Regional Station, Sirsa. Significantly higher seed cotton yield was obtained with a row distance of 2.21 feet × 2.0 feet plant distance (67.5 × 60 cm) (3,285.8 kg/ha), followed by 2.21 feet row distance × 2.5 feet plant distance (67.5 × 75 cm) (3,139.5 kg/ha) over all other crop geometries tested under experiments.

Figure 3.31.1: Field experiment to evaluate the effect of various crop geometries in cotton at ICAR-CICR, Regional Station, Sirsa

4 TECHNOLOGIES DEVELOPED, EVALUATED AND TRANSFERRED

Cultivar Notifications in 2024

Gossypium arboreum

Cultivar: CICR-A NC Cotton 67 (CNA 1092)
Notification Number and Date: S.O. 4388(E), 8th October 2024
Developer: V.N.Waghmare, **Associates:** R V Salame
Salient features: Medium staple and good fibre strength desi cotton variety (*Average Yield – 10.23 q/ha; Potential yield =>22 q/ha; Average boll weight – 2.4 g; Plant height – 160 cm; GOT – 33.1 %; Fibre length – 24.5 mm; Fibre strength – 25.2 g/tex, Micronaire: 5.2 µg/inch, Uniformity Index: 82 %)*
Recommended for: Rainfed Conditions of Central Zone (Maharashtra, Gujarat, Madhya Pradesh and Odisha)

Gossypium hirsutum (Non-Bt)

Cultivar: CICR-H NC Cotton 58 (CNH 17395) Shalini
Notification Number and Date: S.O. 4388(E), 8th October 2024
Developers: Vinita Gotmare, Rachna Pande, Neelkanth Hiremani, M Saravanan, Harish Kumbhalkar, YG Prasad
Salient features: Brown linted naturally coloured cotton variety *(Average Yield– 14.41 q/ha; GOT – 32.6 %; Fibre length – 22.6 mm; Fibre strength – 23.9 g/tex;, Micronaire* - 4.5 µg/in*)*
Recommended for: Rainfed conditions of Central Zone (Madhya Pradesh, Maharashtra and Gujarat)

Cultivar: CICR-H NC Cotton 64 (CNH-18529)
Notification Number and Date: S.O. 4388(E), 8th October 2024
Developer: Vinita Gotmare, **Co-Developers:** Rachna Pande, Neelkanth Hiremani, H B Santosh, M Saravanan, Chandrashekar, Harish Kumbhalkar, Y G Prasad
Salient features: DarkBrown linted naturally coloured cotton variety*(Average seed cotton yield of 1011 kg/ha* under ***Rainfed (R)*** *& 1093 kg/ha under* ***irrigated (I);Rainfed :*** *UHML of 22.5, micronaire of 5.1 µg/inch, and bundle strength of 23.4 g/tex,* ***Irrigated:*** *UHML- 22.6 mm, micronaire 4.1µg/inch and Bundle strength of 24.4 g/tex)*
Recommended for: Rainfed & Irrigated conditions of Central Zone (Chhattisgarh, Gujarat, Madhya Pradesh and Maharashtra)

Gossypium hirsutum (Bt)

Cultivar: CICR-H Cotton 40 (ICAR-CICR PKV 081 Bt)
Notification Number and Date: S.O. 4388(E), 8th October 2024
Developers: Suman Bala Singh, Rahul M. Phuke, Santosh HB, VN Waghmare, G Balasubramani, K. R. Kranti, Sandhya Kranti, KP Raghavendra, S. Manickam, Ramkrushna GI, Vivek Shah, N. S. Hiremani, Y. G. Prasad T. H. Rathod, V. V. Ujjainkar; **Technical Support:** Bhumeshwar Fande, Kunal Gaikwad
Salient features: Medium maturing, medium staple Bt cotton variety amenable for high density planting *(Average Yield – 17.30 q/ha; Potential yield – 32.05 q/ha; Average boll weight– 3.8 g; Plant height – 118.0 cm; GOT – 33.87 %; Fibre length– 25.93 mm; Fibre strength– 25.8 g/tex, Micronaire : 3.53 µg/inch, Uniformity Index : 83.77 %)*
Recommended for: Rainfed conditions of South Zone (Telangana, Andhra Pradesh, Karnataka, Tamil Nadu)

Cultivar: CICR-H Bt Cotton 65 (ICAR-CICR 18- Bt)
Notification Number and Date: S.O. 4388(E), 8th October 2024
Developers: Dr. Suman Bala Singh, Dr. Rahul M. Phuke, Dr. HB Santosh Dr VN Waghmare, Dr KP Raghavendra, Dr. G. Balasubramani, Dr Vivek Shah, Dr. Y. G. Prasad, **Technical Support:** Bhumeshwar Fande
Salient features: An early maturing, medium staple Bt cotton variety amenable for high density planting

(Average Yield – 15.47 q/ha; Potential yield– 22.98 q/ha; Average boll weight– 3.66g; Plant height – 116.5 cm; GOT – 39.23%; Fibre length – 23.4 mm; Fibre strength – 24.3 g/tex, Micronaire: 4.9 µg/inch, Uniformity Index: 81.4 %)

Recommended for: Rainfed conditions of Central Zone (Maharashtra, Madhya Pradesh and Gujarat)

Cultivar: CICR-H Cotton 66 (ICAR-CICR Bt 20 - 31)

Notification Number and Date: S.O. 4388(E), 8th October 2024

Developers: Dr. HB Santosh, Dr. Rahul M. Phuke, Dr.S Manickam, Regional Station, Coimbatore, Dr. Suman Bala Singh, Dr VN Waghmare, Dr KP Raghavendra, Dr Vivek Shah, Dr. G. Balsubramani, Dr. Y. G. Prasad

Collaborator: Dr SS Patil, UAS, Dharwad; **Technical Support:** Mr Kunal Gaikwad

Salient features: An early maturing, medium staple Bt cotton variety amenable for high density planting *(Average Yield – 14.45 q/ha; Potential yield– 21.02 q/ha; Average boll weight– 3.66g; Plant height – 116.4 cm; GOT – 36.0 %; Fibre length – 25.8 mm; Fibre strength – 26.0 g/tex, Micronaire: 5.3 µg/inch, Uniformity Index: 83.0 %)*

Recommended for: Rainfed conditions of Central Zone (Maharashtra, Madhya Pradesh and Gujarat)

ELS cotton productivity enhancement through agronomic manipulation

Increased plant density with appropriate canopy management in Extra Long Staple (ELS) H x B hybrids makes it possible to produce more number of bolls per unit area and higher seed cotton yield without the problem of rank growth and mutual shading effect. Experimental results obtained from field trials conducted at ICAR-CICR RS, Coimbatore on these aspects during kharif 2020 (July 2020-January, 2021) to Kharif 2022 (July 2022-January, 2023) proved that increased plant density (90 x 30 cm; 37,037 plants ha-1) combined with canopy management (Mepiquat Chloride application @ 60 ppm when height node ratio (HNR) reached 1.5 followed by 30 ppm twice at 15 days interval after first spray) significantly enhanced the number of bolls per unit area and seed cotton yield of MRC 7918 BG II (103.8 bolls m-2 and 3,112 kg ha-1) vis-à-vis farmers' practice (90 x 60 cm; 18,518 plants ha-1; 92.1 bolls m-2 2,358 kg ha-1) 32% yield increase over three years.

Gap-filling technology for the better establishment of cotton crop with inherent soil moisture

Gap-filling using inherent soil moisture is done after removing the dry soil layer from the point of non-germinated seed spots (gaps between plants), and the seeds are sown manually at the soil moisture level similar to the first sowing using a dibbler and shovel/trowel tools within 10 days after sowing. SCY was higher in plants established using this technology (97.4 g/plant) than in other methods like flood irrigation (19.6 g/plant) but lower than the plants of normal sowing (183 g/ plant). Lower CLCuD severity was observed in established plants with this technology (13.8%) compared with other (22.8 - 36%) but at par with normally sown plants (4.92%). A good yield of BGII cotton hybrids can be realized with 80-90% plant population (32-35 Q/ha).

Nutrient Expert®: A decision-support system for hybrid cotton for Nutrient Expert® is a cutting-edge decision support system (DSS), which consists of quantitative evaluation of the fertility of tropical soils (QUEFTS) model for fertilizer prescriptions. Developed with the principles of site-specific nutrient management (SSNM) and offers 4R (right source, right rate, right time and right place) nutrient prescriptions to farmers aimed at bridging the yield gaps along with targeted yield and by improving the overall farmer profitability and NUE of cotton. Questionnaire was prepared at the sites before validation. The method uses site profiles (planting time, maturity period, canopy and growing environment) and field size on an acre or hectare basis. The method also uses soil test values. It provide different sources of fertilizer (inorganic of single or compound), organic manures (cartload or tractor trolley) and speciality micronutrients, and split doses. It also delivers profit analysis and compares current farmer fertilizer' practices. This web app and portable document format (pdf) report can be shared through a message or email.

Sr. No.	ICAR certified ICAR-CICR Technologies, Processes, etc
1	Nutrient Expert®: A decision support system for hybrid cotton (ICAR-NRM-CICR-Product-2024-221)
2	Novel cotton based Integrated Farming Systems (IFS) model for rainfed dry sub-humid ecosystem (ICAR-NRM-CICR Technology -2024-222)
3	Gap-filling technology for better cotton crop establishment in inherent soil moisture (ICAR-NRM-CICR Technology -2024-223)

5 EDUCATION,TRAINING AND CAPACITY BUILDING

5.1: Training and Capacity Building

5.1.1: Training Received

Scientists

National

Sr. No.	Name of Training Programme	Name of Scientists	Place/ Training Organized	Training Duration	
				Start Date	End Date
1.	Artificial Intelligence for water resources management in Agriculture	Dr. Amarpreet Singh	Department of Soil and Water Engineering, PAU, Ludhiana Punjab	18.01.2024	07.02.2024 (19 Days)
2.	Voltilomics: A Key to understand plant-microbe interactions and stress management in crop plants for a greener tomorrow	Dr. P. Valarmathi	Department of Microbiology TNAU, Coimbatore	01.02.2024	10.02.2024 (10 Days)
3.	Decoding Genomics & Proteomics data using Machine Learning Approach	Dr. J Amudha Dr. Joy Das	ICAR- Indian Agricultural Statistics Research institute	21.02.2024	27.02.2024 (7 Days)
4.	Pedagogy Development Program for enhancing pedagogical competencies for Agriculture Education	Dr. V. S. Nagrare Dr. Babasaheb Fand Dr. A. Manikandan	NAAS New Delhi	04.03.2024	08.03.2024 (5 Days)
5.	Development of AI-based Android Applications in Agriculture	Dr. Shivaji Thube Dr. Devindrappa	ICAR- IASRI, New Delhi	05.03.2024	25.03.2024 (21 Days)
6.	Pedagogy Development Program for enhancing pedagogical competencies for Agriculture Education	Dr. Ramkrushna G. Idapuganti Dr. Rachna Pande	NAAS New Delhi	29.04.2024	3.05.2024 (5 Days)
7.	Summer School in Geospatial Science & Technology (Level 2) Theme: Geospatial Science and Technology Applications in Agriculture	Dr. R. Raja	Centre for Water and Geospatial Studies, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.	05.06.2024	25.06.2024 (21 Days)
8.	Hands on training in mining of bioactive metabolites -Phenolic compounds	Dr. J Gulsar Banu	TNAU, Coimbatore	12.06.2024	14.06.2024 (3 Days)

Sr. No.	Name of Training Programme	Name of Scientists	Place/ Training Organized	Training Duration	
				Start Date	End Date
9.	"BD-NCBS-CoE Hands on Basic Flow Cytometry Course"	Dr. Rakesh Kumar	Central Imaging and Flow Cytometry Facility, National Centre for Biological Sciences, Bengaluru	25.06.2024	27.06.2024 (3 Days)
10.	"Workshop on Generative AI tools for Agriculture"	Dr. Neelakanth S Hiremani	ICAR-NAARM, Hyderabad	26.06.2024	28.06.2024 (3 Days)
11.	Bioinformatics Advances in Genomics Data Analysis	Dr. KP Raghavendra Dr. Rakesh Kumar	Division of Agricultural Bioinformatics (DABin), ICAR-IASRI, New Delhi	24.06.2024	28.06.2024 (5 Days)
12.	Multivariate Data Analysis Using R	Dr. K Velmourougane	NAARM, Hyderabad	22.07.2024	26.07.2024 (5 Days)
13.	Online workshop on conduct of inquiry on complaints relating to Sexual Harassment of women at workplace	Dr. J Amudha	ISTM, New Delhi	23.09.2024	23.09.2024 (1 Day)
14.	Training Programme for MANAGE Facilitators	Dr. Usha Rani,	MANAGE, Hyderabad.	19.11.2024	22.11.2024 (4 Days)

Technical Staff

Sr. No.	Name of Training/ Programme	Name	Place/ Organized	Training Start Date	Training End Date
1	Digital Competency, New Tools and Software for Computer Applications	Ms. K Subhashree Mrs. Vandana Satish	ICAR-IASRI, New Delhi	03.01.2024	09.01.2024 (7 Days)
2	Technological Advances leading to Smart Farming & Agripreneurship	Mr. Satpal Singh	UTKARSH-PDKV Agribusiness Incubation Centre, Dr. PDKV, Akola	01.01.2024	30.01.2024 (30 Days)
3	Big Data Analysis for Weather based Crop Management	Mrs. Rachana Deshmukh Mrs. Pooja Gonge Mr. Dineshkumar Mahule Mr. Ajit Meshram Mr. Kunal Gaikwad Mr. Akshay Barahate	ICAR-CRIDA, Hyderabad	29.01.2024	07.02.2024 (10 Days)
4	E-Governance tools and applications in ICAR	Mrs. Chetali Rodge	ICAR-IASRI, New Delhi	08.02.2024	14.02.2024 (7 Days)
5	Layout and Maintenance of field experiments and Recording observation on Real time Basis	Dr. Jimmy Vaidhya	ICAR-IARI, New Delhi	10.03.2024	15.03.2024 (6 Days)
6	Training on awareness programme regarding NABL Accreditation of Seed Testing Labs	Mr.J S. Kambe Mr. Krushna Gajghate	SIAET centre, Bhopal	27.05.2024	29.05.2024 (3 Days)

Sr. No.	Name of Training/ Programme	Name	Place/ Organized	Training Start Date	Training End Date
7	"Integrated weed management strategies under changing Agricultural Scenario"	Dr A Karthik	ICAR-Directorate of Weed Research, Jabalpur and Indian Society of Weed Science (ISWS)	28.08.2024	06.09.2024 (10 Days)
8	"MS-Excel (MS -Ex-14)"	Mrs. Mithila Meshram Mrs. Pooja Gonge Mr. Kunal Gaikwad Mr. Akshay Barahate	Institute of Secretariat Training and Management (ISTM), New Delhi	18.12.2024	20.12.2024 (3 Days)
9	21st Advanced level training in Soil testing, plant analysis and water quality assessment	Mr. Chandrashekhar Mundafale,	Division of Soil Science and Agricultural Chemistry, ICAR - IARI, New Delhi	10.12.2024	30.12.2024 (21 Days)

Student Internship

Sr. no	Name of Student	Name of Training Coordinator	Duration		Title
1	Ms. Aarathi Shree M	Dr. Joy Das	27.03.2024	25.05.2024	Molecular characterization and RNAi-mediated functional validation of the Halloween Gene *shroud* from *Pectinophora gossypiella*
2	Ms. Divya Ambadkar	Dr. K P Raghavendra	15.07.2024	30.08.2024	Hands -on training in Basic Molecular Biology and Plant biotechnology Techniques
3	Ms. Kshitij Giripunje	Dr. Joy Das	15.07.2024	30.08.2024	Hands -on training in Basic Molecular Biology and Plant biotechnology Techniques
4	Ms. Omika Sabale	Dr. J Amudha	29.07.2024	30.08.2024	Hands -on training in Basic Molecular Biology and Plant biotechnology Techniques
5	Ms. Ashwini Manikrao Walode	Dr Rakesh Kumar	01.08.2024	31.10.2024	Hands -on training in Basic Molecular Biology and Plant biotechnology Techniques

Student's Dissertation

Sr.No	Name of student	Name of Guide/Advisor	Thesis Title	Institution	University
1	Ms. Asmita Patil	Dr. G. Balasubramani	Simple sequence repeats (SSR) markers aided genetic diversity analysis in upland cotton (G. hirsutum L.)	L.A.D & Smt. R. P. College for women Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
2	Ms. Srushti Bante	Dr. J. Amudha	Studies on SSR marker linked to relative water content in cotton	L.A.D & Smt. R. P. College for women Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
3	Ms. Sakshi Sarda	Dr. J. Amudha	Studies on SSR marker linked to osmotic potential (OP) in drought resistant cotton	Hislop college Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
4	Ms. Suvidha sukhdeve	Dr. Rakesh Kumar	Molecular Studies on shadow (SAD) gene and its Role in the growth and development of	Hislop college Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)

Sr.No	Name of student	Name of Guide/Advisor	Thesis Title	Institution	University
			Pink Bollworm (*Pectinophora gossypiella*), a major cotton pest		
5	Ms. Tanavi Dhanorkar	Dr. K Velmourougane	Cotton-based legume intercropping system on soil biology and nutrient availability in rainfed Vertisol	Hislop college Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
6	Ms. Sejal Bhoyar	Dr. K Velmourougane	Major and minor millets influence soil nutrient and biological attributes in rainfed Vertisols	Hislop college Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
7	Ms. Pranita Ramchndra Begade	Dr. Rakesh Kumar	Protein expression optimization of recombinant *Lachnospiraceae bacterium* Cas12a(LbCas12a) in *E. Coli* Strain	Indraprastha New Arts Commerce and Science College, Wardha	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
8	Ms. Tanvi Rajesh Thool	Dr. Joy Das	Molecular studies on *spook* gene (*PgSpo*) and its role in the growth and development of Pink Bollworm	Indraprastha New Arts Commerce and Science College, Wardha	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
9	Mr. Ashlesha Yelure	Dr. G. Balasubramani	Genetic Analysis of upland cotton (G. hirsutum L.) using SSR markers.	Hislop college Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
10	Ms. Rashmee Rangdar	Dr. Rakesh Kumar	Identification and cloning of Ecdysteriod biosynthesis pathway gene *Diembodied* (DIB) from cotton Pink Bollworm (*Pectinophora gossypiella*)	Hislop college Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
11	Ms. Mayuri Kalbhande	Dr. Pooja Verma	Biochemical and Nutritional characterization of cotton genotypes under organic conditions	Dr. Ambedkar College Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)
12	Ms. Samiksha Bondade	Dr. Pooja Verma	Effect of mulching treatments on biochemical and nutritional characteristics of cotton (*Gossypium spp.*)	Dr. Ambedkar College Nagpur	Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU)

5.2: Trainings Imparted by ICAR-CICR

Sr. No.	Name of the Training	Place & Date	Participants/ Beneficiaries	Scheme under which Training is held	Number of participants		Training Coordinator/s
					Male	Female	
1.	Integrated Cotton Production Technology	Chargaon, Tal - Umred, Dist.- Nagpur 12 January 2024	Farmers	ICAR-CICR and CCI Extension Pilot Project	50	0	Dr DT Nagrale
2.	Integrated Crop Management (ICM) in Cotton	Kallakurichi and Namakkal District 22-24 January 2024	Farmers	ICAR-CICR and CCI Extension Pilot Project	40	40	Dr A H Prakash, Dr S. Usha Rani, Dr A Manivannan, Dr M. Sabesh and Dr A Sampathkumar,
3.	High Density Planting System of Cotton Cultivation	Muthuramalingapuram, Tiruchuli block, Virudhunagar district, Tamil Nadu 30 January 2024	Farmers	ICAR-CICR and CCI Extension Pilot Project	28	27	Dr Sampathkumar A, Dr Usha Rani S, and Dr Sabesh M

Sr. No.	Name of the Training	Place & Date	Participants/ Beneficiaries	Scheme under which Training is held	Number of participants		Training Coordinator/s
					Male	Female	
4.	Techniques in High Density Planting System of Cotton Cultivation	Narthampatti, Tiruchuli block, Virudhunagar district, Tamil Nadu 31 January 2024	Farmers	ICAR-CICR and CCI Extension Pilot Project	19	27	Dr Sampathkumar A, Dr Usha Rani S, and Dr Sabesh M
5.	Management of Off-Season Survival Sources of Pink Bollworm	Jhidi, Sirsa 08 February 2024	Farmers	IRM-PBW	71	9	Dr. Rishi Kumar
6.	Management of Off-Season Survival Sources of Pink Bollworm	Rupawas, Sirsa 08 February 2024	Farmers	IRM-PBW	37	3	Dr. Rishi Kumar
7.	Management of Off-Season Survival Sources of Pink Bollworm	Mallenka, Sirsa 09 February 2024	Farmers	IRM-PBW	86	4	Dr. Rishi Kumar
8.	Improved Cotton Cultivation Technologies	ICAR-CICR, Nagpur 13-21 February 2024	Agricultural extension filed facilitators	ICAR-CICR, Nagpur & Ambuja Foundation	88	40	Dr Ramkrushna GI
9.	Best Cotton Production Technologies to improve Yield and Quality	Hans Roever, KVK, Valikandapuram, Perambalir Dist 22 February 2024	Farmers	CICR-CCI Extension Pilot Project	26	12	Dr A Sampathkumar, Dr S. Usha Rani, Dr M. Sabesh.
10.	High Density Planting System of Cotton Cultivation for Higher Yield and Profitability	Rudriyampalayam village, Annur Block, Coimbatore Dist. 27 February 2024	Farmers	CICR-CCI Extension Pilot Project	23	17	Dr. S. Usha Rani, Dr. M. Sabesh, Dr. A Sampathkumar,
11.	Management of Off-Season Survival Sources of Pink Bollworm	Malikpura, Sirsa 27 February 2024	Farmers	IRM-PBW	102	3	Dr. Rishi Kumar
12.	High Density Planting System of Cotton Cultivation for Higher Yield and Profitability	Anthiyur, Erode district, Tamil Nadu 29 February 2024	Farmers	CICR-CCI Extension Pilot Project	20	16	Dr. S. Usha Rani, Dr. M. Sabesh, Dr A Sampathkumar,
13.	Recent Technologies for ELS Cotton Cultivation with	Vadapudur Village, Kinathukadavu Block, Coimbatore 07 March 2024	Farmers	ICAR-CICR and CCI Extension Pilot Project	21	15	Dr. A Sampathkumar, Dr. S. Usha Rani, Dr. M. Sabesh.
14.	Mela cum Farmers Training on Best Farm Practices for Cotton Farmers to Improve Yield	Kheri, Sirsa 13 March 2024	Farmers	CICR-CCI Extension Pilot Project	90	10	Dr. S.K. Sain & Dr. Amarpreet Singh
15.	Post-Season Consultation Workshop for Cotton Stakeholders	ICAR-CICR Regional Station, Coimbatore 14 March 2024	Farmers, Extension officials, All India Radio and CIRCOT officials	ICAR-CICR and CCI Extension Pilot Project	36	32	Dr Sampathkumar A, Dr Usha Rani S, and Dr Sabesh M
16.	Mela cum Farmers Training on Best Farm Practices for Cotton Farmers to Improve Yield	Jogiwala, District Sirsa, Haryana 15 March 2024	Farmers	CCI-CICR Pilot Project	185	15	Dr. S.K. Sain & Dr. Amarpreet Singh

Sr. No.	Name of the Training	Place & Date	Participants/ Beneficiaries	Scheme under which Training is held	Number of participants		Training Coordinator/s
					Male	Female	
17.	Recent Technologies for ELS Cotton Cultivation with Higher Yields and Profitability	Vellalapatti Village, Salem Dist Ta.mil Nadu	Farmers	CICR-CCI Extension Pilot Project	26	12	Dr A Sampathkumar, Dr S. Usha Rani, Dr M. Sabesh
18.	Exposure visit of ELS Cotton Farmers from Kinathukadavu to Ginning Mill, Pollachi	Sri Santhalakshmi Ginning Mills Pvt Ltd., Pollachi, Coimbatore district 19 March 2024	Farmers	ICAR-CICR and CCI Extension Pilot Project	4	25	Dr Sampathkumar A, Dr Usha Rani S, and Dr Sabesh M
19.	Cotton Fiber Quality, Clean Cotton Picking and Crop Residue Management	Bommakkottai, Tiruchuli block, Virudhunagar district, Tamil Nadu 20 March 2024	Farmers	ICAR-CICR and CCI Extension Pilot Project	27	22	Dr Sampathkumar A, Dr Usha Rani S, and Dr Sabesh M
20.	Mechanization and High-Density Planting System for High Yields and Productivity in Cotton	KVK Aruppukottai, Virudhunagar district, Tamil Nadu 21 March 2024	Farmers	ICAR-CICR and CCI Extension Pilot Project	34	47	Dr Sampathkumar A, Dr Usha Rani S, and Dr Sabesh M
21.	HDPS Cotton Agronomy and disease management	ICAR-CICR, Nagpur 21-22 March 2024	Trainee	ICAR-CICR, Nagpur & Better Cotton Initiative	58	0	Dr. A. S. Tayde, Dr. Ramkrushna G.I., Dr. B.B. Fand, Mayur Meshram
22.	Management of Off-Season Survival Sources of Pink Bollworm	Fatehpuria, Sirsa 26 March 2024	Farmers	IRM-PBW	95	5	Dr. Rishi Kumar
23.	Management of Off-Season Survival Sources of Pink Bollworm	Thiraj, Sirsa 28 March 2024	Farmers	IRM-PBW	126	4	Dr. Rishi Kumar
24.	Management of Off-Season Survival Sources of Pink Bollworm	Biruwala Gudha, Sirsa 28 March 2024	Farmers	IRM-PBW	78	2	Dr. Rishi Kumar
25.	Management of Off-Season Survival Sources of Pink Bollworm	Rania, Sirsa 29 March 2024	Agro Input Dealers	IRM-PBW	160	0	Dr. Rishi Kumar
26.	Management of Off-Season Survival Sources of Pink Bollworm	Mohmadpuria, Sirsa 29 March 2024	Farmers	IRM-PBW	67	3	Dr. Rishi Kumar
27.	Recent advances in Cotton Crop Production & Protection Technologies for North Zone	ICAR-CICR, RS, Sirsa 16-17 April 2024	Field scouts	Others	123	18	Dr. Rishi Kumar and Dr. Debashis Paul
28.	Recent advances in Cotton Crop Production & Protection Technologies for North Zone	ICAR-CICR, RS, Sirsa 26 April 2024	Field scouts	Others	60	10	Dr. Rishi Kumar and Dr. Debashis Paul
29.	Training program on Field and laboratory techniques related to cotton crop	ICAR-CICR, RS, Sirsa 20 May to 08 June 2024	PG Students (Zoology) CDLU, Sirsa	Others	0	14	Dr. Rishi Kumar and Dr. Debashis Paul

Sr. No.	Name of the Training	Place & Date	Participants/ Beneficiaries	Scheme under which Training is held	Number of participants		Training Coordinator/s
					Male	Female	
30.	Training of Foundation batch of Agriculture Assistant from State Department Agriculture	ICAR-CICR, Nagpur 30 May 2024	Agriculture Assistant	ICAR-CICR, Nagpur and RAMETI Nagpur	39		Dr Babasaheb Fand
31.	Training on Management of Pink bollworm & Awareness regarding Off-season sources of survival in North Zone	ICAR-CICR, RS, Sirsa 06 June 2024	Agro Input Dealers	Rasi-ICAR-CICR-CSR project	112	8	Dr Rishi Kumar
32.	Training program on Field and laboratory techniques related to cotton crop	ICAR-CICR, RS, Sirsa 10-30 June 2024	PG Students (Biotechnology) CDLU, Sirsa	Others	2	2	Dr Rishi Kumar and Dr Debashis Paul
33.	Training program on Field and laboratory techniques related to cotton crop	ICAR-CICR, RS, Sirsa 18 June to 09 July 2024	PG Students (Botany), CDLU, Sirsa	Others	1	6	Dr Rishi Kumar and Dr Debashis Paul
34.	Training cum Interactive session among cotton stakeholder & farmers programme on “Best management practices in cotton with special reference to PBW”	ATIC center, Hanumangarh, Rajasthan 19 June 2024	State Agri Dept Officials and Farmers	Rasi-ICAR-CICR-CSR project	95	5	Dr Rishi Kumar and Dr S K Sain
35.	Training cum Interactive session among cotton stakeholder & farmers programme on “Best management practices in cotton with special reference to PBW”	Jhunir, Mansa Punjab 20 June 2024	Farmers, stackholders	Rasi-ICAR-CICR-CSR project	90	0	Dr Rishi Kumar
36.	Demonstration cum Farmers Training on “Management Strategies on Pink Boll Worm in Cotton”	1 AMP, Hanumangarh, Rajasthan 02 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	78	0	Dr Subhash Chandra
37.	Training cum Demonstration on PBW and Insect-pest Management in Cotton	23 ML, Sri Ganganagar, Rajasthan 03 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	107	0	Dr Satish Kumar Sain
38.	Training Program on PBW and Insect-pest Management in Cotton	Chuli Kalan, Hisar 10 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	88	12	Dr S.K. Verma
39.	Training cum Demonstration on PBW and Insect-pest and Disease Management in Cotton	Banwali, Sri Ganganagar, Rajasthan 12 July 2024	Farmers	IRM-PBW	115	10	Dr Satish Kumar Sain

Sr. No.	Name of the Training	Place & Date	Participants/ Beneficiaries	Scheme under which Training is held	Number of participants		Training Coordinator/s
					Male	Female	
40.	Training Program on PBW and Insect-pest Management in Cotton	Umra, Hisar 13 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	95	7	Dr S.K. Verma
41.	Training Program on PBW and Insect-pest and Disease Management in Cotton	9 ML, Sri Ganganagar, Rajasthan 19 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	144	0	Dr Satish Kumar Sain
42.	Training Program on PBW and Insect-pest Management in Cotton	CCS HAU, Hisar 22 July 2024	State Govt. Officials and Stakeholders	Rasi-ICAR-CICR-CSR project	91	9	Dr S.K. Verma
43.	Improved cultivation practices and integrated insect-pest management with special reference to pink boll worm in cotton	Khera Khurd, Mansa, Punjab 23 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	105	0	Dr Amarpreet Singh
44.	Training Program for Cotton Farmers on PBW management	Dingarh, Hanumangarh, Rajasthan 23 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	100	4	Dr Subhash Chandra & Dr. Debashis Paul
45.	Improved cultivation practices and integrated insect-pest management with special reference to pink boll worm in cotton	Jassi Paun Wali, Bathinda, Punjab 25 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	99	11	Dr. Amarpreet Singh
46.	Training program on Field and laboratory techniques related to cotton crop	ICAR-CICR, RS, Sirsa 26 July to 25 August 2025	PG Students (Zoology) JCD, Sirsa	Others	0	1	Dr Rishi Kumar and Dr Debashis Paul
47.	Workshop on “Management of PBW & Awareness regarding Off-season Sources of Survival in North Zone”	Abohar, Punjab 28 July 2024	Agro Input Dealers & ginning cum oil mills owners	Rasi-ICAR-CICR-CSR project	80	0	Dr Rishi Kumar
48.	Training on Management of Pink bollworm & Awareness regarding Off-season sources of survival in North Zone	Sanghar Sarista, Sirsa 29 July 2024	Farmers, Officials and private companies	Rasi-ICAR-CICR-CSR project	98	2	Dr Rishi Kumar & Dr S.K. Sain
49.	Improved cultivation practices and integrated insect-pest management with special reference to pink boll worm in cotton	Khiali Chahilanwal, Mansa, Punjab 29 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	105	0	Dr Amarpreet Singh
50.	Training program on Field and laboratory techniques related to cotton crop	ICAR-CICR, RS, Sirsa 29 July to 20 August 2024	UG Students (Biotech) from UIFT	Others	0	1	Dr Rishi Kumar and Dr Debashis Paul

Sr. No.	Name of the Training	Place & Date	Participants/ Beneficiaries	Scheme under which Training is held	Number of participants		Training Coordinator/s
					Male	Female	
51.	Training program on Field and laboratory techniques related to cotton crop	ICAR-CICR, RS, Sirsa 29 July to 05 September 2024	UG Students (Biotech) from UIFT	Others	1	0	Dr Rishi Kumar and Dr Debashis Paul
52.	Farm Field School on Air (All India Radio) - Valedictory function	ICAR-CICR Regional Station, Coimbatore 30 July 2024	Farmers, All India Radio officials, Scientists and Extension officials	ICAR-CICR and CCI Extension Pilot Project	35	24	Dr Usha Rani S., Dr Sabesh M., Dr Sampathkumar A
53.	Improved cultivation practices and integrated insect-pest management with special reference to pink boll worm in cotton	Mehta, Bathinda, Punjab 30 July 2024	Farmers	Rasi-ICAR-CICR-CSR project	102	8	Dr. Amarpreet Singh
54.	Training cum Demonstration on PBW and Insect-pest Management in Cotton	22 ML, Sri Ganganagar, Rajasthan 02 August 2024	Farmers	Rasi-ICAR-CICR-CSR project	122	0	Dr. SK Sain
55.	Farmers Training on Cotton Cultivation and Input Distribution	Hans Roever KVK, Perambalur, Tami Nadu 08 August 2024	Farmers	SCSP	27	23	Dr Prakash A H., Dr Shankarganesh K, Dr Sampathkumar A -
56.	Farmers Training on “Best Management Practices in Cotton with special emphasis on Pink Bollworm	Mirjawali Mer, Hanumangarh, Rajasthan 12 August 2024	Farmers	Rasi-ICAR-CICR-CSR project	99	3	Dr Subhash Chandra
57.	Training on integrated Pest management in Cotton with Special reference to Pink Bollworm in North Zone	Darbi, Sirsa, Haryana 23 August 2024	Farmers	IRM-Dissemination of PBW management strategies	86	4	Dr. Rishi Kumar and Dr. S K Sain
58.	Integrated crop management practices	ICAR-CICR, Nagpur 26-30 August 2024	Field facilitators (Ambuja Foundation)	ICAR-CICR, Nagpur and Ambuja Foundation	32	15	Dr. Rishi Kumar and Dr. Debashis Paul
59.	Training Program on Hybrid Seed Production of Desi Cotton	ICAR-CICR, RS, Sirsa 28 August 2024	Farmers & cotton Stakeholders	JDA (Cotton), Govt of Haryana	68	2	Dr. Debashis Paul
60.	Training program on Field and laboratory techniques related to cotton crop	ICAR-CICR, RS, Sirsa 09 September to 01 October 2024	UG Students (Biotech) CMK	Others	1	6	Dr. Rishi Kumar and Dr. Debashis Paul
61.	Closer Spacing in cotton	Krosuru Sub Division, Palnadu 25 September 2024	Farmers	NFSM	140	10	Dr. J. Annie Sheeba
62.	Integrated Disease Management in Cotton	ICAR-CICR, Nagpur 27 September 2024	Feld facilitators and PU of Ambuja foundation	ICAR-CICR, Nagpur and Ambuja Foundation	25		Dr SP Gawande

Sr. No.	Name of the Training	Place & Date	Participants/ Beneficiaries	Scheme under which Training is held	Number of participants		Training Coordinator/s
					Male	Female	
63.	Training for Students of Diploma Course in Agricultural Extension Services for inputs dealers	ICAR-CICR, Nagpur 27 September 2024	Students	ICAR-CICR, Nagpur and RAMETI, Nagpur	38		Dr Rachna Pande
64.	Training program on PBW and Insect-pest Management in Cotton	ICAR-CICR, RS, Sirsa 28 September 2024	Farmers & other cotton stakeholders	JDA (Cotton), Govt of Haryana			Dr Rishi Kumar
65.	HDPS on cotton	Peddathanda village, Inguthy Mandal, Mahabubabad district 23 October 2024	Farmers	NFSM special project on cotton	45	35	Dr D. Kanjana
66.	Management of Pink bollworm in north Zone with respect to sources of survival during off-season	Faggu, Sirsa, Haryana 23 October 2024	Farmers	Rasi-ICAR-CICR-CSR project	95	5	Dr. Rishi Kumar
67.	Field Day on HDPS cotton	Tharthur village, Jupadu bunglow Mandal 25 October 2024	Farmers	NFSM	113	28	Dr J. Annie Sheeba
68.	Training program on "Management of Off-season Survival sources of Pink bollworm in North Zone"	Jogiwala, Sirsa, Haryana 27 October 2024	Farmers	Rasi-ICAR-CICR-CSR project	98	2	Dr Rishi Kumar
69.	Training program on "Management of Off-season Survival sources of Pink bollworm in North Zone"	Rohan, Sirsa, Haryana 30 October 2024	Farmers	Rasi-ICAR-CICR-CSR project	99	1	Dr Rishi Kumar
70.	Farmers' Field Training & Input distribution	Vellamadai, Coimbatore 11 November 2024	Farmers	IRM	39	21	Dr K Rameash
71.	Training Program under 'Scientific Social Responsibility Activity"	ICAR-CICR, RS, Sirsa 18 December 2024	Students	DST-SERB (ANRF) Project	32	8	Dr Rishi Kumar and Dr Debashis Paul

