# वार्षिक प्रतिवेदन
# 2023-2024
# Annual Report
# 2023-2024


केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान
केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार
बहरमपुर-742101, पश्चिम बंगाल, भारत

Central Sericultural Research & Training Institute
Central Silk Board, Ministry of Textiles, Govt. of India
Berhampore-742101, West Bengal, India

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**प्रकाशक**
डॉ. जुला एस. नायार
निदेशक, केरेबो-केरेउअप्रसं-बहरमपुर

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# प्रस्तावना

मुझे केरेबो-केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर की वार्षिक रिपोर्ट 2023-24 प्रस्तुत करते हुए अत्यंत प्रसन्नता हो रही है। इस वर्ष संस्थान की पूर्वी और उत्तर-पूर्वी भारत में शहतूत रेशम उत्पादन को बढ़ावा देने की 80 वर्षों से अधिक की विरासत को जारी रखते हुए एक महत्वपूर्ण उपलब्धि का वर्ष है। केंद्रीय रेशम बोर्ड और वस्त्र मंत्रालय के उद्देश्यों के अनुरूप, हमने वैज्ञानिक नवाचार, टिकाऊ प्रथाओं और हितधारक सशक्तिकरण में महत्वपूर्ण प्रगति की है।

हमारी शोध उपलब्धियों के परिणामस्वरूप सी-9 जैसी बेहतर शहतूत किस्मों का विकास संभव हुआ जो कम उर्वरता वाली मिट्टी में अपनी अनुकूलन क्षमता और अधि पर्ण उपज के लिए जानी जाती है। सिंचित परिस्थितियों में सी-2038 के लिए अनुकूलित कृषि पद्धतियों ने बेहतर उत्पादकता और पोषक तत्व उपयोग दक्षता का प्रदर्शन किया। इसके अतिरिक्त, "हरियाली" जैसे नए हार्मोनल फॉर्मूलेशन ने शहतूत के पर्णों की आयु बढ़ाने में उल्लेखनीय क्षमता दर्शायी  तथा जलवायु संबंधी समस्याओं के लिए व्यावहारिक समाधान प्रस्तुत किए है।

हमारी टीम ने उल्लेखनीय आर्थिक विशेषताओं के साथ जलवायु अनुकूल रेशमकीट संकर विकसित किए जो इस क्षेत्र में उच्च कोसा उपज और बेहतर कवच गुणवत्ता प्राप्त करने में सहायक साबित हुई हैं। जैव-प्रौद्योगिकीय हस्तक्षेप और पर्यावरण-अनुकूल नवाचार, जिनमें रोग-प्रतिरोधी नस्लों का विकास और पेटेंटड कीट पालन गृह और संस्तर कीटाणुनाशक शामिल हैं जो टिकाऊ रेशम उत्पादन के प्रति हमारी प्रतिबद्धता को दर्शाता है।

क्षमता विकास हमारे जनपहुंच प्रयासों का एक केंद्रीय स्तंभ बना रहा, जिसके अंतर्गत 108 कार्यक्रमों के माध्यम से 3,000 से अधिक हितधारकों को प्रशिक्षण प्रदान किया गया। आकांक्षी जिलों में महिला उद्यमियों के लिए विशेष पहलों ने जमीनी स्तर पर रेशम उत्पादन की परिवर्तनकारी क्षमता को उजागर किया है। क्षे रे उ अ के और अविके से युक्त हमारा विस्तार नेटवर्क क्षेत्र-स्तरीय समर्थन और प्रौद्योगिकी सत्यापन प्रदान करता रहा, जिससे क्षेत्रीय उत्पादकता में वृद्धि दर्ज हुई। तकनीकी प्रचार-प्रसार को सुदृढ़ प्रकाशन आउटपुट और वैज्ञानिक संलग्नता द्वारा पूरित किया गया, जबकि टोक्यो कृषि और प्रौद्योगिकी विश्वविद्यालय, जापान जैसे शैक्षणिक संस्थानों के साथ सहयोग ने मानव संसाधन विकास को मजबूत किया है।

जैसे-जैसे हम तेजी से गतिशील कृषि परिदृश्य में आगे बढ़ रहे हैं, हमारी प्रतिबद्धता परंपरा को नवाचार के साथ जोड़ने, समावेशी विकास को बढ़ावा देने और वैश्विक रेशम उत्पादक के रूप में भारत की स्थिति में सार्थक योगदान देने के लिए दृढ़ है। मैं अपने समर्पित वैज्ञानिकों, तकनीकी/प्रशासनिक कर्मचारियों, क्षेत्रीय अधिकारियों और सहयोगी साझेदारों की अटूट प्रतिबद्धता के लिए उनके प्रति अपना आभार व्यक्त करती हूँ।

हम इस यात्रा को नए जोश और उद्देश्य के साथ जारी रखने के लिए सदैव तत्पर हैं ।

[डॉ. जुला एस. नायार]
निदेशक

## FOREWORD

It gives me immense pleasure to present the Annual Report 2023–24 of the CSB-Central Sericultural Research and Training Institute (CSRTI), Berhampore. This year marks a milestone as the institute continues its legacy of over 80 years in advancing mulberry sericulture in Eastern and North-Eastern India. Aligned with the objectives of the Central Silk Board and the Ministry of Textiles, we have made significant progress in scientific innovation, sustainable practices, and stakeholder empowerment.

Our research achievements have led to the development of superior mulberry varieties such as C-9, known for its resilience in low-fertility soils and higher leaf yield. Optimized agronomic practices for C-2038 under irrigated conditions demonstrated improved productivity and nutrient use efficiency. Additionally, new hormonal formulations like "Haryali" have shown remarkable potential in prolonging mulberry leaf longevity, offering practical solutions to climatic constraints.

Our team has developed climate-resilient silkworm hybrids with notable economic traits, supporting the sector's shift toward higher cocoon yield and improved shell quality. Biotechnological interventions and eco-friendly innovations, including the development of disease-resistant breeds and patented rearing room and bed disinfectants, reinforce our commitment to sustainable sericulture.

Capacity building remained a central pillar of our outreach, with over 3,000 stakeholders trained through 108 programs. Special initiatives for women entrepreneurs in aspirational districts have highlighted the transformative potential of sericulture at the grassroots. Our extension network comprising RSRSs and RECs continued to deliver field-level support and technology validation, enhancing regional productivity. Technological dissemination was complemented by strong publication output and scientific engagement, while collaborations with academic institutions like Tokyo University of Agriculture and Technology, Japan have strengthened human resource development.

As we navigate an increasingly dynamic agricultural landscape, our commitment remains firm to blend tradition with innovation, promote inclusive growth, and contribute meaningfully to India's position as a global silk leader. I express my sincere appreciation to our dedicated scientists, technical/administrative staff, field officers, and collaborating partners for their unwavering commitment.

We look forward to continuing this journey with renewed vigor and purpose.

[Dr. Jula S. Nair]
Director

# केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान - बहरमपुर का संक्षिप्त विवरण

केंद्रीय रेशम बोर्ड-केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान - बहरमपुर की स्थापना वर्ष 1943 में की गई थी। यह संस्थान भारत सरकार के वस्त्र मंत्रालय के अंतर्गत केंद्रीय रेशम बोर्ड के अधीन एक प्रमुख संस्थान के रूप में कार्य करता है। यह संस्थान पश्चिम बंगाल के ऐतिहासिक महत्व वाले मुर्शिदाबाद जिले में स्थित है। यह पूर्वी और उत्तर-पूर्वी भारत में रेशम उद्योग के लिए अनुसंधान, विकास, प्रशिक्षण और विस्तार सहायता के लिए समर्पित है।

यह संस्थान 63 एकड़ क्षेत्र में फैला हुआ है, जिसमें 30 एकड़ शहतूत की खेती के लिए आरक्षित है। केरेबो-केरेउअप्रसं-बहरमपुर ने पश्चिम बंगाल, ओडिशा, बिहार, झारखंड, छत्तीसगढ़, असम, अरुणाचल प्रदेश, मणिपुर, मेघालय, मिज़ोरम, नागालैंड, सिक्किम और त्रिपुरा सहित 13 राज्यों में शहतूत रेशमकीट पालन के विकास में प्रमुख भूमिका निभाई है। इसकी भागीदारी ने भारत को विश्व का दूसरा सबसे बड़ा रेशम उत्पादक देश बनाए रखने में मदद की है।

संस्थान अपनी मुख्य गतिविधियों को छह प्रमुख प्रभागों द्वारा संचालित करता है: होस्ट प्लांट (शहतूत संवर्धन), रेशम उत्पादन, धागाकरण एवं कताई, प्रशिक्षण, विस्तार और परियोजना निगरानी, समन्वय एवं मूल्यांकन। यह संस्थान आंतरिक और प्रायोजित दोनों प्रकार की अनुसंधान परियोजनाएं संचालित करता है। अनुसंधान के क्षेत्र में शहतूत और रेशमकीट की नस्ल एवं आनुवंशिकी, फसल सुरक्षा, कीट पालन तकनीक, जैव प्रौद्योगिकी, कोसोत्तर तकनीक और फार्म प्रबंधन शामिल हैं। यह संस्थान अपने अनुसंधान परिणामों को प्रकाशनों, पुस्तिकाओं और राष्ट्रीय व अंतरराष्ट्रीय स्तर के वैज्ञानिक पत्रों के माध्यम से विश्व के साथ साझा करता है।

केरेबो-केरेउअप्रसं-बहरमपुर एक सुदृढ़ विस्तार नेटवर्क संचालित करता है जिसके अंतर्गत तीन क्षेत्रीय रेशमकीट अनुसंधान केंद्र जोरहाट (असम), कलिम्पोंग (पश्चिम बंगाल) और कोरापुट (ओडिशा); तथा आठ अनुसंधान विस्तार केंद्र मोथाबाड़ी, मालदा (पश्चिम बंगाल); मामरिंग (सिक्किम); भंडरा (झारखंड); अगरतला (त्रिपुरा); आइज़ोल (मिज़ोरम); शिलांग (मेघालय); दीमापुर (नागालैंड); और मंगलदोई (असम) शामिल हैं। ये इकाइयाँ तकनीकी सहायता प्रदान करने के साथ ही साथ, प्रशिक्षण का आयोजन और तकनीक मूल्यांकन और सत्यापन जैसे कार्यक्रमों को कार्यान्वित करती हैं। ये सरकारी और गैर-सरकारी संगठनों के साथ मिलकर क्षेत्र में अनुसंधान आधारित समाधान मुहैया कराती हैं।

केरेबो-केरेउअप्रसं-बहरमपुर, कल्याणी विश्वविद्यालय के सहयोग से, भारत के छात्रों के लिए 15 माह का पोस्ट ग्रेजुएट डिप्लोमा इन सेरिकल्चर प्रशिक्षण कार्यक्रम संचालित करता आ रहा है। संस्थान किसानों, धागाकारकों, छात्रों और अधिकारियों के लिए अधिकतम 30 दिनों के अल्पकालिक प्रशिक्षण कार्यक्रम भी आयोजित करता है। प्रशिक्षण प्रभाग में आधुनिक कक्षाएं, पुस्तकालय और छात्रावास जैसी सुविधाएं उपलब्ध हैं।

केरेबो-केरेउअप्रसं-बहरमपुर ने 80 वर्षों की सेवा पूरी कर ली है। यह संस्थान क्षेत्रीय आवश्यकताओं के अनुसार शहतूत की किस्मों, रेशमकीट नस्लों/संकर, कीट पालन तकनीकों और रेशमकीट पालन में नवाचारों के विकास में अग्रणी बना हुआ है। यह भारत के रेशम उद्योग की सतत वृद्धि में एक महत्वपूर्ण भूमिका निभाता आ रहा है।

# About CSB-CSRTI-Berhampore

The CSB–Central Sericultural Research & Training Institute (CSRTI), Berhampore, is established in 1943. It functions as a premier institute under the Central Silk Board (CSB), Ministry of Textiles, Government of India. The Institute is located in the historically significant Murshidabad district of West Bengal. It is dedicated to research, development, training, and extension support for the silk industry in Eastern and Northeastern India.

The Institute is spread over 63 acres, including 30 acres of mulberry plantations. CSB-CSRTI-Berhampore has played a key role in improving mulberry sericulture across 13 states including West Bengal, Odisha, Bihar, Jharkhand, Chhattisgarh, Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. Its contribution has helped India maintain its position as the world's second-largest silk producer.

The Institute organizes its core activities into six major divisions: Host Plant (Moriculture), Sericulture, Reeling & Spinning, Training, Extension, and Project Monitoring, Coordination & Evaluation (PMCE). It carries out both in-house and sponsored R&D projects. The areas of research include mulberry and silkworm breeding and genetics, crop protection, rearing technology, biotechnology, post-cocoon technology, and farm management. The Institute shares its research outputs through publications, booklets, and scientific papers at national and international levels.

CSB-CSRTI-Berhampore operates a strong extension network comprising three Regional Sericultural Research Stations (RSRSs) at Jorhat, Assam; Kalimpong, West Bengal; Koraput, Odisha and eight Research Extension Centres (RECs) at Mothabari, Malda, West Bengal; Mamring, Sikkim; Bhandra, Jharkhand; Agartala, Tripura; Aizawl, Mizoram; Shillong, Meghalaya; Dimapur, Nagaland; Mangaldoi, Assam. These units deliver technological support, conduct training, and implement programs like Technology Assessment and Validation. They also work with various government and non-government organizations to extend research-based solutions to the field.

CSB-CSRTI-Berhampore, in collaboration with Kalyani University, offers a 15-month Post Graduate Diploma in Sericulture (PGDS) for students across India. The Institute also conducts short-term training programs of up to 30 days for farmers, reelers, students, and officials. The training division is equipped with modern classrooms, a library, and hostel facilities.

CSB-CSRTI-Berhampore has completed 80 years of service. It continues to lead the development of region-specific mulberry varieties, silkworm breeds/hybrids, rearing techniques, and sericulture innovations. It plays a vital role in the sustainable growth of India's silk industry.

## केरेबो-केरेउअप्रसं-बहरमपुर का अधिदेश

- ✓ पूर्वी और उत्तर-पूर्वी भारत में रेशम की उत्पादकता और गुणवत्ता को बढ़ाने हेतु बुनियादी, रणनीतिक और अनुप्रयुक्त/अनुकूली अनुसंधान करना।
- ✓ तकनीकी प्रबंधन के लिए हितधारकों के साथ विस्तार सेवाओं और समन्वय को मजबूत करना।
- ✓ गुणवत्तापूर्ण मानव संसाधन विकास प्रदान करना और उसका समन्वयन करना।

## MANDATE OF CSB-CSRTI-BERHAMPORE

- ✓ Undertake basic, strategic and applied/adaptive research augmenting silk productivity and quality in Eastern and North Eastern India
- ✓ Strengthening extension and linkage with stakeholders for technology management
- ✓ Impart and coordinate quality human resource development

## अनुसंधान एवं विकास गतिविधियों की मुख्य विशेषताएं

केरेबो-केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर, केंद्रीय रेशम बोर्ड का एक प्रमुख अनुसंधान संस्थान है जो पूर्वी और उत्तर-पूर्वी भारत में शहतूत रेशम उत्पादन की उन्नति के लिए पूर्णता समर्पित है। संस्थान द्वारा प्रस्तुत अनुसंधान और विकास की प्रमुख उपलब्धियाँ रेशम उत्पादन के क्षेत्र में नवाचार और तकनीकी प्रगति की हालिया योगदानों को दर्शाती हैं।

परपोषी पौधे में सुधार

- नव विकसित शहतूत किस्म सी-9 ने लक्षित कम उर्वरता वाले वातावरण (वर्षा आधारित लाल-लैटेराइट मिट्टी) में क्षेत्रीय जांच सी-2038 (14.03 टन/हेक्टेयर) की तुलना में 15% अधिक वार्षिक पर्ण उपज (16.22 टन/हेक्टेयर) प्रदर्शित करने के साथ ही साथ वांछित गुणवत्ता और कम पोषक तत्व के प्रति सहिष्णु भी है।
- सी-2038 शहतूत किस्म के लिए इष्टतम कृषि पैकेज 90 × 90 सेमी के अंतराल दूरी पर सिंचित अवस्था में (पत्ती की उपज: 62 टन/हेक्टेयर/वर्ष) दो बराबर खुराक में 403:216:134 किलोग्राम एनपीके/हेक्टेयर/वर्ष का अनुप्रयोग करने से बेहतर परिणाम प्राप्त हुए।
- चार नए जीनोटाइप पीडी-1, पीडी-8, पीपी-8 और पीपी-10 द्वारा सिंचित अवस्था में वांछनीय पोषण गुणवत्ता और कोसा मापदंडों के साथ-साथ चेक सी-2038 (38.9 टन/हेक्टेयर/वर्ष) की तुलना में 7-18% अधिक वार्षिक पर्ण उपज (41.6 से 45.9 टन/हेक्टेयर/वर्ष) दर्ज की गई।
- एक नए "हार्मोनल फॉर्मूलेशन" का छिड़काव करने से कृषक के प्रक्षेत्र में शहतूत (सी-2038 और एस-1635) में नियंत्रण की तुलना में कम पर्ण जीर्णता दर (25-30%) और अधि पर्ण उपज (26-28%) दर्ज की गई।
- जीवाणु पर्ण चित्ती प्रतिरोधी किस्म सी-2070, कम तापमान सहिष्णु किस्म सी-2060 और सी-2065 तथा कम लागत वाली ड्रिप प्रणाली आधारित खेती ने पूर्वी और उत्तर-पूर्वी क्षेत्रों के विभिन्न स्थानों में नियंत्रण की तुलना में बेहतर प्रदर्शन किया।

रेशमकीट में सुधार

- संकर IN(M) × SK6.SK7 द्वारा बेहतर आर्थिक लक्षण दर्शाए, जिसमें एकल कोसा भार (SCW) 1.720 ग्राम, कवच भार (SSW) 0.274 ग्राम तथा कवच प्रतिशत 15.93% था जो नियंत्रण की तुलना में क्रमशः 29.42%, 35.64%, तथा 4.87% अधिक है।
- एक अन्य संकर, IN(P) × SK6.SK7 द्वारा 1.7 ग्राम का SCW, 0.266 ग्राम का SSW और 15.19% का कवच अनुपात दर्ज किया जो नियंत्रण की तुलना में क्रमशः 25.36%, 29.12% और 2.96% अधिक था।
- पर्यावरण अनुकूल रेशम कीटपालन कक्ष और संस्तर कीटाणुनाशक (NIRMOOL® और सेरी-विन) को लोकप्रिय बनाया गया है और टिकाऊ रेशम उत्पादन प्रथाओं को बढ़ावा देने के लिए समर्थन दिया गया है।

विस्तार और सीबीटी गतिविधियाँ

- कुल 115 ईसीपी आयोजित कर रेशम उत्पादन संबंधी ज्ञान का प्रचार-प्रसार किया गया, नवाचार को बढ़ावा दिया गया और किसानों को संसाधनों, बाजारों और नई प्रौद्योगिकियों से भी जोड़ा गया जिससे रेशम उत्पादन के विकास और ग्रामीण सशक्तिकरण में महत्वपूर्ण योगदान मिला।
- वित्तीय वर्ष 2023-24 में कुल 108 प्रशिक्षण कार्यक्रम आयोजित कर कुल 3079 रेशम उत्पादन हितधारकों को प्रशिक्षित किया गया।
- त्रिपुरा (धलाई जिला) और मणिपुर (चंदेल जिला) राज्यों के आकांक्षी जिलों में जमीनी स्तर पर पारंपरिक रेशम उत्पादन पद्धतियों को व्यावसायिक उद्यमों में परिवर्तित करने के दृष्टिकोण से कुल 100 युवा महिला लाभार्थियों को रेशम उत्पादन उद्यमिता में सफलतापूर्वक प्रशिक्षित किया गया।
- पश्चिम बंगाल के मुर्शिदाबाद जिले में वाणिज्यिक स्तर पर सीआरसी (2 संख्या) स्थापित की गई हैं जो सफलतापूर्वक कार्य कर रही हैं। प्रत्येक सीआरसी द्वारा कुल 15 चॉकी फसल ली गईं और जिले में 1500 से अधिक रेशम उत्पादन करने वाले किसानों को दोनों सीआरसी द्वारा लगभग 1.343 लाख डीएफएल वितरित किए गए। लाभार्थी किसानों के लिए औसत कोसा उत्पादकता 51.6 प्रति किलोग्राम प्रति 100 डीएफएल था जबकि उनके समकक्षों के लिए यह 46.7 प्रति किलोग्राम प्रति 100 डीएफएल था जो कि चॉकी कीड़ों के उपयोग से प्रति 100 डीएफएल कोकून उपज में 10.7% की वृद्धि दर्शाता है।

स्वीकृत पेटेंट

घर शोधन: कीटपालन गृह, कीटपालन उपकरणों और कीटपालन वातावरण को कीटाणुरहित करने के लिए एक नवीन धीमी वाष्पशील, व्यापक स्पेक्ट्रम, उपयोगकर्ता अनुकूल संरचना (पेटेंट संख्या: 440850)

प्रौद्योगिकी का व्यवसायीकरण

लैबेक्स: संस्तर रोगाणुनाशी

मेसर्स हैप्पी एंटरप्राइजेज, नबाग्राम, मुर्शिदाबाद जिले को लाइसेंस दिया गया (एकमुश्त प्रीमियम: एक लाख रुपये; आवर्ती रॉयल्टी: बिक्री पर 3%; लाइसेंस की अवधि: 10 वर्ष; लाइसेंस की प्रकृति: गैर-अनन्य)।

# RESEARCH & DEVELOPMENT ACHIEVEMENTS

The CSB–Central Sericultural Research & Training Institute (CSRTI), Berhampore, is a premier research institute under the Central Silk Board, dedicated to the advancement of mulberry sericulture in Eastern and North-Eastern India. The research and development highlights presented below reflect the institute's recent contributions towards innovation and technological advancement in the field of sericulture.

**Host Plant Improvement**

- The newly developed mulberry variety C-9 exhibited a 15% higher annual leaf yield (16.22 t/ha) over regional check C-2038 (14.03 t/ha) in targeted low fertility environment (rainfed red-laterite soils) along with desired quality and tolerance to low nutrient stress.
- The optimum cultivation package for C-2038 mulberry variety was worked out as 90 × 90 cm spacing with nutrient dose of 403:216:134 kg NPK/ha/y and 20 MT/ha/y in two split application in irrigated condition (Leaf yield: 62 t/ha/y).
- Four new genotypes PD-1, PD-8, PP-8 and PP-10 demonstrated 7-18 % higher annual leaf yield (41.6 to 45.9 t/ha/y) compared to check C-2038 (38.9 t/ha/y) along with desirable nutritional quality and cocoon parameters in irrigated condition.
- A "New hormonal formulation" sprayed mulberry (C-2038 and S-1635) recorded lower leaf fall/ senescence rate (25-30%) and higher leaf yield (26-28%) over control at farmer's field.
- Bacterial leaf spot resistant variety C-2070, low temperature stress tolerant variety C-2060 & C-2065 and low cost drip system based cultivation package performed better than control in different locations of East and North-Eastern regions.

**Silkworm Improvement**

- The hybrid IN(M) × SK6.SK7 showed superior economic traits with a Single Cocoon Weight (SCW) of 1.720 g, Shell Weight (SSW) of 0.274 g, and Shell Percentage of 15.93%, which are 29.42%, 35.64%, and 4.87% higher respectively than the control.
- Another hybrid, IN(P) × SK6.7, recorded an SCW of 1.7 g, SSW of 0.266 g, and shell ratio of 15.19%, which were 25.36%, 29.12%, and 2.96% higher respectively than the control.
- Eco-friendly silkworm rearing room and bed disinfectants (NIRMOOL® & Seri-Win) are popularized and endorsed for the promotion of sustainable sericulture practices.

**Extension & CBT Activities**

- A total of 115 ECPs were organized leading to disseminating of sericultural knowledge, fostering innovation, and connecting farmers with resources, markets, and new technologies, thus contributing significantly to sericultural development and rural empowerment.
- In the fiscal year 2023-24, a total of 108 training programs were organized, benefiting a cumulative total of 3079 sericulture stakeholders.
- A total of 100 young women beneficiaries were successfully trained in sericulture entrepreneurship, poised to uplift traditional sericulture farming practices into commercial ventures at the grassroot level of aspirational districts of Tripura (Dhalai district) and Manipur (Chandel district) states.

- Commercial scale CRCs (2 No's) have been established in Murshidabad district of West Bengal which are running successfully. A total of 15 chawki crops were taken up by each CRC and around 1.343 lakh DFLs were distributed by both the CRCs to more than 1500 sericulture farmers in the district. The average cocoon productivity was 51.6 per kg per 100 dfls for the beneficiary farmers while it was 46.7 per kg per 100 dfls for their counterparts, indicating a gain of 10.7% in cocoon yield per 100 dfls by use of chawki worms

**Patents Granted**

**Ghar Sodhon:** A novel slow volatile, broad spectrum, user friendly composition for disinfecting rearing house, rearing appliances and rearing environment (**Patent No: 440850**)

**Technology Commercialized**

**Labex:** A bed disinfectant

Licensed to M/s. Happy Enterprises, Nabagram, Murshidabad district (Lumpsum Premium: Rupees One lakh; Recurring Royalty: 3 % on Sales; Period of License: 10 Years; Nature of License: Non-Exclusive)

## MULBERRY BREEDING & GENETICS

### Concluded Research Projects

### PIE02002SI: Evaluation of performance of mulberry genotype C-9 under red and laterite soils

### [July 2019 - June 2023]

**PI's:** Suresh K. (from July, 2020), D. Chakravarty (up to June, 2020)

**CI's:** Suresh K. (upto June, 2020), Somen Singh, G.S. Singh (upto May, 2021), Khasru Alam (upto March, 2021) and Dip Kr. Gogoi (April, 2021 to March, 2022)

**Objective:**

- To assess the performance of C-9 under red & lateritic soils of Eastern and North-Eastern India

**Achievements:**

Mulberry leaf yield determines the profitability and sustainability of the sericulture enterprise. Mulberry leaves are a major economic component in sericulture, and the quantity of leaf produced per unit area has a direct impact on cocoon harvest. The Eastern rainfed zone (AEZ 11 & 12) and the North-Eastern hill zone (AEZ-17) of the East and Northeast region contain red-lateritic and red-yellow soils, which are deficient in both major and micronutrients. Poor soil fertility is one of the primary constraints to profitable sericulture in these zones. The less fertile red-lateritic soils, combined with the reduced application of fertilizers by poor marginal farmers, are resulting in a severe reduction in the production of quality mulberry foliage for sericulture. Moreover, high-yielding mulberry varieties do not perform well under low fertilizer input or low-fertility conditions, leading to poor foliage yield and reduced silk output. One approach to address the issue of poor soil fertility is to exploit the natural genetic variation in mulberry to develop improved cultivars that respond better to the small amounts of fertilizer applied by marginal farmers.


In this regard, a mulberry breeding project was undertaken to develop an improved variety suitable for low-fertility environments, with high nutrient use efficiency and tolerance to low nutrient stress. One mulberry genotype exhibiting tolerance to low nutrient stress and producing a higher leaf yield than S-1635 under reduced nutrient conditions was developed. Hence, the present investigation involves the evaluation of one improved mulberry genotype (C-9) for leaf productivity and adaptability in targeted low-fertility environments (red and laterite soils). The test genotype C-9, along with the local check S-1 and regional check C-2038, was multiplied and established in a Randomised Block Design (RBD) with five

replications at two low-fertility/red-laterite soil environments (RSRS-Koraput and REC-Bhandra), and one high-fertility environment (RSRS-Imphal) in the Eastern and North-Eastern regions. After one year of establishment, the mulberry plantation was pruned as per the local crop schedule, and crop production followed the recommendations for the eastern rainfed zone. Observations were recorded for nine leaf yield traits and their attributes, along with insect-pest and foliar disease incidence. Furthermore, low nutrient stress tolerance and nutrient use efficiency were assessed using standard methodologies to understand adaptability in the targeted environments.

The pooled analysis of variance for leaf yield and its component traits among the test genotype and checks was conducted across the three locations. The mean sum of squares due to genotypes, seasons, and years was highly significant at all red and laterite soil locations, indicating significant differences between the genotypes and checks under low-fertility environments. The three-way interaction for genotype × year × season was significant ($P \leq 0.05$) for most of the studied traits, indicating the influence of both season and plantation age on performance. The study revealed that genotypes responded differently across seasons and environments. Pooled mean values of the genotype and two checks for leaf yield and its attributes are presented in the table. The genotype C-9 was observed to produce medium-sized leaves with a fresh weight of 4.261 g and a leaf area of 279.0 cm², compared to the check C-2038 (larger leaves) and check S-1 (smaller leaves).

**Leaf yield and quality performance across three locations in East and NE region**

| Genotype | FLW (g) | LMC (%) | MRC (%) | CPC (%) | FLA ($cm^2$) | LMS (No's) | LLS (cm) | NPS (No's) | TSL (cm) | LYP (g) | LYH (t) | % Gain |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C-9 | $4.261^{b}$ | $74.99^{a}$ | $89.14^{a}$ | $14.75^{ab}$ | $279.0^{b}$ | $20.92^{a}$ | $150^{a}$ | $9.96^{a}$ | $890^{a}$ | $570^{a}$ | $5.87^{a}$ | |
| S-1 | $2.475^{c}$ | $72.51^{b}$ | $85.24^{b}$ | $9.72^{c}$ | $162.6^{c}$ | $20.84^{b}$ | $131^{c}$ | $8.14^{c}$ | $694^{c}$ | $364^{c}$ | $3.75^{c}$ | 36 |
| C-2038 | $4.628^{a}$ | $74.92^{a}$ | $88.38^{a}$ | $15.15^{a}$ | $311.9^{a}$ | $18.95^{c}$ | $128^{b}$ | $8.56^{b}$ | $742^{b}$ | $507^{b}$ | $5.22^{b}$ | 12 |

S-1 is the recommended variety for cultivation in the eastern rainfed zone, while C-2038 is recommended for the subtropical irrigated zone. The maximum number of leaves per meter of shoot (20.92) was recorded in genotype C-9, followed by S-1 and C-2038. The growth of mulberry is determined by the length and number of shoots produced per plant or per unit area. C-9 produced more primary branches (9.96) with greater length (150 cm) compared to both checks. The total length of all shoots per plant was significantly higher in genotype C-9 (890 cm) than in check C-2038 (742 cm). The mean leaf yield per plant across the three locations over different seasons and years under rainfed conditions was highest in the test genotype C-9 (570 g/season), and it was significantly superior to both checks.

**Leaf nutrient content, insect-pests and foliar disease severity in test genotypes**

| Genotype | N (%) | P (%) | K (%) | Whitefly (No /leaf) | Thrips (No /leaf) | Tukra (PI) | PM (PDI) | MLS (PDI) |
|---|---|---|---|---|---|---|---|---|
| **C-9** | $2.36^{ab}$ | $0.23^{bc}$ | $2.04^{ab}$ | $5^{c}$ | $5^{b}$ | $5.42^{ab}$ | $1.09^{a}$ | $3.24^{a}$ |
| **S-1** | $1.56^{c}$ | $0.25^{b}$ | $1.57^{c}$ | $11^{a}$ | $12^{ab}$ | $4.67^{b}$ | $1.35^{a}$ | $0.69^{a}$ |
| **C-2038** | $2.42^{a}$ | $2.04^{a}$ | $2.04^{a}$ | $7^{b}$ | $15^{a}$ | $9.03^{a}$ | $1.3^{a}$ | $0.73^{a}$ |

Leaf productivity is a crucial factor that determines the profitability of silk cocoon production. The highest pooled mean seasonal leaf yield was recorded in genotype C-9 (5.87 t/ha), which was 36% and 12% higher than the local check (S-1) and the regional check (C-2038), respectively. The pooled mean annual leaf yield was 10–16% higher than the regional check and 40–64% higher than the local check in the Eastern and North-Eastern regions. In red soil, C-9 recorded a 16% higher mean annual yield (14.4 t/ha/year) and potential leaf yield (16.4 t/ha/year) compared to check C-2038. In laterite soil, C-9 showed a 14% higher mean yield (12.8 t/ha/year) and potential leaf yield (16.1 t/ha/year) over C-2038. Under high-fertility conditions (alluvial soil), C-9 recorded a 10% higher mean annual leaf yield (25.2 t/ha/year) compared to C-2038 (23.01 t/ha/year). Hence, C-9 demonstrated superior performance in both low- and high-fertility environments under rainfed conditions compared to the regional check C-2038 and the local check S-1. The pooled Percent Disease Index (PDI) for Myrothecium leaf spot was highest in C-9 (3.24), followed by C-2038 (0.73) and S-1 (0.69). For powdery mildew, the highest PDI was recorded in the local check S-1 (1.35), followed by C-2038 (1.30) and C-9 (1.09). Overall, the test genotype C-9 recorded a lower incidence of diseases and insect-pest populations across rainfed locations, all remaining below the Economic Threshold Level (ETL).

Information on the adaptability of a genotype across environments, or its suitability for specific or broad environmental conditions, can be revealed through parametric methods such as the AMMI biplot (Additive Main Effects and Multiplicative Interaction), the GGE biplot (Genotype + Genotype × Environment), and non-parametric stability methods. AMMI analysis of variance revealed highly significant differences ($P < 0.01$) for genotype × environment interactions. Significant differences among genotypes, environments, and GE interactions were observed for all traits studied, except for moisture retention capacity of leaves and primary shoots per plant indicating the influence of environmental factors and the potential for selecting stable genotypes. AMMI analysis for leaf yield showed that 81.5% of the total variation was attributable to environment, 14.9% to genotype, and 3.6% to genotype × environment interaction. In the AMMI biplot, genotype C-9 was identified as highly stable, followed by checks C-2038 and S-1, across the three rainfed environments. Furthermore, non-parametric stability analysis revealed that genotypes C-2038 and C-9 were the most stable and high-yielding across environments, based on Kang's rank-sum method. Imphal was identified as the highest-yielding environment.

**Parametric and non-parametric stability parameters for leaf yield**

| Genotype | Y | $b_i$ | $s^2d_i$ | $\theta_i$ | $\theta_{(i)}$ | $\sigma^2_i$ | $W_i^2$ | KR |
|---|---|---|---|---|---|---|---|---|
| **C-9** | 19.67 | 1.13 | 0.19 | 3.48 | 3.58 | 0.75 | 2.26 | 3 |
| **S-1** | 12.69 | 0.73 | 0.42 | 5.23 | 0.09 | 7.73 | 6.91 | 6 |
| **C-2038** | 17.48 | 1.14 | 0.04 | 3.15 | 4.24 | -0.57 | 1.38 | 3 |

Y: Leaf yield over Environment (t/y) $b_i$: Regression coefficient, $s^2d_i$: Deviation from regression
$\theta_i$: Mean variance component $\theta_{(i)}$: GE variance component $\sigma^2_i$: Shukla's stability variance
$W_i^2$: Wricke's ecovalence KR: Kang's rank-sum

Tolerance to low nutrient stress and nutrient use efficiency among the three test genotypes were assessed based on the percent yield reduction observed in contrasting soil fertility environments. The low soil nutrient levels in red and laterite soils at the test centers, Koraput and Bhandra, indicated a low-fertility (LF) environment. Similarly, the high soil nutrient levels in alluvial soil at Imphal indicated a high-

fertility (HF) environment. The genotypes were classified as sensitive or tolerant to low nutrient stress based on the percent reduction in leaf yield and low nutrient tolerance index (LNTI) values.

The percent reduction in leaf yield due to low fertility stress ranged from 63% in genotype C-9 to 75% in check C-2038. The new genotype, C-9, showed a lower leaf yield reduction than the local variety S-1. Furthermore, based on the low nutrient tolerance index, the local variety S-1 (0.37), with the lowest value, was identified as highly tolerant to low nutrient stress, followed by C-9 (0.39) and C-2038 (0.42). Based on the lower LNTI value and reduced leaf yield loss, genotype C-9 was identified as tolerant to low soil fertility stress.

**Comparative performance in contrasting fertility environments**

| Traits | Leaf yield (t/ha/y) | | Fresh leaf wt. (g) | | Longest shoot (cm) | | Total shoots length (cm) | |
|---|---|---|---|---|---|---|---|---|
| **Genotype** | HF | LF | HF | LF | HF | LF | HF | LF |
| **C-9** | 26.5[a] | 16.2[a] | 5.79[a] | 3.50[b] | 166[a] | 143[a] | 1127[a] | 773[a] |
| **C-2038** | 24.4[b] | 14.0[b] | 5.64[a] | 4.12[a] | 146[b] | 120[c] | 949[b] | 639[b] |
| **S-1** | 16.9[c] | 10.6[c] | 2.93[c] | 2.25[c] | 141[c] | 127[b] | 914[c] | 584[c] |

Genetic improvement efforts need to integrate high yield potential with high nutrient use efficiency, tailored to the target farming system or environment. Nutrient use efficiency refers to the ability of crops to absorb and utilize nutrients effectively for optimal yields. Under low fertilizer input conditions, nitrogen (N) and phosphorus (P) efficient genotypes with high biomass yield are desirable. A field experiment was conducted at Bhandra to evaluate the performance of mulberry genotypes for leaf yield and nutrient content under 100% NPK and 0% NPK conditions. The reduction in plant NPK content was lowest in C-9 (7%), followed by S-1 (29%) and C-2038 (52%). Leaf yield reduction was also lowest in C-9 (59%) compared to the check varieties C-2038 (75%) and S-1 (77%). Estimates of nitrogen and phosphorus uptake and utilization efficiency among the test genotypes were calculated using standard formulas. Genotype C-9 recorded the highest nitrogen uptake (75.19 kg/ha) and nitrogen utilization efficiency (84.6%) compared to the check varieties. C-9 also showed the highest phosphorus uptake (41.8 kg/ha) and phosphorus utilization efficiency (79.59%) compared to the check variety S-1635. Hence, C-9 was identified as highly nutrient use efficient and tolerant to low nutrient stress in rainfed laterite soils.

**Comparative performance in 100% and 0% NPK condition**

| Genotype | Leaf yield (t/ha/crop) | | | Plant NPK content (%) | | |
|---|---|---|---|---|---|---|
| | **100% NPK** | **0% NPK** | **% Reduction** | **100% NPK** | **0% NPK** | **% Reduction** |
| **C-9** | 6.36* | 2.60* | 59 | 5.63* | 5.26* | 7 |
| **S-1** | 4.80 | 1.08 | 77 | 4.18 | 2.96 | 29 |
| **C-2038** | 5.62 | 1.39 | 75 | 7.39 | 3.58 | 52 |
| **CD 5%** | 0.68 | 0.25 | | 1.04 | 0.32 | |

**Inference:** The mulberry genotype C-9 has been identified as suitable for targeted low-fertility environments (red and laterite soils), with a >15% higher leaf yield (16.22 t/ha/year) compared to the regional check C-2038 (14.03 t/ha/year). It may be recommended for commercial cultivation in these regions.

**Future work plan**: On-farm testing and large-scale popularization of the new mulberry variety C-9 ('**Ratna**') in the rainfed red and laterite soils of the Eastern rainfed zone.

**PPA02005SI: Optimization of spacing and nutrient dose for newly developed high yielding mulberry variety (C-2038) under irrigated condition**

**[October 2019 - September 2023]**

**PI's:** Yallappa Harijan, Mahesh R. (upto May, 2021)

**CI's:** Suresh K., Deepika K.U., Vijay V. (upto May, 2021)

**Objective:**

- To find out the optimum spacing and level of fertilizer for higher leaf productivity and better leaf quality under irrigated condition for the high yielding mulberry variety, C-2038

**Acievements:**

The Mulberry Variety Authorization Committee (MVAC) of the Central Silk Board (CSB) has authorized the high-yielding mulberry variety C-2038, developed by CSB-CSRTI, Berhampore, for irrigated and rainfed areas of Eastern and North Eastern India. The C-2038 variety was developed using the existing recommended dose of fertilizers (336:180:112 kg/ha/year), which was originally prescribed for the mulberry variety S-1 in 1973 (Ray *et al.*, 1973).

Although the C-2038 genotype has been selected as a high-yielding mulberry variety, its full genetic potential can only be realized through appropriate agronomic crop management practices, especially optimal plant density and efficient water and nutrient management. Among various agronomic factors, improper spacing and inadequate nutrient management are primarily responsible for low mulberry leaf yield and quality, in addition to biotic and abiotic stresses.

At present, there is no optimized nutrient dose specifically recommended for the newly developed variety C-2038. Thus, it is essential to determine a suitable nutrient dose and crop geometry to fully exploit the potential of this high-yielding variety. In this context, a study was undertaken to optimize spacing and nutrient dose for exploring full genetic potential of newly developed variety C-2038 under irrigated condition. Twenty treatments with four different spacing ($S_1$: 2'×2', $S_2$: 3'×3', $S_3$: PRS & $S_4$: 6'×6') and five nutrient doses indicated below were evaluated for leaf yield and quality traits in Strip plot design under irrigated condition.

- N1: 75% RDF (252:135:84)
- N2: 100% RDF (336:180:112)
- N3: 110% RDF (370:198:123)
- N4: 120% RDF (403:216:134)
- N5: 130% RDF (437:234:146)

(All in $N:P_2O_5:K_2O$ kg/ha/year)

The soil fertility status at the experimental site was tested prior to the commencement of the experiment and again after its completion to ensure that fertility levels were maintained throughout the study. The analysis of variance among the twenty different treatments involving spacing and nutrient doses revealed highly significant differences for all growth and leaf quality traits, indicating the presence of sufficient variability across all parameters studied. The pooled mean data over fifteen crops showed that cultivation of C-2038 under a 120% nutrient dose with 2'×2' spacing resulted in a significantly higher leaf yield (69.82 t/ha), followed by 3'×3' spacing (62.10 t/ha) and the paired row system (60.02 t/ha), compared to the recommended dose/control, as shown in the table below.