6 AWARDS AND RECOGNITIONS

Scientist	Award/Recognition	Awarded by	Conferred on
Dr. A Manikandan	Best Poster Award	ISSLUP, ICAR - NBSS&LUP, Nagpur	23-02-2024
Dr. K. Velmourougane	Best Scientist Award	ICAR-CICR, Nagpur	01-04-2024
Dr. Shivaji Thube	Professor TN Ananthakrishnan-Kannan Nagarajan Award for Young Scientist 2022-23	TN Ananthakrishnan Foundation, Chennai	04-04-2024
Dr. A Manivannan	International Cotton Advisory Committee (ICAC) financial support to participate in World Cotton Research Conference-8 (WCRC8) in Tashkent, Uzbekistan from October 3rd to 10th, 2024.	International Cotton Advisory Committee (ICAC), Washington DC	31-07-2024
Dr. Joy Das	Best Oral Presentation Award for work on “RNAi-Based Strategies for Sustainable Pest Management in Cotton” in the International Conference on Emerging Technologies of Agriculture and Allied Sciences-2024	Society for Agriculture, Allied Sciences and Technology (SAAT), Odisha in association with School of Agriculture, SR university, Warangal and Meadow Agriculture Pvt. Ltd, Uttar Pradesh	11-08-2024
Rathinavel S., Kavitha R., Surendrakumar A., Kannan B., Kalarani K., Sivakumar S.D., Raja R	Certificate of registration of Design "Drone mounted precision fertilizer applicator", Design Number: 427801-001, Class: 15-03	The Patent Office, Government of India	22-08-2024
Dr. A Manivannan	DST SERB ITS -International Travel Scheme – Travel grant was awarded for attending World Cotton Research Conference-8 (WCRC8) in Tashkent, Uzbekistan from October 3rd to 10th, 2024	DST SERB	02-09-2024
Rathinavel S., Kavitha R., Surendrakumar A., Raja R., Kannan B., Kalarani K., Sivakumar S.D.	Copy right for "Software program for site specific granular urea application device", Copy Right Registration Number: SW-19517/2024	Copy Right Office, Government of India	30-09-2024
Dr. Joy Das	Young Scientist Award in Biotechnology in the 10th International Conference on Recent Advances in Agriculture, Engineering, Applied, and Life Sciences for Environmental Stability (RAAALES-2024)	Agro Environmental Development Society (AEDS) Majhra Ghat, Rampur-244922, Uttar Pradesh, India	25-10-2024

Scientist	Award/Recognition	Awarded by	Conferred on
Dr. S. Manickam Dr. Vinita Gotmare	Professional Excellence Award	Cotton Research and Development Association (CRDA), Hisar	13-11-2024
Dr. Rakesh Kumar	CRDA-Best Cotton Thesis Award-2024	Cotton Research and Development Association (CRDA), Hisar	13-11-2024
Dr. Rishi Kumar	Scientist of the Year 2024	Cotton Research and Development Association (CRDA), Hisar	13-11-2024
Dr. V.N. Waghmare	CRDA- Cotton Scientist of the Year Award 2024	Cotton Research and Development Association (CRDA), Hisar	13-11-2024
Dr. K. Velmourougane	Best Oral Presentation Award	Cotton Research and Development Association (CRDA), Hisar	15-11-2024
Dr. Shivaji Thube	Best Oral Presentation Award	Cotton Research and Development Association (CRDA), Hisar	15-11-2024
Dr. Shivaji Thube	Young Agricultural Scientist Award- 2024	Dr.B Vasanthraj David Foundation	17-11-2024
Dr. K. Baghyalakshmi	Indian Indigenous Emerging Scientist Award-2024	An Indian Indigenous Society for Sciences & Social Sciences-IISSS and Shri. Shivaji Education Society, Amravati's Dhanwate National College (DNC), Nagpur	30-11-2024




7 LINKAGES AND COLLABORATIONS

Areas of Linkages	Institution
Project: Refinement of spindle type header prototype for development of a cotton picker	CSIR-CMERI-CoEFM, Ludhiana
Project: Crop pest surveillance in Maharashtra.	CROPSAP, Maharashtra
Project: Insecticide Resistance Management (IRM): Dissemination of Pink bollworm Management Strategies.	DAC, Govt of India and SAUs: Dr PDKV Akola, VNMKV Parbhani, MPKV Rahuri, NAU Surat, JAU Junagarh, RVSKVV Gwalior, UAS Dharwad, UAS Raichur, PITSAU Hyderabad and ANGRAU Guntur
Project: Genetic diversity of pink bollworm in India	DST-SERB, Ministry of Science And Technology, Govt of India
Project: Implementation of PVP legislation 2001 and DUS testing of cotton.	Protection of Plant Varieties and Farmers' Rights Authority, Govt of India
Project: ICAR project on Seed Production in Agricultural Crops and Fisheries.	ICAR, New Delhi
Project: Quantitative estimation of carbon and moisture fluxes over the cotton based agro-ecosystem.	National Carbon Project, ISRO, Hyderabad
Project: Transgenic research on plant protection	CSIR and NBRI, Lucknow
Development of Pheromone technology	CSIR and IICT, Hyderabad
Value addition Naturally colored cotton	Dr. PDKV, Akola and ICAR -CIRCOT, Mumbai
Student collaboration for research	RTMNU, Nagpur
Production and commercialization of Bt cotton varieties.	Maharashtra State Seeds Corporation Ltd. (Mahabeej), Akola
HRD of implementation partners of BCI programme in India	Better Cotton Initiative, New Delhi
Project: Whitefly management in cotton	PAU, Ludhiana, HAU, Hisar RAU, Sriganganagar
Dissemination of weekly advisories and BMPs for cotton	State Agricultural Departments of cotton and State Agricultural Universities pf Cotton growing states
Strengthening Bt referral lab for BT/HT tests	DAC, GoI
Project: Digital landscape diagnostic survey in Maharashtra	Rajiv Gandhi Science and Technology Commission, Mumbai
Project: Breeding for cotton leaf curl virus	ATGC, Hyderabad
Project: Evaluation of mating disruption technology for PBW	Rallis India (Pvt ltd), Bengaluru
Project: Bio-efficacy of new Bt cry proteins against PBW populations	Bayer Crop Sciences
Project: Variable Rate Technologies (VRTs) for site specific input (pesticide, water & Nitrogen) management	Network Program on Precision Agriculture (NePPA)
Promotion and commercialization of Bt cotton varieties	M/s Nairuthi Seeds Pvt Ltd., Hyderabad
Implementation of the Project Bandhan	Agrovision Foundation, 402 Govind Apartment, W.H. C. road, Shankar nagar Nagpur
Project: Establishing sustainable organic cotton production ventures in selected farms located in Ghatanji of Yavatmal District, Kalmeshwar of Nagpur district and Dhamangaon of Amravati District	Cottonguru MahaFPC Limited, 210, 211, 227, Runwal Commercial Complex, LBS Marg, Mulund (W), Mumbai
Popularization of Long linted Desi cotton varieties	Better Cotton Initiative, India and VNMKV Parbhani
Project: To Evaluate Nectariless Rasi Cotton hybrids against pink bollworm and American Bollworm on Cotton	M/s. Rasi Seeds Pvt Ltd

Areas of Linkages	Institution
Project: To develop recommendations for cotton High Density Planting System (HDPS) pertaining to canopy and nutrient management through collaborative agronomy TRIALS/DEMOS	M/s. Rasi Seeds Pvt Ltd, M/s. Nuziveedu Seeds Ltd
Project: Soil Testing Services related to Regenerative Agriculture	World Wide Fund For Nature-India (WWF India)
Project: Evaluation of mating disruption technology	M/s. ATGC Biotech Pvt Ltd
Seed production and commercialization of Bt cotton varieties developed by ICAR -CICR, Nagpur (ICAR -CICR 16 Bt and ICAR -CICR 23 Bt, ICAR-CICR PKV081 Bt (Bt 12), ICAR-CICR RS 2013 Bt (Bt 6), ICAR -CICR GJHV374 Bt (Bt 3)	M/s. ALP GIRI SEED Sciences Pvt Ltd
Project: The response of potassium salt of ac tive phosphorous (PSAP) fertilizer grade by foliar spray in Bt hybrid cotton	M/s. Isha Agro Sciences Pvt. Ltd., Pune
Multiplication and commercialization of Bt Cotton Varieties- ICAR-CICR 16 Bt and ICAR-CICR 23 Bt	M/s. Pinnacle Agri Sciences Pvt Ltd. Kurnool
Multiplication and commercialization of ICAR -CICR 23 Bt Cotton Variety	M/s. Nirupama Seeds Pvt Ltd. Hyderabad
Multiplication and commercialization of Bt Cotton Varieties- ICAR-CICR 16 Bt and ICAR-CICR 23 Bt	M/s. Sahaja Crop Sciences Pvt Ltd. Kurnool
MoU with M/s ITC Limited for advisories to the farmers associated with the e-Choupal network.	M/s ITC Limited, Guntur
Promotion and commercialization of Bt cotton varieties ICAR-CICR GJHV 374 Bt, ICAR -CICR PKV081 Bt and ICAR-CICR 23 Bt	M/s Dinkar Seeds Pvt Ltd. Himatnagar, Gujarat
Use of Entomopathogenic fungi for control of Nematodes in cotton	ICAR- Central Plantation Crops Research Institute (ICAR-CPCRI), Kasargod, Kerala
Non-GM cotton varieties to organic cotton growers in Central Southern part of India	Welspun Foundation for Health and Knowledge (WFHK), Welspun, Kutch, Gujarat

8 ICAR-AICRP ON COTTON

Salient Achievements 2024

List of non-Bt Cotton varieties and hybrids identified by VIC in 2024

Name of entry	Category	Zone	Situation	Remarks
KR 149	Desi hybrid	North	Irrigated	
KR 150	Desi hybrid	North	Irrigated	
F 2743	Hirsutum	North	Irrigated	
FDK 324	Arboreum	North	Irrigated	
TSH 387	Hirsutum	South	Irrigated	
CNH 17395	Hirsutum	Central	Rainfed	Colour Cotton
CNA 1092	Arboreum	Central	Rainfed	Colour Cotton

List of non-Bt Cotton varieties and hybrids notified in 2024

Name of the variety	Category	Gazette no.	Date
Nandyal Cotton 26 (NDLH 2056- 4)	*G. hirsutum*	S. 0. 1560 (E)	26-03-2024
Nandyal Cotton 27 (NDLA 3104-4)	*G. arboreum*	S. 0. 1560 (E)	26-03-2024
Nandyal Cotton 28 (NDLA-3116-3)	*G. arboreum*	S. 0. 1560 (E)	26-03-2024
Phule Shubhra (RHB 1623)	H × B	S. 0. 1560 (E)	26-03-2024
Phule Ekata (RHB-1008)	H × B	S. 0. 1560 (E)	26-03-2024
GN Cot 27 (Surti Sonu) (GShv 331/14)	*G. hirsutum*	S. 0. 1560 (E)	26-03-2024
Narmada Gold (G. Cot. 31) (GBhv 356)	*G. hirsutum*	S. 0. 1560 (E)	26-03-2024
TVH 007	*G. hirsutum*	S. O. 4388 (E)	08-10-2024
PA 833	*G. arboreum*	S. O. 4388 (E)	08-10-2024
PDKV Dhawal (AKA 2013-8)	*G. arboreum*	S. O. 4388 (E)	08-10-2024
TSH 387 (SVPR 7)	*G. hirsutum*	S. O. 4388 (E)	08-10-2024
PBD 88	*G. arboreum*	S. O. 4388 (E)	08-10-2024
Shalini (CNH-17395) (CICR-H Cotton 58)	*G. hirsutum*	S. O. 4388 (E)	08-10-2024
CNH 18529 (CICR-H NC Cotton 64)	*G. hirsutum*	S. O. 4388 (E)	08-10-2024
CICR-A NC Cotton 67 (CNA 1092)	*G. arboreum*	S. O. 4388 (E)	08-10-2024
NH 677	*G. hirsutum*	S. O. 4388 (E)	08-10-2024
VPT 2 (TVH 002)	*G. hirsutum*	S. O. 4388 (E)	08-10-2024

List of Bt Cotton varieties and hybrids identified by VIC in 2024

S. No.	Name of entry	Category	Zone	Situation
1	ACH 559-2 BGII	H×H	North	Irrigated
2	DC 5417 BGII	H×H	North	Irrigated
3	KCH 9355 BGII	H×H	North	Irrigated
4	RCH997BGII	H×H	North	Irrigated
5	Rasi Max001BGII	H×H-C	North	Irrigated
6	Rasi Max003BGII	H×H-C	North	Irrigated
7	ACH 555-2 BGII	H×H	Central	Irrigated
8	DC 5100 BGII	H×H	Central	Irrigated
9	JKCH 18568 BGII	H×H	Central	Irrigated

S. No.	Name of entry	Category	Zone	Situation
10	RCH965BGII	H×H	Central	Irrigated
11	RCH999BGII	H×H	Central	Irrigated
12	SS 1188 BGII	H×H	Central	Irrigated
13	US 711 BGII	H×H	Central	Irrigated
14	ARCH 844 BGII	H×H	Central	Rainfed
15	BIO 6802 BGII	H×H	Central	Rainfed
16	DC 5100 BGII	H×H	Central	Rainfed
17	DC 5101 BGII	H×H	Central	Rainfed
18	Trumpcard BGII	H×H	Central	Rainfed
19	DC 5101 BGII	H×H	Central	Rainfed
20	Rasi Max033BGII	H×H-C	Central	Rainfed
21	ACH 981-2 BGII	H×H	South	Irrigated
22	ARCH 6651 BGII	H×H	South	Irrigated
23	BIO 6938 BGII	H×H	South	Irrigated
24	DC 5100 BGII	H×H	South	Irrigated
25	JKCH 18568 BGII	H×H	South	Irrigated
26	KCH 9111 BGII	H×H	South	Irrigated
27	KCH 9122 BGII	H×H	South	Irrigated
28	NBC-2020 BGII	H×H	South	Irrigated
29	RCH999BGII	H×H	South	Irrigated
30	VSCH 219 BGII	H×H	South	Irrigated
31	US 711 BGII	H×H	South	Irrigated
32	SS 1188 BGII	H×H	South	Irrigated
33	Rasi Max006BGII	H×H-C	South	Irrigated
34	DC 5100 BGII	H×H	South	Rainfed
35	SS-963 Bt2	H×H	South	Rainfed
36	BIO 6802 BGII	H×H	South	Rainfed
37	ARCH 3224 BGII	H×H-C	South	Rainfed
38	VSCH 139 BGII	H×H-C	South	Rainfed
39	Rasi Max033BGII	H×H-C	South	Rainfed
40	Rasi Max066BGII	H×H-C	South	Rainfed
41	PKV 081 Bt	Hirsutum	South	Rainfed
42	ARCH 2020 BGII	H×H-C	North	Irrigated
43	C9403 BG-II	H×H-C	North	Irrigated
44	Rasi Max039BGII	H×H-C	North	Irrigated
45	Rasi Max036BGII	H×H-C	North	Irrigated
46	ACH 27-2 BGII	H×H-C	Central	Irrigated
47	NCS 8022 Bt2	H×H-C	Central	Irrigated
48	Rasi Max069BGII	H×H-C	Central	Irrigated
49	VSCH 139 BGII	H×H-C	Central	Rainfed
50	KCH 9111 BGII	H×H-C	South	Irrigated
51	Rasi Max069BGII	H×H-C	South	Irrigated
52	ACH 27-2 BGII	H×H-C	South	Irrigated
53	ACH 999-2 BGII	H×H	North	Irrigated
54	ACH 981-2 BGII	H×H	Central	Irrigated
55	ACH 909-2 BGII	H×H	South	Irrigated
56	D 1199 BGII	H×H	South	Irrigated
57	US 707 BGII	H×H	South	Irrigated

Research Highlights

Crop Production (2024-25)

- Optimization of spacing and nutrient requirements is a pre-requisite for releasing promising genotypes. Hence, the agronomic requirements of pre-released arboreum hybrids KR-152 and CISAA 19-4 in the North Zone, pre-released *G. arboreum* variety JLA 1204 and CNA 20402 in the Central Zone, and DDCC 2151 in the South Zone were determined.
- Agronomic requirement studies for 62 pre-released genotypes comprising 57 intra hirsutum Bt hybrids, 3 interspecific Bt hybrids, and 4 hirsutum varieties were conducted as per the proposed environment.
- In ELS cotton (*G. barbadense* genotypes) assessment, CICR B-45 produced higher seed cotton yield than Suvin at Chamarajnagar,
- Trials on Conservation agriculture in the North zone revealed that 100% wheat residue incorporation by rotavator followed by sowing of cotton in kharif and 100% cotton residue incorporation after picking + sowing of wheat crop through Super seeder in one go during rabi registered higher seed cotton yield @ 16.3 and 31.3 percent and 33.0 and 20.4 per cent higher wheat grain yield at Faridkot and Bathinda in cotton – wheat rotation, respectively.
- In yield maximization trial, 35 per cent higher seed cotton yield was recorded with Closer planting + Detopping + Pruning of monopodia +Two sprays of mepiquat chloride @ 25 g a.i. at 45 and 60 DAS +Drip fertigation + straw/crop residue mulch @5 t/ha at Bathinda (2573 kg/ha).
- Maximum Seed cotton yield was achieved in Surat by adopting closer planting 90 x 30 cm + Detopping at 100 cm height +Two sprays of Mepiquat chloride @ 25g a.i. at 45 and 60 DAS (2819 kg/ha). In Junagadh, detopping at 100 cm height + pruning of monopodia at 45 DAS + two sprays of mepiquat chloride @ 25 g a.i. at 45 and 60 DAS + polymulch was promising.
- A package that included closer planting + Detopping + Pruning of monopodia +Two sprays of mepiquat chloride @ 25 g a.i. at 45 and 60 DAS + Drip fertigation + polymulch was identified as yield maximization techniques for Rahuri (5138 kg/ha), Coimbatore (2426 kg/ha) and, Srivilliputhur (2585 kg/ha)
- in the rainfed trial of yield maximization, 46.29, 48.67, 39.13 and 39.24% higher seed cotton yield was achieved by adopting of Closer planting +Detopping at 100 cm height + Pruning of monopodia at 45 DAS + Two sprays of Mepiquat chloride @ 25 g a.i. at 45 and 60 DAS at Akola (2879 kg/ha), Bhawanipatna (3824 kg/ha), LAM (2784 kg/ha) and Chamrajnagar (2019 kg/ha), respectively.
- In Nandyal, 30.9 % higher seed cotton yield (2296 kg/ha) was registered with Closer planting +Detopping at 100 cm height + Two sprays of Mepiquat chloride @ 25 g a.i. at 45 and 60 DAS. Closer planting +Detopping at 100 cm height + Pruning of monopodia at 45 DAS recorded 39.6 % higher seed cotton yield in Nanded (3425 kg/ha)
- The drought management strategy of the Broad Bed Furrow with Glycine Betaine @100 ppm spray after depletion of 75 % soil moisture was promising at Dharwad (1784 kg/ha) and Bhawanipatna (2661 kg/ha).
- Adoption of Broad Bed Furrow with Salicylic acid spray @100ppm after depletion of 75% soil moisture performed well in Akola (2810 kg/ha). In Khandwa (1870 kg/ha) and Chamrajnagar (1868 kg/ha), the results revealed that Ridges & Furrow with Salicylic acid @ 100 ppm single spray after depletion of 75 % soil moisture was promising
- Land configuration of the Broad Bed furrow followed by application of 20 kg/ha extra nitrogen and potassium after drainage of water logging field identified as waterlogging management techniques in Bathinda (2061 kg/ha), Junagadh (3545 kg/ha), and Rahuri (2778 kg/ha). In Surat, land configuration with ridges and furrow and application of extra 20 kg/ha of nitrogen and potassium after drainage of water logging field out performed (1974 kg/ha).
- The results of the canopy management trial found that application of mepiquat chloride@45ppm at square initiation and 15 days after first spray and 15 days after second spray (need based) with Detopping registered 34.40, 29.33, 36.45, 23.7, 38.93, 21.35 and 26.9 percent higher seed cotton yield and reduced the plant height to 30.0, 29.7, 27.1, 4.30, 28.7, 24.0 and 36.8 percent respectively in Sriganganagar, Junagadh, Bhawanipatnam, Khandwa Nandyal, Srivilliputhur and Raichur.
- Mepiquat chloride application @ 45ppm at square initiation and 15 days after first spray + Detopping recorded 45.89, 13.7, 16.4, 21.3,18.1, and 36.8 percent higher seed cotton yield and reduced plant height to 11.7, 52.9, 20.6, 27.3, 22.8 and 24.42 percent at Rahuri, Nanded, Akola, Dharwad, Coimbatore and Chamrajnagar, respectively
- Management of square shedding in cotton revealed that shedding percentage was reduced to 59.1% and Seed cotton yield was increased of 12.0% with IAA @ 25ppm+ kinetin @ 20ppm (955 kg/ha) in Bathinda. In Dharwad, the seed cotton yield (kg/ha) was increased to 31.4% by Silver thiosulphate application @ 7.5μM (2562 kg/ha) with fruit shedding percentage reduced to 19.7%. In Sirsa, Glycine betaine application @ 3 g/ha increased the cotton yield by 27.4% and reduced the boll shedding by 38.6%. In Surat, the application of IAA @ 25 ppm + kinetin @ 20 ppm increased the yield by 12.0%, and reduced the

boll shedding by 11.9%.

- Drone application of KNO3 revealed that the 8% concentration is comparable with the manual application of 2% KNO_3 in Surat and Dharwad
- Detopping on the 20th node performed well at Surat (911 kg/ha). Homobrassinolide @ 0.2 ppm at 45 and 60 DAS along with Detopping on 20th node performed well at Dharwad (1294 kg/ha) with respect to the late sown arboreum.
- The HAU Bt 11 and HAU Bt 12 genotypes were identified for drought tolerance in Hisar. The crude oil, crude protein, and gossypol contents decreased significantly under drought conditions in all Hisar genotypes. The H 1353, HAU Bt 11, and HAU Bt 12 genotypes performed better under salinity conditions in Hisar.
- Lower gossypol contents were observed in G. Cot-16 and GISV-419 (0.65 %) under irrigated conditions. Under rainfed conditions, GISV-419 and LRA-5166 showed lower gossypol. The highest protein content was observed in LRA-5166 (19.92%) under rainfed conditions in Surat.
- Higher ethylene concentration (0.166) was found with Thidiazuron @ 500 ppm + Diuron @ 400 ppm (T10) spray, leading to the degradation of chlorophyll content in defoliant experiments. Low content of H2o2 and MDA in treatments sprayed with salicylic acid (0.5 mm) indicated the recovery of plants from water logged conditions.
- Mepiquat chloride @ 45 ppm at square initiation and 15 days after first spray, followed by Detopping showed higher phenol content.
- Primary metabolites (carbohydrates and protein) secondary metabolites (tannin, phenols and flavonoid) were significantly increased by the application of salicylic acid at 100 ppm and Glycine Betaine at 100 ppm sprays for drought management in Dharwad
- Significant positive correlation between phenol content with locule damage and green boll damage was observed
- Biochemical parameters like Protein, reducing sugar, Phenol, Tannin, and Flavanol were increased in all parts of the plants at peak periods of pink boll infestation in Dharwad.

Crop Protection-Entomology (2024-25)

Screening of breeding materials for resistance to insect-pests:

Promising sucking pest-tolerant entries for preliminary screening (National & Zonal Trials)

- North zone: In *G. arboreum*, 4 entries for leafhopper, 5 entires for whitefly, and 6 entries for thrips were identified as highly resistant/tolerant.
- Central zone: In *G. hirsutum*, 11 entries for leafhopper, 16 entries for whitefly, and 10 entries for thrips were identified as highly resistant/resistant and tolerant. In *G. arboreum*, 8 entries for leafhopper, 8 entries for whitefly and 6 entries for thrips were identified as highly resistant/ tolerant. In Barbadense , 1 each entry for the leafhopper , whitefly, and thrips was identified as highly resistant/ tolerant.
- South zone: In *G. hirsutum*, 10 entries for leafhopper and 6 entries for thrips were identified as highly resistant/ tolerant. In *G. arboreum*, 5 each entries for leafhopper, whitefly, and thrips were identified as highly resistant/tolerant. In Barbadense, 1 each entry for the leafhopper and whitefly was identified as highly resistant/ tolerant.

Promising sucking pest-and bollworm-tolerant entries identified for the development of a repository through advance screening:

- **North zone**: 5 entries for the leafhopper, 10 entries for the whitefly, and 1 entry for thrips were found to be promising.
- **Central zone:** 2 entries for the leafhopper and 1 entry for the thrips were found to be promising.
- **South zone**- 2 entries for the leafhopper found to be promising
- **South zone**- 01 entry for PBW was found to be promising.

Promising sucking pest tolerant entries identified for development of repository through advance screening and basis of resistance/tolerance:

- **North zone**: 8 entries for the whitefly and 2 entries for the thrips were found to be promising.
- **Central zone**: 8 entries for the leafhopper and 4 entries for the thrips were found to be promising.
- **South zone**: 11 entries for the leafhopper were found to be promising.

Seasonal dynamics of key pests in relation to climatic conditions recorded in North, Central, and South zone centres on N-Bt and Bt genotypes under unprotected conditions:

- **Leafhopper**: In North zone, peak activity was recorded during 27th-32nd SMW except Faridkot (36th SMW) with a range of 0.00-14.40 jassid/3 leaves; in the Central zone, 36th-46th SMW but at most of the locations it peaked between 42nd-46th SMW with a range of 0.00-33.30 jassid/3 leaves and between 39th-49th SMW; in south zone, at most of the locations it peaked between 46th-49th SMW with a range of 0.00-31.30 jassid/3 leaves.
- **Thrips**: In North zone, peak activity was recorded during 29th-30th SMW with a range of 0.00-213.00 thrips/3 leaves, in the Central zone peaked between 30th-43rd SMW but at most of the locations it was

between 38th-41st SMW with a range of 0.00-49.60 thrips/3 leaves and peak activity between 38th-48th SMW, in the south zone, but it was between 38th-41st SMW at most of the locations with a range of 0.00-88.40 thrips/3 leaves.

- **Whitefly**: In the North zone, peak activity was recorded during 29th SMW at most of the locations, except, for Hisar (39th SMW) & Sriganganagar, (36th SMW) with a range of 0.53-120.90 whitefly/3 leaves;, 37th-52nd SMW in the central zone and at most of the locations it was between 40th-47th SMW with a range of 0.00-36.30 whitefly/3 leaves and peaked between 37th-51st SMW in the south zone but it was between 40th-45th SMW at most of the locations with a range of 0.00-48.87 whitefly/3 leaves.
- **Aphids:** Peak activity in the central zone was recorded during 30th-52nd SMW but at most of the locations it was between 51st-52nd SMW with a range of 0.00-117.65 aphids/3 leaves and between 34th-51st SMW with a range of 0.00-85.00 aphids/3 leaves in the Southern zone.
- **Natural Enemies**: Maximum population was recorded during 29th-33rd SMW at all the locations except Sriganganar (38th SMW) with a range of 0.00-25.50 predators/plant in the North zone, highest population recorded between 49th-52nd SMW at majority locations of the central zone with a range of 0.00-7.80 predator/plant and between 35th-38th SMW at majority locations of South zone with a range of 0.00-5.56 predator/plant.

Bollworms dynamics (non-Bt):

- **North zone**: Negligible population and damage to fruiting bodies due to Earias spp. and *H. armigera* were recorded. Pink bollworm larval recovery and green boll damage (%) ranged between 0.00-20.00/50 green bolls and 0.00-27.00 percent, respectively, and were maximum at Sirsa.
- **Central zone**: Larval populations of *H. armigera*, *Earias* spp., and *S. litura* ranged from 0.00-2.20, 0.00-3.25, and 0.00-2.00 per 5 plants, respectively. Fruiting body and green boll damage due to bollworms other than PBW ranged between 0.00-28.55 & 0.00-15.00 percent, respectively. Rosette flowers (%) due to PBW, larval recovery of pink bollworm (Nos.), and green boll damage (%) ranged between 0.00-23.83 percent (Highest at Nanded), 1.63-17.64/50 green bolls (Maximum at Akola) & 10.67-40.20 percent (Highest at Khandwa), respectively.
- **South zone**: Larval populations of *H. armigera*, *Earias* spp., and *S. litura* ranged from 0.00-5.20, 0.00-1.33 and, 0.00-1.00 per 5 plants, respectively. Fruiting body damage ranged between 0.00-60.65 (%). Rosette flowers due to pink bollworm, pink bollworm larval recovery (Nos), and green boll damage was recorded with a range of 0.00-39.30 percent, 8.01-28.25/50 green bolls and 7.41-66.88 percent (highest at Raichur), respectively.

Bollworms dynamics (Bt cotton):

- North zone-pink bollworm larval recovery (Nos) and green boll damage (%) ranged between 0.00-12.50/50 green bolls and 0.00-21.00 percent, respectively, and were maximum at Sirsa.
- **Central zone**: Larval populations of *H. armigera*, *Earias* spp., and *S. litura* ranged between 0.00-0.60/5, 0.00-0.90/5 s and 0.00-1.20 per 5 plants, respectively. Fruiting body damage (%) and, green boll damage (%) due to bollworms other than PBW ranged between 0.00-21.75 & 0.00-3.47 percent, respectively. Rosette flowers (%) due to PBW, larval recovery of pink bollworm (Nos), and green boll damage (%) ranged between 0.00-20.00 percent (Highest at Nanded), 2.00-15.42/50 green bolls (Maximum at Akola) & 3.00-37.50 percent (Highest at Khandwa), respectively.
- **South zone**: Larval populations of *H. armigera*, *Earias* spp., and *S. litura* ranged from 0.00-1.44, 0.00-0.105 & 0.00-1.11 per 5 plants, respectively. Fruiting body damage (%) ranged between 0.00-42.41 percent. Rosette flowers (%) due to PBW, pink bollworm larval recovery (Nos), and green boll damage (%) were recorded highest at Raichur with a range of 0.00-34.71 percent, 3.85-23.22/50 green bolls & 2.90-43.49 percent, respectively.

Farmers' Field Survey on key and emerging pests to support weekly advisory:

- **North zone**: Of the total 2234 surveyed locations, whiteflies crossed the ETL at 771 (34.51%); PBW at 456 (20.41%); Thrips at 278 (12.45%); and Leafhopper at 101 locations (4.52%) locations. Whiteflies and pink bollworm were key-yield limiting pests during the season.
- **Central zone**: Of the total 3699 locations surveyed, PBW crossed the ETL at 880 (23.79%); Aphids at 597 (16.14%); Leafhopper at 478 (12.92%); Thrips at 448 (12.11%); Whitefly at 148 (4.00%); Shoot weevil at 39 (1.05%), *S. litura* at 12 (0.32%) and Mirid bugs at 08 (0.22%) locations. Pink bollworm and aphids were key-yield limiting pests during the season.
- **South zone**: Of the total 3704 locations surveyed, PBW crossed the ETL at 473 (12.77%); Leafhopper at 435 (11.74%); Thrips at 266 (7.18%); Aphids at 85 (2.29%); Mirid bugs at 68 (1.84%); S. litura at 22 (0.59%); Shoot weevil at 19 (0.52%), and Whitefly at 10 (0.27%) locations. Pink bollworms and leafhoppers were the key yield-limiting pests during the season.

Evaluation of persistence of insecticides against PBW:

- **North zone:** In the North Zone, studies revealed variations in insecticide persistence. Profenofos at Sirsa, spinetoram at Hisar & Faridkot and emamectin

benzoate at Bathinda showed the highest persistence.

- **Central zone**: Field-cum-laboratory studies in the zone revealed varying insecticide persistence across different locations. Chlorantraniliprole at Akola, spinetoram at Junagadh, emamectin benzoate at Nanded and profenofos at Surat were the most persistent insecticides for managing pink bollworm.
- **South zone**: Field and pot-cum-laboratory studies in the zone revealed variations in insecticide persistence across locations. Cypermethrin and bifenthrin at Dharwad, Chlorantraniliprole and spinetoram at Coimbatore and Lam guntur, and fenpropathrin and cypermethrin at Raichur showed the highest persistence. Similar trends were observed at higher application doses (10% & 25% above field dose) and under pot-cum-laboratory conditions.

Evaluation of persistence of insecticides against insect- pests of cotton (through conventional & drone application):

- **Central zone**: At majority of the locations, the different insecticides applied both through drone and conventional methods were statistically non-significant. In Junagarh and Nagpur, insecticide application with drones was more effective than conventional application. Among the tested insecticides, flonicamid in both drone and conventional application technique followed by profenophos in drone application technique and diafenthiuron in conventional application technique were most effective for sucking pests. Spinetoram was the most effective insecticide for PBW, followed by emamectin benzoate in drones and conventional application techniques. Phytotoxicity was also observed in Nagpur when insecticides (profenofos & quinalphos) were applied through drones and conventional application with more than 10 percent of field dose.
- **South zone:** Drone application provided better pest reduction than conventional spraying. Among the tested insecticides, spinetoram and diafenthiuron showed promising results in the management of sucking pests using drone and conventional methods of application. Similarly, in the case of PBW, spinetoram followed by chlorpyriphos was found to be better with the drone method of insecticides application, whereas in conventional spraying, emamectin benzoate followed by profenophos werethe most effective insecticides.

To Evaluate and identify suitable interventions for seed treatment in organic cotton production:

- **North zone**: For all the sucking pests i.e., whitefly, leafhopper, and thrips treatment T-10 (Seed treatment with insecticide) was found to be most effective. However, among non-chemical interventions T-7 (*Beauveria bassiana* + *Pseudomonas fluorescens*) was found to be most effective for whitefly, leafhopper, and thrips at majority of the North zone locations.
- **Central zone**: For sucking pests i.e., whitefly, leafhopper, and thrips treatment T-10 (Seed treatment with insecticide) was most effective. However, among the non-chemical methods, treatment with T-3 (*Beauveria bassiana*) was the most effective followed, by T-1 (Soil application of neem cake) & T-2 (*Pseudomonas fluorescens*).
- **South zone**: For the sucking pests i.e., whitefly, leafhopper, and thrips treatment T-10 (Seed treatment with insecticide) was most effective. However, among the non-chemical methods, treatment T-2 (*Pseudomonas fluorescens*) & T-6 (*Lecanicillium lecanii* + *Pseudomonas fluorescens*) were the most effective followed by T-7 (*Beauveria bassiana* + *Pseudomonas fluorescens*).

Validation of an IPM module-based on the existing interventions for organic cotton production:

- **North zone**: Module 4 (IPM) recorded the lowest pest population and Module 1 (Completely on-farm resources) recorded highest predator's population. Among the three organic modules, Module 3 [Intensive Module, 30% on-farm, 70% off-farm external inputs (cost basis)] recorded with comparatively less insect-pest incidence.
- **Central zone**: Module 4 (IPM) recorded the lowest pest population and the highest yield. Module 1 (Completely on-farm resources) recorded highest predator's population. Among the three organic modules, Module 2 (LEISA module -low external 30% input sustainable model) recorded comparatively less insect-pest incidence.
- **South zone**: Module 4 (IPM) & Module 5 (FP) recorded the lowest pest population, and among the three organic modules, Module 3 {Intensive Module, 30% on-farm, 70% off-farm external inputs (cost basis)} recorded with comparatively less insect-pest incidence and gave the highest yield.

Evaluation of Mak Adjovol (Mineral & Paraffin Oil) as an insecticide adjuvant in all zones:

- **Whitefly**: Flonicamid 50 WG + MakAdjuvol @1.5% was found to be the most effective.
- **Thrips**: Spinetoram 11.7 SC + MakAdjovol @1.5% was found to be the most effective.
- **Leafhopper**: Flonicamid 50 WG + MakAdjuvol @1.5% was found to be the most effective.
- **Aphid**: Flonicamid 50 WG + MakAdjuvol @1.5% was found to be the most effective.
- MakAdjovol@ 0.75% and 1.5% added with insecticides improved efficacy up to some extent in comparison to insecticide application without

adjovol.