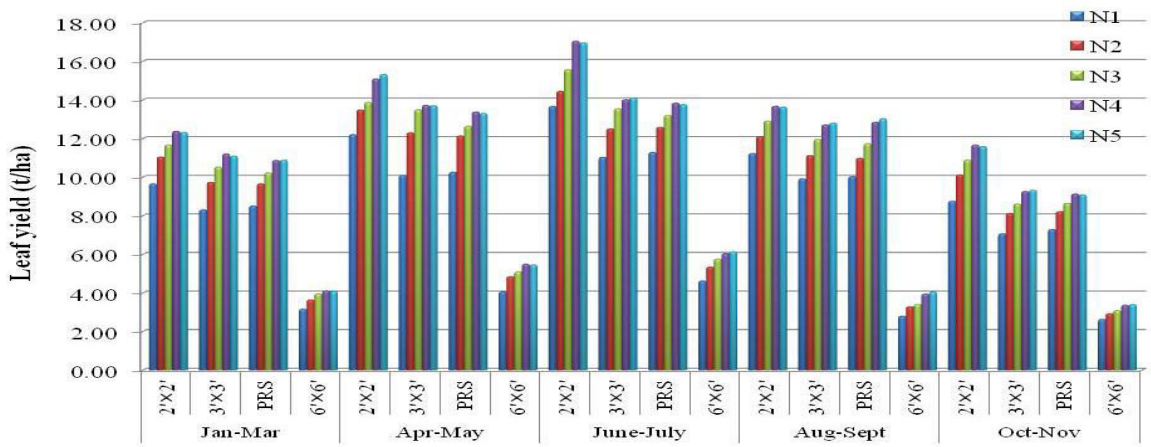
**Mean performance (15 crops) of leaf yield among different nutrient doses and spacing in C-2038**

| Nutrient dose ($N:P_2O_5:K_2O$; Kg/ha/yr) | 2′×2′ | % gain | 3′×3′ | % gain | PRS | % gain | 6′×6′ | % gain | Mean |
|---|---|---|---|---|---|---|---|---|---|
| **$N_1$: 75% RD** | 55.49 | -9.26 | 46.39 | -14.82 | 47.33 | -11.58 | 17.24 | -13.81 | 41.61 |
| **$N_3$: 110% RD** | 65.10* | 6.45 | 58.31* | 7.06 | 56.42* | 5.39 | 22.01* | 10.05 | 50.46 |
| **$N_4$: 120% RD** | 69.82* | 14.19 | 62.10* | 14.03 | 60.02* | 12.13 | 23.28* | 16.41 | 53.80 |
| **$N_5$: 130% RD** | 69.68* | 13.95 | 61.07* | 12.14 | 61.06* | 14.07 | 23.50* | 17.50 | 53.83 |
| **$N_2$: 100% (C)** | 61.15 | | 54.46 | | 53.53 | | 20.00 | | |

Statistical analysis was done with OPSTAT software; CD at 5% level of significance for nutrients: 1.047, spacing: 3.062 and interaction: 2.371

The leaf yield per plant increased with wider spacing and higher nutrient doses, and vice versa. The average leaf yield per plant was highest in 6′×6′ spacing (1510 g/plant), followed by 3′×3′ spacing (1006 g/plant), and lowest in 2′×2′ spacing (503 g/plant) due to differences in plant density per unit area (Refer Table). The application of split-dose fertilizers (NPK) at the 15th and 30th days after pruning resulted in significant differences in both leaf yield and quality. The performance of C-2038 for leaf yield across four spacing treatments and five fertilizer doses over five different seasons is presented graphically in the figure.

The improved leaf yield under higher nutrient doses (120% and 130% RDF) was attributed to enhanced growth and quality parameters. Significantly higher number of productive shoots, total shoot length, number of leaves per shoot, leaf moisture content, chlorophyll content, and specific leaf area were observed under higher nutrient doses, irrespective of spacing, compared to the control. Among the higher nutrient doses (120% and 130% RDF), the performance of these traits was on par (statistically similar), as shown in the table. Growth and quality traits were significantly higher in wider spacing such as 6′×6′, followed by 3′×3′, with the lowest values recorded in 2′×2′ spacing.



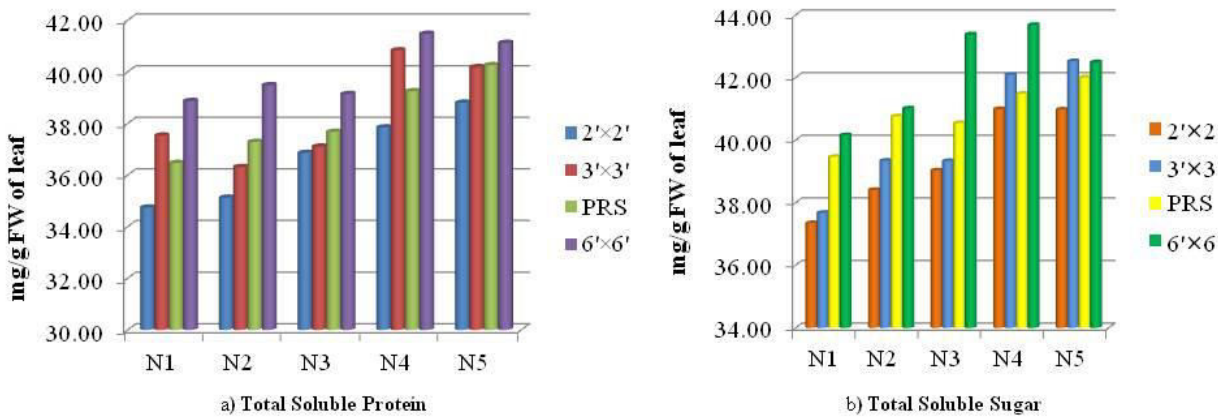

**Mean seasonal performance of leaf yield among different spacing and nutrient doses**

**Mean performance of growth and quality parameters among different treatments of spacing and nutrient doses in C-2038 variety**

| Nutrient doses | Spacing | NPS | TSL | LMS | LFH | LMC | MRC | CCI | SLA | LYP |
|---|---|---|---|---|---|---|---|---|---|---|
| **75%** | 2′×2′ | 8.28 | 728 | 19.80 | 20.13 | 75.38 | 75.16 | 15.76 | 191 | 400 |
| **[252:135:84]** | 3′×3′ | 9.89 | 864 | 20.52 | 14.20 | 75.63 | 75.89 | 16.66 | 196 | 751 |
| | PRS | 9.38 | 810 | 20.52 | 13.70 | 76.01 | 76.84 | 16.00 | 193 | 682 |
| | 6′×6′ | 12.86 | 1139 | 20.73 | 11.36 | 76.25 | 77.02 | 17.58 | 199 | 1118 |
| **100% [C]** | 2′×2′ | 8.58 | 809 | 19.95 | 17.21 | 75.50 | 76.11 | 16.10 | 196 | 440 |
| **[336:180:112]** | 3′×3′ | 10.45 | 912 | 20.26 | 12.30 | 76.43 | 77.18 | 16.43 | 197 | 882 |
| | PRS | 10.01 | 875 | 20.67 | 12.83 | 76.57 | 78.37 | 16.47 | 200 | 771 |
| | 6′×6′ | 14.13 | 1309 | 21.27 | 11.01 | 77.01 | 78.08 | 17.73 | 202 | 1297 |
| **110%** | 2′×2′ | 8.79 | 824 | 20.19 | 15.05* | 76.58* | 77.56 | 17.27* | 197 | 469 |
| **[370:198:123]** | 3′×3′ | 10.93 | 975 | 20.77* | 12.67* | 77.10 | 79.48 | 17.68 | 205* | 945 |
| | PRS | 10.34 | 894 | 20.41 | 12.97 | 76.14 | 77.53 | 16.59 | 204* | 812 |
| | 6′×6′ | 15.01 | 1342 | 21.77* | 10.97 | 78.20* | 78.27 | 18.07 | 204 | 1427 |
| **120%** | 2′×2′ | 10.05* | 837 | 20.92* | 14.93* | 77.70* | 77.94 | 18.02* | 205* | 503 |
| **[403:216:134]** | 3′×3′ | 12.24* | 1034* | 21.19* | 10.94* | 79.26* | 80.40 | 18.42* | 209* | 1006 |
| | PRS | 11.26* | 995* | 21.32* | 11.43* | 78.23* | 79.62 | 18.17* | 204* | 864 |
| | 6′×6′ | 16.39* | 1474* | 23.11* | 9.87 | 80.27* | 82.54 | 20.70* | 216* | 1510* |
| **130%** | 2′×2′ | 9.92* | 881 | 20.39* | 14.61* | 78.40* | 80.12 | 18.82* | 204* | 502 |
| **[437:234:146]** | 3′×3′ | 12.33* | 1029* | 21.40* | 11.71* | 79.63* | 80.61 | 19.35* | 205* | 989 |
| | PRS | 11.32* | 1003* | 21.31* | 11.30* | 79.21* | 79.39 | 18.29* | 210* | 879 |
| | 6′×6′ | 16.59* | 1480* | 23.33* | 9.89 | 80.34* | 81.66 | 20.85* | 212* | 1524* |
| **CD @ 5%** | | *1.15* | *105.1* | *0.43* | *1.19* | *0.75* | 0.91 | *0.67* | *3.01* | *163.62* |

**NPS:** No. of primary shoots/plant; **TSL:** Total shoot length/plant (cm); **LMS:** No. of leaves/meter length of shoot; **LFH:** Leaf fall at harvest (%); **LMC:** Leaf moisture content (%); **MRC:** Moisture retention capacity (%); **CCI:** Chlorophyll content index; **SLA:** Specific leaf area ($cm^2$/g) and **LYP:** Leaf yield per plant (gm)

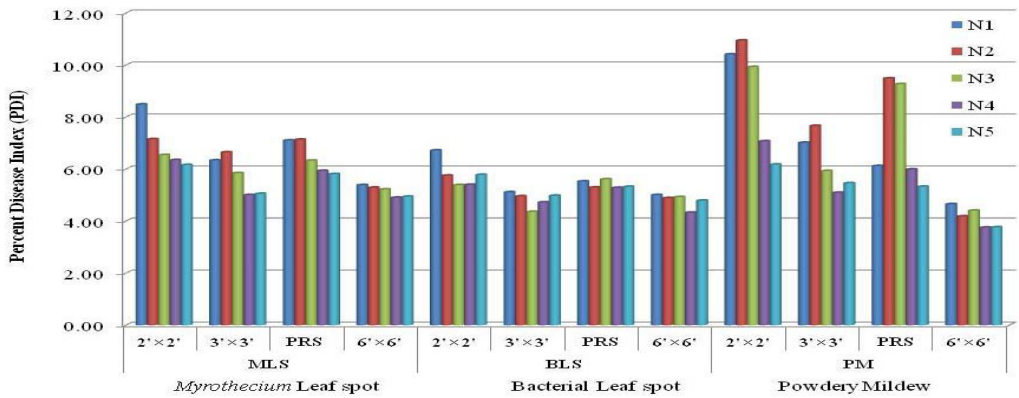
**Biochemical assay:** Leaf nutritional quality was assessed through biochemical analysis. Total soluble protein and sugar content were recorded significantly higher in 6′×6′ spacing with 120% nutrient dose (41.47 mg/g fw and 43.69 mg/g fw, respectively), and lowest in 2′×2′ spacing with 75% nutrient dose (34.74 mg/g fw and 37.35 mg/g fw, respectively). As spacing and nutrient levels increased, protein and sugar contents also increased, as shown in the figure.



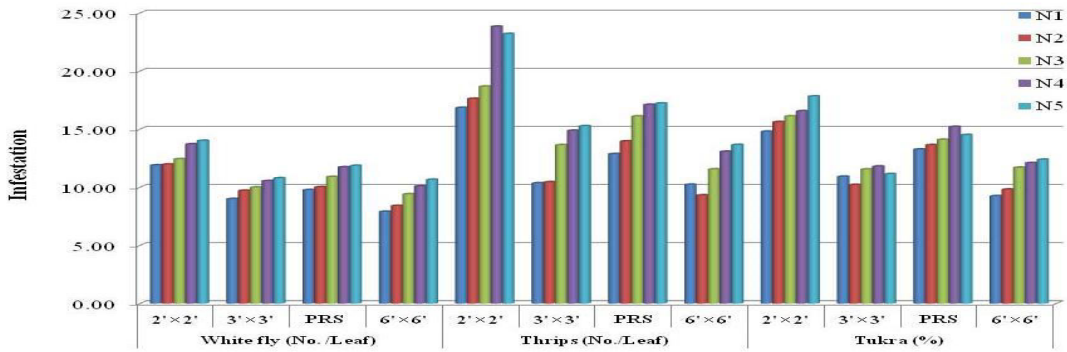

**Total soluble protein and sugar content in different spacing and nutrients**

**Incidence of diseases and insect pests:** The natural incidence of Myrothecium leaf spot, bacterial leaf spot, and powdery mildew indicated that higher nutrient doses combined with wider spacing resulted in lower disease incidence and higher leaf productivity. The sucking pest population (thrips, whitefly) and tukra infestation decreased with increased spacing and reduced fertilizer levels, and vice versa. Therefore, 3'×3' spacing with 120% nutrient dose was found to be optimal for higher leaf productivity and lower pest and disease incidence.

**Nutrient use efficiency indices (Fertilizer based):** Twenty treatments involving different spacings and nutrient levels were evaluated for fertilizer-based indices, i.e., Partial Factor Productivity (PFP), which showed significant differences among treatments (Refer Figure). The highest PFP was recorded under 2'×2' spacing (85 to 118 kg leaf/kg fertilizer), and the lowest under 6'×6' spacing (29 to 100 kg/kg). As the nutrient dose increased, PFP values decreased, and vice versa. 3'×3' spacing and paired row system (PRS) were found to be optimal (75 to 100 kg/kg) for nutrient use efficiency.




**Natural incidence of diseases among different treatments of spacing and nutrient doses**




**Natural incidence of insect pests among different treatments of spacing and nutrients**

**Silkworm bioassay**: Two silkworm bioassay trials using M×Bi [Nistari × (SK6×SK7)] and Bi×Bi [SK6×SK7] hybrids were conducted for the best-performing treatments (120% and 130% RDF with 3'×3' and 2'×2' spacings) during the Baisakhi crop (April–May 2023) and Bhadhuri crop (July–August 2023). Silkworm growth was significantly influenced by feeding on leaves produced under different NPK fertilizer doses in mulberry. The 3'×3' spacing with 130% RDF recorded significantly higher single cocoon weight, single shell weight, and shell ratio compared to the control in both MB and BB hybrid combinations. Overall, the BB hybrid outperformed the MB hybrid across the selected treatments. Considering both leaf productivity and silkworm bioassay results, 120% RDF with 3'×3' spacing was found to be optimal (Refer Table below).

**Mean performance of silkworm bioassay of M× Bi [Nistari × (SK6 × SK7)] & Bi x Bi (SK6 × SK7) hybrids among selected treatments of spacing and nutrient doses**

| Spacing | Nutrients | CW | | SCW | | SSW | | SR % | | ERR (No's) | | ERR (Wt.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MB | BB | MB | BB | MB | BB | MB | BB | MB | BB | MB | BB |
| **2'×2'** | 120% | 395 | 390 | 1.404 | 1.447 | 0.208 | 0.222 | 14.72* | 15.14 | 9156 | 8462 | 13.17 | 13.01 |
| | 130% | 399* | 401 | 1.413 | 1.455 | 0.207 | 0.225* | 14.95* | 15.41* | 9595* | 9245* | 13.82* | 13.38 |
| | 100% (C) | 386 | 412* | 1.401 | 1.476* | 0.204 | 0.224* | 14.26 | 15.23 | 8933 | 9295* | 12.87 | 13.72 |
| **3'×3'** | 120% | 403* | 392 | 1.431* | 1.452 | 0.211* | 0.224 | 14.90* | 15.22 | 9473 | 8828 | 13.24* | 12.65 |
| | 130% | 415* | 406 | 1.439* | 1.487* | 0.216* | 0.227* | 14.79* | 15.55* | 9556 | 8939 | 13.31* | 13.17* |
| | 100% (C) | 392 | 404 | 1.410 | 1.494* | 0.206 | 0.228* | 14.36 | 15.34 | 9372 | 8967 | 12.83 | 13.47* |
| **CD @5%** | | *9.87* | 15.67 | *0.021* | 0.024 | *0.005* | 0.002 | *0.29* | 0.20 | *318* | 351 | *0.32* | 0.51 |

**CW:** Weight of cocoon (g); **SCW:** Single cocoon weight (g); **SSW:** Single shell weight (g); **SR:** Shell ratio; **ERR:** Effective rate of rearing by number and weight.

**Economics of different nutrient doses:** The cost of fertilizer inputs under different nutrient doses was considered to evaluate the economics of mulberry cultivation. Both spacing and nutrient doses had a significant influence on the economic returns. Among the selected treatments, 3'×3' spacing with 120% RDF recorded the highest net returns (Rs. 93,387) and a B:C ratio of 2.01, compared to the control and 130% RDF. The 120% nutrient dose resulted in 26.10% higher net returns in 3'×3' spacing compared to 24.47% in 2'×2' spacing. Considering quality leaf productivity, silkworm bioassay, and other traits, 120% RDF with 3'×3' spacing was found to be the optimum for mulberry cultivation under irrigated conditions.

**Inference:** Under 120% RDF with 3'×3' spacing, the C-2038 variety recorded a 14.03% significantly higher leaf productivity (62.10 t/ha) compared to the recommended fertilizer dose (54.46 t/ha), along with improved leaf quality. Furthermore, considering leaf productivity and quality traits such as total soluble protein, incidence of diseases and insect pests, silkworm bioassay performance, nutrient use efficiency, and benefit-cost ratio, the 120% RDF (403:216:134 NPK kg/ha/year) with 3'×3' spacing was found to be optimal over the existing fertilizer recommendation for C-2038 cultivation.

**Future work plan:** The newly identified fertilizer dose (403:216:134 NPK kg/ha/year) will be tested through On-Station Trials (OST) and recommended for commercial cultivation of the C-2038 variety under irrigated conditions in Eastern and North Eastern India.

**Ongoing Research Projects:**

**PIB02007SI: Improvement of mulberry leaf longevity in Eastern & North Eastern states of India**

**[June 2020 - May 2024]**

**PI:** Deepika K.U.

**CI's:** Yallappa H., Harish Babu S.

**Objectives:**

- To understand hormonal regulation of senescence in mulberry genotypes
- To determine stay-green traits for improved mulberry leaf longevity

**Progress:**

Early leaf senescence and premature abscission make the availability of quality leaves difficult during the commercial crop seasons in West Bengal and other Northeastern states, leading to a reduction

in silk production. Improving the leaf longevity of mulberry by delaying senescence would ensure the availability of quality leaves throughout all rearing seasons. The present study aims to understand the hormonal regulation of senescence in mulberry and determine the role of hormones in maintaining stay-green traits to improve leaf longevity.

**Field Evaluation:** Field evaluation of the newly developed hormone-based formulation, "Haryali," for improving mulberry leaf longevity was conducted on three varieties (S-1635, C-2038, and C-2060) at CSB-CSRTI, Berhampore, and one variety ($BC_2$59) at RSRS-Kalimpong across five (November 2022, March 2023, May 2023, July 2023, and September 2023) and two (April 2023 and October 2023) crop seasons, respectively. It was found that mulberry plants sprayed with Haryali recorded higher leaf yield (18.6–22.4%) compared to the control and two commercial formulations, Morizyme (8.0–12.42%) and Poshan (10.24–15.29%). This increase in leaf yield correlated with higher NDVI, total chlorophyll content, and lower leaf fall percentage in all four varieties. Haryali also improved the leaf quality of mulberry plants, as indicated by their higher moisture and protein content, shown in the tables below.

**Growth, yield, quality and senescence related estimations in S-1635**

| Treat-ments | NDVI (index) | ALY (t/Ha/yr) | TSL (cm) | LMS (nos.) | LA ($cm^2$) | LF (%) | LMC (%) | TCC (mg/g FW) | TSP (mg/g FW) |
|---|---|---|---|---|---|---|---|---|---|
| Haryali | 0.77 | 62.07 | 835.31 | 20.26 | 225.09 | 15.27 | 74.60 | 2.67 | 31.33 |
| Morizyme | 0.72 | 56.05 | 736.89 | 18.46 | 197.04 | 18.14 | 67.12 | 2.32 | 28.04 |
| Poshan | 0.72 | 53.95 | 716.83 | 18.19 | 194.44 | 18.70 | 66.66 | 2.31 | 27.22 |
| Control | 0.65 | 51.22 | 659.96 | 17.31 | 181.05 | 19.44 | 60.48 | 2.22 | 25.00 |
| CD at 5% | 0.02 | 0.38 | 37.09 | 0.65 | 4.86 | 1.1 | 2.37 | 0.11 | 0.95 |
| CV (%) | 2.48 | 2.49 | 3.61 | 2.51 | 1.75 | 4.41 | 2.53 | 3.22 | 2.46 |

(NDVI: Normalized difference vegetation, ALY: Annual leaf yield, TSL: Total shoot length, LMS: Leaf per meter shoot, LA: Leaf area, LMC: Leaf moisture content, TCC: Total chlorophyll content, and TSP: Total soluble protein)

**Growth, yield, biochemical and senescence related estimations in C-2038**

| Treat-ments | NDVI (index) | ALY (t/Ha/yr) | TSL (cm) | LMS (nos.) | LA ($cm^2$) | LF (%) | LMC (%) | TCC (mg/g FW) | TSP (mg/g FW) |
|---|---|---|---|---|---|---|---|---|---|
| Haryali | 0.80 | 63.84 | 1060.80 | 21.54 | 275.64 | 15.01 | 76.55 | 2.92 | 33.76 |
| Morizyme | 0.74 | 59.01 | 938.10 | 19.55 | 247.46 | 16.81 | 69.95 | 2.64 | 30.41 |
| Poshan | 0.73 | 57.30 | 917.22 | 19.24 | 244.46 | 17.37 | 68.41 | 2.63 | 29.47 |
| Control | 0.68 | 53.80 | 861.20 | 18.69 | 232.21 | 18.55 | 63.03 | 2.46 | 27.07 |
| CD at 5% | 0.02 | 0.27 | 21.66 | 0.46 | 4.68 | 0.95 | 2.67 | 0.11 | 1.38 |
| CV (%) | 2.57 | 1.67 | 1.64 | 1.68 | 1.34 | 4.06 | 2.76 | 2.97 | 3.30 |

**Growth, yield, quality and senescence related estimations in C-2060**

| Treat-ments | NDVI (index) | ALY (t/Ha/yr) | TSL (cm) | LMS (nos.) | LA ($cm^2$) | LF (%) | LMC (%) | TCC (mg/g FW) | TSP (mg/g FW) |
|---|---|---|---|---|---|---|---|---|---|
| Haryali | 0.79 | 75.87 | 920.40 | 21.64 | 242.58 | 14.71 | 73.47 | 2.86 | 33.07 |
| Morizyme | 0.72 | 70.25 | 790.30 | 19.70 | 211.45 | 16.22 | 66.63 | 2.61 | 29.78 |
| Poshan | 0.71 | 68.82 | 772.62 | 19.36 | 206.78 | 16.58 | 65.77 | 2.58 | 28.98 |
| Control | 0.66 | 63.95 | 727.20 | 18.55 | 195.33 | 18.05 | 60.99 | 2.39 | 26.74 |
| CD at 5% | 0.02 | 0.26 | 24.7 | 0.63 | 7.01 | 0.88 | 2.66 | 0.09 | 9.96 |
| CV (%) | 2.00 | 1.35 | 2.2 | 2.29 | 2.35 | 3.87 | 2.86 | 2.54 | 2.33 |

**Growth, yield, quality and senescence related estimations in $BC_2$59**

| Treat-ments | NDVI (index) | ALY (t/Ha/yr) | TSL (cm) | LMS (nos.) | LF (%) | LMC (%) |
|---|---|---|---|---|---|---|
| Haryali | 0.76 | 10.86 | 658.35 | 20.06 | 17.10 | 72.79 |
| Morizyme | 0.69 | 9.66 | 593.47 | 17.74 | 19.71 | 64.05 |
| Poshan | 0.66 | 9.42 | 584.48 | 17.46 | 20.35 | 63.03 |
| Control | 0.60 | 8.87 | 524.09 | 16.95 | 21.67 | 58.00 |
| CD at 5% | 0.04 | 0.25 | 24.63 | 0.21 | 1.59 | 2.45 |
| CV (%) | 1.77 | 1.56 | 1.36 | 0.47 | 2.45 | 1.15 |

**Farmer's field evaluation:** Farmer's field evaluation of Haryali was conducted over two crop seasons (November 2023 and March 2024) in the districts of Murshidabad (3 locations), Birbhum (3), and Malda (4) using the S-1635 mulberry variety with 10 farmers, along with a control. It was found that mulberry plants sprayed with Haryali yielded 31.4% more than the control due to improved growth (Refer Table).

**Farmer's field trials (Two Crop mean data)**

| Treatment | LYP (g/pl) | SY (g/pl) | NPS (no.) | TSL (cm) | LLS (cm) | LMS (no.) | LA ($cm^2$) |
|---|---|---|---|---|---|---|---|
| Sprayed | 526.9 | 1002.5 | 11.2 | 875.4 | 120.8 | 21.3 | 280.3 |
| Control | 400.9 | 756.2 | 10.4 | 754.6 | 105.5 | 19.5 | 213.5 |
| CD at 5% | 23.5 | 18.5 | NS | 5.6 | 8.9 | 2.2 | 6.7 |

(LY: Leaf yield per plant, SY: Shoot yield, NPS: No. of pri. shoot, TSL: Total shoot length, LLS: Length of longest shoot, LMS: Leaf per meter shoot, and LA: Leaf area)

**PIB02010SI: Evalaution of promising high yielding mulberry genotypes for Eastern and North-Eastern India**

**[February 2021 - January 2025]**

**PI:** Suresh K

**CI's:** Yallappa H., Deepika K.U., Harshitha B.S. (from Feb. 2024), Ranjith Kumar (from Feb. 2024), Deep Kr. Gogoi (upto Oct. 2023)

**Objectives:**

- To evaluate improved mulberry genotypes for growth traits and leaf productivity
- To assess the leaf quality by biochemical and silkworm bioassay

**Progress:**

Seven test genotypes (drought-tolerant: PD-1, PD-7, PD-8, and PD-27; high-yielding: PP-8, PP-10, and PP-24) along with two check varieties (zonal check: S-1635/C-1730 and regional check: C-2038) were evaluated for leaf yield and quality attributes across different seasons under irrigated (Berhampore) and rainfed (Koraput) conditions in the East and Northeast regions. The experimental plantation was pruned as per the local crop schedule, and recommended agronomic practices were followed to raise a healthy crop.

Under irrigated conditions, four test genotypes recorded significantly higher leaf yield per plant compared to the regional check C-2038 (678 g). The superior leaf yield in the test genotypes was attributed to significantly greater total shoot length and a higher number of leaves per meter of shoot

compared to check C-2038. Seasonal leaf yield among the test genotypes ranged from 5.96 t/ha to 9.18 t/ha, with four genotypes recording significantly higher leaf yield than the regional check C-2038 (7.79 t/ha). Annual leaf yield among the test genotypes ranged from 30 t/ha to 46 t/ha, with four genotypes showing a 7–18% higher leaf yield than the regional check C-2038 (39 t/ha/year). The test genotypes were observed to sprout earlier during both the normal and winter seasons compared to check C-2038. Genotype PD-01 recorded a higher leaf weight (399 g/100 leaves), while PD-07 was observed to have more leaves per meter of shoot length (25 leaves).

**Leaf yield and its attributes in irrigated condition (2023-24)**

| Genotype | DSN | DSW | HLW | LMC | LM6 | LMS | LLS | TSL | SYP | LSR | LYP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PD-01 | 8* | 64* | 399.5* | 78.1* | 74.8* | 21 | 135* | 1195* | 1240* | 58.4 | 726* |
| PD-07 | 9 | 61* | 226.0 | 76.8 | 73.8 | 25* | 117 | 910 | 877 | 59.2 | 507 |
| PD-08 | 9 | 58* | 288.8 | 77.2 | 73.8 | 23* | 134* | 1104* | 1276* | 56.8 | 713* |
| PD-27 | 10 | 64* | 252.2 | 77.9* | 75.1* | 24* | 123 | 1056 | 1042 | 60.2 | 601 |
| PP-08 | 8* | 60* | 269.5 | 77.0 | 73.2 | 21 | 134* | 1215* | 1315* | 61.5 | 793* |
| PP-10 | 9 | 59* | 346.4 | 77.9* | 74.2 | 22* | 120 | 1083 | 1281* | 63.5* | 793* |
| PP-24 | 9 | 65* | 283.3 | 77.4 | 73.3 | 21 | 137* | 1114* | 1158 | 55.5 | 636 |
| S-1635 | 8* | 65* | 284.1 | 76.4 | 72.0 | 23* | 118 | 1032 | 978 | 55.1 | 534 |
| C-2038* | 9 | 68 | 364.1 | 77.0 | 73.7 | 21 | 127 | 1061 | 1113 | 61.6 | 678 |
| CD@5% | 1 | 1 | 11.9 | 0.5 | 0.6 | 1 | 3 | 26 | 48 | 1.0 | 22 |
| CV (%) | 8.39 | 5.10 | 11.02 | 0.77 | 1.10 | 3.64 | 4.63 | 5.63 | 8.80 | 3.31 | 9.39 |

DHS: Days to sprouting in N: Normal; W: Winter season; HLW: Hundred leaf weight (g); LMC: Leaf moisture (%); LM6: Leaf moisture @ 6 hrs (%); LMS: Leaves per meter shoot (No.); LLS: Length of longest shoot (cm); TSL: Total shoot length (cm); SYP: Shoot yield per plant (g); LSR: Leaf to shoot ratio (%) and LYP: Leaf yield per plant (g).

Mulberry is a perennial plant that provides leaves essential for the proper development of silkworms. The mulberry plant produces tender, medium, and coarse leaves on its branches, which were collected for the estimation of biochemical constituents using standard methods. The total soluble protein and sugar content estimated in the test genotypes revealed higher levels, comparable to those in the check variety C-2038. Genotypes PP-8 and S-1635 recorded significantly higher total soluble protein and sugar content, respectively, compared to check C-2038. Incidences of foliar diseases and sucking insect pests were observed in different test genotypes across various seasons. The test genotypes exhibited lower severity of powdery mildew and Myrothecium leaf spot diseases compared to the local check S-1635. The foliar disease severity in the test genotypes was also compared to the regional check C-2038. Sucking insect pests, such as mealybugs, whiteflies, and thrips, were observed in different seasons. The test genotypes recorded lower infestations of these insect pests compared to both check varieties.

Silkworm rearing/bioassays were carried out during the Kharif 2024 season (Nistari × SK6.7) and Autumn 2024 season (B.Con 1 × B.Con 4) to determine cocoon parameters and assess leaf quality. Both silkworm hybrids fed with leaves from the test genotypes recorded significantly higher larval weights compared to the check variety C-2038. Nistari × SK6.7 cocoons showed significantly higher cocoon weight when fed with leaves of PP-10 and PP-24 during Kharif 2024. B.Con 1 × B.Con 4 cocoons recorded significantly higher cocoon weight when fed with leaves of PD-7, PD-8, PD-27, and PP-10. Shell weight was significantly higher in cocoons of both Nistari × SK6.7 and B.Con 1 × B.Con 4 when fed with leaves of PP-10, compared to the check C-2038. Six test genotypes including PD-1, PD-7, PD-8, PP-8, PP-10 and the local check S-1635 exhibited significantly higher leaf-to-cocoon ratios compared to C-2038 in both silkworm hybrids. The cocoon yield of Nistari × SK6.7 in terms of effective rate of rearing (ERR) by weight

was significantly higher in all test genotypes over the check C-2038 (13.8 kg), except PD-27. The cocoon yield of B.Con 1 × B.Con 4, in terms of ERR by weight, was 5–7% higher in genotypes PD-1, PD-8, and PP-10 compared to the check C-2038 (16.3 kg). Overall, the analysis revealed that all test genotypes possess desirable leaf quality reflected in improved leaf-to-cocoon ratios and enhanced cocoon parameters in both hybrids under irrigated conditions, when compared to the check C-2038.

**Leaf nutritional quality and insect pest – disease severity**

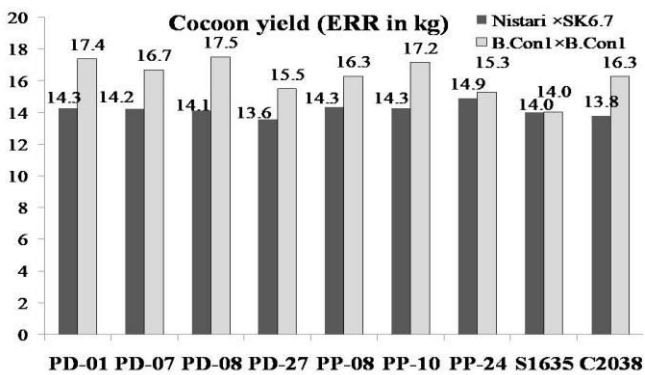
| Genotype | TSP | TSS | CCI | SLA | PMS | BLS | MLS | MBI | WFP | TKP |
|---|---|---|---|---|---|---|---|---|---|---|
| PD-01 | 33.57 | 37.53 | 17.25 | 274.7 | 21.24 | 5.64 | 7.37 | 13.82* | 18* | 6* |
| PD-07 | 33.56 | 40.10 | 18.25 | 295.8 | 23.97 | 7.11 | 6.82 | 22.83 | 11* | 5* |
| PD-08 | 31.22 | 37.14 | 16.22 | 252.7 | 17.30* | 6.73 | 3.30* | 14.19* | 8* | 7* |
| PD-27 | 32.33 | 35.45 | 19.36 | 306.0 | 14.85* | 4.16* | 6.20 | 18.87 | 7* | 4* |
| PP-08 | 34.68* | 39.99 | 15.51 | 307.7 | 18.57* | 6.14 | 9.70 | 14.04* | 15* | 5* |
| PP-10 | 30.14 | 38.65 | 12.72 | 322.1 | 17.14* | 5.77 | 7.62 | 13.75* | 18 | 4* |
| PP-24 | 30.44 | 38.33 | 18.61 | 302.7 | 15.22* | 6.52 | 5.81 | 14.00* | 14* | 9 |
| S-1635 | 32.20 | 42.72* | 21.22* | 254.0 | 26.15 | 4.99* | 10.28 | 28.86 | 23 | 12 |
| C-2038* | 33.14 | 39.52 | 19.12 | 247.0 | 21.08 | 6.35 | 7.60 | 19.92 | 20 | 9 |
| CD@5% | 1.28 | 1.38 | 1.32 | 25.2 | 1.94 | 1.17 | 2.01 | 2.19 | 1 | 1 |
| CV (%) | 4.57 | 4.35 | 8.87 | 11.39 | 10.12 | 11.00 | 16.18 | 14.30 | 18.51 | 20.1 |

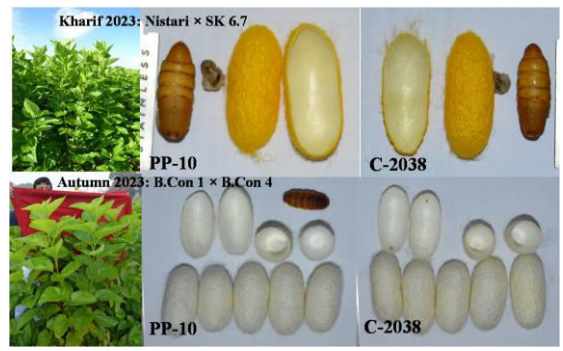
TSP: Total soluble protein (mg/g); TSS: Total sugars (mg/g); CCI: Chlorophyll content index, PMS: Powdery mildew severity (PDI); MLS: Myrothecium leaf spot (PDI); BLS: Bacterial leaf spot (PDI); MBI: Mealybug infestation; WFP: Whitefly population (No./leaf); THP:Thrips population (No./leaf)

**Silkworm cocoon parameters and quality in different seasons**

| Genotype | Larval wt. (g) | | Cocoon wt. (g) | | Shell wt. (g) | | Shell wt. (%) | | Leaf cocoon ratio | |
|---|---|---|---|---|---|---|---|---|---|---|
| | MBH | BBH | MBH | BBH | MBH | BBH | MBH | BBH | MBH | BBH |
| PD-01 | 4.049* | 4.131* | 1.532 | 1.685 | 0.254 | 0.309 | 14.26* | 17.38* | 16.90* | 17.43* |
| PD-07 | 4.098* | 4.182* | 1.529 | 1.705* | 0.244 | 0.314 | 14.24 | 16.70 | 18.67* | 18.87* |
| PD-08 | 4.035* | 4.117* | 1.542 | 1.701* | 0.246 | 0.305 | 14.11 | 17.50* | 17.70* | 18.03* |
| PD-27 | 3.761* | 3.838* | 1.425 | 1.710* | 0.238 | 0.302 | 13.57 | 15.48 | 20.10 | 21.33 |
| PP-08 | 3.530 | 3.602 | 1.591 | 1.689 | 0.249 | 0.317* | 14.34* | 16.29 | 19.25 | 19.77* |
| PP-10 | 4.054* | 4.137* | 1.809* | 1.751* | 0.327* | 0.331* | 14.26* | 17.15* | 16.95* | 17.06* |
| PP-24 | 3.628 | 3.859* | 1.616* | 1.685 | 0.254 | 0.307 | 14.90* | 15.28 | 17.73* | 18.13* |
| S-1635 | 3.837* | 3.799* | 1.488 | 1.575 | 0.231 | 0.274 | 14.00 | 14.03 | 18.38* | 18.77* |
| C-2038* | 3.549 | 3.622 | 1.549 | 1.669 | 0.251 | 0.308 | 13.80 | 16.26 | 19.30 | 21.10 |
| CD@5% | 0.100 | 0.070 | 0.050 | 0.032 | 0.011 | 0.007 | 0.45 | 0.51 | 0.28 | 0.33 |
| CV (%) | 6.02 | 5.70 | 6.93 | 3.11 | 10.93 | 5.20 | 3.48 | 7.08 | 5.87 | 7.78 |

MBH- Multi x Bi hybrid : Nistari × SK6.7 and BBH- Bi x Bi hybrid : B.Con 1 × B.Con 4



Under rainfed conditions, seven test genotypes along with two check varieties, zonal check C-1730 and regional check C-2038 were evaluated for leaf yield and its attributes across three different seasons at Koraput. The experimental plantation was pruned according to the local crop schedule, and recommended agronomic practices for rainfed mulberry were followed to raise a healthy crop. Four test genotypes, viz., PD-1, PD-8, PP-8, and PP-10, recorded 11–18% higher annual leaf yield compared to the regional check C-2038 (17.45 t/ha/year). These superior genotypes were observed to have significantly higher leaf moisture content, more leaves per meter length, longer shoots, and greater total shoot length compared to the regional check C-2038. The test genotypes also showed lower insect-pest infestation and foliar disease incidence compared to the zonal check C-1730, except for genotype PD-27.

**PIE02013SI: Final yield trial of newly identified mulberry genotypes for leaf productivity and quality**

**[December 2021 - November 2024]**

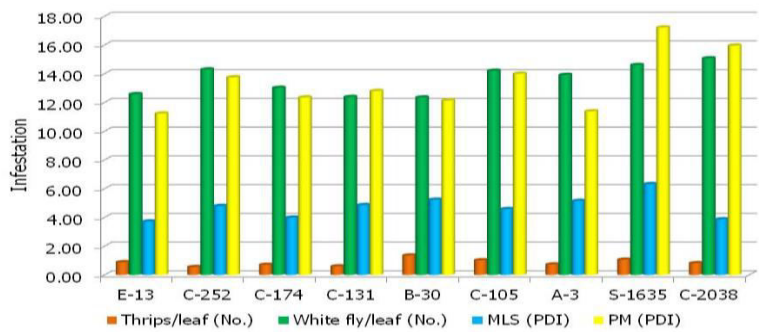
**PI:** Yallappa Harijan; **CI's:** Suresh K., Deepika K.U., Khasru Alam

**Objectives:**

- ➢ To evaluate selected mulberry genotypes for leaf yield and quality traits
- ➢ To assess silk productivity by silkworms with test genotypes

**Progress:**

Seven test genotypes (triploids: C-105, C-252, C-174, and C-131; high NRA: B-30, E-13, and A-3) along with two check varieties (S-1635 and C-2038) were evaluated for leaf productivity and quality over five seasons under irrigated conditions. Mean leaf yield ranged from 40.95 to 48.68 t/ha, compared to the check varieties S-1635 (36.96 t/ha) and C-2038 (42.27 t/ha). Three test genotypes E-13, C-252, and C-174 recorded 10–15% higher leaf yield than C-2038. The annual performance of the test genotypes was significantly superior in most growth and quality traits. The improved leaf yield among these genotypes was attributed to longer shoots, a higher number of productive shoots, reduced leaf fall, and more leaves per meter of shoot length. Biochemical assays revealed better nutritive and moisture quality among the superior genotypes, which were on par with check C-2038. The highest total soluble sugar content was recorded in C-252 (43.48 mg/g fresh weight), and the highest protein content in A-3 (36.0 mg/g fresh weight). Thrips population varied from 0.55 to 1.36 thrips per leaf, while whitefly population ranged from 12.35 to 14.30 per leaf. The Myrothecium leaf spot index ranged from 3.72 to 5.24%, and powdery mildew severity from 11.23 to 14% PDI, with lower incidence observed across all test genotypes. Three genotypes E-13, C-252, and C-174 recorded more than 10% higher leaf yield compared to check C-2038, along with better leaf quality and reduced pest infestation.




**Incidence of pests and diseases among test genotypes in different crop seasons**

**Annual performance of leaf yield & quality traits under irrigated condition (5 crops)**

| GN | NPS | TSL | LMS | SLA | LMC | CCI | TSS | TSP | LY/ha | % gain (C-2038) |
|---|---|---|---|---|---|---|---|---|---|---|
| E-13 | 10.90 | 1229* | 19.79 | 251* | 75.64* | 15.49* | 41.31 | 34.08 | 48.68* | 15.16 |
| C-252 | 11.68* | 1303* | 19.44 | 260* | 75.16 | 15.94* | 43.48 | 32.80 | 47.86* | 13.22 |
| C-174 | 11.62* | 1154 | 18.19 | 221 | 73.79 | 14.21 | 43.14 | 35.69 | 46.85* | 10.83 |
| C-131 | 11.29 | 1195* | 19.24 | 241 | 73.61 | 15.79* | 42.65 | 34.52 | 45.54* | 7.73 |
| B-30 | 11.36 | 1257* | 18.90 | 244 | 74.97 | 15.40* | 38.34 | 32.85 | 44.68 | 5.69 |
| C-105 | 10.97 | 1252* | 20.46 | 252* | 74.20 | 14.14 | 42.19 | 33.50 | 42.38 | |
| A-3 | 11.23 | 1223* | 19.74 | 246* | 75.03 | 14.41 | 38.19 | 36.00 | 40.95 | |
| S-1635 | 10.95 | 1128 | 17.63 | 205 | 72.86 | 15.84 | 40.48 | 31.45 | 36.96 | |
| C-2038 | 11.30 | 1130 | 19.20 | 233 | 74.77 | 14.82 | 42.98 | 36.15 | 42.27 | |
| *CD (5%)* | *0.22* | *46.84* | *0.66* | *13.29* | *0.68* | *0.58* | *1.55* | *1.25* | *2.88* | |

NPS: No. of primary shoots/plant; TSL: Total shoot length/plant (cm); LMS: No. of leaves/meter length of shoot; SLA: Specific leaf area ($cm^2/g$); LMC: Leaf moisture content (%); CCI: Chlorophyll content index; TSS: Total soluble sugar (mg/g fw); TSP: Total soluble protein (mg/g fw); LY/ha: Leaf yield per hector (t).