Impact of Agronomic intervention on insect pest dynamics under HDPS:

- **North zone**: HDPS with IPM consistently recorded the lowest pest populations, least boll damage, and highest fruiting body retention at different locations. Similarly, the highest yield was observed in HDPS with IPM.
- HDPS (90 x 15cm) recorded the lowest sucking pest population, followed by IPM applied HDPS + De-topping (Sirsa). The lowest level of green boll damage (%) due to PBW was recorded in IPM applied De-topping at majority locations. While fruiting body retention was highest in cyclanilide + MC followed by De-topping (Sirsa) along with IPM interventions. Highest yield was obtained from IPM intervened HDPS + De-topping treatment.
- **Central zone**: HDPS with IPM consistently recorded the lowest pest population and the least green boll damage due to PBW compared to HDPS alone. Similarly, the fruiting body retention was significantly higher and highest yield was also obtained from HDPS with IPM.
- Among all canopy management treatments related to HDPS, De-topping was the most effective treatment for reducing the pest population and green boll damage (%) due to PBW. While highest fruiting body retention was recorded in IPM applied HDPS + chlormequat chloride. Among individual interventions of canopy management highest yield was obtained from IPM applied HDPS + De-topping treatment.
- **South zone**: HDPS with IPM consistently recorded lower pest populations compared to HDPS alone at majority locations. HDPS with IPM also resulted in the lowest green boll damage (%) due to PBW, higher fruiting body retention, and higher yield.
- Among all canopy management treatments related to HDPS, De-topping was the most effective treatment in reducing the pest population and green boll damage (%) due to PBW, followed by cyclanilide + MC. The highest fruiting body retention was recorded in HDPS + chlormequat chloride along with HDPS. Highest yield was obtained from IPM applied HDPS + De-topping treatment**.**

Crop Protection: Plant Pathology (2024-25)

- Cotton disease surveillance conducted in 364 villages (5-10 fields in each) of 42 districts in 9 cotton growing states covering all cotton growing zones of India revealed that the major diseases observed during 2024-25 are as under-
- **North Zone**: CLCuD was low in Haryana (17.7%) and Rajasthan (19.1%), severe in Punjab (35.8%), and root rot was low in Haryana (0.4-4.9%) during mid- and late-seasons.
- **Central Zone**: Grey mildew was moderate in Maharashtra (12.9%), Gujarat (11.6%), and Madhya Pradesh (12.3%). Bacterial leaf blight (BLB) was moderate in Maharashtra (9.6%) and slightly high in Gujarat (11.6%). Alternaria leaf spot (ALS) incidence was moderate in Maharashtra (9.6%) and Gujarat (7%). Para wilt was low in Gujarat (5.9%) during mid-season. Target leaf spot (CoLS) was low in Gujarat (1.3%) and moderate in Madhya Pradesh (9.5%) in the late season, while boll rot was low in Maharashtra (1.2%) and moderate in Gujarat (7.6%)
- **South Zone**: Grey mildew was moderate in Karnataka (10.2%) and Tamil Nadu (10.7%). ALS was moderate in Tamil Nadu (9%) and Karnataka (16.7%). BLB was moderate in Karnataka (7.5%) and slightly high in Tamil Nadu (11.9%). Root rot was moderate in Tamil Nadu (8.7%), whereas boll rot was moderate in Tamil Nadu (5.1%) and slightly higher in Karnataka (13.1%).

Disease progress in relation to weather parameters studied at on-station trials conducted and the regression equations developed and validated with the previous year's models:

- **Disease screening trials**: A total of 150 entries were evaluated in 15 National (5) and Zonal (10) trials showed different reactions against location-specific diseases. However, 14 genotypes, including *G. hirsutum* (11), *G. barbadense* (2), *G. arboreum* (1) showed single and or multiple diseases resistance against CLCuD, ALS, BLB, GM, and CoLS under confirmation field and artificial screening trials.
- Multilocation field trials were conducted and promising disease management treatments were recorded
- Among endophytic BCAs, their combinations and recommended chemicals were evaluated for the management of seed and soil-borne diseases at 8 centers, the application of consortium ECN-1 @ 5g/kg seed + foliar spray @ 5g/lit water at 60 and 90 DAS was found to be superior to other treatments for root rot and foliar disease management.
- Among the six chemical treatments evaluated for management of TSV and its vector-thrips at three centers, the maximum reduction in TSV disease was recorded with need-based spray applications of Tolfenpyrad 15 % EC (1000 ml/ha), followed by Spinetoram 11.70 % SC (420 ml/ha) and Dinotefuron 20 SG (150g/ha).
- Among the 11 CIB&RC-recommended chemicals evaluated as spray applications for the management of foliar diseases at Sriganganagar, Nanded, Khandwa, and Coimbatore, the following treatments were found to be better than the control:
- Bacterial leaf blight- Copper sulphate 47.15% + Mancozeb 30% WDG @ 5 g/ liter of water,

Fluxapyroxad 167 g/liter + Pyraclostrobin 333 g/liter SC @ 0.6 g/liter of water at Coimbatore.

- **Alternaria leaf spot** - Fluxapyroxad 167 g/liter + Pyraclostrobin 333 g/liter SC @ 0.6 g/liter of water and Metiram 55% + Pyraclostrobin 5% WG @ 2 g/liter and Azoxystrobin + Difenoconazole @1 ml/L of water at Nanded and Coimbatore
- **Grey mildew** - Fluxapyroxad 167 g/liter + Pyraclostrobin 333 g/liter SC @ 0.6 g/liter, Kresoxim methyl 44.3% SC @ 1 ml/liter of water and Metiram + Pyraclostrobin@.2g/L of water at Khandwa, Nanded and Coimbatore.
- **Target leaf spot** - Fluxapyroxad 167 g/liter + Pyraclostrobin 333 g/liter SC @ 0.6 g/liter of water and Azoxystrobin 18.2% w/w + Difenoconazole 11.4% w/w SC @ 1 ml/ liter of water at Khandwa
- **Boll rot**- Fluxapyroxad 167 g/Liter + Pyraclostrobin 333 g/liter SC @ 0.6 g/L, Metiram 55% + Pyraclostrobin 5% WG @ 2 g/liter, Propineb 70% WP @ 2.5 g/liter and Copper oxychloride @ 2.5 g/L of water at Sriganganagar, Khandwa, Nanded, and Coimbatore
- **Crop loss estimation studies were conducted at on-station trials**: The average reduction in seed cotton yield (SCY) corresponding to CLCuD severity grades was estimated to be grades 1, 2, 3, 4, 5 and 6 was 7.8, 21.1, 37.4, 49.5, 53, and 80.2%, respectively, in Haryana, Rajasthan, and Punjab. The SCY reductions corresponding to TSV grades 1, 2, 3, and 4 were 29.5, 49.8, 53.1, and 41.7%, respectively, in Rahuri, Guntur, and Coimbatore.

Concluded Experiments/Recommendations

- The pooled results of three year trials conducted at TNAU, Coimbatore (2022-23-2024-25) depicted need-based spray application of Propineb 70% WP @ 2.5 g/liter, Fluxapyroxad + Pyroclostrobin @ 0.6 g/L, and Azoxystrobin + Difenoconazole @1 ml/L of water was found promising for Alternaria leaf blight management, while for grey mildew management, Kresoxim methyl 44.3% SC @ 1 ml/liter, Azoxystrobin + Difenoconazole @ 1 ml/L and Fluxapyroxad + Pyroclostrobin @ 0.6 g/L of water were found better than other treatments. Copper sulphate 47.15% + Mancozeb 30% WDG @ 5 g/ liter, Fluxapyroxad + Pyroclostrobin @ 0.6 g/L, and Copper oxychloride @ 2.5 g/L of water for bacterial leaf blight and Fluxapyroxad + Pyroclostrobin @ 0.6 g/L, Metiram + Pyraclostrobin @ 2 g/L, and Azoxystrobin + Difenoconazole @ 1 ml/L for minimizing boll rot diseases were found superior treatments at Coimbatore, Tamil Nadu.
- The pooled results of three-year field experiments conducted at 8 centers in all 3 zones for management of seed and soil-borne diseases (2022-23-2024-25) showed that the highest reduction in plant mortality (65.7, 62.7%) at 120 DAS was achieved with treatment T-5, 6 (*Trichoderma* spp. Rf-B/Th-11 as seed (5g.kg) + soil treatment (1kg. acer) and foliar spray (2 ml/L) plus Mak Adjuvol @1.5% or 0.75% at 60 and 90 DAS), followed by T-4 (*Trichoderma* spp. Rf-B/Th-11 as seed + soil treatment and foliar spray at 60 and 90 DAS) and T-3 (*Trichoderma* spp. -Rf-B/Th-11 as seed + soil treatment). The seed germination rate was ranged from 87.2% to 88% in treatments T-3 to T-7 (seed and soil treatment with *Trichoderma* spp. Rf-B/Th-11).

Annual Group Meeting of AICRP on Cotton

A National-level Annual Group Meeting of the All India Co-ordinated Research Project (AICRP) on Cotton was jointly organized by Dr. PDKV, Akola, and ICAR-CICR at Vastantrao Naik State Agricultural Extension Management Training Institute (VANAMATI), Nagpur. The inaugural session held on 5th April 2024 was presided over by the Hon'ble Vice Chancellor Dr S.R. Gadakh, Dr. PDKV, Akola and Dr. T.R. Sharma, Hon'ble Deputy Director General (Crop Science), ICAR, New Delhi. Special invitees included Dr. C. D. Mayee, Chairman, Program Monitoring and Advisory Committee & Ex-Chairman ASRB; Dr. D. K. Yadava, Assistant Director General (Seeds) and Dr Prashant K Dash, ADG (Commercial Crops); ICAR, New Delhi; Dr S. K. Shukla, Director, ICAR-CIRCOT, Mumbai; Dr. Y.G. Prasad, Director ICAR-CICR, Nagpur, and Dr.V. K Kharche, Director of Research, Dr. PDKV Akola.

9 KRISHI VIGYAN KENDRA

Trainings

On-campus and Off-campus training

Eighty-five short duration (1, 3 and 5 days) on-campus and off-campus training courses were conducted in different disciplines for practicing farmers, rural youth, and extension functionaries. In total 4,454 participants, including 1,079 SC/ST participants benefited from the training programs.

Table: Details of training conducted

Clientele	No. of Courses	Male	Female	Total participants
Farmers & farm women	59	1976	946	2981
Rural youths	16	642	298	956
Extension functionaries	4	124	42	170
Skill Training	6	254	87	347
Vocational Training	0	0	0	0
Total	85	2996	1373	4454



Training Programme

1. The KVK, ICAR- CICR, Nagpur conducted a two-day training program during 23-24 Oct, 2024 for Board of Directors (BODs), Chief Executive Officers (CEOs), and accountants of Farmer Producer Organization (FPOs) on “Sustainable Agribusiness, skill development for entrepreneurs and financial literacy” in collaboration with Savitribai Phule Mahila Ekatm Samaj Mandal (SPMESM), Chatrapati Sambhajinagar. Dr. Y.G. Prasad, Director, ICAR-CICR, Nagpur was the Chairman of the function and Sh. Ravindra Manohare, SAO, Agriculture Department, Nagpur, was the Chief Guest of the inauguration function of the 2-day training program and, Dr. Ramkrushna, G. I., Sr. Scientist and Head KVK, Nagpur, Dr. Suhas Ajgaokar, Secretary, SPMESM, C. Sambhajinagar and other KVK staff were present on this occasion. Approximately 50 participants from six FPOs attended the training to better understand sustainable practices of agriculture and allied enterprises in establishing agribusiness.
2. The five-day training program on "Climate Resilient Agricultural Practices for Cotton Production & Allied Enterprises" was organized by the KVK, ICAR-CICR, Nagpur. The program was held from 26th September to 3rd October 2024.

The venue for the training sessions was the Training Hall of KVK, ICAR-CICR, Nagpur. During the training programme, 40 participants from Ambuja Foundation were present.

Cluster Front Line Demonstrations of Oilseed Crop enterprises

Three CFLDs on oilseeds (i.e., Soybean (NRC-130, Mustard PM-32 and Groundnut TAG-24) was conducted in the adopted villages of Nagpur district, viz. Kanolibara, Kargaon, and Bothli. Several extension activities like field day, field visits of farmers and extension functionaries, group discussion and scientist farmers meet etc. were conducted for effective implementation of technologies. These demonstrations were conducted in 350 farmer fields covering a 140 ha area.

On Farm Trails (OFTs)

Sr. No.	Discipline	OFT Conducted	No. of farmers	Area (ha)/No. of Animals
1.	Agronomy	Assess the performance of different Soybean variety suitable for Nagpur District	13	5.2
2.	Agronomy	Assessment of improved varieties of pigeon -pea for higher productivity	13	5.2
3.	Horticulture	Assessment the effect of foliar application of Grade II micronutrients on quality yield in Tomato	15	6.0
4.	Horticulture	Assess the application of chlormequat chloride 3000 ppm to increase bulb size in Onion	13	5.20
5.	Veterinary Science	Performance of goats on improvised urea molasses mineral block/Laddu under field conditions	15	45 Goats
6.	Veterinary Science	Assessment of production performances of goats fed on cotton straw based pelleted completed feed	15	45 Goats
7.	Veterinary Science	Performance of sex sorted semen under small dairy farming system of cows	14	14 Cows
8.	Home Science	Assessment of heat treatment in increasing the shelf life of pearl millet flour (Bajara))	27	27
9.	Home Science	Assess the efficiency of Phule Drumstick Harvester for drudgery reduction	18	18

Front Line Demonstrations (FLDs)

Sr. No.	Discipline	FLD Conducted	No. of farmers	Area (ha)/No. of Animals
1.	Agronomy	Weed management for maximizing soybean yield	13	5.2
2.	Agronomy	Foliar application of Urea, DAP and MgSO4 to reduce reddening in Bt Cotton	13	5.2
3.	Agronomy	Assessment of weed management practices for cotton production	13	5.2
4.	Agronomy	weed management for maximizing wheat yield	13	5.2
5.	Agronomy	Assessment of high -density planting system (HDPS) and closer spacing system on cotton.	13	5.2
6.	Horticulture	Demonstration of high yielding and YVMV resistant variety of Okra (Kashi Chaman)	50	20

Sr. No.	Discipline	FLD Conducted	No. of farmers	Area (ha)/No. of Animals
7.	Horticulture	Demonstrations of high yielding variety of Brinjal (Hybrid PBL-232)	50	20
8.	Veterinary Science	Supplementation of mineral lick blocks to the cows	15	30 Cows
9.	Veterinary Science	Scientific cultivation of Fodder Super Napier (Packchong-I) variety	15	30 Cows
10.	Home Science	Cultivation of Cole crops in Nutrition Garden through IPM Model	18	18
11.	Home Science	Performance of Saat din Ki Saat Kyari for small land holders for nutritional sustainability	18	18

Income generation through enterprises established under ARYA

Sr. No.	Name of SHG & Address	Product	Average Income before ARYA (2023) Rs./month	Average Income during ARYA (2024 Rs./month	Increase in Income Rs./month
1.	Swayam Sahayta, Nagpur	Pickles, Jam, Jelly, Candy	7000	19000	12000
2.	Sawitribai Phule, Kalmeshwar	Chilli, Turmeric, Spices	14000	29000	15000
3.	Ekta Mahila, Panjari	Millet flour, Urad, Mug, Papad & Wadi	4000	9000	5000
4.	Rakhi Mahila, Kuhi	Mix Fruit Jam	6000	15000	9000
5.	Jijayu SHG,Jamtha	Potato chips	Nil	15000	15000
6.	Samyak SHG,Beltarodi	Snacks from agricultural products Potato chips, Moong Vadi ,Papad, Wheat noodles	Nil	20000	20000
7.	Tirupati Santra Utpadak Gat, Gondbori, Bhiwapur	Sugar cane Juice (January to June)	10000	22000	12000
8.	Bhiwapur Mirchi Utpadak Gat	Chilli powder	25000	60000	35000
9.	Taj Shetkari Gat, Wakodi	Custard apple pulp (October to January)	Nil	30000	30000
		Total			**1,53,000**

KVK, ICAR-CICR holds PM Kisan Webcasting Programme

Krishi Vigyan Kendra, ICAR-CICR, Nagpur organized PM Kisan programme at its premises on 28/02/2024. This event was hosted via webcasting of the programme from Yavatmal, which was presided over by the Hon'ble Prime Minister. On this occasion, the 16th installment of Kisan Samman Nidhi was released in the form of DBT into the farmers accounts by the Prime Minister. More than 212 farmers, especially those from the Scheduled Caste category, actively participated in this programme, which was sponsored under the Development Action Plan for Scheduled Caste (DAPSC) Scheme. A total of 75 water purifiers were distributed to Schedule Caste (SC) beneficiaries under the DAPSC programme.

Speaking on the event, Dr. Y. G. Prasad, Director, ICAR-CICR, Nagpur, urged farmers to take advantage of the benefits of ICAR institutes and SAUs by adopting the

technologies developed by them. He informed the house about the “Special Project on Cotton” in which highdensity planting system was adopted by beneficiary cotton farmers in 28 districts. The results were encouraging clearly indicating increased cotton production in experimental fields.

Dr. R. K. Singh, Sr. Scientist and Head, KVK welcomed the farmers and introduced the house about the role of KVK and its activities in agriculture, livestock production, and allied sciences to uplift the livelihood of the farming community.

In a technical session, Scientists of CICR, Nagpur, Dr. Dipak Nagrale, Dr. Manikandan spoke on various topics like INM, Disease Management in Cotton, whereas Dr. U.V. Galkate, KVK spoke on Goat Production Technologies for rural areas. Dr. Mayurkumar Meshram, KVK, spoke on the technique of soil collection and its testing. Mrs Sunita Chauhan conducted the visit of farmer participants to Cotton Cropping- based Integrated Farming System (IFS) Model developed at KVK with inclusion of agronomy, horticulture – fruits and vegetables, livestock – cow, goat, poultry, duck, and fisheries component.

Dr. G. T. Behere, Head, Division of Crop Protection, Dr. Jayant Meshram, Principal Scientist & Nodal Officer (DAPST), CICR, Nagpur, were present on the occasion.

Tree Plantation Drive Held at ICAR-CICR Nagpur "Ek Ped Maa Ke Naam" Initiative

In a significant step toward environmental conservation, the ICAR-CICR, Nagpur, in collaboration with Krishi Vigyan Kendra (KVK), Nagpur, organized a tree plantation drive on 29.08.2024 under the "Ek Ped Maa Ke Naam" initiative. This event witnessed enthusiastic participation from the Director of CICR, the Head of KVK, scientists from CICR, and all staff of KVK, Nagpur.

The drive was inaugurated by Dr. Y.G. Prasad, Director, ICAR-CICR, Nagpur, who emphasized the critical importance of tree plantation in combating climate change and enhancing green cover. "This initiative is not just about planting trees; it's a tribute to our mothers, and through this, we aim to instill the values of nurturing and care, just like a mother does," said the Director.

Dr Ramkrushna G.I., Head, KVK, CICR, Nagpur, also addressed the gathering, highlighting the role of trees in sustaining biodiversity and improving the quality of life.

"Each tree planted today is a step toward a greener and healthier future”. It's our responsibility to ensure that the environment we pass on to the next generation is better than what we inherited," he stated.

Golden Jubilee Celebration of Krishi Vigyan Kendras (KVKs) at ICAR-CICR KVK, Nagpur-1 on 08.04.2024

The ICAR-Krishi Vigyan Kendras (KVKs) celebrate their Golden Jubilee Year in 2024, marking 50 years of dedicated service to agricultural development. The inaugural KVK, established by the ICAR on 21 March 1974 in Puducherry, established the foundation for a transformative journey in agricultural innovation and outreach.

The Golden Jubilee Celebration Torch, symbolizing the illuminating progress achieved by KVKs over the years, arrived at KVK Nagpur from Puducherry, where a Golden Jubilee celebration started on March 21, 2024.

Dr. Y.G. Prasad, Director, ICAR-CICR, Nagpur, highlighted the collaborative efforts in disseminating CICR technology through KVK networks and encouraged farmers to adopt advanced cotton production techniques.

On the occasion, vegetable seed kits and plant protection inputs were distributed to the farmers. The event was organized by Dr. Ramkrushna G.I., Senior Scientist and Head of KVK, CICR, Nagpur, with dedicated contributions from Dr. S.S. Patil, Dr. U.V. Galkate, Mrs. Sunita Chauhan, Dr. Deepa Lal, Dr. S.Y. Wankhede, Dr. Mayur Meshram, Mr. P. S. Gayakwad, Mr. Amol Raghorte, Mr. Sarang Shrirame, and other KVK staff members. Mrs. Sunita Chauhan facilitated coordination, ensuring the smooth conduct of the event, while Dr. Deepa Lal extended heartfelt gratitude through

a vote of thanks, acknowledging the collective efforts that made the Golden Jubilee Celebration of KVKs a resounding success.

Krishak Swarn Samriddhi Week held at Krishi Vigyan Kendra, ICAR- CICR, Nagpur

The Krishi Vigyan Kendra (KVK), ICAR-Central Institute for Cotton Research (CICR), Nagpur, inaugurated the Krishak Swarn Samriddhi Week on 23rd September 2024. This week-long celebration, from 23rd to 27th September, 2024, aims to promote innovative agricultural practices for sustainable farming and livelihood enhancement, crop diversification and best practices, agri business and value addition, livestock management and allied agriculture and financial and government support for farmers.

The program was chaired by Dr. Y. G. Prasad, Director, CICR, Nagpur. He addressed farmers on the importance of agricultural innovation for achieving self-sufficiency and sustainability. He emphasized the critical role of innovative techniques in improving agricultural productivity and supporting sustainable farming. Krishak Samriddi Rath was inaugurated by the hands of Dr. Y. G. Prasad in the presence of the KVK, CICR staff, and farmers.

During the ceremony, agricultural tools and inputs were distributed to the participating farmers by Dr. Y.G. Prasad and other dignitaries further supported efforts to improve farming techniques and resources.

Following the inaugural ceremony, a technical session covering a range of important topics relevant to sustainable farming and agricultural innovation was held.

PM Kissan Samman Nidhi Programme live webcast

KVK & ICAR-CICR, Nagpur conducted PM Kisan Samman Nidhi Programme live webcasting and also organized Input distribution under TSP: Vegetable seeds Kit, hand sprayer and bio fertilizers were distributed on 18 June 2024 at ICAR-KVK-CICR, Nagpur to benificiary farmers. Fifty participants attended the programme.

World Soil Day celebrated by the KVK, ICAR, CICR, Nagpur

On the occasion of World Soil Day (5th December, 2024) a program was organized in different villages and school to raise awareness about soil health and sustainable agriculture. More than 200 farmers from Walani, Gumthala, and Ramtek participated in the programme wherein awareness was created about the soil health and soil health card.

Attracting and retaining rural youth in Agriculture (ARYA)

Attracting and Retaining Rural Youths in Agriculture (ARYA) project was initiated in 2015-16. KVK-CICR,

Nagpur is one of the centre operating two enterprises for the livelihood of rural youth. 1) Development of disease-free sampling of Nagpur mandarin 2) Fruits and vegetable processing. Project ARYA (Attracting & Retaining Rural Youth in Agriculture) is focuses on creating awareness and capacity building training programmes for youths in rural areas to take up various agricultural, allied and service sector enterprises for sustainable income and gainful employment. During the year 2024, KVK trained 128 rural youths for production of disease-free seedlings of Nagpur mandarin and 110 members of 11 self-help groups for preparation of pickles, citrus juice, Potato chips, preparation of Mixed Fruit Jam, Tomato Ketchup, solar drying of vegetables and preparation of Millet Laddus in different villages of Nagpur (Besa, Beltarodi, Chichbhuvan, Gondbori, Wakodi, Bhiwapur,Nagalwadi, Katol, Jamtha, kukrdi panjara and kherdi).

Additionally, KVK provided technical training support to rural youth of the Katol block for multiplication of disease-free Nagpur mandarin seedlings. 13 rural youth beneficiaries developed their nursery on Nagpur mandarin and generating significant income. 13 Knapsack Sprayers are distributed to Citrus Nursery Growers as critical inputs from Paradsinga, kalmeshwar, Mohpa, Ladgoan, Kukadipanjara village of Tahsil Katol and are receiving training and guidence under ARYA.

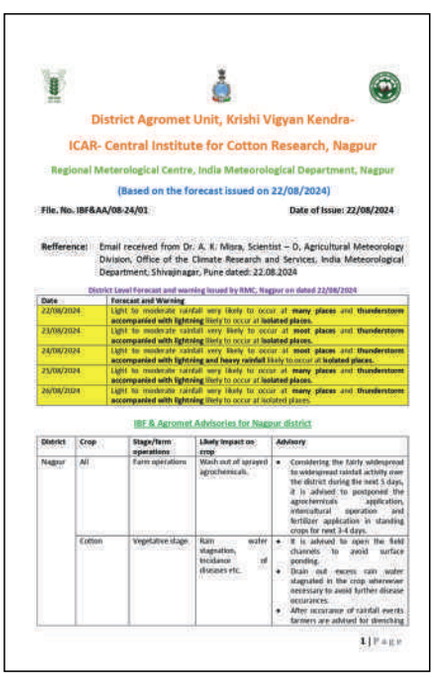
Gramin Krishi Mausam Seva

Agromet Advisory Services Bulletins

Under the KVK- Gramin Krishi Mausam Sewa, Atmosphere & Climate Research- Modelling Observing Systems & Services scheme, a total of 2912 bi-weekly agrometeorological advisory services bulletins were prepared and disseminated to Nagpur district farmers through various modes from the District Agromet Unit, Nagpur.

Impact-based forecasting and advisory services

The impact-based forecasts and advisory were prepared and disseminated by DAMU to the District Collector Office, SAUs, District Disaster Management Authority, District Information Office, State Department of Agriculture, Nagpur, NGOs, FPOs, SHGs, and farmers of the Nagpur district before and after the occurrence of adverse weather events through different modes. A total of 4 I. BF bulletins were prepared and disseminated in 2024.


District Agromet Unit, Krishi Vigyan Kendra-

ICAR- Central Institute for Cotton Research, Nagpur

Regional Meterological Centre, India Meteorological Department, Nagpur

(Based on the forecast issued on 22/08/2024)

File. No. IBF&AA/08-24/01 Date of Issue: 22/08/2024

Refference: Email received from Dr. A. K. Misra, Scientist – D, Agricultural Meteorology Division, Office of the Climate Research and Services, India Meteorological Department, Shivajinagar, Pune dated: 22.08.2024

District Level Forecast and warning issued by RMC, Nagpur on dated 22/08/2024

Date	Forecast and Warning
22/08/2024	Light to moderate rainfall very likely to occur at **many places** and **thunderstorm accompanied with lightning** likely to occur at **isolated places.**
23/08/2024	Light to moderate rainfall very likely to occur at **most places** and **thunderstorm accompanied with lightning** likely to occur at **isolated places.**
24/08/2024	Light to moderate rainfall very likely to occur at **most places** and **thunderstorm accompanied with lightning and heavy rainfall** likely to occur at **isolated places.**
25/08/2024	Light to moderate rainfall very likely to occur at **many places** and **thunderstorm accompanied with lightning** likely to occur at **isolated places.**
26/08/2024	Light to moderate rainfall very likely to occur at **many places** and **thunderstorm accompanied with lightning** likely to occur at isolated places.

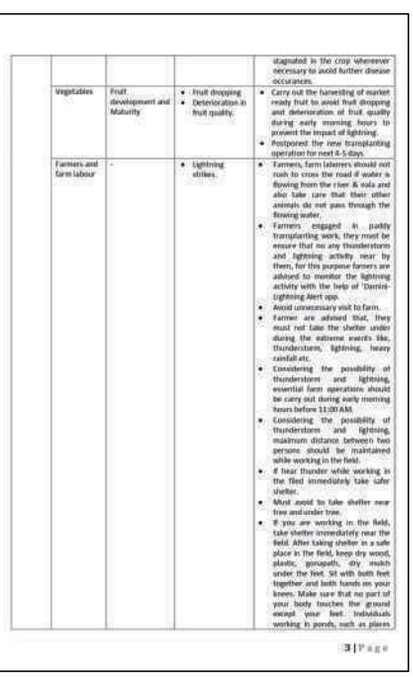
IBF & Agromet Advisories for Nagpur district

District	Crop	Stage/farm operations	Likely impact on crop	Advisory
Nagpur	All	Farm operations	Wash out of sprayed agrochemicals.	• Considering the fairly widespread to widespread rainfall activity over the district during the next 5 days, it is advised to postponed the agrochemicals application, intercultural operation and fertilizer application in standing crops for next 3-4 days.
	Cotton	Vegetative stage	Rain water stagnation, incidence of diseases etc.	• It is advised to open the field channels to avoid surface ponding. • Drain out excess rain water stagnated in the crop wherever necessary to avoid further disease occurances. • After occurance of rainfall events farmers are advised for drenching

1 | Page


				of Carbendazim 50 % WP @ 1.2 gram per litre of water to protect the crop from wilt and root rot disease. • Also the application of Trichoderma formulation @ 1 kg mix with in 50 kg of well decomposed FYM for 1 acre area to protect the crop from seedling diseases is suggested.
Soybean	Post development	Rain water stagnation, crop lodging, incidance of diseases etc.		• It is advised to open the field channels to avoid surface ponding. • Drain out excess rain water stagnated in the crop wherever necessary to avoid further disease occurances. • Suspend all farm operations viz., agrochemicals spraying, fertilizer application, intercultural operations etc. for next 3-4 days on accounts of forecasted fairly widespread to widespread rainfall and heavy rainfall at isolated places along with thunderstorm and lightning.
Arhar	Vegetative	Rain water stagnation, crop lodging, incidance of diseases etc.		• It is advised to open the field channels to avoid surface ponding. • Drain out excess rain water stagnated in the crop wherever necessary to avoid further disease occurances. • Suspend all farm operations viz., agrochemicals spraying, fertilizer application, intercultural operations etc. for next 3-4 days on accounts of forecasted fairly widespread to widespread rainfall and heavy rainfall at isolated places along with thunderstorm and lightning.
Paddy	Tillering	Farm and farm labour may suffer due to heavy rain and lightning.		• Suspend all farm operations viz., agrochemicals spraying, fertilizer application, intercultural operations etc. for next 3-4 days on accounts of forecasted fairly widespread to widespread rainfall and heavy rainfall at isolated places along with thunderstorm and lightning.
Nagpur mandarin, sweet orange and acid lime	Ambia Bahar - Fruit development	-		• It is advised to support the fruit orchards with the help of Bamboos to avoid the fruit dropping. • Drain out excess rain water

2 | Page

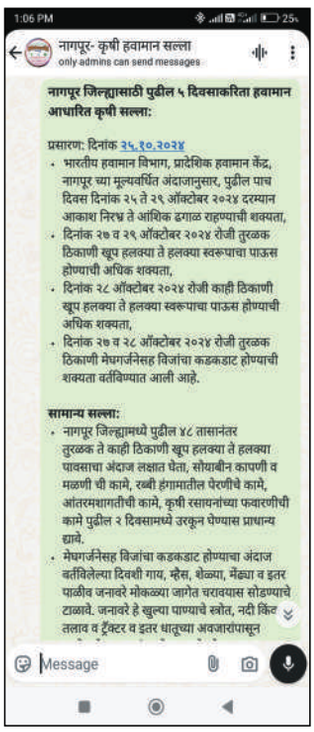

				stagnated in the crop wherever necessary to avoid further disease occurances.
Vegetables	Fruit development and Maturity	• Fruit dropping • Deterioration in fruit quality.		• Carry out the harvesting of market ready fruit to avoid fruit dropping and deterioration of fruit quality during early morning hours to prevent the impact of lightning. • Postponed the new transplanting operation for next 4-5 days.
Farmers and farm labour	-	• Lightning strikes.		• Farmers, farm laborers should not rush to cross the road if water is flowing from the river & nala and also take care that their other animals do not pass through the flowing water. • Farmers engaged in paddy transplanting work, they must be ensure that no any thunderstorm and lightning activity near by them, for this purpose farmers are advised to monitor the lightning activity with the help of 'Damini-Lightning Alert app. • Avoid unnecessary visit to farm. • Farmer are advised that, they must not take the shelter under during the extreme events like, thunderstorm, lightning, heavy rainfall etc. • Considering the possibility of thunderstorm and lightning, essential farm operations should be carry out during early morning hours before 11:00 AM. • Considering the possibility of thunderstorm and lightning, maximum distance between two persons should be maintained while working in the field. • If hear thunder while working in the filed immediately take safer shelter. • Must avoid to take shelter near tree and under tree. • If you are working in the field, take shelter immediately near the field. After taking shelter in a safe place in the field, keep dry wood, plastic, gunypatti, dry mulch under the feet. Sit with both feet together and both hands on your knees. Make sure that no part of your body touches the ground except your feet. Individuals working in ponds, such as places

3 | Page

Impact-based forecast and advisory bulletins

Nowcast warning

The Nowcast warning and forecast are received from time to time by Regional Meteorological Centre, Nagpur and are disseminated to farmers on priority on their registered mobile number through different social media platforms. The Nowcast warning includes warnings about heavy rainfall, hail, thunderstorms, lightning, and gusty winds valid for next 3 hours from the Nowcast forecast issued.



Farmers Awareness Programme on agrometeorological advisory services in Nagpur

A total of 8 farmer awareness programmes were conducted in Nagpur to promote the use and application of agrometeorological advisory services. These programs held at the KVK campus and various villages. Such awarenes programmes play a crucial role in educating farmers about the benefits of utilizing such services for effective farm management, especially in mitigating the risks posed by adverse weather conditions. The use of mobile applications such as Meghdoot, Damini, Mausam and Public Observatories can significantly empower farmers by providing timely weather updates and forecasts. By leveraging these applications, farmers can make informed decisions regarding crop cultivation, irrigation scheduling, pest management, and other agricultural practices, thereby optimizing yields and minimizing losses.

Overall, initiatives like these contribute to enhancing agricultural systems' resilience and sustainability, ultimately improving farmers' livelihoods and strengthening food security in the region.

Exposure visits of students from G. H. Raisoni College of Engineering, Nagpur to Agromet Observatory of ICAR-CICR, Nagpur

Exposure visits of students from Yashwantrao Chavhan College of Engineering, Nagpur to Agromet Observatory of ICAR- CICR, Nagpur

Farmers Awareness programme on Weather Information at Farmers' Doorsteps through Mobile on 8.09.2024 at R.R. Lahoti Science College, Morshi, District Amravati Organized by Late Vasantrao Naik Sheti Swawalamban Mission, Maharashtra, in collaboration with Shri R. R. Lahoti College of Science, Morshi, and Yashwantrao Chavan Open University, Nashik

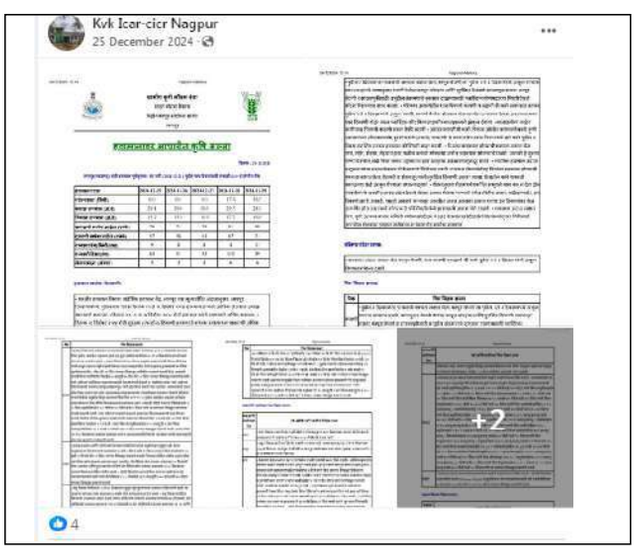
Lightning Awareness Programme at Ghorpad, Tehsil-Kamthee, Nagpur on 24.09.2024 under Krishak Samruddhi Week.

Dissemination of Agromet Advisory Services in Nagpur

The dissemination of the Agromet Advisory Service (GKMS) was effectively carried out through various social media platforms and communication channels, reaching a wide number of farmers. Among the most widely used platforms, WhatsApp was the most prominent, with a total of 82,756 farmers receiving advisories through 342 WhatsApp groups. In addition, a WhatsApp community group of 2,545 farmers also played a key role in sharing important agricultural information.

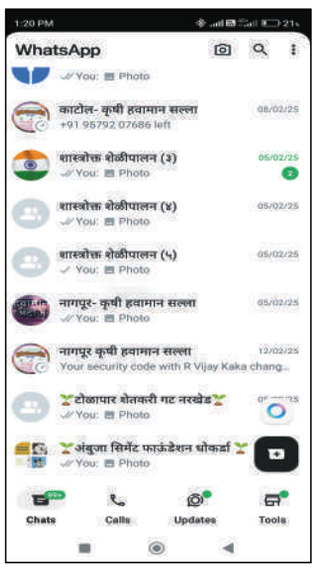
Another significant platform for the advisory service was the mKisan portal, which reached 169,607 farmers, followed by the Kisan Sarathi portal, with 61,393 registered farmers. The Telegram channels (3 in total) served 1,899 farmers, and the Facebook page, although reaching fewer farmers, still contributed with a total of 4,978 farmers.

In total, the combined efforts across these platforms reached 3,23,178 farmers, demonstrating the extensive outreach and impact of the Agromet Advisory Service under the GKMS program.



Dissemination Agromet Advisory Services through Facebook

Dissemination of weather forecast through X (Formerly Twitter)



Dissemination of weather forecast and advisory services through Whats app.

The following social media platform were created and used for dissemination of Agromet Advisory service under GKMS ACROSS-

Sr. No.	Social media platform	No. of farmers
1.	Whats app (342 group)	82756
2.	Whats app community group (1)	2545
3.	mKisan portal (1)	169607
4.	Kisan Sarathi portal (1)	61393
5.	Telegram (3)	1899
6.	Facebook (1)	4978
Total		**3, 23, 178**

Integrated Farming System (IFS) for Doubling Farmer's Income

Krishi Vigyan Kendra, Nagpur, developed an Integrated Cotton based IFS module in 2021, covering a 1 hectare area. This IFS has three components viz., crop component (Cotton + Soybean), a horticulture component (vegetable & fruits) and animal components (Goat, cow, fish), and allied enterprise (mushroom cultivation).

Responsibility for the establishment and strengthening of Horticulture component was given to Ms. Sunita Chauhan, SMS (Home Science), who brought nutritional security and enhanced income of the family at large.