**MOE02015MI: Evaluation of improved technologies developed in the field of mulberry sector for Eastern and North-Eastern India**

**[February 2022 - January 2025]**

**Co-ordinator:** Suresh K

**Component-I: Evaluation of promising bacterial leaf spot resistant and high yielding genotype C-2070 in E & NE States**

**PI:** Deepika K.U. **CI:** Ranjith Kumar; Officers in charge of trial units

**Objective:**

- To evaluate promising BLS resistant and high yielding genotype C-2070 in E & NE states

**Progress:**

The Bacterial Leaf Spot (BLS)-resistant variety C-2070, along with two check varieties, S-1635 and C-2038, was evaluated at two irrigated and four rainfed locations (Irrigated: CSB-CSRTI-Berhampore and REC-Mothabari; Rainfed: RSRS-Koraput, REC-Mamring, Mangaldoi, and Dimapur) under On-Station Trials. Annual crop data (five crops) from the irrigated regions (Refer Table) indicated that C-2070 (46.9 t/ha) yielded less than C-2038 (50.2 t/ha) but more than S-1635 (38.3 t/ha). Similar trends were observed in the rainfed regions (C-2070: 15.84 t/ha, C-2038: 17.25 t/ha, and S-1635: 13.32 t/ha). C-2070 was found to be tolerant to BLS, with a Percent Disease Index (PDI) of 0.3, compared to C-2038 (PDI: 6.8) and S-1635 (PDI: 11.2) in the irrigated regions during the July–September season. No incidence of BLS was observed in the rainfed regions.

**Growth and yield parameters and BLS incidence in irrigated region: Annual data (5 crops: March, May, July, September and November, 2023)**

| Genotype | BLS (PDI) | ALY (t/Ha) | ASY (t/Ha) | LA ($cm^2$) | NPS (no.) | TSL (cm) | LMS (no.) |
|---|---|---|---|---|---|---|---|
| **C-2070** | $0.3^c$ | $46.9^b$ | $20.7^b$ | $206.4^b$ | $12.5^a$ | $1105.4^a$ | $27.3^a$ |
| **C-2038** | $6.8^b$ | $50.2^a$ | $23.6^a$ | $237.7^a$ | $12.3^a$ | $1143.6^a$ | $25.4^a$ |
| **S-1635** | $11.2^a$ | $38.3^c$ | $17.4^c$ | $197.5^c$ | $8.7^b$ | $903.5^b$ | $21.2^b$ |

Means with similar letters are not significantly different ($P \leq 0.05$) as per DMRT

(PDI: Percent disease incidence; ALY: Annual leaf yield; ASY: Annual shoot yield; LA: Leaf area; NPS: No. of pri. Shoot; TSL: Total shoot length and LMS: Leaf per meter shoot)

**Growth and yield parameters and BLS incidence in rainfed region: Annual data (3 crops: March, August and October, 2023)**

| Genotype | BLS (PDI) | ALY (t/Ha) | NPS (No.) | TSL (cm) | LMS (No.) |
|---|---|---|---|---|---|
| **C-2070** | NIL | 15.84$^{ab}$ | 8.2$^{a}$ | 685$^{a}$ | 18$^{a}$ |
| **C-2038** | NIL | 17.25$^{a}$ | 7.5$^{ab}$ | 670$^{ab}$ | 17$^{a}$ |
| **S-1635** | NIL | 13.32$^{c}$ | 5.6$^{c}$ | 526$^{c}$ | 15$^{a}$ |

Means with similar letters are not significantly different (P ≤ 0.05) as per DMRT

(PDI: Percent disease incidence; ALY: Annual leaf yield; LA: Leaf area; NPS: No. of pri. Shoot; TSL: Total shoot length and LMS: Leaf per meter shoot)

**Component-II: Evaluation of low temperature stress tolerant varieties C-2060 and C-2065 in subtropical condition**

**PI:** Suresh K.

**CI's:** Harish Babu S, Santosh Kumar M., Chattar Pal, Officers in charge of trial units

**Objective:**

- To evaluate of high yielding and low temperature stress tolerant varieties C-2060 & C-2065

**Progress:**

Low-temperature stress (LTS) is one of the major abiotic stresses in the subtropical plains and highland areas of the East & North East and North & North West regions. LTS affects mulberry foliage yield and quality during two commercial crop seasons. The currently cultivated mulberry varieties are sensitive to LTS, leading to deterioration in leaf quality and reduced leaf yield during the autumn and spring seasons. The mulberry breeding programme at CSB-CSRTI, Berhampore, has led to the development of two varieties (C-2060 and C-2065) characterized by quick winter sprouting, early vigour, tolerance to LTS, and higher winter yield. These two test varieties, along with zonal checks (S-1635/BC259/S-146) and the regional check (C-2038), were evaluated in a Randomized Complete Block Design (RCBD) with three replications at one irrigated location (Berhampore) and four rainfed centres (Jammu, Jorhat, Kalimpong, and Sahaspur) in the subtropical region during 2022–23. The experimental plantations of the test genotypes and check varieties were pruned according to the local crop schedule, and recommended agronomic practices for irrigated or rainfed mulberry cultivation were followed to raise a healthy crop.

Under irrigated conditions, the test varieties and check varieties were evaluated for ten leaf yield and associated traits across five different seasons. The test varieties C-2060 and C-2065 exhibited significantly earlier sprouting during both winter and normal seasons compared to the check variety C-2038. C-2060 and C-2065 also recorded significantly higher values for fresh leaf moisture content, number of leaves per meter of shoot, shoot length, total shoot length, shoot yield per plant, leaf-to-shoot ratio, and leaf yield per plant compared to the regional check C-2038. The highest mean seasonal leaf yield was observed in variety C-2065 (13 t/ha), followed by C-2060 (12.9 t/ha), regional check C-2038 (11.3 t/ha), and local check S-1635 (9.4 t/ha) under irrigated conditions with high-density plantation (60 × 60 cm spacing). The highest seasonal leaf yield was recorded during the monsoon season, followed by Kharif, summer, autumn, and spring. The test varieties C-2060 and C-2065 (65 t/ha/year) recorded a 15% higher leaf yield compared to the regional check C-2038 (56.4 t/ha/year).

**Leaf yield and its attributes in irrigated condition**

| Genotype | DSN | DSW | HLW | LMC | LM6 | LMS | LLS | TSL | SYP | LSR | LYP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C-2060 | 8* | 57* | 318.4 | 79.0* | 75.6* | 24* | 149* | 1006* | 846* | 56.78 | 479* |
| C-2065 | 9* | 59* | 270.8 | 77.1* | 73.0* | 25* | 120 | 816* | 798* | 60.65 | 482* |
| S-1635 | 8* | 65* | 295.9 | 77.6* | 73.4* | 23 | 120 | 769* | 619 | 56.76 | 352 |
| C-2038* | 10 | 69 | 407.5 | 76.2 | 72.3 | 22 | 123 | 736 | 662 | 62.77 | 417 |
| CD@5% | 1 | 2 | 12 | 0.5 | 0.5 | 1 | 2 | 16 | 23 | 0.27 | 14 |
| CV (%) | 4.79 | 7.58 | 8.27 | 1.32 | 1.38 | 3.95 | 5.83 | 7.21 | 16.12 | 5.18 | 7.16 |

DHS: Days to sprouting in N: normal; W: winter season; HLW: Hundred leaf weight (g); LMC: Leaf moisture (%); LM6: Leaf moisture @ 6 hrs (%); LMS: Leaves per meter shoot (No.); LLS: Length of longest shoot (cm); TSL: Total shoot length (cm); SYP: Shoot yield per plant (g); LSR: Leaf to shoot ratio (%) and LYP: Leaf yield per plant (g).

The severity of powdery mildew and Myrothecium leaf spot diseases in the test varieties was significantly lower than in the regional check C-2038. The incidence of insect pests namely, whitefly, thrips, and mealybug was observed across different seasons, with the test varieties showing significantly lower infestation or population under irrigated conditions. The leaf nutritional quality of the test genotypes was assessed based on total soluble protein, soluble sugars, and chlorophyll content index. The test varieties C-2060 and C-2065 were found to have higher levels of total soluble protein, soluble sugars, and chlorophyll content, comparable to the check variety C-2038.

**Leaf quality and insect pests- foliar disease severity in irrigated condition**

| Genotype | TSP | TSS | CCI | SLA | PMS | MLS | WFP | THP | MBI |
|---|---|---|---|---|---|---|---|---|---|
| C-2060 | 30.82 | 39.47 | 15.80 | 314.0* | 5.80* | 9.83 | 17.00* | 8.33* | 10.24* |
| C-2065 | 30.00 | 40.42 | 14.15 | 260.1* | 8.25* | 6.24* | 13.33* | 12.33 | 10.98* |
| S-1635 | 29.27 | 38.27 | 18.85* | 220.5 | 13.42 | 11.99 | 26.33 | 20.33 | 19.33 |
| C-2038* | 31.52 | 39.82 | 16.19 | 237.3 | 12.72 | 9.87 | 23.00 | 15.00 | 15.49 |
| CD @ 5% | 0.97 | 0.93 | 0.62 | 19.2 | 0.44 | 0.60 | 2.01 | 3.26 | 0.80 |
| CV (%) | 3.42 | 2.76 | 12.86 | 14.90 | 13.32 | 9.02 | 13.56 | 17.43 | 33.23 |

TSP: Total soluble protein (mg/g); TSS: Total sugars (mg/g); CCI: Chlorophyll content index, SLA: Specific leaf area ($cm^2$/g dw); PMS: Powdery mildew severity (PDI); MLS: Myrothecium leaf spot (PDI); Whitefly population (No./leaf), THP:Thrips population (No./leaf), MBI: Mealybug infestation (PI).

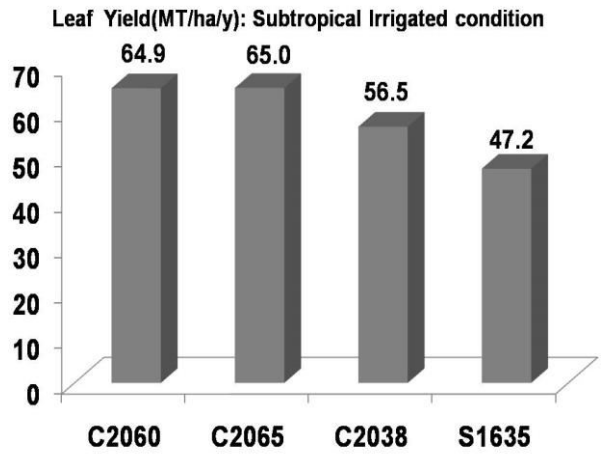
Under rainfed conditions, two test varieties, along with two check varieties (zonal check: S-1635/TR-23/S-146 and regional check: C-2038), were evaluated for leaf yield and associated traits across 2–3 different seasons at two subtropical lowland centers (Jorhat and Jammu) and two highland centers (Kalimpong and Sahaspur). The experimental plantations were pruned according to the local crop schedule during three different seasons (spring, summer, and autumn 2024), and recommended agronomic practices for rainfed mulberry cultivation were followed to raise a healthy crop. At RSRS Jammu, the test varieties exhibited early sprouting during both normal and winter seasons, along with significantly higher numbers of leaves per meter of shoot and greater total shoot length compared to the regional check C-2038. In all three seasons, the test varieties recorded significantly higher leaf yield than C-2038, with a mean seasonal yield exceeding 9.3 t/ha, compared to 8.3 t/ha for C-2038. After one year of establishment under rainfed conditions, C-2060 and C-2065 showed 12–17% higher annual leaf yield than the regional check C-2038 (25.02 t/ha/year). At RSRS Sahaspur, the test varieties also showed significantly earlier sprouting, more leaves per meter of shoot, and greater total shoot length than C-2038. Test varieties C-2060 (8.75 t/ha) and C-2065 (8.17 t/ha) recorded 11–19% higher leaf yield than C-2038 (7.37 t/ha) during the summer season of 2023. At RSRS Jorhat, C-2060 (5.61 t/ha) and C-2065 (5.45

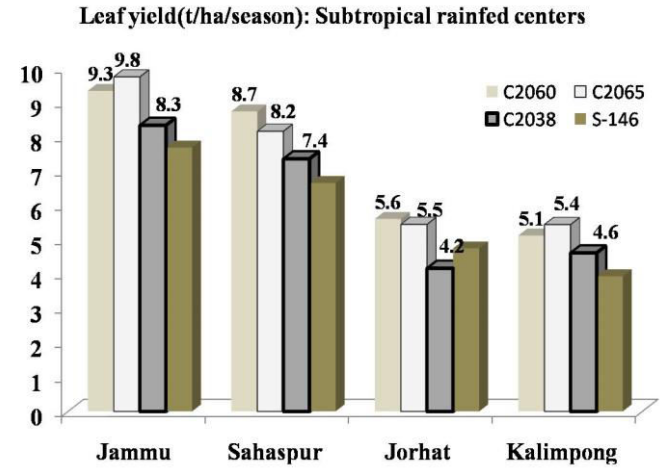
t/ha) recorded 15–18% higher mean seasonal leaf yield compared to C-2038 (4.75 t/ha) during the summer and autumn seasons of 2023. At RSRS Kalimpong, the test varieties recorded 11–18% higher mean seasonal leaf yield compared to the regional check TR-23 (4.62 t/ha/year). Overall, across the four rainfed test centers, the test varieties C-2060 and C-2065 showed an 18% higher pooled mean leaf yield compared to the regional checks.

**Leaf yield and its attributes in rainfed condition**

| Genotype | DSN | DSW | LMC | LMS | LLS | TSL | LYP | NLY |
|---|---|---|---|---|---|---|---|---|
| C-2060 | 13* | 29* | 75.7 | 21* | 138* | 1923* | 780 | 9.34 |
| C-2065 | 13* | 32* | 78.0 | 20* | 131 | 2074* | 847 | 9.75 |
| S-1635 | 15* | 36 | 74.5 | 18 | 129 | 1545 | 700 | 8.34 |
| C-2038* | 18 | 35 | 77.3 | 18 | 131 | 1562 | 647 | 7.69 |
| CD@5% | 1 | 1 | 0.9 | 1 | 7 | 111 | 32 | 0.35 |
| CV (%) | 10.07 | 9.23 | 2.10 | 7.15 | 7.80 | 15.13 | 11.12 | 10.11 |

DSN/W: Days to sprouting in N: normal; W: winter season; LMC: Leaf moisture (%); LMS: Leaves per meter shoot (No.); LLS: Length of longest shoot (cm); TSL: Total shoot length (cm); LYP: Leaf yield per plant (g) and NLY: Net Leaf yield (t/ha/season).




**Component-III: Validation of the low cost drip fertigation system for mulberry cultivation at different locations**

**PI:** Yallappa Harijan; **CI's:** Officers in charge of trial units

**Objective:**

- To validate the low cost drip fertigation system for mulberry cultivation at different locations

**Progress:**

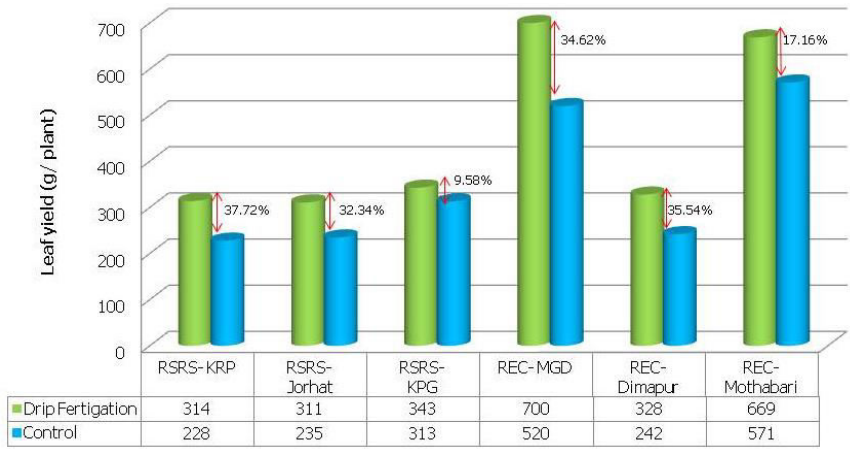
Low-cost drip fertigation systems for efficient utilization of water and nutrients in mulberry cultivation were validated at various locations in the East and North East states. Existing plantations of the S-1635 variety with 3'×3' spacing and low-trunk maintenance were used at all test centres, except at RSRS Kalimpong, where the $BC_2$59 variety with a medium trunk was used to evaluate the drip fertigation system. Growth and yield-related traits were recorded under drum kit fertigation (DKF) and drip tape

fertigation (DTF) systems over five seasons. At CSB-CSRTI, Berhampore, the low-cost drip tape and drum kit fertigation systems recorded 26.61% (47.42 t/ha) and 18.60% (44.42 t/ha) higher leaf yields, respectively, compared to the control (37.45 t/ha). The seasonal pooled mean (3–4 crops) of leaf yield recorded at five locations in the E & NE regions showed a 9.58% to 37.72% increase in leaf yield under drum kit fertigation compared to the control. Higher mean performance in growth and yield-related traits, along with lower incidence of pests and diseases, was observed under drip fertigation systems compared to the control.

**Performance of growth and leaf yield under drip fertigation systems (CSB-CSRTI, Berhampore)**

| | FLW | NPS | LLS | TSL | LMS | LFH | LMC | SLA | CCI | LY/ha | % Gain |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DTF | 4.00 | 14.91 | 151 | 1896 | 17.67 | 26.16 | 77.97 | 289 | 19.06 | 47.42 | 26.61 |
| DKF | 3.90 | 13.27 | 146 | 1597 | 15.96 | 23.95 | 78.36 | 299 | 19.57 | 44.42 | 18.60 |
| Control | 3.48 | 12.69 | 140 | 1417 | 15.21 | 18.26 | 76.48 | 266 | 18.44 | 37.45 | |
| CD (5%) | *0.69* | *2.86* | *13.35* | *600* | *3.13* | *10.13* | *2.47* | *41.93* | *1.40* | *12.70* | |

DTF: Drip tape fertigation; DKF: Drum kit fertigation; FLW: Fresh leaf weight (g); NPS: No. of primary shoots/plant; LLS: Length of longest shoot (cm); TSL: Total shoot length/plant (cm); LMS: No. of leaves/meter length of shoot; LFH: Leaf fall at harvest (%); LMC: Leaf moisture content (%); SLA: Specific leaf area ($cm^2/g$); CCI: Chlorophyll content index & LY: Leaf yield per crop (t/ha).




**Component-IV: Evaluation of an eco-and-user friendly silkworm rearing bed disinfectant Seriwin**

**PI:** M. Rabha

**CI's**: K. Rahul, K. Alam, Officers in charge of trial units

**Objectives:**

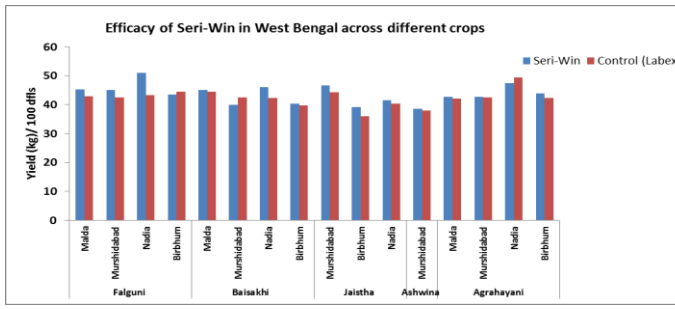
- To validate Seri-Win for efficacy in disease management and cocoon productivity at CSB and DoS units
- To popularize Seri-Win and document efficacy in disease management and cocoon productivity at farmers level in East and NE region

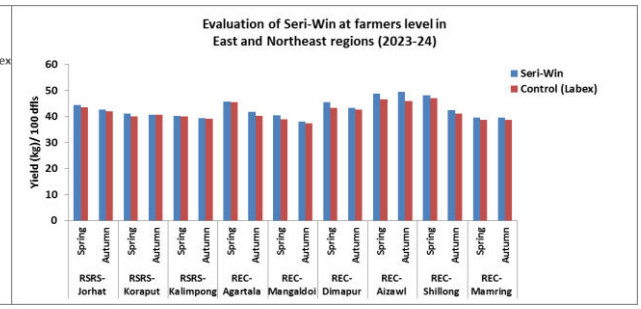
**Progress:**

Seri-Win, a new silkworm rearing bed disinfectant developed by CSB-CSRTI, Berhampore offers broad-spectrum protection against major silkworm pathogens while being eco-friendly, non-corrosive, and

cost-effective. Laboratory and field trials across East and North East regions have confirmed its efficacy in preventing the spread of silkworm diseases.

The OST for Seri-Win were successfully conducted across 23 test locations in the East and North East regions, including DoS farms in West Bengal, during the initial phase. Subsequently, evaluations were carried out at the farmer's level in both E & NE regions. In the Northeast, efficacy assessments were scheduled for two crops (Autumn and Spring), while in West Bengal, trials were planned for five crops (Falguni in January/February, Baisakhi in March/April, Jaistha in June, Ashwina in August/September, and Agrahayani in November). The average yield for Seri-Win users in the Northeast region was 42.81 kg/100 dfls, while for control (Labex) users, it was 41.72 kg/100 dfls. Similarly, in West Bengal, Seriwin users achieved an average yield of 43.72 kg/100 dfls compared to 42.37 kg/100 dfls for Labex users (Multi x Bi). Seriwin was found to be equally effective as Labex in preventing the spread of silkworm diseases while also being eco- and user-friendly.




**Collaborative Ongoing Projects**

**PIE13001MI: All India Co-ordinated Experimental Trial for Mulberry varieties (Phase-IV) [April 2019 - March 2024]**

**Zonal Coordinator:** Kishor Kumar C.M. (upto July, 2023), Jula S. Nair (from August, 2023)

**PI:** Sheik Nazeer Ahmed Saheb

**Co-PI:** Suresh K. (East and NE region)

**CI's:** Suresh K. (Berhampore), Y. Debraj (Imphal), In-charges (Jorhat, Koraput, Bhandra, Ambarifalkata), Ram Mina (Bilaspur), Biswabasu Bagchi (Boswa)

**FCs:** S. Chakraborty, Pooja Makwana, Khasru Alam, Deepika K.U., Yallappa H., Th. Ranjita Devi, Harshitha BS, Y. Nagaraju and Pradeep S.D.

**Objective:**

- To identify and authorize suitable mulberry varieties for commercial use in different agro-climatic mulberry cultivation zones of India

**Progress:**

Three candidate mulberry varieties including CBP1, CMY1, and CPP1 along with two check varieties, C-2038 and S-1635, were evaluated at one irrigated and seven rainfed test centers in the East and North East regions. The test varieties and checks were assessed for leaf yield and its associated attributes, along with cocoon yield parameters across different seasons. Additionally, the incidence of insect pests and severity of foliar diseases were recorded during various seasons. The experimental plantations of the test varieties and checks were pruned according to the local crop schedule, and recommended agronomic practices for irrigated or rainfed mulberry cultivation were followed to raise a

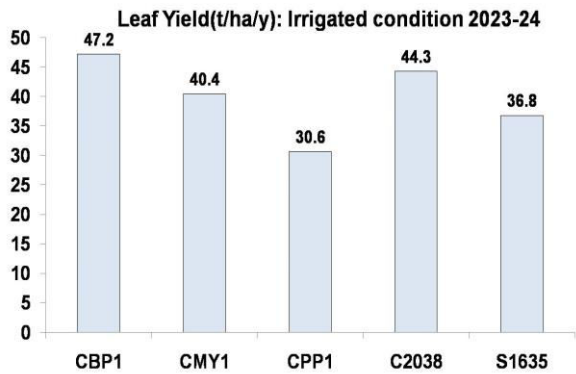
healthy crop. Silkworm bioassays were conducted at all eight centers during the autumn and spring seasons using the bivoltine hybrid B.Con1 × B.Con4, following standard rearing methods.

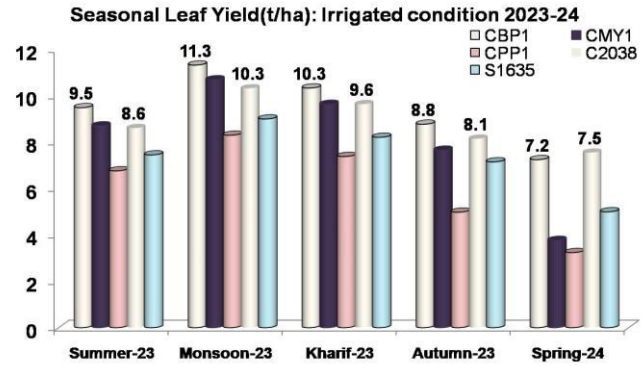
**Mulberry and silkworm crop schedules in East and NE region**

| Test center | Plantation date | Mulberry Crop Seasons | | | | | Silkworm Brushing | |
|---|---|---|---|---|---|---|---|---|
| | | Kharif | Autumn | Spring | Summer | Monsoon | Autumn | Spring |
| CSRTI-BHP | 25.10.2019 | Jul-Sep | Sep-Nov | Jan-Feb | Mar-Apr | May-Jul | November | March |
| DOTS-Boswa | 4.11.2019 | Jul-Sep | Sep-Nov | Jan-Mar | | | October | March |
| DOHS-Bilaspur | 22.7.2019 | Jun-Aug | Aug-Oct | Jan-Mar | | | October | March |
| REC-Bhandra | 8.8.2019 | Jun-Aug | Aug-Oct | Jan-Mar | | | October | March |
| RSRS-Koraput | 20.7.2019 | Jul-Sep | Sep-Nov | Jan-Mar | | | October | March |
| BSF-A'f kata | 9.11.2019 | | Jun-Aug | Jan-Mar | Apr-Jun | | September | March |
| RSRS-Jorhat | 3.11.2019 | | Jul-Sep | Jan-Mar | Apr-Jun | | September | March |
| RSRS-Imphal | 4.11.2019 | | Jul-Sep | Feb-Apr | Apr-Jun | | September | March |

**Irrigated Condition (CSB-CSRTI, Berhampore)**

The test varieties, along with the checks, were evaluated for leaf yield and its attributes across five different seasons, as well as for cocoon yield parameters in two favourable seasons. Common recommended agronomic practices for irrigated and rainfed mulberry cultivation were followed to raise a healthy crop, as per AICEM-IV guidelines. The severity of insect pests and foliar diseases was recorded across different seasons at all eight test centers. Two silkworm rearings/bioassays using the hybrid B.Con1 × B.Con4 were conducted in two favourable seasons to assess cocoon parameters and leaf quality. Plantations were pruned according to the crop schedules of each center, and data on growth and yield were recorded 70–75 days after pruning.




CBP1 recorded the highest mean seasonal leaf yield (9.4 t/ha), followed by C-2038 (8.9 t/ha), CMY1 (8.1 t/ha), S-1635 (7.4 t/ha), and CPP1 (6.1 t/ha). CBP1 outperformed the regional check C-2038 in leaf yield across all seasons except the spring season. It recorded a 7% higher annual leaf yield (47.2 t/ha/year) compared to the check C-2038 (44.3 t/ha/year). CBP1 showed significantly higher leaf yield per plant due to the production of longer shoots and greater total shoot length per plant. CMY1 recorded significantly more leaves per meter of shoot and a higher leaf-to-shoot weight ratio compared to the check C-2038.

**Leaf yield and its attributes in irrigated condition**

| Genotype | DSN | DSW | FLW | FLA | LMS | LLS | TSL | SYP | LSR | LYP |
|---|---|---|---|---|---|---|---|---|---|---|
| CBP-1 | 8 | 66* | 351 | 232 | 22 | 149* | 1363* | 1275* | 58.3 | 742* |
| CMY-1 | 10 | 82 | 309 | 215 | 26* | 117 | 1043 | 999 | 64.7* | 636 |
| CPP-1 | 10 | 80 | 316 | 222 | 23* | 129 | 939 | 822 | 61.2 | 489 |
| C-2038* | 8 | 71 | 409 | 250 | 21 | 137 | 1235 | 1150 | 62.4 | 711 |
| S-1635 | 8 | 65* | 262 | 186 | 22 | 135 | 1223 | 1057 | 57.4 | 600 |
| CD @ 5% | 1 | 1 | 27 | 19 | 1 | 8 | 65 | 66 | 2.2 | 21 |
| CV (%) | 11.06 | 10.1 | 19.6 | 14.7 | 10.0 | 11.0 | 15.6 | 18.4 | 6.04 | 17.2 |

DHS: Days to 100% sprouting in N: normal; W: winter; HLW: Hundred leaf weight (g); MLA: Mean leaf area ($cm^2$); LMS: Leaves per meter shoot (No.); LLS: Length of longest shoot (cm); TSL: Total shoot length (cm); SYP: Shoot yield per plant (g); LSR: Leaf to shoot ratio (%) and LYP: Leaf yield per plant (g).

CBP1 was observed to be highly resistant to powdery mildew and other foliar diseases compared to the check variety C-2038. The incidence of sucking pests such as whitefly and thrips, along with mealybug infestation, was recorded, and CBP1 showed the lowest infestation levels compared to C-2038. A high chlorophyll content index and total soluble protein, along with a lower specific leaf area (SLA), were observed in CBP1, indicating superior nutritive quality over the check variety C-2038.

**Leaf quality and Insect pest –Disease severity in irrigated condition**

| Genotype | TSP | TSS | CCI | SLA | LMC | MC6 | WTF | THP | MBI | MLS | BLS | PMD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CBP-1 | 33.3* | 41.0 | 19.2* | 179.7* | 75.6 | 71.6 | 14* | 7* | 11.1* | 2.5* | 5.8* | 2.0* |
| CMY-1 | 29.0 | 39.7 | 15.9 | 179.2* | 76.2 | 72.0 | 20* | 11 | 19.5 | 5.9 | 4.9* | 8.3 |
| CPP-1 | 32.1 | 39.9 | 15.9 | 175.1* | 75.0 | 70.6 | 18* | 4* | 20.1 | 2.7* | 7.4 | 17.8 |
| C-2038* | 32.1 | 41.3 | 17.0 | 188.2 | 76.1 | 72.0 | 22 | 11 | 17.3 | 5.2 | 8.4 | 7.7 |
| S-1635 | 31.3 | 40.1 | 24.6 | 184.4 | 75.7 | 71.0 | 24 | 15 | 24.2 | 7.1 | 9.7 | 15.6 |
| CD @ 5% | 0.9 | 1.9 | 1.7 | 4.3 | 1.0 | 1.1 | 1 | 1 | 3.6 | 1.1 | 1.8 | 1.5 |
| CV (%) | 9.3 | 6.4 | 9.8 | 11.5 | 1.8 | 2.1 | 5.8 | 13.7 | 17.7 | 14.7 | 19.4 | 19.2 |

TSP: Total soluble protein (mg/g); TSS: Total sugars (mg/g); CCI:Chlorophyll content index; SLA: Specific leaf area ($cm^2$/g); LMC: Leaf moisture content (%); MC6: Leaf moisture content @ 6 hrs (%); WTF: Whitefly (No/leaf); THP: Thrips (No/leaf); MBI: Tukra Infestation (%); MLS: Myrothecium leaf spot (PDI); BLS: Bacterial leaf spot (PDI); PMD: Powdery mildew severity (PDI).

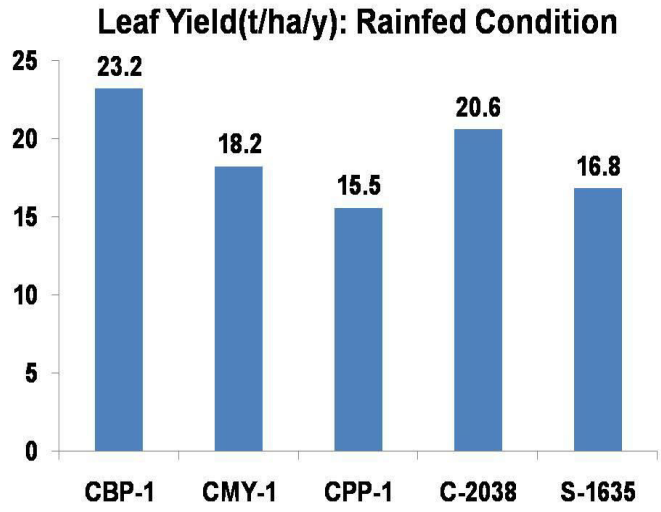
**Cocoon yield and its parameters: Irrigated autumn 2023**

| Genotype | MLW | TLD | CW | SW | SWP | ERR (No) | ERR (Wt.) | LCR |
|---|---|---|---|---|---|---|---|---|
| CBP1 | 3.972 | 26* | 1.639 | 0.299 | 18.25 | 9691 | 14.56* | 17.60* |
| CMY1 | 3.942 | 27 | 1.641 | 0.306 | 18.66 | 9602 | 13.97 | 15.89* |
| CPP1 | 4.050 | 27 | 1.729* | 0.331* | 19.12* | 9811* | 14.81* | 16.47* |
| *C-2038** | *4.019* | *27* | *1.634* | *0.300* | *18.37* | *9559* | *13.63* | *17.93* |
| S-1635 | 4.036 | 26* | 1.622 | 0.298 | 18.38 | 9475 | 13.75 | 17.90 |
| CD 5% | 0.077 | 0.46 | 0.044 | 0.011 | 0.51 | 154 | 0.45 | 0.10 |
| CV (%) | 1.87 | 2.75 | 3.01 | 4.77 | 2.65 | 1.67 | 4.30 | 4.90 |

MLW: Mature larval weight (g); TLD: Total Larval duration (days); CW: Cocoon weight (g); SW: Shell weight (g); SWP: Shell weight percentage (%); ERR: Effective rate of rearing in No. & gram, LCR: Leaf to cocoon weight ratio (%)

Silkworm bioassay results revealed that leaves from CPP1, when fed to the B.Con1 × B.Con4 hybrid, produced significantly higher cocoon weight, shell weight, shell percentage, and overall cocoon yield compared to the regional check C-2038. CMY1 (15.89), CPP1 (16.47), and CBP1 (17.60) recorded significantly lower leaf-to-cocoon weight ratios, indicating superior leaf quality. B.Con1 × B.Con4 hybrids fed with leaves from the test varieties CBP1 and CPP1 recorded significantly higher cocoon yields than those fed with the regional check C-2038.

**Rainfed Condition (Seven centers)**




Three test genotypes and check varieties were evaluated for leaf productivity and quality under seven rainfed locations in the East and North-Eastern states. CBP1 recorded an 11–15% higher leaf yield advantage over the regional check (YAC) C-2038 (20.6 t/ha/year) under rainfed conditions. CBP1 produced significantly longer shoots, greater total shoot length, and higher shoot yield compared to C-2038. The leaf yield potential of CBP1 under rainfed conditions ranged from 21.0 t/ha/year at Jorhat to 25.31 t/ha/year at Imphal. Infestations of insect pests such as mealybugs and whiteflies were observed across seasons, with all test varieties recording lower pest populations compared to the check varieties.

**Leaf productivity under rainfed conditions in East and NE region**

| Genotype | Imphal | Jorhat | Ambari | Boswa | Bhandra | Bilaspur | Koraput |
|---|---|---|---|---|---|---|---|
| CBP-1 | 25.31* | 22.08* | 21.10* | 23.77* | 22.38* | 24.61* | 23.07* |
| CMY-1 | 20.35 | 19.46 | 15.03 | 20.29 | 19.88 | 15.98 | 16.45 |
| CPP-1 | 17.56 | 13.92 | 11.14 | 21.14 | 12.45 | 18.26 | 14.37 |
| C-2038* | 22.44 | 19.23 | 18.31 | 20.79 | 20.28 | 22.29 | 20.80 |
| S-1635 | 17.50 | 15.40 | 14.48 | 17.93 | 16.56 | 18.60 | 17.20 |
| CD@5% | 0.44 | 0.29 | 0.21 | 0.47 | 0.39 | 0.32 | 0.22 |
| CV (%) | 17.42 | 17.93 | 12.48 | 11.62 | 10.24 | 17.23 | 18.67 |
| % YAC | 13 | 15 | 15 | 14 | 10 | 10 | 11 |

**PIE02021SIC: Identification and assessment of superior hybrids of polycross population for leaf yield and quality traits in mulberry**

**[March 2024 - February 2027]**

**PI:** Yallappa Harijan

**CI's:** Harshitha B.S., Deepika, K.U., Sanghamitra Aditya

**Objectives:**

- ➢ To identify superior $F_1$ hybrids of polycross population
- ➢ To evaluate shortlisted $F_1$ hybrids for leaf yield and quality traits

**Progress:**

The experimental material for the study comprised 750 polycross hybrid progenies developed from twenty-nine genetically diverse parents (16 female and 13 male) of a polyclonal seed orchard, as an outcome of the concluded project PIB3627. The desirable seedlings were transplanted to the main field and established under an augmented design at CSB-CSRTI, Berhampore. Twenty-five blocks were maintained, each containing 30 hybrids and 2 check varieties (C2038 and $BC_2$59), with the check varieties repeated twice in each block. The experimental materials were planted at a spacing of 90 cm × 90 cm. Pruning was carried out at 15 cm above the 16 cm stump from ground level to ensure a low-trunk plantation system. All recommended cultural practices, including weeding, fertilization, irrigation, and plant protection, were followed as per the package of practices for irrigated mulberry cultivation in this region. Crop protection measures were implemented according to the recommendations developed by this institute. Morphological characterization will be conducted on this established polycross population to identify superior F1 hybrids.

**PIB03013SI: Development of high yielding quality mulberry (*Morus* spp.) genotypes under sub-tropical conditions of Northern India (Collaboration with CSB-RSRS-Jammu)**

**[June 2022 - May 2026]**

**Project Co-ordinator:** Sardar Singh

**PI:** Santosh Kumar M

**CI's:** Yallappa Harijan, Rita Singh, Satish Y

**Objectives:**

- To develop promising mulberry genotypes with better productivity and leaf quality over the existing ruling variety in North West India
- Maintaining polyclonal seed orchard with recommended cultural practices at CSB-CSRTI-Berhampore

**Progress:**

Polyclonal seed orchard is being maintained with recommended cultural practices at CSB-CSRTI-Berhampore.

**Continuous/Other Activities**

**a. Mulberry germplasm conservation and supply of accessions**

**Investigators:** Suresh K., Yallappa Harijan

Germplasm provides the raw material for breeders to develop high-yielding varieties suitable for different agro-climatic conditions. Accordingly, mulberry germplasm, consisting of mulberry accessions, elite clones, and tetraploids, is maintained in the field gene bank of the Institute.

Approximately 354 mulberry genetic resources from twelve species are maintained as high bush plantations with a spacing of 150 cm × 150 cm. The plantation is pruned twice a year (May and September), and recommended agronomic practices are followed to maintain a healthy crop.

| Mulberry Genetic Resources at CSB-CSRTI, Berhampore | | | |
|---|---|---|---|
| **Species/material** | **Sum** | **Indigenous** | **Exotic** |
| *M. indica* L. | 88 | 83 | 5 |
| *M. alba* L. | 71 | 32 | 39 |
| *M. latifolia* Poir. | 31 | 3 | 28 |
| *M. bombycis* | 14 | - | 14 |
| *M. multicaulis* | 2 | - | 2 |
| Wild species | 13 | 6 | 7 |
| Elite clones | 101 | - | - |
| Tetraploids | 34 | - | - |
| Total | 354 | 124 | 95 |

**b. Mulberry varieties stock maintainance and supply of planting material**

**Investigators:** Suresh K., Yallappa Harijan

The mulberry varieties developed by the Institute and authorized by the MVAC of the Central Silk Board for commercial cultivation in the Eastern and North-Eastern zones are maintained at the institute. The institute maintains the breeder stock of authorized varieties, which serves as the initial source for systematic multiplication at RSRS (Foundation) and RECs or Kissan nurseries (Certified stock). The breeder stock plantation includes the following varieties: S-1635 (0.1 acre), C-2038 (1 acre), $BC_2$59 (0.25 acre), Tr-23 (0.25 acre), C-2028 (0.50 acre), C-1730 (0.25 acre), and C-776 (0.10 acre), all maintained with recommended agronomic practices.

Approximately 1,100 kg of stem cuttings and 35,500 saplings were supplied to farmers and CSB units. Saplings of C-2038 (35,000), Tr-23 (2,000), and C-766 (1,000) were generated from the breeder stock for distribution to farmers under the TOT-OFT programme.

**c. Mulberry garden maintenance and supply of leaves for silkworm rearing**

**Investigators:** Suresh K., Yallappa Harijan

The general mulberry gardens include experimental plantations from concluded projects, breeder stock plots, demonstration plots, and avenue plantations. Six acres of the mulberry garden are suitable for supplying fresh leaves for the Institute's silkworm rearing activities. Around 1,200 kg of fresh leaves were supplied for experimental rearing and silkworm germplasm maintenance to the bivoltine breeding laboratory. Additionally, leaves from the experimental plantations are used for silkworm bioassay studies under mulberry breeding projects, and the cocoons generated are supplied to the reeling and spinning laboratory.

## BIOTECHNOLOGY DIVISION

### Ongoing Research Projects

### AIT02008SI: Identification of high humidity tolerant silkworm breeds/ hybrids for Eastern and North Eastern India

**[June 2020 - May 2024]**

**PI:** Raviraj V.S.

**CI's:** Pooja Makwana, A.R. Pradeep, Harish Babu S

**Objectives:**

- To identify gene markers linked to humidity-tolerance
- To develop silkworm breeds/hybrids tolerant to high temperature and high humidity
- To popularize hardy bivoltine breeds for East and NE India

**Progress:**

Bivoltine silkworm breeds play a crucial role in silk production due to their superior quality and higher yield, making them vital to the sericulture industry. However, the absence of suitable bivoltine breeds for the Eastern and Northeastern regions of India combined with harsh climatic conditions such as high temperature and humidity has resulted in low silk production and productivity in these areas. Currently, the popular bivoltine silkworm hybrids (SK6 × SK7 and B.Con1 × B.Con4) are only reared during favorable seasons. To address this challenge, our ongoing research aims to identify bivoltine breeds that can withstand high temperature and humidity year round. This has been pursued through molecular studies, including gene expression analysis and SNP validation, alongside exposure to high temperature and humidity treatments. We are focusing on genes that encode Transient Receptor Potential (TRP) proteins such as pyrexia and painless as well as circadian rhythm genes like period and timeless, based on preliminary findings from CSB-CSRTI-Mysore and other recent studies. The integration of biotechnological tools with conventional breeding methods such as directional selection for heat tolerance has enabled the identification of silkworm breeds with enhanced resilience to extreme environmental conditions, thereby improving productivity.