- In the horticulture component, all seasonal vegetables of Kharif and Rabi crops are grown organically.
- Organic waste is also converted to manure using a waste decomposer.
- 179 Amrapali mango plants wereplanted in March 2021 using the high- density method and 64 Guava of L-49 variety are planted in June 2021 on mulch.
- Nearly 996 Dignitaries, tribal and schedule caste farmers, Farm Women, RAWE students, and SHG visited the IFS module. Skill training on Nursery raising, Seedling transplanting on mulch, and operation of drudgery reduction tools were provided during the reporting period for women empowerment.
- A model of Cole Crops with Bio Control was demonstrated. Excellent quality Cabbage, Cauliflower, Broccoli, and red cabbage were cultivated during the Rabi Season. All produce was sold to the ICAR-CICR staff on a first-come-first-serve basis.
- Onions and green leafy vegetables were also cultivated during the Rabi Season. Training on value addition of turmeric and chili was given to Farm Womens, SHGs for enhancing income of rural community.
- Demonstration and use of Jivamrutham, Panchgavya, Dashparni, fermented fruit Juice to PFM, PFF, EFF.
- Introduction of cultivation of watermelon in Zaid season.
- Demonstration of Oyster Mushroom in an Outdoor, Mobile Unit for additional income generation.
- A demonstration of a Type C variety Dragon Fruit plantation was successfully conducted in IFS for tribal farmers of Hingna Tahsil. The initiative was aimed to introduce modern cultivation techniques, improve productivity, and promote sustainable farming practices among the tribal community. The farmers were guided on proper land preparation, planting methods, irrigation management, and post-harvest practices to ensure better yield and profitability. This effort is expected to enhance livelihood opportunities and encourage the adoption of high-value horticultural crops in the region through IFS.

A low-cost small model shade for a family 0f 2-4 person is also established. In one hectare area crop like cotton, soybean, gram, seasonal and exotic vegetables, fruits, and flowers, were grown in kharif and rabi season and other components such as animal, poultry, duck, goat, cow, fish were demonstrated for enhancing the income of marginal farmers.

Integrated farming system module units were visited by

the State Agriculture Departments and officials of Nagpur Universities , Wardha, Akola, Gadchiroli, Durg, Narmadapuram (MP), and 950 students from 3rd to 9th standard of PM Kendriya Vidyalaya, Nagpur from January to December 2024. In all 26 visits in IFS were carried out. They observed the organic cultivation practices of vegetables, fruits, and flowers grown under IFS, composting technique & animal components of IFS, viz. Ducks, Poultry, Fish, and Goats.

Natural Farming

Krishi Vigyan Kendra conducted workshop cum training on Natural farming under the Home Science discipline for farmers, farm women, students, and Farmers Producing Organization (FPO) on 20 August 2024. In his

inaugural address, Dr. Ramkrushna Senior Scientist and Head KVK, ICAR-CICR, Nagpur emphasized the need for popularization efforts for “Natural Farming” and stressed the role to be played by the FPOs. In the technical session, demonstration on preparation of biological inputs, viz. Jivamrut, Panchagavya, and Saptdhanankur, and preparation of Bio-pesticides, viz. Dashparni, LAMIT Ark, and Botanicals for use in Natural Farming by Smt. Sunita Chauhan, SMS, Home Science, KVK, ICAR-CICR, Nagpur. 132 farmers, 184 students, FPO Nagpur, Umred, Bhiwapur, and Hingna were benefited during 2024.

Swachhta Bharat Diwas and Decade of Swachh Bharat Mission:

ICAR-Central Institute for Cotton Research (CICR), Nagpur, celebrated Swachhta Bharat Diwas and a decade of Swachh Bharat Mission at Community Hall, Krishi Kunj, Bajaj Nagar, Nagpur on 2nd Oct 2024. Twenty sanitation workers who take care of the surroundings of quarters (Type 1 to Type 5), play grounds, gardens, roads, and Guest house participated in the programme. During the glorious event celebration, a felicitation was given to all sanitation workers, who also distributed lunch boxes, water bottles, and sanitation kits. The best sanitation workers and security guards were awarded for their contributions during the covid and fire accident at Krishi Kunj. Earlier Swachh Food Streets Initiative at Punarvasan Weekly Bazaar, Khapri was inspected for sanitation being followed by different fast-food stalls, Chaupati stalls, Chat Centre, and Food Junction. During the programme, awareness of the importance of Swachh food and cleanliness was taught to the participants. In another activity, Swachhata Sabha at Village level a special Gram Sabha conducted at Panjari village through newly formed women self-help group (SHG) for minimum plastic use.

Meetings

29th Scientific Advisory Committee Meeting of KVK, ICAR-CICR, Nagpur,

The meeting was held on 21.08.2024 at ICAR-CICR and chaired by Dr. Y.G. Prasad, who reviewed the progress and ongoing activities of the Krishi Vigyan Kendra (KVK), Central Institute for Cotton Research (CICR), with SAC members.

Dr. Prasad highlighted the need to focus on the upscaling of closer spacing and High-Density Planting System (HDPS) for cotton cultivation in various tehsils of the district, in collaboration with the state agriculture department. He also stressed the importance of promoting climate-resilient agricultural technologies in partnership with relevant line departments and a district-specific action plan for cotton production.

Dr. Ramkrushna G.I., Senior Scientist and Head of KVK, CICR, Nagpur, presented the action taken report for the previous year and the action plan for the current year. His presentation included plan for on-farm trials, frontline demonstrations, training programs for women, rural youth, extension functionaries, and farmers as well as the progress of agro-meteorological advisory services in the district.

Meetings/ Workshop/Conference/Training attended

Name of the officials	Name of event	Location/Venue	Date
Dr. U. V. Galkate	ATMA Meeting & Pre-kharif Review Meeting	Collector Office, Nagpur	25.04.2024
Dr. U. V. Galkate	Online Meeting Review of ICAR Institutes	ICAR Head Quarter	20.06.2024
Dr. M. R. Meshram	Action Plan Workshop of KVKs	Dr. PDKV, Akola	10-11.02.2025
Dr. M. R. Meshram	Online Training on safe chemical uses for crop management	NIPHM, Hyderabad	14.10.2024
Dr. M. R. Meshram	AGRITECH EXPO 2024	Dr. PDKV, Akola	27-29.12.2024
Dr. Sachin Wankhede	Training programme on Advanced data analysis using 'R' organized by Centre for e-learning Kerala Agricultural University and Dept. of Agricultural Statistics, Vellanikkara, Thrissur.	Online	11th to 15th, November, 2024.
Dr. Sachin Yadavrao Wankhede	one day Workshop on "Training Need Analysis" to finalized the time tables of annual trainings organized by Regional Agricultural Extension Management Training Institute, Nagpur	RAMETI, Nagpur	04.12.2024.

Publication: Research Paper/Technical Bulletins/ Books

Technical Bulletins

i. Wankhede, S.Y., Ramkrushna G.I., Galkate, U.V., Lal Deepa, Prasad, Y.G. Climate Normal and Rainfall Probabilities for Climate Resilient Agriculture in Nagpur. CICR Technical Bulletin 2024- Pages-59.

Book

i. Wankhede, S.Y., Ramkrushna G.I., Galkate, U.V., Lal Deepa, Prasad, Y.G. Analysis of Historical Rainfall and Future Trends for Climate Resilient Agriculture in Nagpur. CICR, Book 2024- Pages- 112. ISBN Number: 978-93-93826-58-9.

Research Paper

i. S. Ghosal, T.P. Rathour, P. Datta, Neladri S Sarkar, Deepa Lal, Jitendra Gurjar, R. M. Reja, Mouli Paul and Ritik Chawla.; Influence Of Nano Urea On The Fruit Qualitative Features Of Litchi Cv. Bombai Grown In New Alluvial Zon e Of West Bengal India. Plant Archives Vol. 24, Special Issue (GABELS), pp.149-153(2024).

ii. Soustav Datta, Niladri Dutta, Susmita Dey, Chinmoy Mandal, Ritwika Sen, Sarthak Bhattacharya, Pallab Datta, T.P. Rathour, Deepa Lal and Lipsa Prit Bhusan. Response of Time and Severity of Pruning on Vegetative and Reproductive Characteristics of Ber cv. BAU Kul. Journal of Advances in Biology & Biotechnology Volume 27, Issue 8, Page 758-766, (2024).

iii. T. P. Rathor, R.P.Singh, Dev A Raju, Nilay Kumar And Deepa Lal. 2024 Leafy and minor vegetable: An Inclusive Study, SR Edu Publication, ISBN :97892941-65-8,2024

iv. Ankit Mohanty, Surekha S., Afsanabanu Manik and Deepa Lal, 2024. Crop physiology: A collaborative Insights Vol -1, (2024), Stella international Publication, ISBN No. 978-81-9203-7-1

Published popular articles:

i. U. V. Galkate, S.Y. Wankhede. Unhalyat Pashudhanachi Ghya Kalji (Care & management of livestock in summer). Krushakonnati. 17.05.2024.

ii. U. V. Galkate, S.Y. Wankhede. Kami Kharchatil Shelyanche Vyavasthapan (Low cost feed management in goats). Krushakonnati. 16.09.2024.

iii. B. Pavan Kumar Naik, Anjana Suresh, Deepa Lal, Sagar Chaudhary, Gayatri Sinha, T.P. Rathour. Plasticulture. Agri Articles (e-Magazine for Agricultural Articles). Volume: 04, Issue: 05 (SEP-OCT, 2024).

iv. R. M. Reja, Chethan B.L., Anjana Suresh, Deepa Lal, Mouli Pau, Sagar Chaudhary. Hi-tech Nursery. New Era Agriculture Magazine, E-ISSN: 2583-5173 Volume-3, Issue-4, September, 2024.

v. Tejavath Ram Raju, Subrat Kumar Senapati, Arpan Sain, Deepa Lal, Sagar Chaudhary, Snigdhya Bhowmik. Precision Farming. New Era Agriculture Magazine, E-ISSN: 2583-5173 Volume-3, Issue-4, September, 2024.

vi. T. P. Rathour, Chethan B. L., Amirthavarshini E. S., Nagaraju Vankadavath, Deepa Lal, Niteen. Mahua: An Economic Multifunctional Tree of India. Agriculture and Food: E Newsletter, Volume 06 - Issue 05 - May, pp 405-407 (2024).

vii. T.P. Rathour, Gayatri Sinha, Chelsea G. N, Joseph Lalchhuansanga, Anubhav Pathania, Deepa Lal. Application of Drone Technology in Agriculture. New Era Agriculture Magazine, E-ISSN: 2583-5173 Volume-2, Issue-12, May, 2024.

viii. P. Pratyusha, T.P. Rathour, Deepa Lal, V.K. Maheshwari, Gayatri Sinha, D.D Wavre. Dichogamy in Fruit Crops. New Era Agriculture Magazine, E-ISSN: 2583-5173 Volume-2, Issue-12, May, 2024.

ix. Deepa Lal, Jayashree Khobragade, Rakesh Kumar Singh. Manjula Self Help Group's Triumph: Vegetable Momos – A Profitable Business. Agri Tech Today, Volume 1, Issue 11, pp 57-59 (2024).

x. Deepa Lal, Jayashree Khobragade, Rakesh Singh. From Struggles to Success: The Inspiring Journey of Mr. Pratik Gulande's Disease-Free Citrus Nursery. Agri Tech Today, Volume 1, Issue 11, pp 14-15 (2024).

Book chapter

i. Sea Buckthorn, Shivam, Dr. Deepa Lal, Dr.Ajay Kumar Karna and Dr. Gopa Mishra, in Minor Fruit Crops An inclusive Study. Walnutpublocation.com, (2024), pp455-459

ii. Ramontchi Fruit (2024) Dr. Deepa Lal and Vidhya Sagar Mali in Minor Fruit Crops An inclusive Study. Walnutpublocation.com pp 435-436

iii. Integrated Pest Management in Fruit Crops (2024), Deepa Lal and Rakesh Kumar Singh, Fruit Science Chronicles: A Collaborative Insight Vol. -1 Stella international Publication,. pp 314-328

iv. Sorrel, Deepa Lal and Hima Bindu SR edu publication, ISBN :97892941-65-8,(2024)

Guest Lectures:

i. Dr. U. V. Galkate, SMS, Veterinary Sciences, had delivered lecture on "Climate resilient livestock production methods on 27.09.2024 during the training organized for Ambhuja Foundation staff at KVK, ICAR- CICR, Nagpur

ii. Dr. U. V. Galkate, SMS, Veterinary Sciences, had delivered lecture on Goat farming: As a promising entrepreneurship for small farmers and rural youth in a SCSP training programme organized by LDO (Extension) Panchayat Samiti, Nagpur at Tembhari, Tehsil- & Dist. Nagpur on 18.10.2024.

iii. Dr. U. V. Galkate, SMS, Veterinary Sciences, had delivered lecture on Livestock & poultry business for FPO's in training programme organized in collaboration with Savitribai Phule Mahila Ekta Samaj Mandal, Sambhaji nagar at KVK, ICAR-CICR, Nagpur on 23.10.2024

iv. Dr. Sachin Yadavrao Wankhede, SMS, Agro-meteorology had delivered a lecture as a resource person in 5 day "Trainers Training Programme on Integrated Pest & Disease Management Programme organized by Regional Agricultural Extension Management Training Institute, Nagpur during 03.06.2024 to 07.06.2024 on topic entitled "Integrated Nutrient Management in Paddy crop" for official staff of Department of Agriculture, Government of Maharashtra on 06.06.2024.

v. Dr. Sachin Yadavrao Wankhede, SMS, Agro-meteorology had delivered a lecture as a resource person in training organized by Regional Agricultural Extension Management Training Institute, Nagpur on topic entitled "Integrated Weed Management in Wheat and Chickpea crop" for official staff of Department of Agriculture, Government of Maharashtra on 06.09.2024.

vi. Dr. Sachin Yadavrao Wankhede, SMS, Agro-meteorology had delivered his lecture as resource person "Weather Information for Crop Production" at Regional Agricultural Extension Management Training Institute (RAMETI), Nagpur to the 40 participants of Diploma in Agricultural Extension Services for Input Dealers (DAESI) (Batch No-2) on dated 06.04.2024.

vii. Dr. Sachin Yadavrao Wankhede, SMS, Agro-meteorology had delivered his lecture as resource person "Crop Production Technology of Gram and Wheat" at Regional Agricultural Extension Management Training Institute (RAMETI), Nagpur to the 40 participants of Diploma in Agricultural Extension Services for Input Dealers (DAESI) (Batch No-6) on dated 26.10.2024.

viii. Dr. Sachin Yadavrao Wankhede, SMS, Agro-meteorology had delivered his lecture as resource person "Crop Production Technology of Sugarcane" at Regional Agricultural Extension Management Training Institute (RAMETI), Nagpur to the 40 participants of Diploma in Agricultural Extension Services for Input Dealers (DAESI) (Batch No-6) on dated 09.11.2024.

ix. Dr. Sachin Yadavrao Wankhede, SMS, Agro-meteorology had delivered his lecture as resource person "Crop Production Technology of Paddy" at Regional Agricultural Extension Management Training Institute (RAMETI), Nagpur to the 40 participants of Diploma in Agricultural Extension Services for Input Dealers (DAESI) (Batch No-6) on dated 22.06.2024.

x. Smt. Sunita Chauhan, SMS, Home-Science had delivered lecture on Climate resilient technology for improving the vegetable and fruit production methods on 27.09.2024 at training programme organized for Ambuja Foundation staffs at KVK, ICAR-CICR, Nagpur.

xi. Smt. Sunita Chauhan, SMS, Home-Science had delivered his lecture on Soybean processing and its

value-added products for the Extension Functionaries of State Agriculture Department at Kuhi on dated 22.03.2024.

xii. Smt. Sunita Chauhan, SMS, Home-Science had delivered his lecture on value added products for income generation for the Extension Functionaries of State Agriculture Department and farmers of Kamptee on dated 27.03.2024.

Awards received

i. Dr. Deepa Lal has received Outstanding Technology Transfer Award 2021-2022, Indian Society of Horticulture Research & Development (ISHRD) Uttarakhand, India, during Progressive Horticulture Conclave (PHC 2024) held Navasari Agricultural University (Gujarat), during 18-20 January 2024.

ii. Dr. Deepa Lal has received for outstanding contribution in the field of Horticulture in Young Horticulturist Award 2024, 2nd International Agriculture Conference held at Hansraj College, University of Delhi, India, during 3-5 November, 2024.

iii. Smt. Sunita Chauhan, SMS (Home Science), KVK, ICAR-CICR, Nagpur has received Best Presentation Award during the Annual Zonal Workshop held at JAU, Junagadh (Gujarat) by the auspicious hand of honourable DDG.U.S. Gautam, ICAR, New Delhi & in presence of Honorable Dr. Kokate formar DDG, ICAR and Dr. S.K Roy Director, ATARI, Pune during 16.12.2024.

iv. Dr. Sachin Wankhede, SMS, Agrometeorology has received the Certificate of Appreciation from Department of Agriculture, Government of Maharashtra for significant contribution in agrometeorological advisory services and awareness on lightning and promotion and publicity of mobile apps such as Meghdoot, Mausam, Sachet and Kisan Sarathi web portal at State Level Agricultural Technology Exhibition – 2024 organized on the occasion of 68th Dhammachakra, Pravartan Day from 11th October 2024 to 13th October 2024 by Department of Agriculture, Agriculture Technology Management Agency and Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

v. Dr. Ulhas Galkate, Subject Matter Specialist (Veterinary Science), KVK, ICAR-CICR, Nagpur was honoured with the Swargiya Dr. P. N. Sagdev Smriti Award for the year 2023-24. The award recognizing him as the Best Extension Research Officer was presented by the Hon'ble Vice-Chancellor of MAFSU, Nagpur at a distinguished ceremony organized by the Senior Veterinary Forum at Nagpur Veterinary College on 15th February 2025

Radio Talks (AIR, Nagpur):

- Dr. U. V. Galkate delivered Radio talk “Uhhalyat Janawarache Aahar Vyavasthapan” (Nutritional management of livestock in summer) broadcasted by All India Radio on dated 17.04.2024 at 7.30 PM.
- Dr. U. V. Galkate participated as expert veterinarian in Phone in Programme broadcasted by All India Radio on dated 06.11.2024 & 20.11.2024 at 7.30 PM.
- Dr. M. R. Meshram, I/c SMS (Agronomy), KVK, ICAR-CICR, Nagpur delivered a Radio talk on “Supikatesathi Jaminichi Aarogya Tapasani ani Khat Vyavsthapan” which was broadcasted in All India Radio on dated 22.06.2024.
- Dr. M. R. Meshram, I/c SMS (Agronomy), KVK, ICAR-CICR, Nagpur delivered a Radio talk on “Gahu ani Harbhara Lagwad Tantragyan” which was broadcasted in All India Radio on dated 13.10.2024.
- Dr. Sachin Wankhede, SMS, Agrometeorology had delivered radio talk on Aapatkalin Pik Vyasthapan (Contingency Crop Planning) on 19th, August, 2024 which was broadcasted in Majh Gaon Majh Waver programme of All India Radio on 24th August, 2024.
- Dr. Sachin Wankhede, SMS, Agrometeorology had delivered radio talk on Hawaman Shastra ani Aapli Sheti (Meteorology & Our Agriculture) on 04th, april, 2024 which was broadcasted in Majh Aawar Majh Shiwar programme of All India Radio on 09th, April, 2024.
- Dr. Sachin Wankhede, SMS, Agrometeorology had delivered radio talk on Rabi Pikanchya Perniche Pawasawar Aadharit Vyawasthapan (Management of Rabi Crop Sowing based on Rainfall) on 14th, October, 2024 which was broadcasted in Majh Gaon Majh Wavar programme of All India Radio on 20th, October, 2024.
- Smt. Sunita Chauhan delivered Radio talk “Shashwat Bhajipalasathi Sendriya Nivishtha” (Organic input for sustainable vegetable production) broadcasted by All India Radio on dated 14.04.2024 at 7.30 PM.
- Smt. Sunita Chauhan delivered Radio talk “Importance and value-added product from barnyard millet” broadcasted by All India Radio on dated 11.06.2024 at 7.30 PM.

10 GENERAL

10.1: Publications

10.1.1 Research papers (NAAS Score>6)

1. Surabhi Rode, Harry Kaur, Monica Sharma, Shah Vivek, Shiv Shakti Singh, Mrugendra Gubyad, Dilip Kumar Ghosh, Debabrata Sircar, Pravindra Kumar, Partha Roy and Ashwani Kumar Sharma (2024). Characterization of type 1 lipid transfer protein from *Citrus sinensis:* unravelling its potential as an antimicrobial and insecticidal agent. *International Journal of Biological Macromolecules* 265(1):130811. (NAAS Score: 14.2)
2. Sain, S.K., Paul, D., Kumar, P., Kumar, A., Mohan, M., Monga, D., Prakash, A.H. and Prasad, Y.G. (2024). Cotton leaf curl disease (CLCuD) prediction modelling in upland cotton under different ecological conditions using machine learning tools. Ecological Informatics doi.org/10.1016/j.ecoinf. 2024.102648. (NAAS Score: 11.1)
3. Sain, S.K., Kranthi, S., Kranthi, K.R., Monga, D., Paul, D. and Prasad, Y.G. (2024). Diversity study of *Beauveria bassiana* species for finding the most virulent strain to manage *Bemisia tabaci* in cotton. *Applied Microbiology and Biotechnology* doi.org/10.1007/s00253-024-13188-1. (NAAS Score: 11)
4. Kaur Harry, Rode Surabhi, Lonare Sapna, Demiwal Pratibha, Narasimhappa Pavithra, Arun Etisha, Kumar Rakesh, Das Joy, Ramamurthy Praveen C, Sircar Debabrata, Sharma Ashwani Kumar (2024). Heterologous expression, biochemical characterization and prospects for insecticide biosensing potential of carboxylesterase Ha006a from *Helicoverpa armigera*. *Pesticide Biochemistry and Physiology* https://doi.org/10.1016/j.pestbp. 2024.105844. (NAAS Score: 10.7)
5. D. Dhivyapriya, S. Ramchander, K Baghyalakshmi, G. Subashini, M. Raveendran & P. Jeyaprakash. (2024). Marker-assisted pseudo-backcrossing for developing climate-resilient rice. *Scientific Reports* 14, 30219. (NAAS Score: 10.6)
6. Kaur Harry, Singh Simranjeet, Rode Surabhi, Chaudhary Pankaj Kumar, Khan Nadeem A., Ramamurthy Praveen C., Gupta Deena Nath, Kumar Rakesh, Das Joy, & Sharma Ashwani Kumar (2024). Fabrication and characterization of polyvinyl alcohol-chitosan composite nanofibers for carboxylesterase immobilization to enhance the stability of the enzyme. *Scientific Reports* https://doi.org/10.1038/s41598-024-67913-x. (NAAS Score: 10.6)
7. Harry Kaur, Simranjeet Singh, Sandra Kathott Prakash, Surabhi Rode, Sapna Lonare, Rakesh Kumar, Pravindra Kumar, Ashwani Kumar Sharma, Praveen C. Ramamurthy, Joginder Singh & Nadeem A. Khan (2024). Identification and biophysical characterization of potential phytochemical inhibitors of carboxyl/choline esterase from *Helicoverpa armigera* for advancing integrated pest management strategies. *Scientific Reports* 14. (NAAS Score: 10.6)
8. Simranjeet Singh, Pavithra N., Harry Kaur, Radhika Varshney, Nadeem A. Khan, Rakesh Kumar, Ashwani Kumar Sharma, Joginder Singh & Praveen C. Ramamurthy (2024). Enzyme-based sensor for the real-time detection of atrazine: Evidence from electrochemical and docking studies. *Scientific Reports* 14. (NAAS Score: 10.6)
9. Tenguri Prabhulinga, Kranthi Sandhya, Naik Chinna Babu, Mari Amutha, Kumar Rishi, Suke Ruchika, Nagrare Vishlesh Shankar, Narkhedkar Nandini Gokte, Waghmare Vijay Namdeo and Prasad Yenumula Gerard. (2024).The comparison of species diversity and abundance of insect natural enemies in the domesticated species of cotton using the yellow pan trap method. *Scientific Reports* 10.1038/s41598-023-48347-3. (NAAS Score: 10.6)
10. Madhu Tadagavadi Nagaraju, Kamanur Murali Mohan, Manikyanahalli Chandrashekara Keerthi, Tenguri Prabhulinga, Shivaji Thube, Vivek Shah, Hosam O. Elansary, Ihab Mohamed Mousa & Mohamed A. El-Sheikh (2024). Effect of temperature on the biological parameters of pink bollworm, *Pectinophora gossypiella* Saunders (Lepidoptera: Gelechiidae). *Scientific Reports* 14: 17882. (NAAS Score: 10.6)
11. Sain SK, Gawande SP, Kumar V, Chandrashekar N, Prakash A. H. and Y. G. Prasad (2024). First Report of Target Spot caused by *Corynespora cassiicola* on Cotton in Northwestern India. *Plant Disease* 108 (2): 530. (NAAS Score: 10.4)
12. Parida P.K., Somasundaram E., Krishnan R., Radhamani S., Sivakumar U., Parameswari E., Raja, R. (2024). Machine learning approaches for estimation of the fraction of absorbed photosynthetically active radiation and net photosynthesis rate of maize using multi-spectral sensor. *Heliyon* 10(13): e34117 (doi: 10.1016/j.heliyon. 2024.e34117). (NAAS Score: 10)
13. Maity, A., Paul, D., Rocha, R.L., Bagavathiannan, M., Beckie, H.J. and Ashworth, M.B. (2024). Intensive

cropping influences the success of seed dormancy breaking methods in Australian collected *Hordeum, Avena,* and *Bromus* sp. *Pest Management Science* 81(4):2133-2143. DOI: 10.1002/ps.8616 (NAAS Score: 10)

14. Jain H, Rawal E, Kumar P, Sain SK, Siwach P. (2024). In Silico Investigation of the Interactions Between Cotton Leaf Curl Multan Virus Proteins and the Transcriptional Gene Silencing Factors of *Gossypium hirsutum* L. *Journal of Molecular Evolution* 92(6):891-911. (NAAS Score: 9.9)
15. Blaise, D., Desouza, N.D., Singh, A. (2024). Satellite based measurements of temporal and spatial variations in C fluxes of irrigated and rainfed cotton grown in India. *Remote Sensing Applications Society and Environment* 36: 101365. (NAAS Score: 9.8)
16. Parida P.K., Somasundaram E., Krishnan R., Radhamani S., Sivakumar U., Parameswari E., Raja, R., Rangasami S.R.S., Sangeetha S.P., Selvi R.G. (2024). Unmanned Aerial Vehicle-Measured Multispectral Vegetation Indices for Predicting LAI, SPAD Chlorophyll, and Yield of Maize. *Agriculture* 14, 1110. https://doi.org/10.3390/ agriculture 14071110. (NAAS Score: 9.6)
17. Patra, S., Chakraborty, D., Verma, V.K., Pande, R., Sangma, R., Chakraborty, M., Layek, J. and Hazarika, S. (2024). Influence of shifting thermal regimes on tomato fruit borer, *Helicoverpa armigera* (Hubner) in the Eastern Himalaya: implications for pest management strategies. *International Journal of Biometeorology* https://doi.org/10.1007/s00484-024-02741-2. (NAAS Score: 9.2)
18. Alagarsamy, M. (2024). Combining ability studies in *desi* cotton (*Gossypium arboreum* L.) genotypes. *Journal of Cotton Research* 7, 37. https://doi.org/10.1186/s42397-024-00200-2. (NAAS Score: 9.1)
19. Mawblei, C., Premalatha, N., Manivannan, A. et al. (2024). Characterization and screening of cotton (*Gossypium hirsutum* L.) germplasm for leafhopper (*Amrasca biguttula biguttula* (Ishida)) resistance. *Journal of Cotton Research* 7, 19. https://doi.org/10.1186/s42397-024-00182-1. (NAAS Score: 9.1)
20. Jain H, R Kaur, SK Sain, P Siwach. (2024). Development, Design, and Application of Efficient siRNAs against Cotton Leaf Curl Virus-Betasatellite Complex to Mediate Resistance against Cotton Leaf Curl Disease. *Indian Journal of Microbiology* 1-14. (NAAS Score: 9)
21. Sivakumar, S., Manickam, S., Madhu, B., Kumar, K. B., and Iyanar, K. (2024). Feasibility studies on plant architecture traits influence on seed cotton yield of *Gossypium hirsutum* zero monopodial genotypes and assessment of ecological suitability to machine harvesting. *Turkish Journal of Agriculture and Forestry* 48: 634-646. (NAAS Score: 8.9)
22. Manivannan Alagarsamy, Thomas Cheeran Amal, Shankarganesh Karuppan, Karthikeyan Adhimoolam (2024). Comparative proteomic analysis of resistant and susceptible cotton genotypes in response to leaf hopper infestation. **Journal of Proteomics** 303, 105258, https://doi.org/10.1016/j.jprot.2024.105258. (NAAS Score: 8.8)
23. Shivaji Hausrao Thube, R Pandian, M Rajkumar, Merin Babu, A Josephrajkumar, BJ Nirmal Kumar, Vinayaka Hegde, Balanagouda Patil, H Rajashekara, T Prabhulinga, Babasaheb B Fand, Shailesh Gawande, Dipak Nagrale, M Devindrappa, MK Rajesh (2024). *Euwallacea perbrevis* (Schedl, 1951) and associated novel fungal symbiont, Fusarium sp.: A potential cause of wilting in cocoa, Theobroma cacao in India. *Crop Protection* https://doi.org/10.1016/j.cropro. 2024.106754. (NAAS Score: 8.8)
24. Kumar, Rishi, Sain, S.K., Singh, S., Pandher, S., Meena, R.S., Jakhar, A., Kaur, J., Pathania, M., Paul, D., Prakash, A.H. and Prasad, Y.G. (2024). Investigating the second whitefly population outbreak within a decade in the cotton growing zone of North India. *Peer J* DOI 10.7717/peerj.17476. (NAAS Score: 8.7)
25. Nankade Vaishnavi A., Fand Babasaheb B., Lavhe N.V., Thube Shivaji H., Gawande Shailesh P., Nagrale D.T., Borkar S.L., Pillai Tini S., Nikoshe Akash, Prasad Y.G. (2024). A GIS-coupled thermal response model for predicting the population growth potential of the red cotton bug, *Dysdercus koenigii* (Fabricius) (Hemiptera: Pyrrhocoridae) in India under climate change conditions. *Journal of Thermal Biology* https://doi.org/10.1016/j.jtherbio.2024.104010. (NAAS Score: 8.7)
26. K. Baghyalakshmi, A.R. Priyanka, G. Sarathapriya, S. Ramchander, A.H Prakash. (2024). Genetic improvement of fiber quality in tetraploid cotton: an overview of major QTLs and genes involved in and edited for the quality of cotton fibers. *Journal of Cotton Research* 7:33. (NAAS Score: 8.6)
27. Kaur, Taranjeet, Shiwani Mandhania, Vikram Singh, Rashi Datten, Prakash Banakar, Karmal Malik, K. Sankaranarayanan (2024). Differential biochemical and physiological responses to cotton leaf curl virus infection in contrasting cotton genotypes. *Acta Physiologiae Plantarum* 46 (4): 46. (NAAS Score: 8.6)
28. Ramteke R., Rajput L. S., Nataraj V., Tiwari S., Borah M., Kumar S., Shivakumar M., Ratnaparkhe M. B., Mandloi S., Jaiswal S., Maheswari H. S., and Vishwakarma R. (2024). Evaluation of soybean genotypes for resistance to collar rot (*Sclerotium rolfsii*) under field and glasshouse condition. *Tropical Plant Pathology* https://doi.org/10.1007/s40858-024-00652-6. (NAAS Score: 8.5)
29. Maranna, S., Nataraj, V., Kumawat, G., Mehetre, S.P., Reddy, R., Jaybhay, S., PG, S., Rathod, S., Agrawal,

N., Rajesh, V., Kumar, S., Rajput L.S., Talukdar A., Gireesh C., Chandra Subhash, Ratnaparkhe, M.B., Ramteke, R., Satpute, G.K., Gupta, S. and K.H. Singh (2024). Understanding of G× E interactions of yield attributes in soybean MAGIC population and characterization for charcoal rot resistance. *Agronomy Journal* https://doi.org/10.1002/agj2.21572. (NAAS Score: 8.1)

30. K. Baghyalakshmi, S. Ramchander, N. Jagadeeshselvam, M. Raveendran, & P. Jeyaprakash. (2024). Comparative transcriptome profiling to untie the drought tolerance molecular mechanism of backcross rice (*Oryza sativa* L.) inbred. *Plant Breeding* 1-13. (NAAS Score: 8)
31. Balanagouda Patil, Shankarappa Sridhara, R. Thava Prakasa Pandian, Shivaji Hausrao Thube, Nandeesha C V, Pruthviraj, Ryan Casini, Fahed A. Almana & Hosam O. Elansary (2024). Evaluation of oomycete-specific fungicides and application strategies for controlling fruit rot disease on arecanut (*Areca catechu* L.). *Cogent Food & Agriculture* DOI: 10.1080/23311932.2024.2314227. (NAAS Score: 8.0)
32. Shah Vivek, Rachna Pande, Pooja Verma, Prabhulinga T., Shivaji Thube, Babasaheb B. Fand, Madhu T.N., Nandini Gokte-Narkhedkar and Y. G. Prasad (2024). Evaluation of vegetable oil as oviposition deterrents for the management of pink bollworm, *Pectinophora gossypiella* (Saunders) in cotton. *Journal of Plant Disease and Protection* 131: 403-412. (NAAS Score: 8)
33. Kumar, P., Paul, D., Jhajhriya, S., Kumar, R., Dutta, S., Siwach, P. and Das, S. (2024). Understanding heat-shock proteins abundance and pivotal function under multiple abiotic stresses. *Journal of Plant Biochemistry and Biotechnology* doi.org/10.1007/s13562-024-00932-x. (NAAS Score: 7.9)
34. Paul, D., Chakrabarty, S.K., Nain, L. and Maity, A. (2024). Studies on key seed physico-chemical factors and climatic variables regulating hardseededness in green gram (*Vigna radiata* L.) genotypes. *Crop & Pasture Science* doi: 10.1071/CP24259. (NAAS Score: 7.9)
35. Kumar Rakesh, Das Joy, Puttaswamy Raghavendra Keelara, Kumar Manoj, Balasubramani Ganesan, Prasad Yenumula Gerard (2024). Targeted genome editing for cotton improvement: prospects and challenges. *Nucleus* https://doi.org/10.1007/s13237-024-00479-1. (NAAS Score: 7.8)
36. Paul, D., Chakrabarty, S.K., Nain, L. and Maity, A. (2024). Genotype and harvesting time influence development of hard seeds and its physico-chemical constituents in green gram (*Vigna radiata* (L.) (Wilczek). *Plant Physiology Reports* doi.org/10.1007/s40502-024-00848-7. (NAAS Score: 7.5)
37. Dutta, S., Paul, D., Das, A., Kumar, S., Roy, A., Barua, A. and Chinnusamy, V. (2024). Directed mutagenesis in plants through genome editing using guide RNA library. *The Nucleus* doi.org/10.1007/s13237-024-00481-7. (NAAS Score: 7.5)
38. Paul, D., Kumar, R., Balasubhramani, G., Bagri, S., Chandra, S., Manickam, S., Singh, S., Prakash, A.H. and Prasad, Y.G. (2024). Quantitative Analysis on Expression of Insecticidal Crystal Proteins in Different Plant Parts of BG-II Cotton Hybrids at Various Phenological Stages. *Agricultural Research* 13:1-9, doi.org/10.1007/s40003-024-00763-1. (NAAS Score: 7.4)
39. Paul, D., Chakrabarty, S.K., Chawla, G., Kundu, A. and Maity, A. (2024). Assessment of Hardseededness and Its Seasonal Dynamics through Scanning Electron Microscopy in Green Gram (*Vigna radiata*) Genotypes. *Agricultural Research* doi.org/10.1007/s40003-024-00751-5. (NAAS Score: 7.4)
40. Manikandan, A., Blaise, D., Nalayini, P., Nagrare, V., Prasad, Y.G. (2024). Intercropping legumes with high density cotton to improve the land use efficiencies of rainfed Vertisols of India. *Agricultural Research* DOI: 10.1007/s40003-024-00833-4. (NAAS Score: 7.4)
41. Rao Naveen, Gaur Ram Karan, Singh Satnam, Rachna R.R., Kumar Rishi, Pandher Suneet, Kaur Ramandeep, Yadav Sunita, Udkeri Shashikant S., and Srinivas A.G. (2024). Thrips composition in north Indian cotton agroecosystem: a single species or a species complex. *Phytoparasitica* https:// doi.org/ 10. 1007/ s12600- 024- 01120-2. (NAAS Score: 7.4)
42. Pon Arasan A., Radhamani S., Pazhanivelan S., Kavitha R., Raja R., Kumaraperumal R. (2024). Mapping and monitoring of weeds using unmanned aircraft systems and remote sensing. *Plant Protection Science* https://doi.org/10.17221/74/2024-PPS. (NAAS Score: 7.3)
43. Dhanorkar, T.B., Velmourougane, K., Harinkhede, L.R., Bhardwaj J., Vaidya, Bhoyar, S.N., Manikandan, A., Blaise, D., Mundafale, C., Prasad, Y.G. (2024). Legume intercropping in cotton under high-density planting system enhances soil biological health and nutrient availability in rainfed Vertisol. *National Academy Science Letters* https://doi.org/10.1007/s40009-024-01533-x. (NAAS Score: 7.1)
44. Vanitha, Kaliaperumal; Jacob, David Karamankodu; Thube, Shivaji; Prakasa Pandian, R. Thava; Raviprasad, Thippagonahally Nagaiya; Rajashekara, Hosahatti (2024). The first record of conopid fly *Zodiomyia sumbaensis* as a parasitoid of a reed bee *Braunsapis mixta*. *Bulletin of Insectology* eISSN 2283-0332. (NAAS Score: 7.2)
45. Paul, D., Chakrabarty, S.K., Dutta, S. and Dikshit, H.K