**SSR and SNP markers for high temperature and high humidity stress**

Through Sanger sequencing of the pyrexia gene amplicon, two potential single nucleotide polymorphism (SNP) markers *Pyx3* and *Pyx4* associated with high humidity tolerance were identified. These SNP markers were validated across various bivoltine silkworm populations that survived simulated environmental conditions of 36°C temperature and 85 ± 5% relative humidity (RH), mimicking the extreme climates of certain regions. Primers specific to these SNP sequences were subsequently used to screen different populations and broods, helping identify individuals with natural tolerance to high humidity. In addition, two simple sequence repeat (SSR) markers S0803 and S0816 were employed to identify thermo-tolerant bivoltine breeds. These SSR markers proved valuable in pinpointing genetic variations linked to temperature tolerance. Breeds that demonstrated a survival rate above 50% under simulated high-temperature and high-humidity conditions were considered significant. The presence of these SSR and SNP markers in those breeds confirmed their potential for thriving under extreme climatic stress.

**Identification of high humidity and high temperature tolerance breeds**

Five bivoltine breeds SK7HH, B.Con4HH, N5HH, HTH10HH, and WB1HH have been identified as tolerant to high temperature and humidity. Additionally, two single-cross hybrids CSR2 × SK7HH and

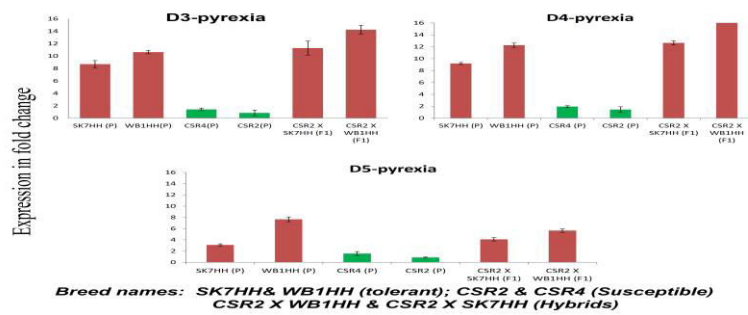
CSR2 × WB1HH were developed. This identification was initially based on phenotypic survival studies under simulated conditions, followed by marker-based screening using SNP and SSR markers. The hybrids were evaluated for economic traits and survival rates, showing over 68% survival. These breeds demonstrated strong tolerance to simulated environmental conditions of 36°C and 85% RH in controlled chambers, as well as during the unfavorable seasons (33°C–35°C and 75–90% RH) typical of West Bengal. The identified pure breeds exhibited an average pupation rate ranging from 60% to 69%, as shown in the table below.

**Overall performance of bivoltine silkworm breeds with tolerance to high humidity (85±5%) and high temperature (35±5˚C)**

| Breed | Pupation (%) | Mean Cocoon Wt (g) | Mean Shell Wt. (g) | Mean Shell Ratio (%) | HH Marker | HT Marker |
|---|---|---|---|---|---|---|
| SK7HH | 69 | 1.43 | 0.25 | 17.73 | | ü |
| B.Con4HH | 66 | 1.30 | 0.22 | 17.27 | ü | ü |
| HTH10HH | 63 | 1.25 | 0.22 | 17.62 | ü | ü |
| N5HHHH | 60 | 1.29 | 0.24 | 18.63 | ü | ü |
| WB1HH | 68 | 1.40 | 0.25 | 17.84 | ü | ü |
| **SINGLE HYBRIDS** | | | | | | |
| CSR2 x WB1HH | 84 | 1.61 | 0.31 | 19.57 | ü | ü |
| CSR2 x SK7HH | 76 | 1.66 | 0.35 | 21.19 | ü | ü |

**Transient receptor proteins (TRP) and circadian rhythm gene expression in high humidity tolerant breeds**

The thermoTRP channel genes *Painless* and *Pyrexia* are known to be activated in *Drosophila melanogaster* (Sokabe *et al*., 2009) at temperatures higher than the optimal range (18–24 °C). In this study, TRP channel genes and circadian rhythm genes were analyzed for their expression in the brain of the bivoltine silkworm *Bombyx mori*. Although *B. mori* is domesticated to thrive at an ambient temperature of 25 ± 2 °C, it frequently encounters high temperatures during the summer season across India. Four genes *pyrexia*, *painless*, *period*, and *timeless* were selected for expression analysis. The results revealed upregulation of these genes, particularly in the two breeds WB1HH and SK7HH. A significant association was observed for the *pyrexia* and *painless* genes, while *period* and *timeless* were not significantly associated with heat tolerance. These bivoltine breeds demonstrated thermo-tolerance. In contrast, the breeds CSR2 and CSR4, known to be stress-susceptible, showed low expression levels of *pyrexia*, *painless*, *period*, and *timeless* genes when exposed to abiotic stress conditions.




Fold change in expression of "thermoTRP" channel gene *pyrexia* in larval brain of tolerant (red column) and susceptible (green column) breeds exposed to high temperature and high humidity

**AIT02012CI: Characterization of mulberry silkworm, *Bombyx mori* L. mutants for tolerance to flacherie syndrome through genome editing tools**

[DST-JSPS-CSB funding in collaboration with Tokyo University of Agriculture and Technology and Yamaguchi University, Japan]

**[October 2021 - September 2024]**

**PI:** Sivaprasad V. (upto 31st May, 2023), Pooja Makwana (from 1st June, 2023)

**CI:** K. Rahul

**JRF:** Sabina Khatun

**Japanese collaborators**

Katsuhiko Ito (**PI**), Tokyo University of Agriculture & Technology, Tokyo

Jun Kobayashi (**CI**), Yamaguchi University, Yamaguchi

**Objectives:**

- To develop silkworm site-directed mutants exhibiting tolerance to flacherie syndrome by genome editing
- To evaluate developed mutants for cocoon crop improvement in Eastern and North Eastern India and Japan

**Progress:**

Viral flacherie in silkworms is caused by Bidensovirus (*BmBDV*), which belongs to the *Bidnaviridae* family. A few silkworm breeds exhibit resistance to *BmBDV* due to the presence of the *nsd*-2 gene, which encodes a putative amino acid transporter that may function as a receptor for *BmBDV* (Ito *et al*., 2016). Both bivoltine and multivoltine silkworm breeds were screened using markers for the putative virus receptor: *nsd*-2 (resistance gene) and +*nsd*-2 (susceptibility gene). The Nistari and SK7 breeds were selected for developing *BmBDV*-resistant mutants by targeting the nsd-2 gene.

Hands-on training in designing CRISPR/Cas constructs and performing microinjections was provided by Japanese counterparts in Tokyo to Indian investigators during their visit from February 12–24, 2023. During the visit, the Indian investigators designed guide RNAs for nsd-2, synthesized *g*RNA *in vitro*, prepared CRISPR/Cas constructs, and carried out microinjections in silkworm eggs. Upon returning, genome editing and microinjection experiments were initiated in the Nistari and SK7 breeds at CSB-CSRTI, Berhampore. The microinjection experiment was repeated thrice. Following successful microinjection, $G_0$ larvae were reared under optimal temperature and humidity conditions. The microinjected eggs of Nistari and SK7 exhibited approximately 70% and 50% hatching rates, respectively.

The $G_0$ individuals were crossed with their respective wild-type counterparts to obtain $G_1$ eggs. A batch check at the $G_1$ egg stage was conducted using the T7E1 assay to identify mutant lines. $G_1$ eggs carrying mutations were selected for rearing, and after the rearing cycle, $G_1$ moths were tested again for mutations using the T7E1 assay. Mutant $G_1$ moths were sib-mated to obtain the $G_2$ generation. The Nistari and SK7 mutant lines exhibited approximately 85% survival and 95% pupation. The performance of these mutant lines was on par with the respective wild-type (control) breeds.

**AIB02019MI: Development of bivoltine double hybrids suitable for different regions of India**

**[June 2022 - May 2025]**

**Collaborating Institutes and Units:** CSB-CSRTI, Mysuru, CSB-CSRTI, Pampore, CSB-RSRS, Jammu and CSB-RSRS, Manipur

Coordinator: Dr. S. Manthira Moorthy, Director (Tech.)

**PI:** Raviraj V.S.

**PA:** Yendrembam Surjalata Devi (CSB-CSRTI, Berhampore)

**Co-PI:** Kusuma L.

**PA:** Harshitha (CSB-CSRTI, Mysore)

**Co-PI:** Kiran R.

**PA:** Nadiya Ashraf (CSB-CSRTI, Pampore)

**CI:** L. Soumen Singh (CSB-RSRS, Imphal)

**CI:** Santosh Magadum (from April 23 – December 23); Sunil Rathod (from Dec, 2023; CSB-RSRS, Jammu)

**Objectives:**

- Development of bivoltine breeds with high temperature and humidity tolerance through marker assisted selection
- Improvement of viability in the parents FC1, FC2 through marker assisted selection
- Evaluation and identification of productive bivoltine double hybrids with abiotic tolerance

**Progress:**

Bivoltine silk production in Northern and Northeastern India has lagged behind that of Southern India due to the lack of suitable bivoltine hybrids and frequent seed crop failures. The main challenges include limited rearing schedules, unfavorable weather conditions (high temperature and humidity), and poor economic traits of the silkworms. High humidity and temperature adversely affect silkworm growth and development, leading to lower survival rates, which restrict bivoltine silk production.

To address these issues, several bivoltine breeds capable of tolerating high temperature and humidity have been developed using molecular markers such as SSRs. Recently, CSB-CSRTI-Berhampore developed bivoltine lines with improved tolerance to high humidity through marker-assisted selection based on the *pyrexia* gene (*Pyx*3 and *Pyx*4). This project aims to enhance the genetic traits of the parental breeds FC1 and FC2 by integrating traditional breeding methods with molecular biology techniques, specifically introducing markers for high temperature and humidity tolerance.

The goal is to develop improved hybrid silkworm lines with enhanced economic traits that can thrive in hot and humid conditions. Experiments will be conducted during both unfavorable and favorable seasons at CSB-CSRTI-Berhampore, CSB-CSRTI-Mysore, and CSB-CSRTI-Pampore. This study ultimately aims to develop hybrids suitable for commercial use across India.

**Breeding lines**

In this study, ten new silkworm lines were developed by crossing high temperature and humidity-tolerant females (identified from project AIT02008SI) with high-yielding FC1 and FC2 males. The female parents used were WB1HH, SK7HH, HTH10HH, and B.Con4HH. The resulting ten new lines are:

Oval lines: HH2, HH2A, HH2B, HH27, HH27A, HH27B; Dumbbell lines: HH6, HH6A, HH26, HH26A

Currently, these breeding lines are in the F6 generation.

### Marker assisted selection

PCR-based multiplexing assays are used to test SNP markers (*Pyx3* and *Pyx4*) for high humidity tolerance, and the SSR marker S0803 for high temperature tolerance, all in a single reaction.

### Experimental rearing

Experimental rearing is being conducted during both favorable and unfavorable seasons. The new breeds are being stabilized based on their survival rates 80–95% in favorable seasons and 68–76% in unfavorable seasons as well as economic traits such as single cocoon weight (approximately 1.57 ± 0.05 g). These experiments are carried out at multiple locations, including CSB-RSRS Jammu and CSB-RSRS Imphal, to evaluate performance under diverse climatic conditions.

The following data show the rearing performance at CSB-CSRTI-Berhampore, CSB-RSRS Jammu, and CSB-RSRS Imphal for the year 2023–24.

**Rearing performance of newly developed lines from crosses between high temperature/humidity tolerant females and FC1/FC2 males at CSB-CSRTI-Berhampore**

| H2 Breed | Fecundity | Basic Larvae | ERR No. | ERR Wt. | SCW | SSW | SR % |
|---|---|---|---|---|---|---|---|
| HH2 | 542 | 300 | 7932 | 11.40 | 1.35 | 0.27 | 20.28 |
| HH2A | 509 | 300 | 9283 | 11.97 | 1.34 | 0.25 | 18.37 |
| HH2B | 501 | 300 | 8609 | 10.72 | 1.40 | 0.31 | 22.08 |
| HH27 | 409 | 300 | 8637 | 11.37 | 1.45 | 0.29 | 20.22 |
| HH27A | 515 | 300 | 8671 | 11.14 | 1.35 | 0.28 | 20.82 |
| HH27B | 438 | 300 | 7098 | 11.86 | 1.34 | 0.28 | 21.09 |
| HH6 | 401 | 300 | 8850 | 11.24 | 1.35 | 0.27 | 20.30 |
| HH6A | 441 | 300 | 8631 | 11.03 | 1.39 | 0.31 | 21.16 |
| HH26 | 522 | 300 | 6800 | 10.55 | 1.27 | 0.26 | 20.35 |
| HH26A | 528 | 300 | 6753 | 10.12 | 1.35 | 0.26 | 19.34 |

**On-Station Trials at CSB-RSRS Imphal: Performance of newly developed lines from crosses between high temperature/humidity tolerant females and FC1/FC2 males**

| H2 Breed | Fecundity | Basic Larvae | ERR No. | ERR Wt. | SCW | SSW | SR % |
|---|---|---|---|---|---|---|---|
| HH2 | 599 | 250 | 9013 | 12.05 | 1.51 | 0.32 | 20.83 |
| HH2A | 597 | 250 | 8907 | 11.86 | 1.51 | 0.32 | 20.85 |
| HH2B | 576 | 250 | 8960 | 12.25 | 1.54 | 0.31 | 20.23 |
| HH27 | 596 | 250 | 8947 | 12.24 | 1.55 | 0.30 | 19.61 |
| HH27A | 545 | 250 | 8813 | 13.07 | 1.67 | 0.31 | 18.60 |
| HH27B | 573 | 250 | 8867 | 13.66 | 1.72 | 0.35 | 20.17 |
| HH6 | 584 | 250 | 8747 | 13.07 | 1.68 | 0.33 | 19.71 |
| HH6A | 595 | 250 | 9000 | 10.75 | 1.37 | 0.29 | 21.34 |
| HH26 | 603 | 250 | 8880 | 13.13 | 1.66 | 0.31 | 18.52 |
| HH26A | 504 | 250 | 8787 | 11.27 | 1.46 | 0.31 | **20.91** |

**On-Station Trials at CSB-RSRS Jammu: Performance of newly developed lines from crosses between high temperature/humidity tolerant females and FC1/FC2 males**

| H2 Breed | Fecundity | Basic Larvae | ERR No. | ERR Wt. | SCW | SSW | SR % |
|---|---|---|---|---|---|---|---|
| HH2 | 600 | 250 | 9013 | 11.87 | 1.43 | 0.25 | 17.31 |
| HH2A | 546 | 250 | 8907 | 13.32 | 1.55 | 0.31 | 19.77 |
| HH2B | 517 | 250 | 8960 | 12.36 | 1.49 | 0.28 | 18.37 |
| HH27 | 507 | 250 | 8947 | 13.99 | 1.62 | 0.34 | 21.14 |
| HH27A | 542 | 250 | 8813 | 13.35 | 1.48 | 0.30 | 19.88 |
| HH27B | 577 | 250 | 8867 | 13.45 | 1.56 | 0.32 | 20.49 |
| HH6 | 584 | 250 | 8747 | 12.70 | 1.50 | 0.28 | 18.87 |
| HH6A | 575 | 250 | 9000 | 14.19 | 1.66 | 0.33 | 20.15 |
| HH26 | 554 | 250 | 8880 | 13.53 | 1.65 | 0.32 | 19.35 |
| HH26A | 556 | 250 | 8787 | 13.18 | 1.54 | 0.29 | 18.69 |

**Collaborative Concluded Research Projects**

**AIB01009MI: Evaluation of new bivoltine double hybrid, TT21 x TT56 at farmers level for authorization for commercial exploitation (Collaboration with CSB-CSRTI, Mysore)**

**[April 2020 - December 2023]**

**Investigators (CSB-CSRTI-Berhampore):** Raviraj VS (from April, 2023) and N. Chandrakanth (upto March, 2023)

**Objective:**

- To evaluate the performance of bivoltine hybrid, TT21 x TT56 in field for productivity and silk quality

A total of 16,000 DFLs of TT21 × TT56 were distributed among farmers in West Bengal (10,000), Tripura (2,000), Manipur (2,000), and Assam (2,000) during October–November 2023, along with the check hybrid FC1 × FC2. Brushing with over 90% hatching was observed in both Assam and Tripura.

Under this TT21 × TT56 trial, a total of 57,000 DFLs were distributed and evaluated in the Eastern and Northeastern regions, surpassing the target of 55,000. This double hybrid has demonstrated better survival (~65%) and yield (~50 kg) during the unfavorable seasons in the Eastern and Northeastern regions.



**Collaborative Ongoing Research Projects**

**SIB01038MGC: Utilization of Japanese silkworm genetic resources for the development of productive bivoltine hybrids (Collaboration with CSB-CSRTI, Mysore)**

**[January 2024 - March 2028]**

**PI (CSB-CSRTI-Mysuru):** Chandrakanth N.

**CI (CSB-CSRTI-Berhampore):** Pooja Makwana

**CI's:** Himanshu Dubey, P. Kumaresan, L. Kusuma, Rajal Debnath

**Japanese Investigator:** Prof. Tomita Shuichiro

**Objectives:**

- To identify the informative markers associated with the productivity in silkworm genetic resources of Japan
- To develop productive silkworm breeds and hybrids through marker assisted selection
- Evaluation of the hybrids at Institute level

**Progress:**

The FC1 × FC2 ruling bivoltine double hybrid is known for its high productivity in Southern India but is vulnerable to high temperatures and humidity. In contrast, the SK6 × SK7 bivoltine foundation cross from East India is tolerant of these conditions; however, its productivity is low. To enhance sericulture productivity across India, it is crucial to develop a bivoltine hybrid that combines the productivity of the leading Southern hybrids with the climate tolerance of those thriving in the challenging conditions of East and North India.

To address this issue, new silkworm genetic resources from various countries need to be utilized. Five lines of bivoltine silkworms including NCO, NCD, NCFDH, OWO, and OWD were received from CSB-CSRTI, Mysore, and rearing was conducted.

**AIE08011MI: Evaluation of NPV tolerant bivoltine hybrids & cross breeds at farmer's level (Collaboration with CSB-ISBR, Kodathi)**

**[July 2022 - July 2025]**

**Co-Ordinator:** Dr. Moorthy S.M., Director (Tech.), CSB-CO, Bangalore
**PI:** Dr. G. Subrahmanyam, CSB-ISBR, Kodathi
**CI's:** A.R.Pradeep, Satadal Chakrabarty (CSB-CSRTI, Berhampore)

**Objective:**

- Evaluation of NPV tolerant cross-breed Nistari x MASN at farmers' level in Eastern and North-Eastern regions

A total of 30,000 Nistari × MASN (Multi × Bi) DFLs were distributed in Nadia (3,000 DFLs), Murshidabad (8,000 DFLs), Birbhum (7,000 DFLs), and Malda (12,000 DFLs) during the Falguni Commercial Crop 2024 through the Department of Sericulture, West Bengal. The performance report is anticipated and will provide further insights.

## SILKWORM BREEDING AND GENETICS

**Ongoing Research Project**

**AIB02006MI: Improvement of Nistari lines for survival and silk productivity**

**[June 2020 - May 2024]**

**PI:** Th. Ranjita Devi

**CI's:** K. Rahul, Pooja Makwana, Mihir Rabha (CSB-CSRTI, Berhampore) and Chandra Shekar (CSB-CSRTI, Mysore)

**Objectives:**

- To develop Nistari lines for improved survival and silk productivity
- To evaluate improved Nistari crossbreeds for productivity traits

**Progress:**

The experimental Nistari Marked (iNM) and Plain (iNP) lines, developed through directional selection for improved economic traits, were crossed with SK6 × SK7 to produce crossbreeds. The performance of these experimental crossbreeds was evaluated during both favorable and unfavorable seasons in the Multivoltine Breeding Lab. Their performance was also assessed in farmers' fields. The percentage improvement over the control in both iNM × SK6.7 and iNP × SK6.7 exceeded 18% in the breeding lab. In the farmers' fields, the experimental crossbreeds showed an improvement of approximately 15% over the existing crossbreeds. The rearing performance of the experimental crossbreeds, both in the breeding laboratory and in farmers' fields during favorable and unfavorable seasons, is documented in the tables below.