(2024). Studies on Identification of Putative SSR Markers Linked with Hardseededness in Mung Bean (*Vigna radiata* L.) Using Bulk Segregant Analysis. *National Academy Science Letters* https://doi.org/10.1007/s40009-024-01570-6. (NAAS Score: 7.1)

46. Suman Bala Singh, H B Santhosh, KR Kranthi, G Balasubramani, B Fande, V Shah, GI Ramakrushna, AH Prakash, S Manickam, K Baghyalakshmi, V Santhy, K. Gaikwad and G Gawande. (2024). Variety release Notification, ICAR, CICR 25Bt. *Indian J of Genet Plant Breeding* 84(1); 139-141. (NAAS Score: 7)
47. Paul, D., Kumar, R. and Prasad, Y.G (2024). Blending procedure is crucial for BG-II cotton hybrids to adhere to the prescribed 'Refugia in Bag' standards. *Current Science* 127(1). doi: 10.18520/cs/v127/i1/101-104. (NAAS Score: 7)
48. Santosh, S., Velmourougane, K., Verma, P., Santosh, H.B., Blaise, D. (2024). Cotton-mycorrhizal symbiosis: a comprehensive review of benefits for sustainable agriculture. *Israel Journal of Plant Sciences* doi: 10.1163/22238980-bja10109. (NAAS Score: 7)
49. Rashmi Mayank, Murmu Sneha, Nagrale Dipak T., Singh Mahender Kumar, Behera Santosh Kumar, Shankar Raja, Ranjan Rajiv, Jha Girish Kumar, Chaurasia Anurag, Kumar Sunil (2024). Dataset on double mutation in PGIP of *Glycine max* improves defense to PG of *Sclerotinia sclerotiorum*. *Data in Brief* 54:110518, https://doi.org/10.1016/j.dib.2024.110518. (NAAS Score: 7)
50. Madhu, B., Sivakumar, S., Manickam, S., Murugan, M., Rajeswari, S. and Boopathi, N. M. (2024). Evaluating morphological and biochemical traits in cotton genotypes mediating resistance to leafhopper *Amrasca biguttula biguttula* (Ishida). *Pakistan Journal of Agricultural Sciences* 61:103-115. (NAAS Score: 6.8)
51. Rathinavel S., Kavitha R., Surendrakumar A., Kannan B., Raja R., Sivakumar S.D., Kalarani M.K. (2024). Leaf colour chart-guided prescription mapping for unmanned vehicle-assisted nitrogen dispensation in rice (*Oryza sativa* L.). *Journal of Animal & Plant Sciences* 34(6): 1486-1496 (https://doi.org/10.36899/JAPS.2024.6.0826). (NAAS Score: 6.7)
52. Alagarsamy, M., Karuppan, S., Amal, T. C., and Markkandan, K. (2024). Sequencing and analysis of the complete mitochondrial genome of *Amrasca biguttula biguttula* Ishida, 1913 (Hemiptera: Cicadellidae: Typhlocybinae: Empoascini). *Mitochondrial DNA Part* B 9(6), 725-728. https://doi.org/10.1080/23802359.2024.2358958. (NAAS Score: 6.5)
53. Kumari, S., Chakrabarty, S. and Paul, D (2024). Influence of pre-harvest climatic variables and natural storage duration on seed physico-chemical profile in diverse maturity groups of rice (*Oryza sativa*) varieties. *Indian Journal of Agricultural Sciences* 94 (6): 600–605. (NAAS Score: 6.13)

10.1.2 Research papers (NAAS Score<6)

1. Manna Sheersa, Gawande Shailesh Pandurang, Meshram Mithila Deorao, Ingle Rajesh, Nagrale Dipak (2024). Phenotypic and genetic characterization of *Xanthomonas citri* pv. Malvacearum strains affecting upland cotton in Central India. *Indian Phytopathology* https://doi.org/10.1007/s42360-024-00713-5. (NAAS Score: 5.97)
2. Baghyalakshmi, K. Priyanka, A.R., Aravind, K. and Manickam, S. (2024). Genetic analysis for estimating combining ability in *Gossypium hirsutum* L. x *Gossypium barbadense* L. hybrids. *Electronic Journal of Plant Breeding* 15: 21-30. (NAAS Score: 5.6)
3. Ananda Lekshmi, L., Kumar, M., Rajeswari, S., Raveendran, M., Uma, D. and Manickam, S. (2024). Assessment of heterotic potential and association analysis in direct and reciprocal hybrids for seed cotton yield and fiber quality traits involving lintless – fuzzless genotypes in upland cotton (*Gossypium hirsutum* L.). *Electronic Journal of Plant Breeding* 14: 410-418. (NAAS Score: 5.6)
4. Tamilmounika R., Muthumanickam D., Pazhanivelan S., Ragunath K.P., Kumaraperumal R., Sivamurugan A.P. and Raja R. (2024). Spatial Chlorophyll Estimation from Rice Field using Drone-derived Spectral Indices. *Indian Journal of Agricultural Research* doi: 10.18805/ IJARe. A-6267. (NAAS Score: 5.6)
5. Paul, D., Kumar, R., Verma, S.K., Singh, A. and Bagri, S., (2024). Impact of Climatic Variable Induced Abiotic Stress on Flowering Pattern In BG-II Cotton (*G. hirsutum*) Hybrids. *Plant Archives* e-ISSN: 2581-6063 (online), ISSN: 0972-5210. (NAAS Score: 5.59)
6. Majare, A., Lavhe, N., Biradar, V., Pillai, T., Deshmukh, V., Nayak, D., Banu, J.G., Shah, V., B. Fand, B., Pande, R., Mhatre, P., Prabhulinga, T., Nikoshe, A., Behere, G., Prasad, Y.G., and Thube, S. (2025). Bio-efficacy of a native strain of entomopathogenic nematode, *Steinernema siamkaya*i against fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae). *Journal of Biological Control* 38(4), 406–412 https://doi.org/10.18311/jbc/2024/45792. (NAAS Score: 5.46)
7. Blaise. D., Sabesh. M., Prakash. A. H., and Prasad. Y.G. (August 2024). Fertilizer Use Trends and Partial Factor Productivity in Cotton Growing Region of India. *Indian Journal of Fertilisers* Vol.20 N0.8, ISSN 0973-1822, pages 28-35. (5.29)
8. Sahil D Meshram, Prabhulinga Tenguri, VK Biradar, Shivaji H Thube, Babasaheb B Fand, Vivek Shah,

Rachna Pande, V C. Naik (2024). Investigation on the Biological Characteristics and Thermal Requirements of Egg Parasitoid *Trichogrammatoidea bactrae* on Eggs of Cotton Pink Bollworm. *Asian Research Journal of Agriculture* https://doi.org/10.9734/arja/2024/v17i4555. (NAAS Score: 4.86)

9. Baghyalakshmi K. K. Balasubramanium, Y.G. Prasad (2024). Extra-long staple cotton in India: to meet the demand of a long-term goal. *Journal of Cotton Research and Development* 38:1-6. (NAAS Score: 4.78)
10. Verma Surender Kumar, Kumar Rishi, Sain Satish Kumar, Singh Amarpreet, Bagri Sandeep, Paul Debashis. (2024). Emerging challenges in cotton cultivation and strategies for improving productivity in north zone of India. J*ournal of Cotton Research and Development* 38(1):7-18. (NAAS Score: 4.7)
11. Singh I, Jain H, Chahal S, Rani A, Kumar P, Sain SK, Siwach P (2024). Survey and Assessment of Cotton Leaf Curl Disease Severity in North- Cotton Growing Zone of India. *Annals of Biology* 40 (2): 313-320. (NAAS Score: 4.68)
12. O. P. Zalte, P. R. Panchbhai, Tini Pillai, N. V. Lavhe, Vrushali Deshmukh, Vivek Shah, Babasaheb B. Fand, Rachna Pande, T. Prabhulinga, Akash Nikoshe and Thube Shivaji (2024). Bio-efficacy Evaluation of *Beauveria bassiana* against Fall Armyworm, *Spodoptera frugiperda* (J.E. Smith). *Hexapoda* DOI: 10.55446/hexa.2024.12. (NAAS Score: 2.72)
13. Kumar, R., Paul, D., Singh, S. and Cheema, R.S (2024). Removing Potential Sources of Off-season Survival of Pink Bollworm is the Key to Reducing its Carryover in Succeeding Cotton Crops in North India. *International Cotton Researchers Association* 1-11.
14. Kumar, R., Paul, D., Sain, S.K., Singh, A., Chandra, S., Singh, S., Cheema, R.S. and Prasad, Y.G (2024). Pink Bollworm, *Pectinophora gossypiella* (Saunders) Infestation Escalates from Incipient to Serious Proportions in North Cotton Zone of India. *Journal of Crop Health* doi.org/10.1007/s10343-024-01086-5.

10.1.3 Other Publications

10.1.3.1 Book

Arbuscular Mycorrhizal Fungi for Nutrient, Abiotic and Biotic Stress Management in Rice. 2024. Eds. Panneerselvam P, Pradeep Kumar Das Mohapatra, Nayak AK, Mitra D, Velmourougane K, Santos-Villalobos SDL. Boca Raton, CRC Press. P. 230. https://doi.org/10.1201/9781003354086

10.1.3.2 Book Chapters

1. Velmourougane K, Prasanna R. (2024). Microbial enhancement of phosphorus availability in soil systems. In: Norman Uphoff, Janice E.Thies (Eds.) Biological Approaches to regenerative soil systems, 2nd Edition, CRC Press. pp. 181-190. DOI: 10.1201/9781003093718-20
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11. Sabesh. M, Sujeetha. T.N, Sathyamoorthy. G, Madhumitha. R. (2024). Computer's role in Cotton Cultivation. Prosperous life through cotton. Edited by Usha Rani. S, Sampathkumar. A, Sabesh. M, Prakash. A.H, Prasad. Y.G, Sujeetha. T.N, Sathishkumar. M, Suresh. G. pp. 161-174 (Tamil)
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21. Usha Rani, S., A.H. Prakash, D. Kanjana, T.N. Sujeetha and M. Sathishkumar. (2024). Cotton Cultivation - A Review. Book on Vaazhvai Viruthiyakkum Paruthi (Prosperous Life through Cotton) (Tamil), ICAR-Central Institute for Cotton Research. Edited by Usha Rani, S., A. Sampathkumar, M. Sabesh, A. H. Prakash, Y.G. Prasad, T.N. Sujeetha, M. Sathishkumar and G. Suresh. pp. 1-5 (Tamil)
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24. Rishi Kumar, Vivek Shah, Debashis Paul, Satpal Singh, Gurpreet Singh and Shubham Chandak. (2024). Eco-friendly Management Strategies for Insect-Pests of Cotton. Recent Advances in Ecofriendly Management of Crop Pests. Edited by Sunita Yadav, Deepika Kalkal, Harish Kumar and Varun Saini. pp.144-160 (English)
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6. Alagesan P., Sankaranarayanan K., Nalayini P., Srinivasan R. D, Saravanakumar S., Balaji Arun G, Thangadurai R., Ram Prabha R.G. (2024). Technology on High Density Planting System. MYRADA KVK, Erode pp2. 12/24/2024 (Tamil)
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10. Gangadevi M. Yugandhar M, Prasad Y.G., Sankaranarayanan K., Shaik N. Meera and Reddy A.R. (2024). Harvest and handling techniques in cotton. KVK Guntur, pp 1 11/19/2024 (Telugu)
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12. Sheeba JA. (2024). Physiology behind Shade Avoidance Responses (SAR) under High Density Planting System (HDPS). Cotton Innovate, January 2024, pp 1-2 03/27/2024 (English)
13. Prasad Y.G., Prabhakar M., Raja, R. (2024). Remote sensing applications in cotton farming. The ICAC Recorder, XLII, No. 4: 11-16 12/01/2024 (English)
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19. अमरप्रीत सिंह, ऋषि कुमार, एस. के. सैन, देबाशीष पॉल और संजीव कुमार. (२०२४). कपास में समेकित पोषक तत्व प्रबंधन. खेती. ७७ (दिसम्बर, २०२४ अंक –८): २१–२२. १२/१५/२०२४
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21. Singh Satpal, Kumar Rishi, Indira, Cheema Rupinder Singh & Pooniya Sajjan Kumar. (2024). Kapas mein Gulabi Sundi Niyantran. Kheti, 7:55-56 11/30/2024 (Hindi)
22. Singh Satpal, Kumar Rishi, Pooniya Sajjan Kumar, Shubham, Chandak, Rahul, Indira and Paul Debashis. (2024). Kapas ki fasal mein tinde ki sundiyo ke liye aarthik nuksaan star va nuksaan lakhshano ki pehchaan. Keshav Kheti, 23(3-4): 8-13 09/30/2024 (Hindi)
23. Singh Amarpreet, Kumar Sanjeev, Kumar Rishi, Sain, S.K., Shefali, Chandra Subhash, Paul Debashis and Verma S.K., (2024). Uttari Bharat mein Narma-Kapas Ki Jado Ke Ache Vikas Ke Liye Jaroori Baaten. Keshav Kheti, 23(3-4): 2-4 09/30/2024 (Hindi)
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10.1.3.4 Technical Publications

Folders:

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2. Annie Sheeba J., Usha Rani S., Sampathkumar A., Sabesh M., Prakash A.H., Prasad Y.G., Sujeetha T.N., Sathishkumar M. and Suresh G. (2024). Square and Boll shedding and their Management in Cotton. ICAR-CICR, Regional Station, Coimbatore. ICAR-CICR/ Folder/2024 (English)
3. Amutha M., Usha Rani S., Sampathkumar A., Sabesh M., Prakash A.H., Prasad Y.G., Sujeetha T.N., Sathishkumar M. and Suresh G. (2024). Thrips and its Management in Cotton. ICAR-CICR, Regional Station, Coimbatore. ICAR-CICR/Folder/ 2024 (English)
4. Kanjana D., Usha Rani S., Sampathkumar A., Sabesh M., Prakash A.H., Prasad Y.G., Sujeetha T.N., Sathishkumar M.and Suresh G. (2024). Importance and techniques of Soil sampling for better Cotton production. ICAR- Central Institute for Cotton Research, Regional Station, Coimbatore. ICAR-CICR/Folder/2024 (English)
5. Manickam S., Usha Rani S., Sampathkumar A., Sabesh M., Prakash A.H., Prasad Y.G., William Raja J., Senthil Kumar R., Aravind K., Sujeetha T.N., Sathishkumar M. and Suresh G. (2024). Nano (CICR H-Cotton 54) Compact, High Yielding, Good Quality, Long Staple G. hirsutum variety. ICAR-CICR, Regional Station, Coimbatore. ICAR-CICR/ Folder/ 2024 (English)
6. Raja R., Usharani S., Sampathkumar A., Sabesh M., Prakash A.H., Prasad Y.G., Karthik A., Suresh K. (2024). Mechanization in Cotton Cultivation. ICAR-Central Institute for Cotton Research, Regional Station, Coimbatore. ICAR-CICR/Folder/2024 (English)
7. Raja R., Usharani S., Sampathkumar A., Sabesh M., Prakash A.H., Prasad Y.G., Karthik A., Suresh K. (2024). Paruthi sagupadiyil iyanthiramayamakkalin pangu (Mechanization in Cotton Cultivation). ICAR-Central Institute for Cotton Research, Regional Station, Coimbatore. ICAR-CICR/Folder/2024 (Tamil)
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Leaflets:

1. A. Manikandan and JH. Meshram, Plant growth regulators (PGRs) registered for commercial cotton production and nutrient deficiency symptoms ICAR-CICR, Nagpur. 2023, 2023-2 2 (Marathi)
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3. Kumar Rishi, Singh Satpal and Prasad Y.G. (2024). Kapas ki katai ke uprant agami fasal mein gulabi sundi ka prakop kam karne ke liye kya karen aur kya na karen. ICAR-CICR, Regional Station, Sirsa. CICR-Leaflet/2024/01 (Hindi)
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2. Sampathkumar A., Usha Rani S., Sabesh M., Prakash A.H., Prasad Y.G., Sujeetha T.N., Sathishkumar M. and Suresh G. (2024). Cotton Diseases: Symptoms Identification and Integrated Management Practices. ICAR-CICR, Regional Station, Coimbatore. ICAR-CICR/Technical Bulletin/2024 (Tamil) pp 27, ISBN: 978-93-340-9299-32
3. Usha Rani S., Sankaranarayanan K., Sampathkumar A., Sabesh M., Prakash A.H., Sujeetha T.N., Sathishkumar M., Suresh G., Karthika R., Suganya K. and Arun Balaji K. (2024). High Density Planting System in Cotton - Questions & Answers- Tamil Translation. ICAR-CICR, Nagpur. ICAR-CICR Technical Bulletin No.1 (Tamil) pp 43. ISBN: 978-93-341-1829-2 50

Training Manuals:

1. Usha Rani. S, Sampathkumar. A, Sabesh. M, Prakash. A.H, Prasad. Y.G, Sujeetha. T.N, Sathishkumar. M, Suresh. G. (March 2024). Computer's role in cotton cultivation. Edited by Usha Rani. S, Sampathkumar. A, Sabesh. M, Prakash. A.H, Prasad. Y.G, Sujeetha. T.N, Sathishkumar. M, Suresh. G., p 161-174 (Tamil).

10.2: List of on-going projects

SN	Project title and Investigators	Duration	EFC
	Crop Improvement (20)		
1.	Development of varieties with high boll weight, ginning percent, fiber traits and disease resistance in *G. arboreum* and *G. hirsutum*. **V.N. Waghmare (PI)**, Shailesh Gawande	Institute* (2024-2028)	**1**
2.	Collection, conservation, evaluation, documentation and maintenance of germplasm of cultivated species of *Gossypium*. **Vinita Gotmare (PI),** S.S. Mahajan, M. Saravanan, N. S. Hiremani, Manickam, A.H. Prakash, A. Manivannan, Debashis Paul, Anjali Kak	Institute (2018-2028)	**1**
3.	Genetic diversity and utilization of wild germplasm for cotton improvement. **Vinita Gotmare (PI)**, Rachna Pande, Neelkanth Hiremani, Rakesh Kumar, A H Prakash, M. Saravanan, K. Baghyalakshmi, Subhash Chandra	Institute* (2023-2028)	**1**
4.	Development of *Bt* hybids in tetraploid cotton with high yield, superior fibre quality and tolerance to jassids. **M. Saravanan (PI),** Rahul M. Phuke, Amudha J.	Institute (2022-2027)	**1**
5.	Rapid development of high-yielding Bt cotton varieties amenable for high-density planting system. **Rahul M. Phuke (PI),** Ramkrushna GI, Raghavendra KP, Vivek Shah, Neelakanth S. Hiremani, S. Manickam, K. Baghyalakshmi, K. Rameash, A. Sampathkumar, Subhash Chandra, Debashis Paul	Institute* (2023-2028)	**1**
6.	Advancement of MAGIC population to development of core set for genetic mapping and identification of potential inbred lines. **Rahul M. Phuke (PI)**	Institute (2022-2026)	**1**
7.	Mapping QTL's for drought tolerance in Cotton. **J. Amudha (PI)**, Jayanth Meshram, M. Saravanan	Institute* (2024-2027)	**1**
8.	Genome editing in cotton: Enhancing climate resilience and ensuring food security with genome editing tools. **Raghavendra K.P. (CCPI)** , Jayant Meshram, Joy Das, Rakesh Kumar, Pooja Verma, Rahul Phuke	**ICAR-EFC** (2024-26)	**1**

SN	Project title and Investigators	Duration	EFC
9.	Development of transgenic cotton events for RNAi of chitin synthesis genes from pink bollworm. **Joy Das (PI),** Rakesh Kumar, K P Raghavendra	Institute* (2024-2029)	**1**
10.	Structure-function relationship studies on farnesol dehydrogenase from *Helicoverpa armigera* (Hübner) for developing novel insect growth regulatory molecules. **Ashwani Sharma (PI)** (IIT Roorkee), Pravindra Kumar (IIT Roorkee), **Rakesh Kumar, Joy Das**	**DST SERB** CRG (2024-2027)	**1**
11.	Precise base editing in Acetolactate synthase gene (*ALS* Gene) for herbicide tolerance in Cotton. **Rakesh Kumar (PI)**, Joy Das	Institute (2022-2027)	**1**
12.	Implementation of PVP legislation 2001 and DUS testing of cotton under ICAR-SAU system. **V. Santhy (PI)** , A. Manivannan	**DUS, ICAR** (From 2003)	**1**
13.	AICRP on Seeds (Crops) **V. Santhy (PI),** Sunil Mahajan, Debashis Paul	**AICRP(Seeds)** (From 2007)	**1**
14.	Development of long staple Bt varieties with improved ginning out turn. **S. Manickam (PI)**	Institute* (2024-2029)	**1**
15.	Breeding for compact, high ginning out turn (GOT) and high yielding extra-long staple *G. barbadense* white and colored lint. **A. Manivannan (PI)**	Institute* (2024-2029)	**1**
16.	Development of transgenic HxB ELS hybrids with enhanced yield and fiber quality combined with improved tolerance against biotic stress. **K. Baghyalakshmi (PI)**, M. Amutha, A. Sampath Kumar	Institute* (2024-2029)	**1**
17.	Molecular mapping for CLCuD resistance in upland cotton *G. hirsutum* (L.). **S. K. Verma (PI)**	Institute* (2024-2026)	**1**
18.	Development of varieties of upland cotton having better fiber traits and tolerance to CLCuD. **Subhash Chandra (PI)**	Institute (2017-2025)	**1**
19.	Combating seedling burning in cotton through induction of early heat tolerance in North zone. **Debashis Paul (PI),** Subhash Chandra, Amarpreet Singh, K. Velmourougane	Institute* (2023-2026)	**1**
20.	Bollworm resistance by Bt genes in cotton. Raghavendra K.P, Joy Das, Rakesh Kumar, Pooja Verma, Rahul Phuke	**AINP Biotech Crops** (2024-26)	**1**
	Crop Production (27)		
21.	ICAR-Network Project on Precision Agriculture. **Y.G. Prasad (PI)**, Blaise Desouza, R. Raja, Amarpreet Singh, K. Rameash, B.B. Fand, Shailesh Gawande, Dipak Nagrale, N. S. Hiremani, P. Nalayini, A. Manikandan, D. Kanjana, J. H. Meshram, Pooja Verma	**NePPA** (2022-2027)	**3**
22.	Special project on cotton: Targeting technologies to agro -ecological zones- large scale demonstrations of best practices to enhance cotton productivity. **Y.G. Prasad (PL)**, **A. S. Tayade (PI)** , (Selected Scientists as Co-PIs *cum* Nodal officers of different districts as per Office order)	**MoT & MoAFW** (2023-2026)	**5**
23.	Effects of varied canopy management and mulching on growth and productivity and profitability of cotton. **A.S. Tayade (PI)** , Ramkrushna G.I., K. Velmourougane, A. Manikandan	Institute* (2024-2027)	**3**
24.	Long-term impacts of sub-soiling and cover crop rotation on soil properties and N requirement of cotton. **D. Blaise (PI)**, R. K. Singh (ICAR-IISS, Bhopal)	Institute (2022-2026)	**3**
25.	Landscape Diagnostic Survey of cotton production practices and crop performance in Maharashtra. **Ramkrushna GI (PI)**, A.R. Reddy, Jaya Kumaravaradan, Shailesh Gawande, Rahul M. Phuke, M. Sabesh, Ranjit Kumar Paul (IASRI)	**RGSTC** (2022-2024)	**3**
26.	Quantitative estimation of carbon and moisture fluxes over the cotton based agro-ecosystem: Integrating ground observations, satellite data and modelling. **Ramkrushna G.I. (PI)**, A. Manikandan	**NCP** (2017-2025)	**3**

SN	Project title and Investigators	Duration	EFC
27.	Validation and refinement of organic cotton production technology. **Ramkrushna G.I. (PI),** Rachna Pande, Neelakanth S. Hiremani	Institute* (2021-2027)	**4**
28.	Nutrient profile-based fertilizer management in rainfed *Bt*-Cotton. **A. Manikandan (PI),** K. Sankarnarayanan	Institute (2022-2025)	**3**
29.	Study on different saturated biochar application for regenerative cotton and enhancing soil health. **A. Manikandan (PI)**, D. Blaise, A.S. Tayade	Institute* (2024-2029)	**3**
30.	Establishment of cosmic ray soil moisture instrument for validation of model computed soil moisture under national hydrology project. **A. Manikandan (PI)**, Ramkrushna G.I.	**NRSC** (2023-2026)	**3**
31.	Evaluation of chemical defoliants augmenting leaf senescence for mechanical picking in Bt Cotton**. J.H. Meshram (PI)**	**DST-SERB** (2022-2025)	**3**
32.	Bioprospecting microbial volatiles for the management of major foliar and root diseases of cotton. **K. Velmourougane (PI),** Shailesh Gawande, Dipak T. Nagrale	Institute* (2023-2026)	**4**
33.	Microbially mediated abiotic stress (drought and waterlogging) tolerance in cotton. **K. Velmourougane (PI),** J.H. Meshram, Raghavendra K.P., J. Annie Sheeba	Institute* (2023-2026)	**3**
34.	Phytohormone profiling by targeted metabolomics in cotton. **Pooja Verma (PI),** Joy Das	Institute (2021-2025)	**3**
35.	Impact of High-Density Planting System and Closer Spacing on cotton productivity and farmers' livelihood under rainfed conditions. **R. Jaya Kumaravaradan (PI)**, Y. G. Prasad, A. S. Tayade, Ramkrushna G.I., K. Sankarnarayanan	Institute* (2024-2026)	**3**
36.	Elucidation of radiation use efficiency of cotton genotypes with altered canopy architecture and planting geometries. **A.H. Prakash (PI)**, S. Manickam, R. Raja	Institute (2024-2026)	**3**
37.	Adoption and validation of best management practices for yield enhancement in extra-long staple cotton. **R. Raja (PI**), J. Usha Rani	Institute* (2024-2027)	**4**
38.	Integrated Nitrogen management under elevated CO_2. **P. Nalayini (PI)** , K. Sankarnarayanan, A.H. Prakash, M. Amutha	Institute* (2023-2026)	**3**
39.	Evaluation of agro techniques to overcome the impact of weather aberrations (drought, water logging) in ELS cotton. **K Sankarnarayanan (PI)**, P. Valarmathi, J.H. Meshram	Institute (2020-2026)	**4**
40.	Formulation of customized fertilizers for cotton. **D Kanjana (PI)**, R. Raja, Usha Rani	Institute (2021-2025)	**3**
41.	Effect of long-term application of organic and inorganic sources of nutrients on continuous cultivation of Bt and non Bt cotton with maize and wheat cropping system under irrigated conditions. **D. Kanjana (PI)**, Amarpreet Singh	Institute (2017-2025)	**3**
42.	Identification and characterization of germplasm lines and advance breeding with higher photosynthetic efficiency and harvest index for better yield in cotton. **J. Annie Sheeba (PI),** S. Manickam	Institute* (2023-2026)	**1**
43.	Efficient resource allocation pattern for cotton farms in Tamil-Nadu Fuzzy goal programming approach.**Isabella Agarwal (PI)**	Institute* (2023-2026)	**5**
44.	ICT dissemination of cotton technologies for production augmentation and knowledge empowerment **S. Usha Rani (PI),** M. Sabesh, J. H. Meshram, S.K. Sain	Institute (2022-2025)	**5**
45.	Development of web-based Cotton data query system. **M. Sabesh (PI),** Sunil Mahajan, Isabella Agarwal	Institute (2021-2026)	**5**
46.	Effect of monopodial removal practices on the hybrid *Bt* cotton. **Amarpreet Singh (PI)**	Institute* (2023-2025)	**3**
47.	Conservation agriculture practices for cotton-wheat system. **Amarpreet Singh (PI)**	Institute (2022 2027)	**3**

SN	Project title and Investigators	Duration	EFC
	Crop Protection (25)		
48.	Deployment of AI based Pheromone trap for real-time monitoring of cotton pink bollworm in Punjab. **Y. G. Prasad (PL)** , **Rameash, K. (PI)**, Rishi Kumar, Amarp reet Singh, Satnam Singh (PAU), Jasjinder Kaur (PAU)	**MoA&FW** (2024-2025)	**2**
49.	Cotton Mission: Prospecting of novel *Bt* toxins and bio-efficacy of newer events for bollworms management in cotton. **Y. G. Prasad (PL), G.T. Behere (PI)**, Vivek Shah, Joy Das, K. P. Raghavendra *(ICAR-CICR in collaboration with ICAR-NIPB, New Delhi and CSIR-NBRI, Lucknow)*	**Collaborative** (2024-2026)	**2**
50.	Crop pest surveillance and advisory project (CROPSAP) in Maharashtra. **V. S. Nagrare (PI),** Babasaheb B Fand	**CROPSAP** (From 2010)	**2**
51.	Insecticide Resistance Management (IRM): Dissemination of Pink bollworm Management Strategies. **V.S. Nagrare (PI)** , Rachna Pande, Shivaji H. Thube, Neelkanth S. Hiremani, S.P. Gawande, B.B. Fand, D.T. Nagrale, K. Rameash, Rishi Kumar, S.K. Sain, J.H. Meshram, K. Shankar Ganesh	**IRM-DAC** (From 2018)	**2**
52.	Neonicotinoid and pyridinecarboxamide insecticides resistance monitoring in cotton Jassid, *Amrasca biguttula biguttula* (Ishida). **V.S. Nagrare (PI),** Rishi Kumar, K. Shankarganesh, Joy Das	Institute* (2023-2026)	**2**
53.	Identification of host cues from cotton (*Gossypium hirsutum*) to elicit behaviour of female pink bollworm (*Pectinophora gossypiella*). **Rachna Pande (PI)**, Pooja Verma	Institute (2022-2025)	**2**
54.	Development and validation of Cotton - Microclimate and Insect Monitoring System (C-MIMS) based on 5G enabled AI powered wireless sensors and imaging tools. **Babasaheb B Fand (PI)**, Shailesh Gawande, Rameash K., Rishi Kumar	Institute* (2024-2027)	**2**
55.	Monitoring insecticide resistance in American bollworm, *Helicoverpa armigera* (Hubner) populations from cotton growing regions of Maharashtra and Gujarat. **Vivek Shah (PI)**, Rachna Pande	Institute (2021-2026)	**2**
56.	Evaluation of toxicity of newer insecticides against pink bollworm, *Pectinophora gossypiella* (Saunders). **Vivek Shah (PI)**, Babasaheb Fand, G. T. Behere	*Ad hoc* (2024-25)	**2**
57.	Investigations on host plant resistance mechanisms in cotton genotypes against thrips. **Shivaji Thube** , Pooja Verma, Rachna Pande	Institute (2022-2025)	**2**
58.	Development of EPF (*Beauveria bassiana* and *Metarhizium anisopliae*) & EPN based bio-formulation for sustainable management of pink bollworm and sucking pest complex in cotton. **Shivaji Thube (PI),** G. T. Behere, Gulsar Banu	Institute (2022-2025)	**2**
59.	Studies on target leaf spot of cotton caused by *Corynespora cassiicola.* **S.P. Gawande (PI)**, Babasaheb B Fand, Rakesh Kumar, S.K. Sain	Institute (2020-2025)	**2**
60.	Dynamics of boll rot disease complex of upland cotton in India: Basics to integrated management approaches. **D. T. Nagrale (PI)** , S. P. Gawande, B. B. Fand, N.S. Hiremani	**CSR-Rasi Seeds** (2024-2027)	**2**
61.	Studies on grey mildew disease of cotton caused by *Ramularia areola.* **Neelkanth Hiremani (PI)**, P. Valarmathi	Institute (2020-2025)	**2**
62.	Development of AI enabled pheromone trap for lepidopteran pests and multi-fin glue trap for sucking pests on cotton. **K. Rameash (PI)**, M. Sabesh	Institute (2022-2025)	**2**

SN	Project title and Investigators	Duration	EFC
63.	Biology and holistic management strategies for emerging pest Tea mosquito Bug (*Helopeltis*) in Cotton. **M. Amutha (PI)**	Institute* (2020-2025)	**2**
64.	Development of semiochemcal based attractants for sustainable management of cotton stem weevil *Pempherulus affinis* (Faust) Curculionidae: Coleoptera). **Shankar Ganesh (PI)**	**DST-SERB** (2022-2025)	**2**
65.	Exploration of native Bt isolate derived novel crystal toxin genes for development of transgenic cotton against cotton stem weevil *Pempherulus affinis* (Faust) Curculionidae: Coleoptera). **K. Shankar Ganesh (PI)**, A.H. Prakash, Joy Das, B. Singaravelu (SBI, Coimbatore),	Institute* (2024-2029)	**2**
66.	Survey, molecular characterization, vec tor transmission and exploiting host plant resistance for tobacco streak virus (TSV) in cotton. **A. Sampath Kumar (PI)**, P. Valarmathi, S. P. Gawande, Shivaji Thube, Sivaramakrishna (RARS-Nandyal)	Institute* (2023-2026)	**2**
67.	Studies on rust disease of cotton caused by *Phakopsora gossypii* and Cotton Necrosis disease caused by TSV, its management. **P. Valarmathi (PI)**	Institute (2021-2024)	**2**
68.	Studies on plant parasitic nematodes of cotton. **J. Gulsar Banu (PI)**	Institute (2020-2025)	**2**
69.	Development of biocontrol consortia with multifaceted fungi for the management of important pests and nematodes of cotton. **Gulsar Banu (PI)**, Shivaji Thube	Institute (2020-2025)	**2**
70.	Thermal stress induced effect on insecticide susceptibility and fitness traits in whitefly, *Bemisia tabaci, a* serious pest of worldwide concern. **Rishi Kumar (PI)**, Debashis Paul, Babasaheb Fand	**DST-SERB** (2022-2025)	**2**
71.	Season-long monitoring & management of pink bollworm in cotton crop in north zone. **Rishi Kumar (PI)**, Anil Kumar, Jasjinder Kaur, Ranvir Sing h, Umesh Kumar, Roop Singh Meena	**CSR-Rasi Seeds** (2024-2027)	**2**
72.	Collection, characterization and evaluation of beneficial fungal microorganisms from North, Central and South Cotton growing zones. **S.K. Sain (PI)**, Shailesh P. Gawande, P. Valarmathi	Institute (2020-2025)	**2**

Special Project on Cotton (2024-25)

Ministry of Agriculture & Farmers Welfare, Govt. of India and Ministry of Textiles jointly launched a special project on cotton 'Targeting technologies to agro-ecological zones- large scale demonstrations of best practices to enhance cotton productivity' under National Food Security Mission (NFSM) for implementation during 2024-25 kharif season with an outlay of 4045.13 lakhs. The project was implemented by the ICAR-Central Institute for Cotton Research (CICR), Nagpur in Public-Private Partnership (PPP) mode in the identified clusters adopting a value chain approach. The holistic plan is being implemented in collaboration and partnership with Confederation of Textile Industry (CITI), South India Mills Association (SIMA), Federation of Seed Industry of India (FSII), and National Seed Association of India (NSAI). Field extension support for technology dissemination and farmers' training on best practices is extended by 48 Krishi Vigyan Kendras (KVKs) of three Agricultural Technology Research Institutes (ATARIs at Pune, Hyderabad and Bengaluru), CITI, and SIMA cotton development and research association. CICR is providing technical backstopping and knowledge support on best practices for increasing productivity.

The Special Project expects scaling up three cotton technologies and has been extended in 2024-25 for implementation in 65 districts of 8 states covering an area of 14740 ha involving 17251 farmers. The farmer beneficiary validation was performed by the officials of the state department of agriculture.

Farmers adopting High-density planting system (HDPS) technology have used three times higher seed rate of 6 seed packets per acre against the current practice of 2 packets/acre to have a high-density plant stand of 74,000 plants/ ha. The technology targets deployment of a suitable compact seed variety in shallow soil areas

along with need-based canopy management techniques. HDPS field demonstrations in 5,777.12 ha areas involving 5,664 farmers were conducted in 40 districts across the states of Maharashtra, Telangana, Gujarat, Andhra Pradesh, Madhya Pradesh Tamil Nadu, and Karnataka. The target is nearly double the current productivity level. The average yield in the HDPS demonstrated plot was 11.46 q/acre over average yield of 8.19 q/acre in neighbouring conventional plots, resulting in an increase of 39.81% over Farmers Practices.

Farmers adopting Closer planting technology used two times higher seed rate of 4 seed packets per acre to have a medium-density plant stand of 37000 plants/ha. The technology targets medium-soil areas along with need-based canopy and pest management techniques. Demonstrations in 7,018.15 ha areas involving 8,937 farmers were conducted in 57 districts across the states of Gujarat, Rajasthan, Madhya Pradesh, Maharashtra, Telangana, Andhra Pradesh, Tamil Nadu, and Karnataka. The average yield in the CS demonstrated plot was 10.91 q/acre over average yield of 8.24 q/acre in neighbouring conventional plots, resulting in an increase of 32.45 % over Farmers Practices.

In order to boost the production of ELS cotton, demonstrations were conducted in 9 districts of Rajasthan, Madhya Pradesh, and Tamil Nadu in over a 1945.2 ha area involving more than 2650 farmers. The average yield in the ELS demonstrated plot was 8.04 q/acre over the average yield of 6.76 q/acre in neighbouring conventional plots, resulting in an increase of 18.91 % over Farmers Practices.

During 2024-25, 295 farmers' trainings, 164 Field days, 47 workshops, and 40 Kisan Melas outreach activities were organized by KVKs, CITI and SIMA.

Impact of Special Project on Cotton- Scalable technologies for targeted agro-ecological zones

S. No.	Scalable technology	Current (Kg lint/ha)	Target (kg lint/ha)	Achieved yield (kg lint/ha)
1.	High Density Planting System (HDPS) in low productivity areas under rainfed cotton ecosystem with canopy management	350	750	945.45
2.	Closer spacing 90 x 30 cm in medium deep soils with canopy management	600	1000	900.08
3.	Production technology for ELS cotton in niche areas under irrigated/rainfed farming situations	500	750	663.30

Technology interventions Summary – target vs. achievement- 2024-25

Interventions	Target (ha)	Implemented (ha)	Total production (q)	Total lint production (q)
HDPS at 90 x 15 cm in shallow soils	6202	5777.12	165514.49	54619.78
Closer spacing 90 x 30 cm in medium soils	7339	7018.15	201070.00	66353.10
Production technology for Extra Long Staple	2000	1945.2	39098.52	12902.51
Grand Total	**15541**	**14740.47**	**405683.01**	**133875.39**

Conclusion

Concerted efforts under the Project to promote HDPS among cotton farmers, especially in rainfed regions, to increase cotton yield and, thereby, the income and livelihood of the farmers yielded positive results. Although, HDPS has increased the cost of cultivation by around Rs.4,000/acre due to increased seed rate and harvesting labour cost, farmers realized an approximately Rs.10,500 hike in their net income/acre over the conventional cotton cultivation. The yield distribution has shifted from a lower range of 7.48 to 9.2 q/acre to a higher range of 10.40 to 12.24 q/acre. Overall, HDPS increased the rainfed cotton yield by 39.81% compared to conventional cotton cultivation in 2024-25. For the year 2023-24, at the disaggregated level, 34% of farmers realized 30 - 60 % increased yield and another 38% have realized 20 to 30% hike in yield. Higher B:C ratio of >2.0 was achieved under HDPS and Closer planting compared to 1.6 in conventional system of wider spacing.

A publication on the success stories of farmers was published by the Directorate of Cotton Development (DCD), Nagpur.

10.3:Consultancy, Patents, Commercialization of Technology

10.3.1 Contract Research / Revenue generation / Commercialization of Technology Contract Research Project

S.No.	Title of the Project	Name of Industry Partner	Year	Total Amount of the Project excluding GST
1	Evaluation of Evonik product with Emamectin benzoate 5% SG to manage population of pink bollworm in cotton.	M/s. Evonik India Pvt. Ltd., Mumbai	12.09.2024	Rs. 20.98926 Lakh

Details of Consultancy Research Project

S.No.	Title of the Project	Name of Industry Partner	Year	Total Amount of the Project excluding GST
1.	Capacity building of making cotton production more sustainable.	Better Cotton, New Delhi	05.01.2024	No fees
2.	Cosmic Ray Soil Moisture Instrument for Validation of Model Computed Soil Moisture under National Hydrology Project (NHP).	National Remote Sensing Centre, Hyderabad	05.03.2024	13.41 Lakh
3.	Explore innovative solutions at the intersection of Artificial Intelligence-Embedded Systems (AI-Embedded) and Smart-Agriculture and skill developments.	NIELIT, Aurangabad	30.04.2024	No fees
4.	State the intentions of the parties in undertaking collaboration in and to innovate new and improved techniques for cotton cultivation, undertake research and development	Heartfulness Institute, Telangana	30.04.2024	No fees
5.	Technical backstopping and help in establishing sustainable organic cotton production model in tribal villages such as Dahegaon, Manoli, Kumbhari, Sasani, Tiwasala Tehsil of Ghatanji Yavatmal Dist.	Cottonguru MahaFPC Limited, Mumbai.	31.01.2024	No fees
6.	Research, capacity building and demonstrations of technologies in Comilla Cotton.	Central Agricultural University Imphal, Manipur	29.08.2024	No fees

Commercialization of Technology

Name of the Technology	Name of the Industry Partner	Amount of Licensing Fee (Rs. in lakhs)
Multiplication and commercialization of Bt cotton variety (ICAR-CICR 25 Bt)" developed by ICAR-CICR.	M/s.Nirupama Seeds Pvt Ltd, Hyderabad	2
Continuation of MoU with Dhanalaxmi Seeds Pvt Ltd. for taking up seed production and commercialization of Bt cotton variety (ICAR-CICR Bt-23) on (Addendum) 8/7/2021.	M/s.Dhanalaxmi Seeds Pvt Ltd. Karnool, AP	2

10.3.2 Patents

Sr. No.	Patents	Patents No./ status	Year of grant
1.	Bacterial-based volatiles composition as aphid attractant	553413	2024
2.	Bacterial-based volatiles composition as thrip attractant	554409	2024
3.	Bacterial-based volatiles composition as whitefly attractant	541777	2024
4.	Bacterial-based volatiles composition as beneficial insects attractant	546146	2024
5.	Bacterial-based volatiles composition as jassid attractant	Filed	-
6.	Bacterial-based volatiles composition as whitefly attractant	PCT Filed	-

Sr. No.	Patents	Patents No./ status	Year of grant
7.	Bacterial-based volatiles composition as jassid attractant	PCT Filed	-
8.	A system for attracting pink bollworms, trapping and reporting and a method Thereof	Filed	-
9.	Semi-synthetic diet for cotton stem weevil	Filed	-

10.4: Quinquennial Review Team Meeting

The Quinquennial Review Team (QRT) to review the work done by ICAR-Central Institute for Cotton Research, Nagpur and All India Coordinated Research Project on Cotton for the period 2018 to 2023 was constituted under the Chairmanship of Dr. B. Venkateswarlu, Former Vice Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani by the Indian Council of Agricultural Research vide Office Order No: F.No.CS.5/2/2006-IA.III (e-24484) dated 12th June 2023. The other members of the QRT team were Dr. SS. Patil, Former Director Research, UAS Dharwad and Emeritus Scientist Dept. of Genetic & Plant Breeding UAS, Dharwad; Dr. SR. Bhat, Former Principal Scientist, NIPB, IARI, New Delhi; Dr. NT. Yaduraju, Former Director, ICAR-DWR, Jabalpur & Former National Coordinator, NAIP, ICAR, New Delhi; Dr. Chandish R. Ballal, Former Director, ICAR, NBAIR, Bengaluru; Dr. D. Monga, Former, Head, ICAR-CICR, RS, Sirsa; Dr. AJ. Shaikh, Former Director, ICAR-CIRCOT, Mumbai, and Dr. K. Velmourougane, Principal Scientist, Crop Production Division, ICAR-CICR, Nagpur served as the Member Secretary.

The QRT conducted total 5 meetings including visits to 2 Regional Stations of ICAR-CICR (Coimbatore and Sirsa) and AICRP (Cotton) centres. The QRT interacted with the Director, Head of Divisions and staff, Individual Scientists of the Institute and Collaborating Centres, Heads of the Finance and Administration in the Institute, farmers, industry people and other cotton stakeholders, including representatives from the cotton trade and textile industry. The QRT also interacted with the Chairman, RAC, and IMC and finalized the report along with the QRT recommendations of the ICAR-CICR and AICRP on Cotton.

QRT meetings held at various locations of Institute and the AICRP during the period are as follows-.

Date	Venue	Agenda	Participating members
26th October, 2023	DDG (CS) Office ICAR, New Delhi	Discuss the review process and other important issues to be reviewed	Dr. B. Venkateswarlu Dr. Y.G. Prasad Dr. K. Velmourougane
27th October, 2023	PAU, Bathinda	Review of work done at Bathinda and Faridkot centres of PAU	Dr. B. Venkateswarlu Dr. Shreekant S. Patil Dr. S. R. Bhat Dr. Chandish R. Ballal Dr. D. Monga
	ICAR-CICR, RS, Sirsa	Review of work done at ICAR-CICR Regional Station, Sirsa	Dr. A. J. Shaikh Dr. S. Manickam Dr. K. Velmourougane
28th October, 2023	CCSHAU, Hisar	Review of work done at CCSHAU, Hisar and SKRAU, Sriganganagar	Dr. B. Venkateswarlu Dr. Shreekant S. Patil Dr. S. R. Bhat Dr. Chandish R. Ballal Dr. D. Monga Dr. A. J. Shaikh Dr. S. Manickam Dr. K. Velmourougane
28th November 2023	NAU, Surat	Review of work done at NAU, Surat, JAU, Junagarh, and MPUAT, Banswara	Dr. B. Venkateswarlu Dr. N.T. Yaduraju Dr. Shreekant S. Patil Dr. Chandish R. Ballal Dr. A. J. Shaikh Dr. Y.G. Prasa d, Director Dr. G.T. Behere Dr. S. Manickam Dr. K. Velmourougane
6th January 2024	ICAR-CICR, RS, Coimbatore	Review of work done at ICAR-CICR, RS, Coimbatore	Dr. B. Venkateswarlu Dr. N.T. Yaduraju Dr. Shreekant S. Patil

Date	Venue	Agenda	Participating members
		Interactive meeting with cotton stakeholders including representatives from cotton trade and textile industry	Dr. Chandish R. Ballal Dr. A. J. Shaikh Dr. Dilip Monga Dr. S.R. Bhat Dr. Y.G. Prasad Dr. G.T. Behere Dr. S. Manickam Dr. K. Velmourougane
7th January 2024	ICAR-CICR, RS, Coimbatore	Review of work done at UAS, Dharwad, UAS, Raichur, UAS, Chamaraja Nagar ANGRAU, Guntur, ANGRAU, Nandyal PJTSAU, Warangal, PJTSAU, Adilabad, TNAU, Coimbatore, and TNAU, Srivilliputhur centres of AICRP on cotton	Dr. B. Venkateswarlu Dr. N.T. Yaduraju Dr. Shreekant S. Patil Dr. Chandish R. Ballal Dr. A. J. Shaikh Dr. Dilip Monga Dr. S.R. Bhat Dr. Y.G. Prasad Dr. G.T. Behere Dr. S. Manickam Dr. K. Velmourougane
9th February 2024 10th February 2024	ICAR-CICR, Nagpur	Presentation of ATR of last QRT report. The approved ATR is given in Annexure III Review of work done at ICAR-CICR, Nagpur Interactive meeting with cotton stakeholders including representatives from cotton seed, trade and textile industry Review of work done at RVSKKV, Khandwa, Dr PDKV, Akola, VNMKV, Nanded, MPKV, Rahuri, CSAUAT, Kanpur, and OUAT, Bhawanipatna centres of AICRP on cotton	Dr. B. Venkateswarlu Dr. N.T. Yaduraju Dr. Shreekant S. Patil Dr. Chandish R. Ballal Dr. A. J. Shaikh Dr. Dilip Monga Dr. S.R. Bhat (Online) Dr. Y.G. Prasad Dr. G.T. Behere Dr. V.N. Waghmare Dr. A.S. Tayade Dr. S. Manickam Dr. K. Velmourougane
10th April 2024	ICAR-CICR, Nagpur	Finalization of Recommendations	Dr. B. Venkateswarlu Dr. N.T. Yaduraju Dr. Shreekant S. Patil Dr. Chandish R. Ballal Dr. A. J. Shaikh Dr. Dilip Monga Dr. S.R. Bhat Dr. P.K. Chakrabarty, Chairman, RAC Shri. Srirang Devba Laad, Member, IMC Dr. Y.G. Prasad Dr. G.T. Behere Dr. V.N. Waghmare Dr. A.S. Tayade Dr. S. Manickam Dr. K. Velmourougane

10.5: Other Important Meetings/ Workshops/Events

10.5.1: Meetings

57th Institute Management Committee Meeting

The 57th Institute Management Committee Meeting was held on 4th January, 2024, under the Chairmanship of Dr. Y.G. Prasad, Director, ICAR-CICR, Nagpur. The meeting was attended by Dr. D.K. Yadava, ADG (CC), New Delhi; Dr. G. Ravindra Chary, PC, CRIDA, Hyderabad; Dr. S. Manickam, PS, Regional Station, Coimbatore; Dr. S.K. Ray, I/c Head, NBSS & LUP Regional Station, Kolkata; Dr. R.N. Sahoo, PS, Division of Agriculture Physics, IARI, New Delhi; Shri Srirang Devba Laad, and Shri H. Murthy (Progressive farmers - nominated by Council).

Cotton Germplasm Field Day

ICAR-CICR, Nagpur organized a "Cotton Germplasm Field Day" on 5th January, 2024. Dr. C.D. Mayee, Ex-Chairman, ASRB, New Delhi graced the occasion as Chief Guest and informed about the importance of

Public-Private Partnership in germplasm exchange needed for diversification of Genetic base of Cotton. Dr. Y.G. Prasad, Director, ICAR-CICR, briefed about the cotton Germplasm Field Day for Public-Private Partnership germplasm collection, their utilisation in diversification of genetic base for developing hybrids/ varieties to increase the productivity of cotton in India. Dr. V.N. Waghmare, Head, Division of Crop Improvement, emphasized and urged breeders for providing feedback on germplasm utilization. The objective of the programme was to showcase the diversity in the cotton gene-pool and to facilitate Public-Private Partnership for cotton germplasm exchange, as presented by Dr. Vinita Gotmare, Principal Scientist & Germplasm Curator. Approximately 56 breeders representing 37 State Agricultural Universities, 19 private seed companies and scientists from the regional stations of CICR Coimbatore and Sirsa participated in this event. A field visit was organized for all participants to select the desired germplasm accessions for utilization in their breeding programme.

Brainstorming Workshop on Biotech interventions in Cotton:

ICAR- CICR, Nagpur in association with Biotech Consortium India Limited (BCIL), with support from the Federation of Seed Industry of India (FSII) organized a brainstorming workshop on 'Biotech Interventions in Cotton Improvement: Opportunities and the Challenges' on 4th April, 2024. Dr. Paresh Verma, Executive Director-Bioseeds Division, DCM Shriram Limited, Hyderabad; Dr. Vibha Ahuja, Chief General Manager, Biotech Consortium India Limited; Dr CD Mayee, Former Chairman, ASRB and Former Director, ICAR-CICR, Nagpur; and Dr Y.G. Prasad, Director, ICAR-CICR, Nagpur were the experts in the programme.

Interactive meeting at ICAR-CICR, RS, Coimbatore

An interactive meeting with Hon'ble DDG (Crop Science) Dr. Tilak Raj Sharma, ADG (Seed) Dr. D.K. Yadava, and Director, ICAR-NBPGR Dr. G. P. Singh at CICR-RS, Coimbatore was held on April 1, 2024. The other dignitaries at the meeting included the Director, ICAR-

SBI, and scientists from NBPGR, New Delhi and CICR, RS, Coimbatore. DDG, along with other guests, visited the recently renovated silver jubilee building block of the institute, followed by a discussion with fellow breeders regarding recently released varieties of cotton.

Stakeholder consultation meeting with the seed industry

The ICAR-CICR Nagpur hosted a stakeholder consultation meeting on 4th July 2024 with the seed industry, focusing on research collaboration between public and private sector researchers to address the key challenges in the cotton sector in a mission-mode approach.

Dr. Y.G. Prasad, Director, ICAR-CICR, highlighted the scope and need for collaboration between the public and private sectors in view of the stagnation in cotton productivity in the country for the last several years. He proposed the development of variety product profiles, including the development of compact BG II varieties suitable for HDPS and finding a transgenic technology solution for the management of the dreaded cotton pink bollworm by pooling the strengths of public and private sectors in partnership mode. Dr. C.D. Mayee, Former Chairman, ASRB, chaired the session and urged the industry to come forward with collaborative proposals in the areas of basic and strategic research of national importance. Dr. Prasanta Dash, ADG (Commercial Crops), ICAR briefed about the vision of the Ministry for enhancing cotton productivity. Dr. L.K Gupta, CMD, CCI Mumbai highlighted the growing demand for quality cotton by the textile sector. ICAR-CICR scientists presented the status of research on novel genes, advanced breeding, and germplasm materials available for sharing with the industry for development. Detailed deliberations were held between the representatives of the seed industry, focusing on the industry perspective and identified five research thrust areas viz., Pink bollworm resistance, development of compact varieties for HDPS, sharing of germplasm, marker assisted breeding for pest and disease tolerance, and defoliant technologies for mechanization of cotton harvesting.

Seed industry stalwarts Dr. M. Ramasami, Chairman, Rasi seeds, Dr. M. Prabahakar Rao, Chairman, Nuziveedu ; Dr Paresh Verma, Executive Director, Bioseed Research India; Dr Ashwin Kashikar, GM (R&D), Ankur seeds; Dr R.S. Mahala, President (Research), Seed Works International; Dr Vipin Dagaonkar, Crystal Croptech, guided the proceedings. Representatives from Mahyco, Ajit seeds, Daftari seeds, Prabhat seeds and members Federation of Seed Industry of India (FSII) and National Seed association of India (NSAI) participated in the meeting. The meeting was also attended by Dr. AL Waghmare, Director, Directorate of Cotton Development and Scientists of CICR. The meeting was coordinated by Dr. Babasaheb Fand, and a vote of thanks was proposed by Dr Raghavendra, Head, PME Cell.

Training on Special Cotton Technology

Dr. YG Prasad, Director, ICAR-Central Institute for Cotton Research (ICAR-CICR), Nagpur, spearheaded a training session on special cotton technology was organized by ICAR-CICR on 5th July 2024 for the Confederation of Indian Textile Industry - Cotton Development and Research Association (CITI-CDRA). This initiative was part of a special project titled "Targeting Technologies to Agro Ecological Zones – Large-Scale Demonstrations of Best Practices to Enhance Cotton Productivity," funded

by the Ministry of Agriculture & Farmers Welfare and the Ministry of Textiles, Government of India.

The event, held at the institute, aimed to disseminate advanced cotton cultivation practices tailored to different agro-ecological zones. Distinguished guests in attendance included Dr. AL Waghmare, Director, Directorate of Cotton Development (DoCD), and Dr. Wairale, Retired General Manager of Maharashtra Cotton Federation. Their participation underscored the significance of the training and the collaborative efforts of various agricultural and textile bodies in advancing cotton production.

Special Cotton Project Workshop for Nagpur and Wardha Districts

Under the aegis of special cotton project, ICAR-CICR and CITI-CDRA combinedly organized a workshop on July 27, 2024, to showcase the best technologies for cotton cultivation tailored to site-specific conditions. The workshop focused on three technologies such as High-density planting system (HDPS) for shallow soils, Closure Spacing (CS) for medium deep soils, and the CICR- Dada Lad technique for heavy deep soils. A total of 160 cotton farmers from Nagpur and Wardha district actively participated in the workshop. To support the adoption of monopodia removal and detopping practices, 40 pruning secateurs were distributed to farmers.

Dr. Y.G. Prasad, Director, CICR, Nagpur, emphasized that these technologies are designed to enhance cotton productivity and sustainability in the region. During kharif 2024, a cluster approach was implemented in 103 villages in these three districts (Yavatmal, Wardha and Nagpur). The large-scale demonstration covered an area of 961 hectare to benefit 1070 farmers. Dr. AL Waghmare, Director, DCD, Nagpur, highlighted the significance of special cotton technology demonstrations in rainfed cotton growing areas and emphasized the potential to revolutionize cotton production. He also noted that the project also facilitates direct benefit transfer (DBT) to farmers.

Dr. AS Tayade, Head, Crop Production elaborated on the specific requirements of the special project, including geo-fencing, crop cutting, and post-harvest shredding. Mr. RJ. Manohare, DSAO, Nagpur outlined the initiatives of agriculture department schemes, such as crop insurance, soil testing, and drip irrigation in cotton farming and discussed the opportunities of lint-based cotton marketing to enhance income of cotton farmers.

Mr. GH Wairale, Project Coordinator, CITI-CDRA, highlighted that these large-scale demonstrations are being promoted through a collaborative public -private partnership (PPP) model. Dr. A. Manikandan, Senior Scientist, Soil Science emphasized the timeliness of interventions for a positive impact on cotton productivity. The inaugural session was moderated by Mr. Jagdish Niralwar, Officer, CITI-CDRA.

During the technical session, a panel of experts comprising Dr GI Ramkrushna, Dr. A. Manikandan, Dr. Rachana Pandey, Dr. Shailesh Gawande, and Dr. Rajkumar Ramteke delivered presentations on technologies integrated crop, nutrient, pest, and disease management with practical guidance. The farmers visited various technology demonstrations and field experiments at the CICR Research farm.

Workshop cum Focus Group Discussion on "Best Management Practices (BMPs) for Sustainable Cotton Production in Maharashtra

ICAR-CICR, Nagpur organized a Workshop cum Focus Group Discussion on "Best Management Practices (BMPs) for sustainable cotton production in Maharashtra" on 24th October, 2024. The salient

findings of the "Landscape Diagnostic Survey (LDS) of 3000 farmers on cotton production practices in Maharashtra" funded by the Rajiv Gandhi Science and Technology Commission (RGSTC), Mumbai, were discussed. KVK experts, officials from the Agriculture

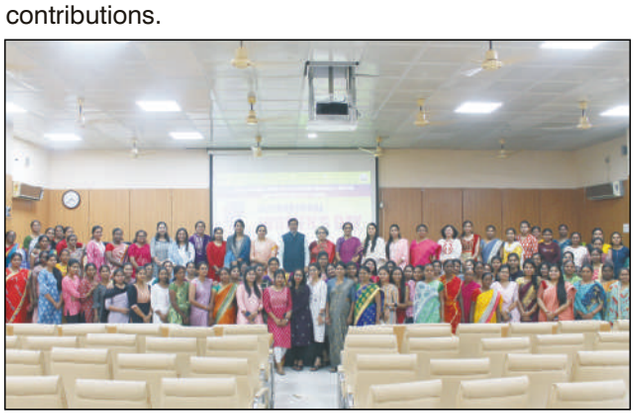
department, industry, and farmers from 10 districts provided feedback on the BMPs for the preparation of district plans.

10.5.2: Events

ICAR-CICR celebrates the 75th Republic Day on January 26, 2024, marking the day on which the Constitution came into effect after the country gained independence in 1947.

International Women's Day

ICAR-CICR, Nagpur celebrated Women's Day program on March 8, 2024 under the Chairmanship of Director, Dr. Y. G. Prasad, Director, ICAR-CICR, Nagpur. Dr. Nandini (Gokte) Narkhedkar, Former Principal Scientist, ICAR-CICR, was the Chief Guest of the occasion. The dias was shared by Dr. Vinita Gotmare, Principal Scientist. All the women staff of the institute including Scientists, Technical staff, administrative staff, SRF, JRF, Young Professionals, Students, and supporting staff, have witnessed the program, which includes recreational activities and fun games. The women technical staff, including Mrs. Mithila Meshram and Mrs. Chaitali Rodge have arranged the overall program theme and activities for successful completion of program. On this occasion, the Director rewarded the young scientists and other staff members for their noble contributions.



48th Foundation Day of ICAR-CICR

ICAR-CICR under the leadership of Dr. Y.G. Prasad, Director celebrated its 48th Foundation Day on 1 April 2024 with bliss and enthusiasm. Padma Bhushan Dr. RS Paroda, Former Director General ICAR and Chairman TAAS graced the occasion as Chief Guest and delivered a foundation day lecture on “Cotton – A New Way Forward”. Dr. CD Mayee, Former Chairman (ASRB) presided over the function. Prof. Indra Mani, Vice-Chancellor, VNMKV, Parbhani; Dr NG Patil, Director, ICAR-NBSS&LUP; Dr DK Ghosh, Director, ICAR-CCRI Nagpur; Dr. Ashutosh A Murkute, Director, MGIRI, Wardha; Dr. AL Waghmare, Director, DCD, 02 Nagpur; Dr. SK Shukla, Director, ICAR-CIRCOT, Mumbai were the Guests of Honour. The program was condcuted in hybrid mode where staff from two regional stations (Sirsa and Coimbatore) and retired staff of the CICR Regional stations joined through online mode. To provide farmers with detailed information in an accessible language, the institute has crafted special publications on the occasion of the foundation day, which include the following: Success stories under special project on cotton, HDPS for cotton (English and Hindi) and KAPASIKA- 2023.

10th International Yoga Day Celebration

In order to commemorate the International Yoga Day 2024 on 21st June with the theme “yoga for self and society”. ICAR-CICR Nagpur celebrated this yoga day at the institute with the Yoga Trainer Mr. G V. Deogirkar Farm superintendent, ICAR-CICR and the guest of honour, Dr Nupur Angal, physiotherapist Nagpur in the presence of Director ICAR-CICR, Dr YG Prasad and Dr. Mahajan-Vice President SRC. The event was organized by recreation club, ICAR- CICR Nagpur.

96th ICAR Foundation and Technology Day July 15-16,2024

Celebrating Independence Day at ICAR-CICR, Nagpur

The Independence Day flag hoisting ceremony was held at the ICAR-Central Institute for Cotton Research (CICR), Nagpur, on August 15, 2024. The event took place at 8:30 AM, with Dr. Y.G. Prasad, Director of ICAR-CICR, presiding over the flag hoisting. The ceremony was attended by all staff members who gathered to celebrate the occasion.

19th "Parthenium Awareness Week" program

The 19th "Parthenium Awareness Week" program was organized on 21st August 2024 near the KVK campus of the institute to raise awareness about the importance of eradicating Parthenium weed, which causes health hazards to animals, humans, and environmental biodiversity, and its role in transmission of TSV disease in cotton. Dr. Y.G. Prasad, Director of ICAR-Central Institute for Cotton Research, along with Heads of Division, scientists, and all staff of ICAR-CICR, Nagpur, participated in the event.

Celebrating World Cotton Day at ICAR-CICR, Nagpur

Kisan Diwas

ICAR-Central Institute for Cotton Research, Nagpur, celebrated Kisan Diwas on 23rd December 2024 in the institute under the Special Project on Cotton. The programme was inaugurated by Smt. Shubha Thakur, Additional Secretary (Crops & Seeds), Ministry of Agriculture and Farmers Welfare, Government of India. Dr. C.D. Mayee, Former Chairman, ASRB, ICAR. Dr. A.L. Waghmare, Dr. Govind Wairale, and Dr. Arjun Tayde, attended the programme along with 75 farmers.

10.6:Participation of Scientists in Symposia/ Conference/Seminars/ Webinar

Name of Scientist	Title of Seminar/ Webinar/ Conference/Symposia	Seminar/ Webinar/ Conference/ Symposia	Place/Organized by	Date and Duration
Dr. Satish Kumar Sain	National Conference on "Plant Health for Food Security: Threats and Promises"	Conference	ICAR-IISR, Lucknow, Uttar Pradesh	01-02-2024 to 03-02-2024 (3 Days)
Dr. Satish Kumar Sain	ISMPP 3rd Asian Congress on Plant Pathology: Plant and Soil Health Management for a Better Tomorrow	Conference	SDAU, Sardar krushinagar Gujarat	07-02-2024 to 10-02-2024 (4 Days)
Dr. A. Manikandan	National Seminar on Soil Ecosystem Services for Sustainable Agriculture	Seminar	ICAR-NBSS&LUP, Nagpur	21-02-2024 to 23-02-2024 (3 Days)
Dr. Usha Rani	39th Annual Conference of Association for International Agricultural and Extension Education (AIAEE) on "Technology, Pluralism and Inclusiveness in Agriculture, Food, and Environment"	Conference	Association for International Agricultural and Extension Education (AIAEE) at University of Guelph, Guelph, Canada	26-04-2023 to 29-04-2023 (4 Days)
Dr. Joy Das, Dr. Rakesh Kumar	International Conference on Advancements in Science, Engineering and Management ICASEM 2024	Conference	Vidya Vihar Institute of Technology, Purnea, Bihar, India & RSP Conference Hub, Coimbatore	30-05-2024 to 31-05-2024 (2 Days)
Dr. Joy Das, Dr. Rakesh Kumar	International conference on Emerging Technologies in Agriculture and Allied Sciences	Conference	Society for Agriculture, Allied Sciences and Technology (SAAST), Odisha in association with School of Agriculture, SR University, Warangal and Meadow Agriculture Pvt. Ltd., Uttar Pradesh	10-08-2024 to 11-08-2024 (2 Days)
Dr. K. Sankaranarayanan	International Conference on Agrovoltaics and Sustainability in Farming	Conference	TNAU, Coimbtore	19-09-2024 to 20-09-2024 (2 Days)

Name of Scientist	Title of Seminar/ Webinar/ Conference/Symposia	Seminar/ Webinar/ Conference/ Symposia	Place/Organized by	Date and Duration
Dr. K. Baghyalakshmi, Dr. K.Sankaranarayanan , Dr. A Manivannan, Dr. Amudha J, Dr. P Nalayini, Dr. Gulsar Banu, J, Dr. S Usha Rani, Dr. Amarpreet Singh, Dr. Satish Kumar Sain, Dr. Rishi Kumar	WCRC-8 (World Cotton Research Conference-8)	Conference	International Cotton Advisory Committee, Washington DC, USA, at Hotel Intercontinental in Tashkent, Uzbekistan	03-10-2024 to 07-10-2024 (5 Days)
Dr. Rakesh Kumar	National Conference on Frontiers in Science & Technology-2024 (NCFIST- 2024)	Conference	Mahatma Gandhi College of Science, Gadchandur, in association with Gondwana University, Gadchiroli & UltraTech Cement Ltd., Unit-Manikgarh Cement Works, Gadchandur, Chandrapur	05-10-2024 (1 Days)
Dr. Jaya Kumaravaradan R	84th Annual Conference of Indian Society of Agricultural Economics (ISAE)	Conference	PAJANCOA & RI in Karaikal, Puducherry	11-11-2024 to 13-11-2024 (3 Days)
Dr. Y G Prasad, Dr. V. N. Waghmare, Dr. K. Velmourougae, Dr K. Baghyalakshmi, Dr. K. Sankaranarayanan, Dr. S. Manickam, Dr Subhash Chandra, Dr. A Manivannan, Dr. Amudha J, Dr. P Nalayini, Dr. Joy Das, Dr Sampathkumar A., Dr. Usha Rani, DR K Shankarganesh, Dr. Rishi Kumar, Dr. Dipak T. Nagrale, Dr. S.P.Gawande,	International conference on Innovative technologies for research and development for sustainable production of cotton, oilseeds and fibre crops	Conference	Cotton Research and Development Association (CRDA), CCSHAU, Hisar, Indian Society of Oilseeds Research (ISOR), Hyderabad and ICAR- Indian Institute of Oilseeds Research (IIOR), Hyderabad.	13-11-2024 to 15-11-2024 (3 Days)
Dr. A. Manikandan	Global Soils Conference	Conference	NAAS Complex, New Delhi	19-11-2024 to 22-11-2024 (4 Days)
Dr K Rameash, Dr Sampathkumar A	International Conference on Unleashing the Power of Seed and Crop Health Innovations for a Food Secure World	Conference	TNAU, Coimbatore and Shastri Indo-Canadian Institute, New Delhi.	21-11-2024 to 22-11-2024 (2 Days)

Distinguished Visitors

Visit of the Hon'ble Secretary DARE and Director General, ICAR, New Delhi to ICAR-CICR, RS, Coimbatore on 11.07.2024

Hon'ble Dr. Himanshu Pathak, Secretary DARE and Director General, ICAR, New Delhi Visited at ICAR-CICR, RS, Coimbatore on 11.07.2024 and addressed te staff. Dr. Himanshu Pathak, DG, ICAR, New Delhi visited the exhibition stall and interacted with scientists about the various technologies and varieties displayed in the stall, such as Drones, HDPS, protection technologies and latest released varieties viz., Nano, Suraksha, ELS varieties viz., CICR B cotton 55, 45 and 37. Later, he addressed the staff gathering at seminar hall of the station. He appreciated the technologies and varieties released by the institute for the cotton farming community.

In the Special address, DG informed that cotton crop has been highly discussed in almost all important meetings at the ICAR. The recently joined Minister of Textiles personally visited him to discuss issues related to the crop, along with other secretaries and Director, CICR, Nagpur. A few concerns about the crop are - the total production and yields remains stagnant Although we have many success stories; it seems we may have not sustain in future. The varieties that are coming up are also from private firms such as Monsanto etc.,. The main problem to be addressed is the stagnation of total production and productivity and their reduction in recent years. As such, cotton crop is difficult to grow under external drought and stresses, makes the yield reduction.

To address these difficulties in cotton production, two or three kinds of interventions ave been putforth. 1. HDPS in order to boost the production in which the station scientists are being involved. 2. Development of resistant varieties (resistant lines and those in pipelines). He emphasized the Coimbatore scientists to collaborate with Nagpur scientists to come up with good action plan for 3 to 4 years to address cotton scenario to overcome low production so as to reverse back again He added that the cotton sector is our concern. We should consider how best to handle and focus on our contributions. He congratulated the station for being handling the project of 40 crores, and he emphasized the need of such kind projects, especially in collaboration wit textiles industries.

He informed the gathering that council support in release of herbicide-tolerant cotton variety as it is in the Ministry of Environment, Forest and Climate Change (MoEFCC) for GAC meeting and added that the Head of CICR, being a member, will update the proceedings. He shared his happiness that the centre was good, large enough with good work and strength. He emphasized the importance of cotton as prior commodity for Govt. of India. The council will extend the support to the station in all aspects to ensure its smooth operation.

Visit of Shri. Giriraj Singh Ji, Hon'ble Union Minister of Textiles, GoI, New on 25th September 2024

Shri. Giriraj Singh Ji, Hon'ble Union Minister of Textiles, GoI, New Delhi made his maiden visit to Nagpur based ICAR-Central Institute for Cotton Research on 25th September 2024 and chaired the interactive meet held on HDPS. He informed that Saturation model Project will be initiated at Akola by Ministry of Textiles, GoI, New Delhi with the support of ICAR-CICR, Nagpur. He visited field experiments and interacted with scientists, students and stake holders in cotton farming.

Australian Consul-General, Mumbai, visited ICAR-CICR Nagpur

On 9th October 2024, The Australian Consul-General (Mumbai), Mr. Paul Murphy visited to the ICAR-Central Institute for Cotton Research (ICAR-CICR) Nagpur. The visit aimed to foster stronger ties between India and Australia in cotton research, knowledge exchange, and extension. The visit was marked by a series of productive interactions and discussions with the Director, Heads of Divisions, and scientists.

10.7: Personnel

Director

Dr. Y. G. Prasad

CROP IMPROVEMENT DIVISION

Genetics & Plant Breeding

Nagpur

Dr. VN Waghmare, Head

Dr. (Mrs.) Vinita Gotmare, Pr. Scientist

Dr. DV Patil, Pr. Scientist (Retired on 30.06.2024)

Dr. Rajkumar Ramteke, Pr. Scientist

Dr. M Saravanan, Sr. Scientist

Dr. RM Phuke, Sr. Scientist

Coimbatore

Dr. S Manickam, Pr. Scientist

Dr. Manivannan A, Sr. Scientist

Dr. (Mrs.) K Baghyalakshmi, Scientist

Sirsa

Dr. SK Verma, Pr. Scientist

Dr. Subhash Chandra, Scientist

Agril. Biotechnology

Nagpur

Dr. G Balasubramani, Pr. Scientist (Retired on 30.06.2024)

Dr. (Mrs.) J Amudha, Pr. Scientist

Dr. KP Raghavendra, Sr. Scientist

Dr. Joy Das, Sr. Scientist

Dr. Rakesh Kumar, Sr. Scientist

Seed Science &Technology

Nagpur

Dr. (Mrs.) V Santhy, Pr. Scientist

Dr. SS Mahajan, Pr. Scientist

Coimbatore

Dr. K Rathinavel, Pr. Scientist (Retired on 30.03.2024)

Sirsa

Dr. Debashis Paul, Scientist

CROP PRODUCTION DIVISION

Agronomy

Nagpur

Dr. AS Tayade, Head

Dr. Blaise Desouza, Pr. Scientist

Dr. AR Raju, Pr. Scientist (Retired on 29.02.2024)

Dr. Ramkrushna I Gandhiji, Sr. Scientist

Coimbatore

Dr. (Mrs.) P Nalayini, Pr. Scientist

Dr. K Sankaranarayanan, Pr. Scientist

Dr. R Raja, Pr. Scientist

Sirsa

Dr. Amarpreet Singh, Sr. Scientist

Soil Science

Nagpur

Dr. A Manikandan, Sr. Scientist

Coimbatore

Dr. (Mrs.) D Kanjana, Sr. Scientist

Farm Machinery & Power

Nagpur

Er. G Majumdar, Scientist (SG) (Retired on 30.04.2024)

Plant Physiology

Nagpur

Dr. JH Meshram, Pr. Scientist

Coimbatore

Dr. AH Prakash, Head, RS Coimbatore

Dr. (Mrs.) Annie Sheeba, Sr. Scientist

Plant Biochemistry

Dr. (Mrs.) Pooja Verma, Sr. Scientist

Agricultural Microbiology

Nagpur

Dr. K Velmourougane, Pr. Scientist

Agricultural Extension

Coimbatore

Dr. (Mrs.) Usha Rani, Pr. Scientist

Agricultural Economics

Nagpur

Dr. R. Jaya Kumara Varadan, Scientist

Coimbatore

Dr. (Mrs.) Isabella Agarwal, Pr. Scientist

Computer Application in Agriculture

Coimbatore

Dr. M Sabesh, Pr. Scientist

CROP PROTECTION DIVISION

Agricultural Entomology

Nagpur

Dr. GT Behere, Head

Dr. V S Nagrare, Pr. Scientist

Dr. (Mrs.) Rachna Pande, Sr. Scientist

Dr. Babasaheb Fand, Sr. Scientist

Dr. Shivaji Thube, Sr. Scientist

Dr. Shah Vivek Hanskumar, Scientist

Coimbatore

Dr. K Rameash, Pr. Scientist

Dr. (Mrs.) M Amutha, Pr. Scientist

Dr. K Shankarganesh, Sr. Scientist

Sirsa

Dr. Rishi Kumar, Pr. Scientist (Station I/c w.e.f. 24.03.2023)

Plant Pathology

Nagpur

Dr. SP Gawande, Sr. Scientist

Dr. DT Nagrale, Sr. Scientist

Dr. Neelakanth Hiremani, Scientist

Coimbatore

Dr. A Sampath Kumar, Sr. Scientist

Dr. P Valarmathi, Sr. Scientist

Sirsa

Dr. Satish Kumar Sain, Pr. Scientist

Nemotology

Nagpur

Dr. Devindrappa, Scientist (Transferred to ICAR-IIRR, Bengaluru, Relieved on 10.04.2024)

Coimbatore

Dr. (Mrs.) J Gulsar Banu, Pr. Scientist

KRISHI VIGYAN KENDRA

Senior Scientist-cum-Head, KVK

Dr Raksh Kumar Singh, (Transferred to KVK, Lakhimpur Kheri under ICAR-IISR, Lucknow on 18.03.2024)
Dr. Ramkrishna GI, Senior Scientist & Incharge KVK

Technical Staff

T- 6 of Category III

Sh. SS Patil, T-9 SMS (Retired on 30.06.2024)

Dr. UV Galkate, T-9 SMS

Mrs. Sunita N Chauhan, T-9 SMS

Dr. UA Nandankar, T-9, CTO (Retired on 29.02.2024)

Dr. Deepa Lal, T-6 SMS

T-4 of Category II

Dr. PB Deulkar, T (7-8)

Dr. HB Kumbhalkar, T-6, Sr. Tech. Officer

Mrs. Vandana Satish, T-6, Sr. Tech. Officer

T-1 of Category I

Sh. AK Sherkar, T-5 Driver

Sh. Naresh Raut T-3 Driver

Skilled Support Staff

Sh. Naresh Gorghate

ADMINISTRATION

Nagpur

CAO

Sh. A A Goswami (Retired on 15.01.2024)

SAO

Sh. Rakesh Kumar Jatav (Joined on 31.01.2024)

FAO

Sh. Sanjay Kumar Singh

AO

Sh. Puneet Kumar (Joined on 22.04.2024)

PR. PRIVATE SECY.

Sh. DB Mundharikar

PRIVATE SECY.

Smt. RG Iyer

Sh. MC Tiwari

AAO

Sh. Rakesh Tiwari

Sh. VD Bende

PERSONAL ASSISTANT

Sh. SS Chalkhure (Transferred to ICAR-CCRI, Nagpur promoted to the post of PS on 27.06.2024)

Sh. PP Ambade

Sh. K Vedavyas

ASSISTANT

Smt. SP Kharche

Sh. VM Waghmare

Sh. KB Nandeshwar

Sh. Chirag Singla (Joined on 28.08.2024)

Sh. Chandan Kumar (Joined on 02.09.2024)

Sh. Akshay Kumar (Joined on 04.09.2024)

Sh. Sanjay Meena (Joined on 06.09.2024)

Sh. Raj Gawande (Joined on 21.11.2024)

UDC

Sh. AM Kawale

Sh. Saurabh Patil

LDC

Sh. Shital Kumar Sharma (Transferred to ICAR-VPKAS, Almora appointed to the post of Technical Assistant, T-3 on 10.06.2024)

Coimbatore

ASSISTANT

Sh. N Ramesh

UDC

Miss RP Deepa

Miss R Ramya

Sirsa

AAO

Ms. Kalpna Singh

ASSISTANT

Sh. Satbir Singh

Sh. Sanjay Kumar

TECHNICAL STAFF

Nagpur

CAT. III

Sh. Sanjay Kushwaha, CTO

CAT. II

Sh. CK Shastry, CTO (Retired on 31.10.2024)

Smt. SU Dixit, CTO

Sh. RV Salame, ACTO

Sh. GV Deogirkar, TO

Smt. RS Deshmukh, TO

Smt. Chetali Rodge, TO

Sh. MR Meshram, STA

Sh. HS Mundafale, STA

Dr. Vrushali Deshmukh, STA

Dr. Jimmy B. Vaidya, STA

Ms. Mithila Meshram, STA

Sh. Rohit Katiyar, STA (Transferred to ICAR-IIPR, Kanpur on 25.10.2024)

Sh. Ratnadeep Ramteke, STA

Dr. E. Raghu, STA (Transferred to ICAR-IIOR, Hyderabad on 23.07.2024)

Mr. Atul Lende, STA

CAT. I

Sh. SN Ingle, T-5 (Driver)

Sh. Diwakar Sawaji, TO

Sh. RK Gaikwad, T-4 (Driver) (Retired on 31.07.2024)

Sh. BA Fande, Tech. Astt

Sh. SH Kumbhare, Tech. Astt

Sh. SH Mandpe, Sr. Technician

Sh. Abdul Waseem, Tech. Astt

Sh. KH Mogre, Sr. Technician

Sh. AB Mate, Sr. Technician

Sh. Krushna Gajghate, Sr. Technician

Smt. Pooja Ghonge, Sr. Technician

Sh. Ajit Meshram, Sr. Technician

Sh. Pankaj Gadge, Sr. Technician

Sh. Kunal Gaikwad, Sr. Technician

Sh. Akshay Barahate, Sr. Technician

Sh. Akshay K. Kamble, Sr. Technician

Sh. Jaibhim S. Kambe, Sr. Technician

Sh. Chandrashekhar Mundafale, Sr. Technician

Sh. Paresh Bhoyar, Sr. Technician

Sh. Dinesh kumar Mahule, Sr. Technician

Sh. Praful Margaye, Sr. Technician

Sh. Ajay Sirsam, Sr. Technician

Sh. Anup Kumar, Technician (Joined on 09.05.2024)

Sh. Ahutosh Kumar Mishra, Technician (Joined on 09.05.2024)

Coimbatore

CAT. II

Sh. S Satyakumar, ACTO

Smt. KS Subasri, ACTO

Ms. V Anisha, TO

Sh. A Karthick, TO

Mr. K Muthukumar, TO

CAT. I

Sh. S Manikandan, T-4 (Driver)

Sh. J William Raja, Sr. Tech

Sh. Sabarinathan, Sr. Tech

Sh. M Sampath Kumar, Sr. Technician

Sh. Koppula Suresh, Sr. Technician

Sirsa

CAT. II

Sh. Satpal Singh, Tech. Asst.

CAT. I

Sh. Sanjeev Kumar, Tech. Asstt.

Sh. Bhura Ram, Sr. Technician

Sh. Naresh Kumar, Sr. Technician

Sh. Satbir Singh, Sr. Technician

Sh. Pali Ram, Technician

Sh. Prabhat Yadav, Technician (Joined on 15.05.2024)

Skilled Support Staff

Nagpur

Smt. LS Kanfade

Sh. Rewnath S Ambarte (Retired on 30.04.2024)

Smt. Kamala R. Kawale

Sh. Dhanraj S. Nagrare

Smt. Durga R. khandate

Sh. Kishor Barahate

Smt. Sulochana Tekam

Sh. Subhash R. Mankar

Sh. Haridas K. Dange

Sh. Anil B. Barahate

Sh. Kishor P. Bondade

Sh. Ankush V. Chaudhari

Smt. Chhaya R. Ganorkar

Sh. Damodar S. Chinurkar

Sh. Arun Wadguji Thool

Sh. Vijay Shyam Mogre

Sh. Indrapal R. Dhakne (Retired on 31.07.2024)

Sh. Deocharan P. Barahate

Smt. Lilabai R. Ambarte

Smt. Subhadra B. Kawale

Smt. Panchfula H. Pandhram

Smt. Tanabai A. Puram

Smt. Pushpa S. Sarate

Smt. Shobha K. Kumbhare

Smt.Chandabai S. Chapekar

Smt. Nanda Ramesh Ukre (Retired on 30.04.2024)

Smt. Indu I. Sayam (Retired on 30.11.2024)

Smt. Chindhabai V. Wankhede

Coimbatore

Sh. Karuppasamy

Sh. Manimekalai Karuppusamy

Smt. Lakshmi Rangasamy

Sirsa

Sh. Balli Ram

Sh. Madan Gopal

Sh. Radhey Shyam (Retired on 30.04.2024)

Sh. Ishwar Dutt

Sh. Anil Kumar

Sh. Subash Chander

Sh. Sharwan Kumar S/o Sh. Chandra Ram

Sh. Gurmeet S/o Sh. Ramkisan

Smt. Kesro W/o Sh. Gurmeet

Sh. Deepak Kumar S/o Sh. Nand Lal

Sh. Ram Avatar

Sh. Rajender Kumar (Retired on 31.12.2024)

Smt. Kamla

Joined

Name and Designation	w.e.f.
Sh. Rakesh Kumar Jatav, Senior Administrative Officer joined at ICAR-CICR, Nagpur	31.01.2024
Sh. Puneet Kumar, Administrative Officer joined at ICAR-CICR, Nagpur	22.04.2024
Sh. Anup Kumar, Technician, T-1, ICAR-CICR, Nagpur	09.05.2024
Sh. Ashutosh Kumar Mishra, Technician, T-1, ICAR-CICR, Nagpur	09.05.2024
Sh. Prabhat Yadav, Technician, T-1, ICAR-CICR RS, Sirsa	15.05.2024
Sh. Chirag Singla, Assistant joined at ICAR-CICR, Nagpur	28.08.2024
Sh. Chandan Kumar, Assistant joined at ICAR-CICR, Nagpur	02.09.2024
Sh. Akshay Kumar, Assistant joined at ICAR-CICR, Nagpur	04.09.2024
Sh. Sanjay Meena, Assistant joined at ICAR-CICR, Nagpur	06.09.2024
Sh. Raj Gawande, Assistant joined at ICAR-CICR, Nagpur	21.11.2024

Transfer

Name and Designation	From	To	w.e.f.
Dr. Rakesh Kumar Singh, Senior Scientist-cum-Head, KVK,	KVK, ICAR-CICR, Nagpur	KVK, Lakhimpur Kheri under ICAR-IISR, Lucknow	18.03.2024
Dr. Devindrappa, Scientist (Nematology)	ICAR-CICR, Nagpur	ICAR-IIHR, Bengaluru	10.04.2024

Name and Designation	From	To	w.e.f.
Sh. Shital Kumar Sharma, LDC	ICAR-CICR, Nagpur	ICAR-VPKAS, Almora appointed to the post of Technical Assistant, T-3	10.06.2024
Sh. Sameer Chalkhure, PA	ICAR-CICR, Nagpur	ICAR-CCRI, Nagpur promoted to the post of PS	27.06.2024
Dr. E. Raghu, Technical Assistant, T-3	ICAR-CICR, Nagpur	ICAR-IIOR, Hyderabad	23.07.2024
Sh. Rohit Katiyar, Technical Assistant, T-3	ICAR-CICR, Nagpur	ICAR-IIPR, Kanpur	25.10.2024

Promotion

Name and Designation	Promoted to	w.e.f.
Dr. M. Sabesh, Sr. Scientist	Pr. Scientist	10.04.2022
Dr. K. Velmourougane, Sr. Scientist	Pr. Scientist	08.01.2023
Dr. PB Deulkar, ACTO, T(7-8)	CTO, T-9	07.04.2019 (DPC on 29.08.23)
Dr. Jimmy Vaidya, Tech. Asstt. (T-3)	Sr. Tech. Asstt. (T-4)	14.09.2023
Ms. Mithila Meshram, Tech. Asstt. (T-3)	Sr. Tech. Asstt. (T-4)	30.10.2023
Sh. Rohit Katiyar, Tech. Asstt. (T-3)	Sr. Tech. Asstt. (T-4)	20.11.2023
Sh. Satpal Singh, Tech. Asstt. (T-3)	Sr. Tech. Asstt. (T-4)	22.11.2023
Sh. Ratnadeep Ramteke, Tech. Asstt. (T-3)	Sr. Tech. Asstt. (T-4)	26.11.2023
Dr. E. Raghu, Tech. Asstt. (T-3)	Sr. Tech. Asstt. (T-4)	08.01.2024
Sh. K. Muthukumar, Tech. Asstt. (T-3)	Sr. Tech. Asstt. (T-4)	25.03.2024
Sh. Atul Lende, Tech. Asstt. (T-3)	Sr. Tech. Asstt. (T-4)	09.04.2024
Sh. Bhumeshwar Fande, Sr. Technician (T-2)	Tech. Asstt. (T-3)	07.02.2024
Sh. Sanjeev Kumar, Sr. Technician (T-2)	Tech. Asstt. (T-3)	07.02.2024
Sh. Sujit Kumbhare, Sr. Technician (T-2)	Tech. Asstt. (T-3)	21.03.2024
Sh. Abdul Waseem, Sr. Technician (T-2)	Tech. Asstt. (T-3)	14.08.2024
Sh. Koppula Suresh, Technician (T-1)	Sr. Technician (T-2)	02.04.2024
Sh. Krushna Gajghate, Technician (T-1)	Sr. Technician (T-2)	03.04.2024
Ms. Pooja Ghonge, Technician (T-1)	Sr. Technician (T-2)	12.04.2024
Sh. Ajit Meshram, Technician (T-1)	Sr. Technician (T-2)	15.04.2024
Sh. Pankajkumar Gadge, Technician (T-1)	Sr. Technician (T-2)	18.04.2024
Sh. Kunal Gaikwad, Technician (T-1)	Sr. Technician (T-2)	23.04.2024
Sh. Akshay Barahate, Technician (T-1)	Sr. Technician (T-2)	23.04.2024
Sh. Akshay Kamble, Technician (T-1)	Sr. Technician (T-2)	03.06.2024
Sh. Jaibhim Kambe, Technician (T-1)	Sr. Technician (T-2)	07.06.2024
Sh. Chandrashekhar Mundafale, Technician (T-1)	Sr. Technician (T-2)	07.06.2024
Sh. Paresh Bhoyar, Technician (T-1)	Sr. Technician (T-2)	07.06.2024
Sh. Dineshkumar Mahule, Technician (T-1)	Sr. Technician (T-2)	13.06.2024
Sh. Praful Margaye, Technician (T-1)	Sr. Technician (T-2)	22.07.2024
Sh. Ajay Sirsam, Technician (T-1)	Sr. Technician (T-2)	24.07.2024
Sh. Saurabh Patil, LDC	UDC	04.12.2024
Dr. M. Sarvanan, Sr. Scientist (RGP 8000)	Sr. Scientist (RGP 9000)	20.04.2024
Dr. A. Sampathkumar, Sr. Scientist (RGP 8000)	Sr. Scientist (RGP 9000)	04.05.2023
Dr. Rahul Phuke, Scientist (RGP 7000)	Sr. Scientist (RGP 8000)	01.07.2024
Dr. P. Valarmathi, Scientist (RGP 7000)	Sr. Scientist (RGP 8000)	01.01.2024
Dr. Rakesh Kumar, Scientist (RGP 7000)	Sr. Scientist (RGP 8000)	01.01.2024
Dr. Joy Das, Scientist (RGP 7000)	Sr. Scientist (RGP 8000)	01.01.2024
Dr. Pooja Verma, Scientist (RGP 7000)	Sr. Scientist (RGP 8000)	01.07.2024
Dr. Shivaji Thube, Scientist (RGP 7000)	Sr. Scientist (RGP 8000)	01.07.2024
Dr. Amarpreet Sngh, Scientist (RGP 7000)	Sr. Scientist (RGP 8000)	15.09.2020
Dr. Debashis Paul, Scientist (RGP 6000)	Scientist (RGP 7000)	07.01.2024

* Technical Assessment Committee (DPC) meeting held on 17.12.2024 for considering the promotions in respect of Sh. S. Sathyakumar, ACTO, T(7-8) of Laboratory Technician Group under Category-III, Proceedings send to Council for approval, recommendation yet to come.

Retirements

Name	Post held	Date of retirement
Sh. AA Goswami	CAO	15.01.2024
Dr. AR Raju	Principal Scientist	28.02.2024
Dr. UA Nandankar	CTO	28.02.2024
Dr. K. Rathinavel	Principal Scientist	31.03.2024
Sh. Rewnath Ambarte	SSS	30.04.2024
Er. G. Majumdar	Scientist	30.04.2024
Smt. Nanda Ukre	SSS	30.04.2024
Sh. Radhey Shyam	SSS	30.04.2024
Dr. G. Balasubramani	Principal Scientist	30.06.2024
Sh. SS Patil	SMS, T-9	30.06.2024
Dr. DV Patil	Principal Scientist	30.06.2024
Sh. RK Gaikwad	T-4 (Driver)	31.07.2024
Sh. Indrapal Dhakne	SSS	31.07.2024
Sh. Chandrashekhar Shastry	CTO, T-9	31.10.2024
Smt. Indu Sayam	SSS	30.11.2024
Sh. Rajender Kumar	SSS	31.12.2024

10.8: Other Information

10.8.1: Mera Gaon Mera Gaurav

Mera Gaon Mera Gaurav (MGMG) program has been implemented by ICAR- CICR Nagpur and its Regional Stations at Coimbatore and Sirsa as per the guidelines during 2024. The program was implemented in 55 adopted villages in 11 clusters by 45 Scientists as 11 teams. The details of Scientists involved and villages adopted are given below.

Details of Scientists involved and Villages adopted under MGMG during 2024

Team	Villages / Clusters / Districts adopted	Name of the Team Leader and Members
I	District: Nagpur Cluster: Hingna Villages: Khairi Pannase, Girola, Mohgaon, Salaimendha, Kohda	1. Dr. V. Santhy (SeedTechnology) 2. Dr. Dipak Nagrale (Plant Pathology) 3. Dr. Shivaji Thube (Entomology) 4. Dr. Rakesh Kumar (Biotechnology)
II	District: Nagpur Cluster: Umred Villages: Pipla, Vihirgaon, Dhurkheda, Pusagondi, Jhiri (Na)	1. Dr. Sunil S. Mahajan (Seed Technology) 2. Dr. Rachana Pande (Entomology) 3. Dr. Neelkanth Hiremani (Plant Pathology) 4. Dr. Pooja Verma (Plant Biochemistry)
III	District: Wardha Cluster: Arvi Villages: Dabalipur, Malegaon theka, Saheli, Kharangana, Kachanpur	1. Dr. Ramkrushna GI (Agronomy) 2. Dr. Shailesh Gawande (Pathology) 3. Dr. Babasaheb Fand (Entomology) 4. Dr. Rahul Fuke (Plant Breeding)
IV	District: Wardha Cluster: Wardha Villages: Narsola, Anji, Ganeshpur, Majra and Kamthi	1. Dr. J. H. Meshram (Plant Physiology) 2. Dr. K. P. Raghvendra (Biotechnology) 3. Dr. M Sarvanan (Plant Breeding) 4. Dr R. Jaya Kumaravardan (Agrl. Economics)
V	District: Nagpur Cluster: Umred Villages: Wadegaon (kale), Akola, Karandla, Navegaon (Sadhu), Barva	1. Dr. Vishlesh Nagrare, (Entomology) 2. Dr. Manikandan (Soil Science) 3. Dr. Joy Das (Biotechnology)
VI	District: Nagpur Cluster: Nagpur Villages: Chichkhota, Mohgaon, Chimnazari, Sonegaon, Alagondi	1. Dr. Vinita Gotmare (Genetics & Cytogenetics) 2. Dr. J. Amudha (Biotechnology) 3. Dr. Rajkumar Ramteke (Genetics and Plant Breeding) 4. Dr. Vivek Shah (Entomology)
VII	District: Coimbatore Block: SS Kulam Villages: Kondeyam Palayam, Keeranatham, Kaalipalayam, As Kulam, SS kulam	1. Dr. P. Nalayini (Agronomy) 2. Dr. Isabella Agarwal (Agrl. Economics) 3. Dr. M. Amutha (Agrl. Entomology) 4. Dr. A. Manivannan (Plant Breeding and Genetics) 5. Dr. Sampath Kumar (Plant Pathology)

Team	Villages / Clusters / Districts adopted	Name of the Team Leader and Members
VIII	District: Tiruppur Block: Gudimanagalam Villages: Virukalpatti, Virukalpatti-Pudur, Vallakundapuram, Marikanti Puthupalayam	1. Dr. J. Gulsar Banu (Nematology) 2. Dr. R. Raja (Agronomy) 3. Dr. K. Shankarganesh (Agrl. Entomology) 4. Dr. K. Baghyalakshmi (Plant Breeding and Genetics)
IX	District: Coimbatore Block: Pollachi North Villages: Devambaduvalasu, Vadakkipalayam, Puravipalayam, Zaminkalathur and Athiyur	1. Dr. S. Manickam (Plant Breeding and Genetics) 2. Dr. M. Sabesh (Computer Applications) 3. Dr. D. Kanjana (Soil Science) 4. Dr. P. Valarmathi (Plant Pathology)
X	District: Coimbatore Block: Karamadai Villages: Periyanaickenpalayam, Kuppuchipalayam, Kasthuripalayam, Veerapandi, Vellamadai	1. Dr. K. Sankaranarayanan (Agronomy) 2. Dr. S. Usha Rani (Agrl. Extension) 3. Dr. K. Ramaesh (Agrl. Entomology) 4. Dr. J. Annie Sheeba (Plant Physiology)
XI	District: Sirsa Villages: Khedi, Chaharwala, Chadiwal, Hanzira	1. Dr. S.K. Sain (Plant Pathology) 2. Dr. S.K. Verma ((Plant Breeding and Genetics) 3. Dr. Rishi Kumar (Agrl. Entomology) 4. Dr. Amarpreet Singh (Agronomy) 5. Dr. Subash Chandra ((Plant Breeding and Genetics)

Extension Activities conducted during the year 2024 under MGMG in the adopted villages

Farmers Interface meeting at Village Khedi by MGMG Team XI

Field Visit by MGMG Team XI at village Khedi

Participation of MGMG farmers in the district level Kisan Mela and Exhibition at Bhattu, Sirsa

Participation of MGMG farmers in the training on organic cotton production technologies at KVK, Sirsa

Visit by MGMG Team VIII to cotton fields for creating awareness about Clean Cotton Cultivation

Visit by MGMG Team VIII to cotton fields for recommending strategies to manage pests and diseases

Visit by MGMG Team X to HDPS cotton fields

Participation of MGMG farmers in Krishi Mela in the village Kuppachipalayam

Scientists' visit to demonstration filed on HDPS cotton in MGMG village

10.8.2: Development Action Plan for Scheduled Caste (formerly SCSP) 2024

Overview of the Scheme:

The Development Action Plan for Scheduled Castes (DAPSC), previously known as the Scheduled Caste Sub Plan (SCSP), is a central government-sponsored initiative aimed at improving the livelihoods of Scheduled Caste (SC) communities, primarily through agricultural development and skill enhancement. Implemented by ICAR-CICR, Nagpur, the program sought to enhance productivity and income within SC households by addressing agribusiness needs and promoting the use of available resources.

Objective:

The main objectives of the scheme were:

1. Increase Income Levels: Elevate the income of SC families through targeted income-generating schemes, skill development, and infrastructure improvement.
2. Enhance Agricultural Productivity: Provide technological support and scientific guidance to increase productivity and improve agricultural practices.
3. Capacity Building: Offer training and workshops to build skills and knowledge, empowering the SC community, especially women.

Program Implementation:

The DAPSC was implemented in five districts of Maharashtra with a high SC population (50% or more). These districts included:

- Nagpur
- Wardha
- Chandrapur
- Amaravati
- Yavatmal

Key implementation steps:

- Beneficiary Identification: Families were identified with the help of State Government Agencies.
- Program Planning & Execution: Planned at the institute level and executed through a committee formed for each adopted village.
- Targeted Poor SC Families: The scheme directly benefited the poorest families, providing them with agricultural inputs and technological support.

Key Activities and Interventions:

1. Technological Interventions:
   - Dissemination of scientific knowledge and agricultural practices.
   - Introduction of new technologies and pest management solutions.
   - Regular interface meetings and timely solutions to farmers' issues.
2. **Skill Development:**
   - Regular skill development programs and workshops on agricultural practices, business development, and entrepreneurship.
   - Exposure visits to improve farmers' understanding of best practices.
3. **Empowerment of Women Farmers:**
   - Mobilization of women from SC families to form Self-Help Groups (SHGs).
   - SHGs received capacity-building training, entrepreneurship development, and technical assistance to generate sustainable, year-round income.
4. **Agricultural Support:**
   - Farmers were trained in the scientific cultivation of cotton through a complete package of practices, including the use of high-quality seeds and integrated pest management.

Team Involved in the Implementation: The program was executed by the following committee members:

- **Nodal Officer:**
  - Dr. J. H. Meshram, Principal Scientist (Plant Physiology)
- **Members:**
  - Dr. Ramkrishna G. I., Sr. Scientist (Agronomy)
  - Dr. S. P. Gawande, Sr. Scientist (Plant Pathology)
  - Dr. B. B. Fand, Sr. Scientist (Entomology)
  - Dr. N. S. Hiremani, Scientist (Plant Pathology)
  - Dr. U.V. Galkate, SMS (Veterinary Sciences), KVK
  - Shri. Sheopal H. Mandape, Sr. Technician
  - Shri. Akshay K. Kamble, Sr. Technician
  - SAO & FACO

Achievements:

- Improved Productivity & Income: Farmers' agricultural productivity improved, leading to increased incomes.
- Empowered Women: Women farmers gained independence and entrepreneurship skills through SHGs.
- Enhanced Agricultural Knowledge: Farmers were trained in modern cotton cultivation techniques, leading to better yields.
- Infrastructure Development: Improvements in sanitation, public premises cleanliness, and awareness of state agricultural schemes benefited the local communities.

Conclusion:

The Development Action Plan for Scheduled Caste (DAPSC) in 2024 successfully enhanced the livelihoods of SC communities through targeted agricultural and capacity-building interventions. By empowering both men and women, the program brought about sustainable changes in farming practices and household incomes, making a significant impact in the rural areas of Maharashtra.

The Details of various Training programme conducted under DAPSC during 2024

Sl. No.	Name of programme	Venue and Date	Male benefi-ciary	Female benefi-ciary	Total No. of benefic-iaries	Programmes Details
1.	Farmers training on "Opportunities and Challenges in Livestock Production"	Veterinary College, Nagpur 16 January 2024	100	0	100	Farmers from Khadki Ta. Narkhed, Hingna Ta. Saoner, Parsodi Ta. Parseoni, Wadvihara & Mendhepathar Ta. Katol, dist. Nagpur participated in training cum workshop on livestock production and management.
2.	Farmers training on "Role of Livestock Production in Sustainable Agriculture"	ICAR-CICR, Nagpur 21 February 2024	98	8	106	SC Farmers from Nagpur and Wardha District participated in Interface Farmers Meeting on "Livestock Production in Sustainable Agriculture "
3.	Farmers meet on the occasion of "16th instalment of PM KISAN SAMMAN NIDHI" and Training on Integrated Cotton Management	ICAR-CICR, Nagpur 28 February 2024	67	4	71	Online webcasting of Hon. Prime Minister Shri. Narendra Modi on the occasion of "16th instalment of PM KISAN SAMMAN NIDHI"
4.	Livelihood Enhancing Skill Development Training for Rural Women.	ICAR- CICR, Nagpur 06 March 2024	0	60	60	One day training on Livelihood Enhancing Skill Development Training for Rural Women from Nagpur, Wardha and Yavatmal District.
5.	Cotton farmers Training cum workshop, on "HDPS & Closer Spacing cotton cultivation Technologies"	Malkapur & Gandhinagar Ta, Kalamb, Dist. Yavatmal. 14 June 2024	47	9	56	One day Farmers training cum workshop on HDPS & Closer Spacing cotton cultivation Technologies.
6.	Cotton farmers Training on "Integrated Cotton Management"	ICAR-Central Institute for Cotton Research, Nagpur. 12 July 2024	124	15	139	Conducted Workshop on Best Management Practices for Enhancing Cotton Productivity. Farmers from Nagpur, Amravati and Wardha participated in this program.
7.	"Training on PB Rope"	Naigaon Ta. Daryapur, Dist. Amravati 12 August 2024	19	6	25	Farmers training on PBW Management and use of PB rope technologies.
8.	"Training on PB Rope"	Bhajipani Ta. Katol, Dist. Nagpur 13 August 2024	12	2	14	Farmers training on PBW Management and use of PB rope technologies.
9.	"Training on PB Rope"	Malkapur, Ta. Kalamb, Dist.Yavatmal 13 August 2024	14	3	17	Farmers training on PBW Management and use of PB rope technologies.

Sl. No.	Name of programme	Venue and Date	Male benefi-ciary	Female benefi-ciary	Total No. of benefic-iaries	Programmes Details
10.	Field Exposure Visit	PDKV, Akola 20th to 22nd September 2024	244	68	312	Field Exposure Visit on the Occasion of Shivar Pheri at. PDKV, Akola. Conducted for SC Farmers from Nagpur, Amravati, Yavatmal and Wardha district
11.	Visit of Shri Giriraj Singh Ji, Hon'ble Union Minister of Textiles	ICAR-Central Institute for Cotton Research, Nagpur. 25 September 2024	3	2	5	Interaction with farmers and critical input distribution by the hands of Shri Giriraj Singh Ji, Hon'ble Union Minister of Textiles.
12.	Cotton growing farmers training cum Field Visit at Cotton growing area	Malkapur & Gandhinagar Ta. Kalamb, Dist. Yavatmala 16 October 2024	40	10	50	One day framers training cum field day program.
13.	Farmers Training cum Demonstration of Cotton Stalk Shredder.	ICAR-Central Institute for Cotton Research, Nagpur. 17 December 2024.	30	0	30	Farmers training cum live demonstration of Cotton Stalk Shredder and Drone at CICR cotton field. Total 30 farmers from Malkapur & Sherad Ta. Kalamb, Dist. Yavatmal participated in this programme.
14	Water ATM Visit	Khadki Ta. Narkhed & Chikhali Maina Ta. Katol Dist Nagpur 19 December 2024.	65	27	92	Water ATM RO Plant Inspection and Inauguration programme organized by ICAR-CICR, Nagpur under DAPSC at Khadki Ta. Narkhed and Chikhali Maina, Ta. Katol, Dist. Nagpur.
15	Krishi Mela cum Input Distribution Programme	ICAR-Central Institute for Cotton Research, Nagpur. 20 December 2024.	41	3	44	Krishi Mela cum Input Distribution Programme organized by ICAR-CICR, Nagpur under DAPSC dated on 20 Dec. 2024 at ICAR-CICR, Nagpur. Total 44 SC farmers from Chondi Bahadarpur and Sawalapur, Ta. Arvi, dist. Wardha actively participated in Krishi Mela. Critical inputs like Tarpaulin, Irrigation Tube (Lapeta Pipe) and Pesticide Protection Kit distributed to SC beneficiaries.

The details of Critical input distribution under the DAPSC schemes during 2024

Sl. No.	Name of Item	Venue and Date	No of SC bene ficiaries	Male Bene ficiary	Female bene ficiary	Input distributed/ skill imparted
1.	Milk Can	ICAR-CICR, Nagpur 21 February 2024	106	98	8	Distribution of Milk Can to SC beneficiaries from Pipardol, Amboli, Welsakhara, Godhani, Wadegaon, Tirkhura, Dhurkheda, Ta. Umred, Chikhali Maina, Mendhepathar, Wadvihara, Ta. Katol Dist. Nagpur. & Salapur, Ta. Samudrapur, Dist. Wardha.
2.	Water Purifier	ICAR-CICR, Nagpur 21February 2024	71	67	4	Distribution of Water Purifier to SC beneficiaries from Sawarkhanda, Ta. Kuhi, Hingna, Ta. Saoner, Dist. Nagpur, Mangaon & Salapur Ta. Samudrapur, Dist. Wardha
3.	Sewing Machine	ICAR- Central Institute for Cotton Research, Nagpur. 06 March 2024.	60	0	60	Distribution of Sewing Machine to SC female beneficiaries from Mendhepathar, Wadvihara Ta. Katol, Parsodi, Ta. Parseoni, Sawar khanda, Ta. Kuhi, Wadegaon, Ta. Umred Dist. Nagpur, Durgada, Ta. Deoli, Dist. Wardha, Gandhinagar, Sherad & Malkapur Ta. Kalamb, Dist. Yavatmal.
4.	Goat and Goat feed	Punyashlok Ahilyadevi Mendhi Va Sheli Vikas Prakshetra, Bondri, Taluka. Ramtek, Dist. Nagpur 19 March 2024	52	43	9	Vaccinated Two female goats & 50 Kg Goat Feed distributed to each Beneficiary from Hingna, Ta. Saoner, Parsodi, Ta. Parseoni, Wadvihara, Ta. Katol, Khadki, Ta. Narkhed. Dist. Nagpur.
5.	Goat and Goat feed	Punyashlok Ahilyadevi Mendhi Va Sheli Vikas Prakshetra, Pohra Bandi, Taluka, Dist. Amravati 21 March 2024	41	32	9	Vaccinated Two female goats & 50 Kg Goat Feed distributed to each Beneficiary from Husenpur, Palwadi, & Katsur Ta. Teosa. Dist. Amravati.
6.	Tur Seed and Bio-Fertilizer	Vadvihara, Mendhepathar, Chikhali Maina, Ta. Katol, Khadki Ta. Narkhed, Hingna Ta. Saoner, Parsodi, Ta. Parseoni, Husenpur, Sultanpur, Katsur, Ta. Tiosa, Dist. Amravati Mangaon, Salapur Ta. Samudrapur Dist. Wardha Malkapur, Gandhinagar, Sherad, Ta. Kalamb, Dist. Yavatmal 6 June to 14 June 2024	500	410	90	Tur (PKV – TARA) Seed having 2 kg packing (4 Kg to each) distributed for Cotton intercropping to Scheduled caste farmers in Kharif season.
7.	Cotton Seed & Herbicide	Malkapur & Gandhinagar Ta, Kalamb, Dist. Yavatmal. 14 June 2024.	56	47	9	Rasi RCH 929 BGII & Rasi RCH 971 BGII of Cotton variety distributed for HDPS & Closer spacing cultivation Technologies to Scheduled caste farmers from Malkapur & Gandhinagar Ta, Kalamb, Dist. Yavatmal.
8.	Crop Protection Kit	Vadvihara, Mendhepathar, Chikhali Maina, Ta. Katol, Khadki Ta. Narkhed, Borgaon, Ta. Kamptee, Wadegao n, Pipardol, Ta. Umred, Khobna, Bodkhipeth, Amti, Sawarkhanda, Ta. Kuhi Hingna, Khairi Panjabrao, Ta. Saoner, Parsodi, Ta. Parseo ni, Dist. Nagpur Husenpur, Sultanpur, Katsur, Ta. Tiosa, Morshi Khurd, Ta. Warud, Pohra Purna, Ta. Bhatkuli, Dist.	871	734	137	Crop Protection kit contain Fungicides, Insecticides and Nutrient Kit

Sl. No.	Name of Item	Venue and Date	No of SC bene ficiaries	Male Bene ficiary	Female bene ficiary	Input distributed/ skill imparted
		Amravati Mangaon, Salapur Ta. Samudrapur Chondi Bahadarpur, Sawalapur, Ta. Arvi, Durgada, Ta. Deoli, Dist. Wardha Malkapur, Gandhinagar, Sherad, Ta. Kalamb, Dist. Yavatmal 06 June 2024 to 30 August 2024 .				
9	LED Torch	Vadvihara, Mendhepathar, Chikhali Maina, Ta. Katol, Khadki Ta. Narkhed, Borgaon, Ta. Kamptee, Wadegaon, Pipardol, Ta. Umred, Hingna, Ta. Saoner, Dist. Nagpur Husenpur, Sultanpur, Katsur, Ta. Teosa, Morshi Khurd, Ta. Warud, Pohra Purna, Ta. Bhatkuli, Dist. Amravati Chondi Bahadarpur, Sawalapur, Ta. Arvi, Dist. Wardha 06 June 2024 to 30 August 2024	415	348	67	LED Torch distributed to SC Farmers from DAPSC adopted villages of Wardha, Amravati and Nagpur districts.
10	Pesticide Protection Kit	ICAR- Central Institute for Cotton Research, Nagpur 12 July 2024	64	59	5	Pesticide Protection kit having Apron, Hand Gloves, Gumboot, Helmet, Eye protection Goggle, Mask distributed to SC farmers from Nagpur, Amravati and Wardha district.
11	Pharomone Trap & PBW Lure	Naigaon Ta. Daryapur, Dist. Amravati Malkapur Ta. Kalamb, Dist. Yavatmal and Bhajipani, Ta. Katol, Dist. Nagpur Date 12 & 13 August 2024	42	33	9	Pharomone Trap & PBW Lure distributed to SC Cotton Growing farmers from Nagpur, Yavatmal and Amravati district for Pink Bollworm management.
12	Cremit PBW Tube	Naigaon Ta. Daryapur, Dist. Amravati Malkapur Ta. Kalamb, Dist. Yavatmal and Bhajipani, Ta. Katol, Dist. Nagpur Date 12 & 13 August 2024	42	33	9	Cremit PBW Tube distributed to SC Cotton Growing farmers from Nagpur, Yavatmal and Amravati district for Pink Bollworm management.
13.	Gram Seed (Chickpea)	ICAR- Central Institute for Cotton Research, Nagpur 24 & 25 October 2024	299	256	43	Gram seed Distributed to Scheduled caste farmers for Rabi season. Gram Variety, Jaki-9218 having packing 30 Kg bag. (one bag to each farmer)
14.	Wheat Seed	ICAR-CICR, Nagpur 24 & 25 October 2024	200	166	34	Wheat seed Distributed to Scheduled caste farmers for Rabi season. Wheat variety 'MACS-6222' having packing 20 kg bag. (two bag to each farmer)
15.	Bicycle Distribution	ICAR- Central Institute for Cotton Research, Nagpur. 05 December 2024.	115	39	76	39 Men & 76 Woman bicycle distributed to SC student from DAPSC adopted villages of Wardha, Yavatmal and Nagpur districts.
16.	Student Kit	ICAR- Central Institute for Cotton Research, Nagpur. 05 December 2024.	99	34	65	Student kit having School bag, Water bottle, Compos box, Notebooks etc. distributed to SC student from DAPSC adopted villages of Wardha, Yavatmal and Nagpur districts
17.	Mobile Cotton Stalk Shredder	ICAR- Central Institute for Cotton Research, Nagpur. 17 December 2024.	48	41	7	2 Mobile Cotton Stalk Shredder distributed to Farmers group 1. Krushi Utkarsh shetkari Sendriya Kad-Dhanya Uttpadak Gat, Malkapur, Ta. Kalamb and 2. Baliraja Shetkari Sendriya Dhanya Uttpadak Gat, Sherad Ta. Kalamb, Dist. Yavatmal.

Sl. No.	Name of Item	Venue and Date	No of SC bene ficiaries	Male Bene ficiary	Female bene ficiary	Input distributed/ skill imparted
18.	Tarpaulin	ICAR- Central Institute for Cotton Research, Nagpur. 20 December 2024.	44	41	3	Tarpaulin distributed to SC farmers from Wardha District
19.	Irrigation Tube (Lapeta Pipe)	ICAR- Central Institute for Cotton Research, Nagpur. 20 December 2024.	44	41	3	Irrigation Tube (Lapeta Pipe) distributed to SC farmers from Wardha District
20.	RO Water ATM unit	Khadki, Ta. Narkhed; Chikhali Maina, Ta. Katol; Khobna & Amti, Ta. Kuhi, Nagpur district	170	132	38	Four RO Water ATM machine installed to provide clean, and safe drinking water facility to rural villages- Khadki Ta. Narkhed, Chikhali Maina Ta. Katol, Khobna & Amti, Ta. Kuhi, of Nagpur district.

Input Distribution on the occasion of 16th installment of PM KISAN SAMMAN NIDHI at ICAR-CICR, Nagpur on 28 February 2024

Livelihood Enhancing Skill Development Training for Rural Women & Sewing Machine Distribution at ICAR-CICR, Nagpur on 6 March 2024

Goat feed distribution at Ahilyadevi Mendhi Va Sheli Vikas Prakshetra Bondari, District Nagpur on 19 March 2024

Cotton Seed & Bio-Fertilizers Distribution at Malkapur, Ta. Kalamb, Dist. Yavatmal on 14 June 2024

Cotton farmers Training on “Integrated Cotton Management” at ICAR-CICR, Nagpur on 12 July 2024

Gram Seed, Wheat seed & Bio-Fertilizer kit distribution at ICAR-CICR, Nagpur on 24 December 2024

DAPSC activities at ICAR-CICR, Coimbatore

"Leveraging improved cotton technologies and sustainable interventions for marginal SC Livelihoods / SC farmers empowerment in Prambalur District of Tamil Nadu"

Beneficiaries identified: to address the issues, fifty farmers were identified from A. Kudikadu, Neikuppai and Keelaperambalur villages which comes under Veppanthattai and Veppur block of Perambalur district and the necessary inputs were supplied.

Details of input distributed to the beneficiaries: Seed, wooden scale, NSKE 1L + Pseudomonas 1 kg + Ullala 60 g + Emamectin Benzoate 100g + Cabrio top 300g + Planifix 100ml, + All19 - 4kg + PN- 4kg + Westa boran - 2kg + MAP - 2kg + Imidacloprid 17.8 % SL 250ml, Lambdacyhalothrin 5% EC 500ml, Profenofos 50 % EC 500ml, Carbendazim 50 % WP 1 kg, Dryland weeder, Waterproof Tarpaulin Sheet, Sprayer, Back pack bag, File, Pen and Note pad.

Aim: This program is aimed to enhance the productivity of cotton from the SC farmers of selected village by providing key competencies to the farmers and through technology intervention.

Objectives:

- To identify the critical needs of SC farmers through baseline surveys in the study areas
- To carry out the need-based Capacity augmentation programmes, like training on selected technologies - closer spacing, drip fertigation, and other crop protection technologies for enhancing the yield and income.
- To provide critical inputs to identified &needy beneficiaries, enhance the cotton production and increase the income.
- To obtain feedback from the selected SC beneficiaries for project appraisal and further Scalability

Outcome:

- After completing this programme, all the beneficiaries were able to Understand the best varietal selection, the Importance of soil health in better crop yield
- Importance of closer spacing in rainfed cultivation of cotton
- Role of organic and bio-intensive pest management practices in sustainable cotton production
- Reduce cost of cultivation: Preparation and use of organic inputs will reduce the cost of cultivation and increase the yield, and the quality of the crop is improved. Further, all the beneficiaries acknowledged this project by witnessing a higher yield than that of the previous years.

The details of various Training programme conducted under the DAPSC during 2024.

S. No.	Name of programme	Venue and Date	Male Beneficiary	Female Beneficiary	No of SC beneficiaries	Programmes Details
1.	"Leveraging improved cotton technologies and sustainable interventions for marginal SC Livelihoods / SC farmers'	KVK, Perambalur, 08 August 2024	29	21	50	Farmers training cum input distribution
2.	Farmers training on Cotton HDPS field Demonstration cum input distribution event for SC farmers engaged in cotton cultivation	Panchayat Union Office in Valikandapuram, Perambalur district 13 September 2024	29	21	50	HDPS field Demonstration cum input distribution event for SC farmers engaged in cotton cultivation
3.	Cotton HDPS field Demonstration cum input distribution event for SC farmers engaged in cotton cultivation	Kudikadu, Neykuppai, and Keezhaperambalur villages of the Perambalur district 24-25 October 2024	29	21	50	Farmers awareness programme on cotton pest management cum input distribution

Publications

- Shankarganesh, K., Rameaseh, K., Sampathkumar, A., Raja, R., Manicckam, S., Prakhash, A.H and Prasad, Y.G. 2023. Cotton Insects Pests and their Management (Tamil Bulletin) P.1-24.
- Sampathkumar, A., Shankarganesh, K., Rameaseh, K., Raja, R., Manicckam, S., Prakhash, A.H and Prasad, Y.G. 2023. Disesses of cotton and their Intgreated Diseasis management (Tamil Folder) P. 1-6
- Raja, R., Shankarganesh, K., Rameaseh, K., Sampathkumar, A., Manicckam, S., Prakhash, A.H and Prasad, Y.G. 2023. Fertilizer management of ELS cotton (Tamil Folder). P. 1-4

DAPSC training programme on 08.08.2024

DAPSC training programme and Inputs distribution to the farmers on 13.09.2024

DAPSC training programme and Inputs distribution to the farmers on 13.09.2024

- Shankarganesh, K., Rameaseh, K., Sampathkumar, A., Raja, R. and Manickam, S. 2025. A training on Cultivation of cotton to Perambalur district farmers, Thinamani (Local Daily)
- Shankarganesh, K., Rameaseh, K., Sampathkumar, A., Raja, R., Manicckam, S. and Prakhash, A.H. 2025. A training on Cultivation of cotton and inputs distirubution to Perambalur district farmers, Thinamani (Local Daily).

Inputs distribution to SC farmers

10.8.3: Development Action Plan for Scheduled Tribe (DAPST)

The Development Action Plan for Scheduled Tribes (DAPST), formerly known as the Tribal Sub Plan (TSP), is an initiative by the Government of India aimed at enhancing the socio-economic conditions of Scheduled Tribes (ST's) communities. This initiative provides comprehensive support to tribal farmers through training, resource distribution, and skill development programs. By integrating modern farming techniques with traditional agricultural knowledge, the program seeks to improve productivity, income and sustainability among ST's farmers, conducting specialized training programs, educational initiatives, and exposure visits to empower tribal farmers with advanced agricultural knowledge, promoting environmental friendly and economically viable farming practices to ensure long-term benefits, encouraging the active participation of women in farming through Self-Help Groups (SHGs), thereby strengthening their financial independence, distribution of essential farming resources such as high-yielding seeds, bio-fertilizers, and pest management solutions to enhance agricultural productivity and facilitating income-generating activities through integrated farming systems and agribusiness models to boost financial stability among tribal communities. Conducting workshops on improved farming techniques for key crops such as cotton, paddy and vegetables; organizing exposure visits and awareness programs focused on modern agricultural practices, farm mechanization, and climate-resilient farming, providing vocational training in agribusiness, pest management, and conservation farming to enhance livelihood options; Offering personal safety training for

handling agrochemicals and farm machinery to ensure the well-being of farmers.

Formation and strengthening of Self-Help Groups (SHGs) to encourage women's participation in sustainable farming and agribusiness activities, Capacity-building programs aimed at financial literacy, leadership skills, and cooperative management facilitating access to credit and market linkages to improve women farmers' earning potential, to improve agricultural productivity and sustainability. The following inputs will be distributed High-quality seeds of cotton, paddy, and vegetable seed kits to encourage kitchen gardening and nutrition security, bio-fertilizers, organic pesticides to promote eco-friendly farming, groundnut Seeds, Summer Moong Seeds, Lapeta pipes, Battery cum hand operated sprayers, pest control pheromone traps along with pectin lure to assist in efficient farming operations, Cotton picking bags which are used to collect harvested cotton, N: P: K fertilizers are used to promote plant growth, increase crop yields, and improve soil health, tarpaulins, Rechargeable torch, Vermiculture vermibed and non-electrical water purifier which is primarily used to provide clean drinking water to STs Farmers.

The DAPST program has a transformative effect on tribal farming communities. The expected impact for 2024-25 includes increased agricultural productivity & income by adopting modern farming techniques and utilizing high-quality inputs to tribal farmers are expected to achieve higher yields and better market prices. Improved Integrated Pest & Disease Management (IPM) techniques will result in reduced crop losses and healthier produce. The program will ensure long-term agricultural sustainability & benefits by promoting organic farming, conservation techniques, and water-efficient irrigation systems. The overall overview of Development Action Plan for Scheduled Tribes (DAPST/TSP) is to helps improve tribal communities by supporting economic growth, sustainable farming, and self-reliance. It focuses on modern farming, women's empowerment, and environmental conservation to create a lasting impact.

Data base of training programme conducted under DAPST/ TSP during 2024

Sr. No.	Name of training	Input Delivered	No. of participants		Total	Date of training	Duration of training (Days)	Venue	Name of Coordinator
			Male	Female					
1.	Farmer's training cum Input distribution program.	Distribution of Tarpaulin, Cotton Picking Bag (2 nos. each) & *Trichoderma viride* formulation to schedule tribe farmers	11	-	11	01-01-2024	1 Day	Village-Muradpur Taluka-Umred, Dist.- Nagpur	Dr. D.T. Nagrale, Dr. Rakesh Kumar
2.	Farmer's Training cum Vegetable Seed Kit Distribution Program	Distribution of Vegetable seed kit, Neem oil, *Trichoderma viride* formulation	28	02	30	30-01-2024	1 Day	Village- Banera, Taluka-Parseoni, Dist.-Nagpur	Dr. D.T. Nagrale
3.	Farmers Training Cum Vegetable Seed Kit Distribution Program	Distribution of Vegetable seed kit and *Trichoderma* powder	29	21	50	06-02-2024	1 Day	KVK, Sonapur, Gadchiroli	Dr. D.T. Nagrale
4.	Exposure Visit cum Groundnut Seed Distribution Program	Distribution of Groundnut seeds bags (2 nos. each) and *Trichoderma* powder formulation	12	-	12	07-02-2024	1 Day	ICAR-CICR, Nagpur	Dr. D.T. Nagrale
5.	Distribution of Vegetable Seed Kit and Organic Inputs Program	Distribution of Vegetable Seed Kit, Neem Oil, & Phosphate solubilising bacteria formulation	33	2	35	08-02-2024	1 Day	Z. P. High School Ghoti (Ramjan), Taluka-Ramtek, Dist.-Nagpur	Dr. D.T. Nagrale,
6.	Exposure Visit cum Groundnut Seed Distribution Program	Distribution of Groundnut seeds bags (2 nos. each) and *Trichoderma* powder formulation	05	-	05	12-02-2024	1 Day	ICAR-CICR, Nagpur	Dr. D.T. Nagrale
7.	Exposure Visit cum Groundnut Seed Distribution Program	Distribution of Groundnut seeds bags (2 nos. each) and Trichoderma Powder	03	-	03	16-02-2024	1 Day	ICAR-CICR, Nagpur	Dr. D. T. Nagrale,
8.	Farmers Training Cum Input Distribution Programme	Distribution of Vegetable seed kit, Phosphate solubilising bacteria, *P.*	45	05	50	22-02-2024	1 Day	Village- Nimboni, Taluka-Navapur, District-Nandurbar	Dr. D. T. Nagrale, Dr. Ramakrishna G.I.

Sr. No.	Name of training	Input Delivered	No. of participants		Total	Date of training	Duration of training (Days)	Venue	Name of Coordinator
			Male	Female					
		flourascens *Trichoderma* powder formulation							
9.	Farmer's training, awareness camp cum summer moong seeds distribution program	Distribution of Summer Moong and Phosphate solubilising bacteria formulation	71	9	80	11-03-2024	1 Day	KVK, Sonapur, Gadchiroli	Dr. D.T. Nagrale
10.	Exposure Visit cum Summer moong Seed Distribution Program	Distribution of Summer Moong Seeds	17	0	17	27-03-2024	1 Day	ICAR-CICR, Nagpur	Dr. D.T. Nagrale,
11.	Awareness Camp cum Exposure Visit Program	Exposure visit of farmers to ICAR-CICR, Napur	30	-	30	08-04-2024	1 Day	ICAR-CICR, Nagpur	Dr. D.T. Nagrale
12.	Farmers Training, Awareness Camp cum Paddy Seeds Distribution program	Distribution of paddy seeds varieties (PKV-Tilak) (PKV-Sadhana) and Vegetable seed Kit (50 nos.)	85	15	100	11-06-2024	1 Day	Krishi Vigyan Kendra (KVK) Hiwara, Gondia	Dr. D.T. Nagrale
13.	One day Farmer's Training, Awareness Camp cum Paddy Seeds Distribution program	Distribution of paddy seeds variety (PKV-Tilak), (PKV-Kisan) and Vegetable seed kit (27 nos.)	90	10	100	13-06-2024	1 Day	Krishi Vigyan Kendra (KVK), Sonapur, Gadchiroli	Dr. D.T. Nagrale, Dr. Rakesh Kumar
14.	Farmers Training cum Distribution of BG -II Hybrid seeds to schedule tribe's farmers	Distribution of Ankur Kirti, Nuziveedu Armita, and Rashi RCS 929 were distributed 6 packets to each HDPS cotton producing scheduled tribe (ST) farmer	42	09	51	15-06-2024	1 Day	Village- Marram, Taluka-Sausar, Dist.-Pandhurna (Madhya Pradesh)	Dr. D.T. Nagrale, Dr. Ramakrishna G.I.
15.	Farmers Training cum Distribution of Input Program	Distribution of rechargeable torch, Special proofed tarpaulin, N: P: K (18:18:18) 5 packets to each farmer	89	11	100	04-07-2024	1 Day	Village- Kumbhari, Taluka-Ghatanji, Dist.-Yavatmal	Dr. D.T. Nagrale

Sr. No.	Name of training	Input Delivered	No. of participants		Total	Date of training	Duration of training (Days)	Venue	Name of Coordinator
			Male	Female					
16.	Farmers Training cum Distribution of Inputs Program	Distribution of Mepiquat Chloride 5% aqueous solution, N:P:K (13:00:45)	42	09	51	07-08-2024	1 Day	Village- Marram, Taluka-Sausar, Dist.-Pandhurna (Madhya Pradesh)	Dr. D.T. Nagrale, Dr. Ramkrushna G.I.
17.	Farmer Training cum Inputs Distribution Program	Distribution of Vermiculture vermicompost beds, plant protection chemicals like Dinotefuran 20% SG, Propiconazole 25% EC and Water soluble fertilizer (N:P:K 19:19:19)	38	12	50	29-08-2024	1 Day	Village(s)-Sharad and Gandhinagar, Taluka-Kalamb, District-Yavatmal	Dr. D.T. Nagrale, Dr. U.V. Galkate
18.	Farmers Training cum Distribution of Inputs Program	Distribution of Pheromone Traps (2 nos.) with Pectinolure (4 nos.), Profenofos 50% EC, Propiconazole 25% EC	89	11	100	20-09-2024	1 Day	Village- Kumbhari, Taluka-Ghatanji, Dist.-Yavatmal	Dr. D.T. Nagrale, Dr. S.H. Thube, Dr. Rakesh Kumar
19.	Farmer's training, Field Day cum critical input distribution program	Distribution of N: P: K (19:19:19), *Pseudomonas Fluorascens* 500 g, Dinotefuran 20% SG, *Trichoderma viride* 1% WP	47	03	50	01-10-2024	1 Day	Village-Jambhali, Taluka-Armori, District-Gadchiroli	Dr. D.T. Nagrale, Dr. U.V. Galkate, Dr. Rakesh Kumar
20.	Farmers training cum critical input distribution program	*Distribution of Trichoderma viride* 1%, *Pseudomonas fluorascens*, Dinotefuran 20% SG, Pheromone trap (2 nos.) with Pectinolure (04 nos.) and Water-soluble fertilizer (N: P: K, 19:19:19)	46	04	50	11-10-2024	1 Day	Village-Chutugunta, Taluka-Mulchera, District-Gadchiroli	Dr. D.T. Nagrale
21.	Awareness Camp on Pest Management in Cotton" Program	Training programme on pest management in cotton	10	-	10	15-10-2024	1 Day	Village-Salaimendha Taluka-Hingna,	Dr. D.T. Nagrale

Sr. No.	Name of training	Input Delivered	No. of participants		Total	Date of training	Duration of training (Days)	Venue	Name of Coordinator
			Male	Female					
22.	Awareness Camp cum Pest Management and Field Sanitation Program	Distribution of Non-electric water purifier	17	-	17	16-10-2024	1 Day	ICAR-CICR, Nagpur	Dr. D.T. Nagrale, Dr. Ramkrushna G.I. Dr. U.V. Galkate
23.	Farmer's Training, Field Day cum critical input Distribution program	Distribution of tarpaulins, spray protection kits, Distribution of Trichoderma viride, Neem-based extracts and water-soluble fertilizers (19:19:19, NPK)	46	14	60	18-12-2024	1 Day	Village-Mutnur Taluka-Chamorshi Dist.-Gadchiroli	Dr. D. T. Nagrale, Dr. U.V. Galkate, Dr. S.H. Thube
24.	Kisan Mela cum input Distribution program	Distribution of Tarpaulin, Lapeta Pipe, N: P: K (19:19:19), Neem Oil, *Pseudomonas fluorescens*	45	05	50	20-12-2024	1 Day	ICAR-CICR, Nagpur	Dr. D.T. Nagrale
25.	One Day Farmer's training cum Input Distribution program	DistributionNeem Oil, *Trichoderma viride* formulation	10	-	10	27-12-2024	1 Day	Village-Parsoda, Taluka-Warora, Dist.- Chandrapur	Dr. D.T. Nagrale, Dr. S.H. Thube

Activity Photos under DAPST/TSP Scheme

10.8.4: Library

In the year 2024, the Library procured 109 new books for scientists and students of the Academic Hub.

The Library also procured the E-book series of Advances in Agronomy 2024 thus adding to its existing e-book collection.

19 Hindi books were procured. The Library also subscribed to 7 Indian Journals. Annual Report 2023 was distributed to ICAR Institutes and dignitaries.

Certificate of Appreciation and a Memento was presented to the Library ICAR-CICR Nagpur for Highest number of hits on J-Gate Discovery platform among ICAR institutions for Western Regions for the year 2023 in the Regional Training Workshop organized jointly by Informatics India and Agricultural Education Division, ICAR at BSKVV Dapoli on 12/12/2024.

DOCUMENTATION SERVICES

- The Library has started a monthly documentation service to highlight the worldwide ongoing research and development in Cotton science by the name "Gleanings in Cotton Research". 12 issues of this monthly publication were compiled for the year 2024 and e-mailed to all scientists.
- Library provides E-Reference Service by virtue of which, important information vital for research such as, alerts, bulletins, articles and circulars received by the Library in electronic format are immediately circulated to all scientists by sending regular E-mails.
- The Library also acts as a Repository for scholarly papers published by the scientists of the institute. Soft copies of the research papers are stored in the Library and are made available as and when required in multiple formats.
- Articles appearing in newspapers on Cotton are digitally scanned and the copy is emailed to all scientists for information. A collection of all news items appearing in 2023 was compiled and published by the name "CICR in News 2023".
- The Library is actively participating in the E-Journal Consortium by responding regularly through E-mails and thus also receiving updates. More than 2000 on-line journals on agriculture and crop science are made available over the network through this consortium.
- Eight User Terminals installed in the Library have facilitated the library users to access the databases uploaded in the Library Server. Users can also access the Internet on these terminals. Similarly the entire catalog of the library has been downloaded on these terminals for ease of use.
- Charging points for laptops and Wi-Fi router was installed in the Library for the students of the Academic hub.
- KOHA Library software was installed in the Library and the data comprising the entire Library collection that includes books, bound volumes, Annual Reports, Hindi books and Gratis publications was migrated on the new platform. The Library catalog is available on LAN terminals of the Institute.

10.8.5: Progressive Use of Hindi

राजभाषा (हिंदी) : प्रचार–प्रसार

• राजभाषा कार्यान्वयन समिति की बैठकों की तिथि:

क.	दिनांक	विषय
१	०२ फरवरी, २०२४	वर्ष–२०२४ की राजभाषा कार्यान्वयन समिति की प्रथम बैठक
२	१२ जून, २०२४	वर्ष–२०२४ की राजभाषा कार्यान्वयन समिति की द्वितीय बैठक
३	२६ अगस्त, २०२४	वर्ष–२०२४ की राजभाषा कार्यान्वयन समिति की तृतीय बैठक
४	१३ दिसंबर, २०२४	वर्ष–२०२४ की राजभाषा कार्यान्वयन समिति की चतुर्थ बैठक

• हिंदी सप्ताह २०२४

हिंदी सप्ताह : उदघाटन एवं समापन समारोह का आयोजन :

नागपुर, वर्धा रोड स्थित भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान, नागपुर में बड़े ही उत्साह पूर्ण वातावरण में 'हिंदी पखवाड़ा (दिनांक : १४ – ३० सितंबर, २०२४) समारोह' का विधिवत् उद्घाटन दिनांक : १७ सितम्बर, २०२४ को डॉ. जी.टी.बेहेरे, प्रभारी, निदेशक, भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान

संस्थान, नागपुर के शुभहस्ते दीप प्रज्ज्वलित कर किया गया।

इस कार्यक्रम का संचालन डॉ. रचना पाण्डे, वरिष्ठ वैज्ञानिक, डॉ. पूजा वर्मा, वैज्ञानिक एवं श्रीमती रचना देशमुख, तकनीकी अधिकारी, भा.कृ.अनु.प. –केन्द्रीय कपास अनुसंधान संस्थान, नागपुर ने किया तथा आभार डॉ. पूजा वर्मा, वैज्ञानिक ने किया। इस सुअवसर पर उपस्थित अधिकारियों एव कर्मचारियों का संस्थान की राजभाष ाकार्यान्वयन समिति की ओर से हार्दिक स्वागत करते हुए उन्हें हिंदी पखवाड़ा (दिनांक : १४ – ३० सितंबर, २०२४) समारोह' के अंतर्गत आयोजित किए जानेवाली विभिन्न हिंदी प्रतियोगिताओं (हिंदी गीत गायन, हिंदी निंबंध प्रतियोगिता, चित्र आधारित कहानी लेखन प्रतियोगिता, हिंदी शुद्ध लेखन प्रतियोगिता, एक मिनट की प्रस्तुति (वन मिनट शो), सामान्य ज्ञान/हिंदी बहुविकल्पी प्रश्नोत्तरी प्रतियोगिता, पर्यायवाची शब्द/अनुलोम : विलोम शब्द प्रतियोगिता, शब्दानुवाद प्रतियोगिता, मूक अभिनय प्रतियोगिता एवं हिंदी काव्य पाठ प्रतियोगिता के विजेता प्रतिभागियों को) की जानकारी अधिकारियों एव कर्मचारियों को देते हुए उनसे यह आग्रह किया कि वे इन विभिन्न हिंदीप्रतियोगिताओं में अधिक–से–अधिक की संख्या में भाग लेकर इस आयोजनको सफलबनाएँ।

३० सितंबर, २०२४ को हिंदी पखवाड़ा का समापन किया गया। इस समारोह के कार्यक्रमाध्यक्ष डॉ.जी. टी. बेहेरे, प्रभारी, निदेशक, भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान, नागपुर एवं मंचासीन मान्यवरों के शुभहस्ते संस्थान में हिंदी पखवाड़ा समारोह –२०२४ के अंतर्गत आयोजित हिंदी संबंधित विभिन्न प्रतियोगिताओं के विजयी प्रतिस्पर्धी, अधिकारियों एवं कर्मचारियों को नकद पुरस्कार वितरित किए गए।

(संस्थान में आयोजित हिंदी पखवाड़ा: समापन समारोह का परिदृश्य)

कार्यशालाएं : २०२४

केन्द्रीय कपास अनुसंधान संस्थान, नागपुर तथा क्षेत्रीय केन्द्र, कोयंबटुर के कार्यालय में वैज्ञानिक/प्रशासनिक/तकनीकी अधिकारी संवर्ग हेतु एक दिवसीय कार्यशालों का आयोजन किया गया। संस्थान में इस वर्ष निम्नलिखित विषयों पर कार्याशालाओं का प्रस्तुतीकरण किया गया।

क्र.	दिनांक	विषय	वक्ता
१	२१ मार्च, २०२४	कपास में गूलाबी सूंडी का प्रकोप तथा मित्र कीट ट्रायकोग्रामा द्वारा उसका नियंत्रण	श्रीमती पूजा घोंगे, वरिष्ठ तकनिशियन एवं श्री सुजित कुंभारे, तकनीकी सहायक, फसल संरक्षण विभाग
२	१४ जून, २०२४	जैवप्रोद्योगिकी द्वारा कपास के पादप रोग जनक की पहचान एवं उनका निदान	श्रीमती मिथिला मेश्राम, वरिष्ठ तकनीकी सहायक, फसल संरक्षण विभाग
३	२३ अगस्त, २०२४	आणविक जीव विज्ञान पर मूलभूत जानकारी एवं प्रयोगशाला में होने वाले कार्यों की जानकारी	डॉ. जॉय दास, वैज्ञानिक एवं श्री जयभिम कांबे, वरिष्ठ तकनिशियन, जैव प्राद्योगिकी प्रयोग शाला, फसल सुधार विभाग
४	१८ नवंबर २०२४	कपास के बॉलवॉर्म समूह की पहचान एवं उनका निदान	श्रीमती पूजा घोंगे, वरिष्ठ तकनिशियन फसल संरक्षण विभाग

भा.कृ.अनु.प.–केंद्रीय कपास अनुसंधान संस्थान, क्षेत्रीय केन्द्र, सिरसा, हरियाणा में वर्ष २०२४ के दौरान हिंदी अनुभाग द्वारा आयोजित गतिविधियां

१. हिंदी सप्ताह का आयोजन :

भा.कृ.अनु.प.–केंद्रीय कपास अनुसंधान संस्थान, क्षेत्रीय केन्द्र, सिरसा, हरियाणा में दिनांक १४–२० सितंबर, २०२४ को ''हिंदी सप्ताह'' का आयोजन किया गया। इस दौरान विभिन्न गतिविधियां आयोजित कि गयीं। इनमें मुख्य रूप से सुलेख प्रतियोगिता, सुविचार प्रतियोगिता एवं वाद विवाद प्रतियोगिता आदि शामिल हैं। ''हिंदी सप्ताह–२०२४'' के दौरान आयोजित किये गए कार्यकर्मों में भा.कृ.अनु.प.–केंद्रीय कपास अनुसंधान संस्थान, क्षेत्रीय केन्द्र, सिरसा, हरियाणा के वैज्ञानिक, प्रशासनिक एवं तकनीकी कर्मचारी व अधिकारी, कुशल सहायक कर्मचारी, वाई पी १, २ एवं दैनिक वेतनभोगी शामिल हुए ।

२. हिंदी कार्यशालाओं का आयोजन :

भा.कृ.अनु.प.–केंद्रीय कपास अनुसंधान संस्थान, क्षेत्रीय केन्द्र, सिरसा, हरियाणा में वर्ष २०२४ में विभिन्न ''हिंदी कार्यशालाओं'' का आयोजन २०–०९–२०२४ एवं ११–११–२०२४ को किया गया। इन ''हिंदी कार्यशालाओं'' के दौरान आयोजित किये गए कार्यक्रमों में भा.कृ.अनु.प.–केंद्रीय कपास अनुसंधान संस्थान, क्षेत्रीय केन्द्र, सिरसा, हरियाणा के वैज्ञानिक, प्रशासनिक एवं तकनीकी कर्मचारी व अधिकारी, कुशल सहायक कर्मचारी, वाई पी १, २ एवं दैनिक वेतनभोगी शामिल हुए।

भा.कृ.अनु.प.–केंद्रीय कपास अनुसंधान संस्थान, क्षेत्रीय स्टेशन, सिरसा, हरियाणा में वर्ष २०२४ में आयोजित हिंदी कार्यशालाएं

भा.कृ.अनु.प.–केंद्रीय कपास अनुसंधान संस्थान, क्षेत्रीय स्टेशन, सिरसा, हरियाणा में वर्ष २०२४ में आयोजित हिंदी सप्ताह

10.9: Weather

Nagpur

Month	Temperature (0C)		Relative Humidity (%)		Rainfall (mm)	No. of Rainy Days
	Max	Min	Max	Min		
January, 2024	28.23	14.88	71.28	47.21	8.8	2
February, 2024	31.90	17.75	69.73	39.62	10.8	1
March, 2024	36.17	20.07	62.79	31.91	28	3
April, 2024	38.45	23.75	67.79	37.56	123	8
May, 2024	40.40	26.39	63.66	36.50	54.1	2
June, 2024	38.25	27.27	69.81	44.72	102.8	8
July, 2024	31.20	25.45	78.53	65.88	677.6	21
August, 2024	31.18	24.81	79.21	68.60	317.2	14
September, 2024	32.17	24.85	80.62	68.08	289.6	11
October, 2024	33.75	23.44	78.00	57.40	16.2	2
November, 2024	30.49	16.05	72.64	45.91	0	0
December, 2024	29.12	15.31	74.02	48.61	0	0
Total					**1628.1**	**72**

Coimbatore

Month	Tmax (°C)	Tmin (°C)	Relative Humidity (%)		Rainfall	Rainy (mm) Days
			Max	Min		
January, 2024	29.2	21.5	85	54	34.9	2
February, 2024	32.9	22.0	81	40	0.0	0
March, 2024	35.6	23.6	73	32	0.0	0
April, 2024	37.8	25.7	75	32	0.0	0

Month	Tmax (°C)	Tmin (°C)	Relative Humidity (%)		Rainfall	Rainy (mm) Days
			Max	Min		
May, 2024	34.4	24.6	84	54	175.8	9
June, 2024	32.1	24.3	82	60	27.0	2
July, 2024	30.6	23.6	84	63	89.3	8
August, 2024	31.8	23.9	87	57	31.8	3
September, 2024	32.9	23.7	84	55	11.2	1
October, 2024	30.8	22.7	92	68	369.4	14
November, 2024	29.8	22.0	91	60	64.2	5
December, 2024	29.6	21.0	92	60	39.1	5
Total					842.7	49

Sirsa

Month	Temperature (°C)		Relative Humidity (%)		Monthly Rainfall (mm)	No. of Rainy Days
	Maximum Monthly Average (Range)	Minimum Monthly Average (Range)	Maximum Monthly Average	Minimum Monthly Average		
January, 2024	13.6 (11.0 - 18.0)	2.7 (1.2 - 7.0)	86.0	80.0	0.0	0.0
February, 2024	22.5 (18.0 - 28.4)	7.4 (2.8 - 9.5)	81.0	52.9	8.0	2.0
March, 2024	28.2 (20.2 - 34.5)	11.7 (6.0 - 17.2)	71.6	44.3	0.0	0.0
April, 2024	37.2 (32.4 - 41.0)	18.9(15.0-21.5)	52.4	31.2	0.0	0.0
May, 2024	43.9(33.2-49.0)	26.1(16.0-30.5)	45.3	26.2	0.0	0.0
June, 2024	43.7(36.5-48.2)	28.7(25.0-30.0)	55.8	30.3	59.7	3.0
July, 2024	37.2(14.0-41.0)	28.1(25.2-30.0)	73.4	51.8	114.0	6.0
August, 2024	35.2(29.2-37.5)	26.7(25.5-28.0)	76.1	63.2	78.0	7.0
September,2024	35.2(33.0-38.8)	24.7(22.2-26.5)	77.0	61.9	0.0	0.0
October, 2024	35.4(32.8-38.0)	19.2(16.0-23.0)	68.8	37.3	0.0	0.0
November,2024	29.1(24.4-34.5)	13.2(10.0-18.0)	80.4	40.8	0.0	0.0
December,2024	20.2(13.5-26.6)	5.0(2.0-10.8)	81.4	52.0	23.9	3.0
Total					283.6	21

10.10: Cotton Scenario

Area in Lakh hectares
Production in lakh bales of 170 kgs each
Yield in lint Kilogram / Hectare

Name of the state	Area		Production		Yield	
	2023-24 (P)	2024-25 (P)	2023-24 (P)	2024-25 (P)	2023-24 (P)	2024-25 (P)
Punjab	2.14	1.00	6.29	2.72	499.67	462.40
Haryana	5.78	5.78	15.09	12.44	443.82	365.88
Rajasthan	10.04	6.27	26.22	18.45	443.96	500.24
NORTHERN ZONE	17.96	13.05	47.60	33.61	450.56	437.83
Gujarat	26.83	23.92	90.57	71.34	573.87	507.02

Name of the state	Area		Production		Yield	
	2023-24 (P)	2024-25 (P)	2023-24 (P)	2024-25 (P)	2023-24 (P)	2024-25(P)
Maharashtra	42.34	40.86	80.45	89.09	323.02	370.66
Madhya Pradesh	6.30	5.37	18.01	15.35	485.98	485.94
CENTRAL ZONE	75.47	70.15	189.03	175.78	425.80	425.98
Telangana	18.18	18.11	50.80	49.86	475.03	468.04
Andhra Pradesh	4.22	4.05	7.37	8.77	296.90	368.12
Karnataka	7.43	6.70	20.59	19.15	471.10	485.90
Tamilnadu	1.30	0.63	2.52	1.30	329.54	350.79
SOUTHERN ZONE	31.13	29.49	81.28	79.08	443.87	455.87
Orissa	2.16	1.47	7.05	5.17	554.86	597.89
Others	0.16	0.31	0.26	0.61	276.25	334.52
TOTAL	**126.88**	**114.47**	**325.22**	**294.25**	**435.75**	**436.99**

P – Provisional

* - As estimated by Committee on Cotton Production and Consumption (COCPC) in its meeting held on 24.03.2025

भा.कृ.अनु.प.–केन्द्रीय कपास अनुसंधान संस्थान, नागपुर

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