**iNM x SK6.7**

**iNP x SK6.7**

**Rearing performance of experimental Nistari Marked x SK6.SK7 in breeding laboratory**

| Seasons | Fecundity (No.) | Pupation (%) | Avg. SCW (g) | Avg. SSW (g) | Shell Ratio (%) | FL (m) |
|---|---|---|---|---|---|---|
| Favourable | 460 | 97 | 1.720 | 0.274 | 15.930 | 734 |
| Unfavourable | 465 | 96 | 1.741 | 0.283 | 16.255 | 654 |

**Rearing performance of experimental Nistari Plain x SK6.SK7 in breeding laboratory**

| Seasons | Fecundity (No.) | Pupation (%) | Avg. SCW (g) | Avg. SSW (g) | Shell Ratio (%) | FL (m) |
|---|---|---|---|---|---|---|
| Favourable | 466 | 96 | 1.700 | 0.266 | 15.647 | 714 |
| Unfavourable | 455 | 95 | 1.722 | 0.277 | 16.085 | 655 |

**Rearing performance of experimental Nistari Marked x SK6.SK7 in farmers field**

| Seasons | Fecundity (No.) | Pupation (%) | Avg. SCW (g) | Avg. SSW (g) | Shell Ratio (%) |
|---|---|---|---|---|---|
| Favourable | 477 | 96 | 1.842 | 0.285 | 15.47 |
| Unfavourable | 459 | 95 | 1.663 | 0.254 | 15.273 |

**Rearing performance of experimental Nistari Plain x SK6.SK7 in farmers field**

| Seasons | Fecundity (No.) | Pupation (%) | Avg. SCW (g) | Avg. SSW (g) | Shell Ratio (%) |
|---|---|---|---|---|---|
| Favourable | 463 | 97 | 1.728 | 0.248 | 14.35 |
| Unfavourable | 453 | 94 | 1.703 | 0.250 | 14.679 |

**AIE02018SI: Identification of superior bivoltine foundation cross as a male component to improve crossbreed productivity in Eastern and North Eastern India**

**[May 2022 - October 2024]**

**PI:** Satadal Chakraborty (from 01.4.2023)
**CI's:** Th. Ranjita Devi, Raviraj V.S.
**PA's:** Anower Hossain (upto 30.12.2023), Randip Das (from 20.01.2024), Officers in charge of trial units

**Objectives:**

- To identify and evaluate the superior bivoltine foundation crosses (FCs) with high shell content in E and NE India
- To identify and evaluate the superior crossbreed (CB) produced by utilizing the identified bivoltine FCs as male component in E and NE India

**Progress:**

OST for cross-breed DFLs using a superior bivoltine male (NFC: 18M × 12M) and popular multivoltine females (N, 12Y, and M6DPC) was conducted during June–July 2023, August–September 2023, November–December 2023, and February–March 2024 at eight test centers: CSB-CSRTI-Berhampore; RSRS, Kalimpong; REC, Mothabari, Malda; RSRS, Koraput; REC, Lohardaga/Bhandra; RSRS, Jorhat; REC, Dimapur; REC, Agartala; and REC, Sille. A total of 961 DFLs were distributed to these centers under OST and 1,384 DFLs under OFT during 2023–24. Rearing of pure lines and foundation crosses of bivoltine and multivoltine lines was carried out to prepare cross-breed DFLs for both OST and OFT. Cocoons from OST trials were sent for reeling analysis in November–December 2023 and February–March 2024, while green cocoons from OFT were analyzed during the Agrahayani 2023 and Falguni 2024 crops. OFT was conducted in Malda and Birbhum districts during the Falguni and Baisakhi 2024 commercial crop seasons. High single shell weights (0.272g–0.289g) were recorded in crosses such as N × NFC (18M × 12M), 12Y × NFC (18M × 12M), and M6DPC × NFC (18M × 12M), indicating strong trait performance.

**Distribution of DFLs at different nested units under OST for 2023-24**

| Season | Combination | RSRS Koraput | RSRS Jorhat | RSRS Kalimpong | REC Mothabari | REC Bhandra | REC Sille | REC Agartala | REC Dimapur | CSRTI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **June-July, 23** | N x NFC (18M.12M) | 6 | - | 7 | - | - | - | - | - | 7 | 20 |
| | N x NFC (12M.18M) | 3 | - | 3 | - | - | - | - | - | 1 | 7 |
| | M6DPC x NFC (18M.12M) | 1 | - | 2 | - | - | - | - | - | 2 | 5 |
| | 12Y x NFC (18M.12M) | 4 | - | 1 | - | - | - | - | - | 5 | 10 |
| | 12Y x NFC (12M.18M) | 2 | - | 2 | - | - | - | - | - | 1 | 5 |
| | N x (SK6.SK7) | 5 | - | 5 | - | - | - | - | - | 5 | 15 |
| | **Sub Total** | **21** | **-** | **20** | **-** | **-** | **-** | **-** | **-** | **21** | **62** |
| **Aug-Sept., 23** | N x NFC (18M.12M) | 10 | 10 | 10 | 10 | - | - | 10 | - | 10 | 60 |
| | N x NFC (12M.18M) | - | - | - | - | 10 | 10 | - | - | - | 20 |
| | M6DPC x NFC (12M.18M) | - | 5 | 5 | - | 5 | 4 | 5 | - | - | 24 |
| | M6DPC x NFC (18M.12M) | 5 | - | - | 5 | - | - | - | - | 5 | 15 |
| | 12Y x NFC (18M.12M) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | - | 10 | 80 |
| | N x (SK6.SK7) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | - | 10 | 80 |
| | **Sub Total** | **35** | **35** | **35** | **35** | **35** | **34** | **35** | **-** | **35** | **279** |
| **Oct-Nov., 23** | N x NFC (18M.12M) | 10 | 10 | - | 10 | 10 | 10 | 10 | 10 | 10 | 80 |
| | M6DPC x NFC (12M.18M) | - | - | - | - | - | - | 10 | - | - | 10 |
| | M6DPC x NFC (18M.12M) | 10 | 10 | - | 10 | 10 | 10 | - | 10 | 10 | 70 |
| | 12Y x NFC (18M.12M) | 10 | 10 | - | 10 | 10 | 10 | 10 | 10 | 10 | 80 |
| | N x (SK6.SK7) | 10 | 10 | - | 10 | 10 | 10 | 10 | 10 | 10 | 80 |
| | **Sub Total** | **40** | **40** | **-** | **40** | **40** | **40** | **40** | **40** | **40** | **320** |
| **Jan-Feb., 24** | N x NFC (18M.12M) | - | - | - | 10 | - | - | - | - | 10 | 20 |
| | M6DPC x NFC (18M.12M) | - | - | - | 10 | - | - | - | - | 10 | 20 |
| | 12Y x NFC (18M.12M) | - | - | - | 10 | - | - | - | - | 10 | 20 |
| | N x (SK6.SK7) | - | - | - | 10 | - | - | - | - | 10 | 20 |
| | **Sub Total** | | **-** | **-** | **40** | **-** | **-** | **-** | **-** | **40** | **80** |
| **Mar-Apr., 24** | N x NFC (18M.12M) | 10 | 10 | 10 | 10 | - | 5 | - | - | 10 | 55 |
| | M6DPC x NFC (18M.12M) | 10 | 10 | 10 | 10 | - | 5 | - | - | 10 | 55 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 12Y x NFC (18M.12M) | 10 | 10 | 10 | 10 | - | 5 | - | - | 10 | 55 |
| N x (SK6.SK7) | 10 | 10 | 10 | 10 | - | 5 | - | - | 10 | 55 |
| **Sub Total** | **40** | **40** | **40** | **40** | **-** | **20** | **-** | **-** | **40** | **220** |

**Distribution of DFLs at farmers' field under OFT for 2023-24**

| Season | Combination | Malda | Birbhum | Total |
|---|---|---|---|---|
| **Oct-Nov., 23** | N x NFC (18M.12M) | 10 | - | 10 |
| | N x NFC (12M.18M) | 10 | - | 10 |
| | M6DPC x NFC (18M.12M) | 10 | - | 10 |
| | M6DPC x NFC (12M.18M) | 10 | - | 10 |
| | 12Y x NFC (18M.12M) | 10 | - | 10 |
| | 12Y x NFC (12M.18M) | 10 | - | 10 |
| | N x (SK6.SK7) | 10 | - | 10 |
| | **Sub Total** | **70** | - | **70** |
| **Jan-Feb., 24** | N x NFC (18M.12M) | - | 65 | 65 |
| | M6DPC x NFC (18M.12M) | - | 35 | 35 |
| | M6DPC x NFC (12M.18M) | - | 8 | 8 |
| | 12Y x NFC (18M.12M) | - | 54 | 54 |
| | N x (SK6.SK7) | - | 50 | 50 |
| | **Sub Total** | **-** | **212** | **212** |
| **Mar-Apr., 24** | N x NFC (18M.12M) | 52 | 100 | 152 |
| | M6DPC x NFC (18M.12M) | 45 | - | 45 |
| | 12Y x NFC (18M.12M) | 127 | 100 | 227 |
| | N x (SK6.SK7) | 66 | 100 | 166 |
| | **Sub Total** | **290** | **300** | **590** |

**OST: Performance of NFC cross-breeds during 2023-24**

| Season | Combination | ERR (No.) | ERR (kg.) | SCW (g) | SSW (g) | SR (%) | FL (m) | Renditta (kg) |
|---|---|---|---|---|---|---|---|---|
| **Nov.-Dec., 23** | N x NFC (18M x 12M) | 8416 | 12.65 | 1.731 | 0.259 | 15.96 | 599 | 9.64 |
| | M6DPC x NFC (18M x 12M) | 8377 | 12.18 | 1.716 | 0.265 | 16.32 | 582 | 9.88 |
| | 12Y x NFC (18M x 12M) | 8438 | 11.94 | 1.641 | 0.254 | 16.50 | 627 | 9.37 |
| | N x (SK6 x SK7) Control | 8090 | 12.55 | 1.715 | 0.293 | 17.78 | 574 | 12.67 |
| **Aug.-Sept., 23** | N x NFC (18M x 12M) | 8133 | 11.77 | 1.602 | 0.276 | 17.24 | 528 | 11.68 |
| | M6DPC x NFC (18M x 12M) | 7202 | 10.61 | 1.515 | 0.245 | 16.04 | 533 | 13.34 |
| | 12Y x NFC (18M x 12M) | 7926 | 11.72 | 1.563 | 0.273 | 17.35 | 516 | 12.60 |
| | N x (SK6 X SK7) Control | 8310 | 13.29 | 1.564 | 0.262 | 16.31 | 515 | 12.68 |
| **June-July, 23** | N x NFC (18M x 12M) | 7885 | 12.57 | 1.695 | 0.272 | 16.04 | 618 | 10.32 |
| | M6DPC x NFC (18M x 12M) | 5865 | 15.17 | 1.776 | 0.289 | 16.16 | 600 | 10.43 |
| | 12Yx NFC (18M x 12M) | 9136 | 12.32 | 1.514 | 0.253 | 16.65 | 646 | 11.22 |
| | Nx (SK6 X SK7) Control | 7588 | 11.55 | 1.593 | 0.244 | 15.08 | 563 | 11.77 |
| **Anova** | Treatment (units) | NS | NS | NS | NS | NS | NS | NS |
| | Season | NS | NS | * | NS | NS | ** | * |
| | T x S | NS | NS | NS | NS | NS | NS | NS |

** = P <1.0, * = P < 5.0, NS= Non-Significant.

**OST of cross-breeds at REC, Mothabari, Malda (Feb-Mar, 2024)**

| M6DPC x NFC (18M x 12M) | 12Y x NFC (18M x 12M) | N x NFC (18M x 12M) | N x (SK6.7) Control |
|---|---|---|---|

**OST of cross-breeds at CSB-CSRTI-Berhampore (Feb-Mar, 2024)**

| DPC x NFC (18M x 12M) | 12Y x NFC (18M x 12M) | N x NFC (18M x 12M) | N x (SK6.7) Control |
|---|---|---|---|

**OST of cross-breeds at RSRS-KALIMPONG (Sept.-Oct., 2023)**

| M6DPC x NFC (18M x 12M) | 12Y x NFC (18M x 12M) | N x NFC (18M x 12M) | N x (SK6.7) Control |
|---|---|---|---|

**Continuous/Other Activities:**

Twenty-three multivoltine silkworm germplasm breeds were maintained over five generations during 2023–24. The average performance of these germplasm breeds is presented in the table.

**Rearing performance of Germplasm Stocks**

| Race/ Breed | Fecundity (No.) | Hatching (%) | SCW (g) | SSW (g) | Shell % | ERR by wt. (kg) | Pupation (%) |
|---|---|---|---|---|---|---|---|
| Cambodge | 345 | 94 | 0.878 | 0.110 | 12.53 | 6.597 | 75 |
| CB5 | 360 | 94 | 0.864 | 0.112 | 12.96 | 6.739 | 78 |
| M12W | 409 | 93 | 0.912 | 0.121 | 13.27 | 7.663 | 84 |
| M6M81 | 385 | 95 | 0.891 | 0.111 | 12.46 | 7.625 | 86 |
| M6DPC | 379 | 94 | 1.126 | 0.160 | 14.22 | 9.607 | 85 |
| OS616 | 401 | 95 | 1.199 | 0.137 | 11.43 | 10.595 | 88 |
| M.Con1 | 403 | 94 | 1.200 | 0.134 | 11.17 | 10.730 | 89 |
| M.Con 4 | 397 | 94 | 1.210 | 0.145 | 12.01 | 9.928 | 82 |
| O | 399 | 95 | 1.112 | 0.132 | 11.87 | 9.737 | 88 |
| G | 403 | 94 | 1.021 | 0.123 | 12.05 | 9.070 | 89 |
| M15 | 394 | 94 | 0.986 | 0.122 | 12.34 | 8.546 | 87 |
| M6DPC (Green) | 393 | 94 | 1.210 | 0.159 | 13.14 | 10.801 | 89 |
| SARUPAT | 387 | 95 | 0.972 | 0.119 | 12.27 | 8.054 | 83 |
| A-23 | 374 | 95 | 0.854 | 0.110 | 12.88 | 6.870 | 80 |
| A-25 | 376 | 93 | 0.830 | 0.111 | 13.38 | 6.382 | 77 |
| 12Y | 480 | 94 | 1.234 | 0.219 | 17.75 | 11.573 | 94 |
| 21Y | 450 | 94 | 1.199 | 0.199 | 16.60 | 10.791 | 90 |
| 8W | 430 | 93 | 1.210 | 0.180 | 14.88 | 11.011 | 91 |
| 28(RY) | 377 | 94 | 0.982 | 0.128 | 13.02 | 8.465 | 86 |
| N (Marked) | 409 | 94 | 1.001 | 0.124 | 12.39 | 9.109 | 91 |
| N (Plain) | 400 | 93 | 1.030 | 0.121 | 11.75 | 9.270 | 90 |
| N (Chalsa) | 403 | 95 | 1.089 | 0.129 | 11.85 | 9.905 | 91 |
| N (Debra) | 408 | 95 | 1.101 | 0.131 | 11.91 | 10.129 | 92 |

**Basic Seed Supply:**

A total of 1,033 DFLs of multivoltine basic silkworm seed (M6DPC, 12Y, M. Con4, Nistari Marked, and Nistari Plain) were supplied to NSSO, DoS, and the nested units of CSB.

## FARM MANAGEMENT AND REARING & SEED TECHNOLOGY

**Ongoing Research Project**

**APS02020MI: Improvement of seed crop productivity in West Bengal**

**[November 2022 - October, 2025]**

**PI:** Satadal Chakraborty

**CI's:** Th. Ranjita Devi, P. Naik, Mihir Rabha, Khasru Alam, Harish Babu S, B.V Naidu, HR Ahmad, Officers in charge of trial units

**Objectives:**

- To improve quality of multivoltine and bivoltine seed cocoons crops
- To improve sustainable production of commercial hybrid dfls in West Bengal

**Progress:**

A total of 200 ASRs from West Bengal were trained in modern sericulture technologies by scientists and DoS officers. Three seed crop rearings Aghrahayani P1 (2023), Falguni P1 (2023), and Baisakhi P1 (2024) were successfully conducted by these trained ASRs. During these three crops, approximately 80.07 lakh bivoltine seed cocoons were produced from the brushing of 40,479 P1 DFLs, 94.43 lakh multivoltine (Nistari) seed cocoons from 72,650 P1 DFLs, and 16.47 lakh M12W seed cocoons from 5,750 P1 DFLs. The average productivity of bivoltine seed cocoons reached 30.9 kg per 100 DFLs, compared to the benchmark of 25.7 kg, reflecting a 42.1% improvement. Similarly, multivoltine (Nistari) seed cocoon productivity averaged 26.7 kg per 100 DFLs against the benchmark of 11.1 kg, showing a 139.6% improvement. Sericulture inputs were distributed to 200 ASRs across nine districts including Nadia, Murshidabad, Malda, Birbhum, Jalpaiguri, Darjeeling (Hill and Plain), Kalimpong, and Cooch Behar. Grainage reports for the Agrahayani and Falguni commercial crops were collected from the DoS, Malda, and SSPCs (D.B. Pur and Berhampore) for analysis. Financial assistance for 'Shelf Rearing' (first installment) amounting to ₹3.69 lakhs was transferred via Direct Beneficiary Transfer (DBT) to 164 ASRs, and support for the cost of DFLs is under process in consultation with the DoS, Government of West Bengal. Additionally, a workshop titled "Feedback Information from Stakeholders and District Officers," involving scientists from SSPCs (NSSO) and discussions on the Action Plan for 2024–25, was conducted on 21.03.2024 at the Matigara Sericulture Complex, Siliguri.

**Improvement in Nistari (Multivoltine) and SK6 × SK7 (Bivoltine) seed cocoon yield over benchmark during 2023–24 (Unit: kg per 100 DFLs)**

| # | Nistari (MV) | Avg. Bench Mark | Agrahayani P1 | Falguni P1 | Baisakhi P1 |
|---|---|---|---|---|---|
| 1 | Murshidabad | 10.5 | 11.5 | 32.5 | 36.0 |
| 2 | Nadia | 11.4 | 20.8 | 27.0 | 36.6 |
| 3 | Malda | 11.3 | 9.4 | 27.8 | 36.5 |
| 4 | Birbhum | 11.0 | 15.5 | 28.2 | 31.4 |
| 5 | Darjeeling (P) | 11.5 | 23.2 | 16.2 | - |

| # | SK6 X SK7 (BV) | Avg. Bench Mark | Agrahayani P1 | Falguni P1 | Baisakhi P1 |
|---|---|---|---|---|---|
| 1 | Murshidabad | 31.4 | 12.0 | 37.5 | 45.0 |
| 2 | Nadia | 35.1 | - | 37.1 | 57.8 |
| 3 | Malda | 18.1 | 20.2 | 43.0 | 24.4 |
| 4 | Birbhum | 31.9 | - | 47.1 | 33.3 |
| 5 | Jalpaiguri | 21.5 | 9.0 | - | 22.5 |
| 6 | Darjeeling (P) | 22.8 | - | 35.9 | - |
| 7 | Coochbehar | 24.8 | 17.4 | 24.6 | - |
| | | | **APRIL-MAY** | **JUNE-JULY** | **AUG.-SEPT.** |
| 8 | Kalimpong | 23.3 | 43.8 | 36.5 | 40.1 |
| 9 | Darjeeling (H) | 22.3 | 24.4 | 18.4 | 8.8 |

**Bivoltine seed cocoon generation at hill region of West Bengal for 2023-24**

| Mar-Apr, 2023 | BV (P1) DFLs | BV Seed Cocoon |
|---|---|---|
| Gorubathan Farm | 150 | 68191 |
| Bijanbari | 50 | 26416 |
| **Sub Total** | **200** | **94607** |
| **Spring ( April-May 2023)** | | |
| Kalimpong farm | 720 | 332793 |
| Kalimpong village | 2850 | 391219 |
| Gidabling village | 1000 | 213278 |
| Darjeeling farm | 725 | 288444 |
| Darjeeling village | 425 | 66248 |
| Sittong village | 50 | 7220 |
| **Sub Total** | **5770** | **1299202** |
| **Summer ( June-July, 2023)** | | |
| Kalimpong farm | 699 | 333264 |
| Kalimpong village | 1370 | 314189 |
| Gidabling village | 800 | 143000 |
| Darjeeling farm | 425 | 30197 |
| **Sub Total** | **3294** | **820650** |
| **Autumn ( Aug.-Sept., 2023)** | | |
| Kalimpong farm | 820 | 150612 |
| Kalimpong village | 2900 | 755068 |
| Gitabling village | 1100 | 69572 |
| Pedong village | 500 | 33774 |
| Darjeeling farm | 600 | 149677 |
| Darjeeling village | 500 | 29232 |
| Sittong village | 50 | 1500 |
| **Sub Total** | **6470** | **1189435** |
| **Oct.-Nov., 2023** | | |
| Kalimpong / Gorubathan Farm | 145 | 42212 |
| **Grand Total** | **15879** | **3446106** |

**Seed cocoon generation in plain areas during Aghrayani P1, 2023**

| Seed Crop (P1) | BV (P1) | Cocoon (No.) | Nistari (P1) | Cocoon (No.) | Total (dfls) | Total (cocoon) |
|---|---|---|---|---|---|---|
| Murshidabd | 100 | 8400 | 2900 | 422300 | 3000 | 430700 |
| Nadia | 1900 | 36000 | 1300 | 900000 | 3200 | 936000 |
| Jalpaiguri | 900 | 89940 | 1800 | 174595 | 2700 | 264535 |
| Darjeeling (P) | 300 | 13890 | - | - | 300 | 13890 |
| Malda | 1800 | 189000 | 1500 | 80000 | 3300 | 269000 |

**Seed cocoon generation in plain areas (Falguni P1, 2024)**

| Seed Crop (P1) | BV (P1) | Cocoon (No.) | Nistari (P1) | Cocoon (No.) | Total (dfls) | Total (Cocoon) |
|---|---|---|---|---|---|---|
| Murshidabad | 1600 | 476474 | 2400 | 664395 | 4000 | 1140869 |
| Birbhum | 2500 | 737565 | 5000 | 113613 | 7500 | 851178 |
| Nadia | 1900 | 798000 | 1300 | 390000 | 3200 | 1188000 |
| Darjeeling(P) | 600 | 139984 | 1000 | 145790 | 1600 | 285774 |
| Coochebehar | 1600 | 235852 | 12400 | 1141230 | 14000 | 1377082 |
| Jalpaiguri | 100 | 20150 | 200 | 14220 | 300 | 34370 |
| Malda | 1800 | 579600 | 1500 | 390000 | 3300 | 969600 |
| Uttar Dinajpur | - | - | 400 | 96915 | 400 | 96915 |

**Seed cocoon generation in plain areas (Baisakhi P1, 2024)**

| Seed Crop (P1) | BV (P1) | Cocoon (No.) | Nistari (P1) | Cocoon (No.) | $M_{12}W$ (P1) | Cocoon | Total (dfls) | Total (Cocoon) |
|---|---|---|---|---|---|---|---|---|
| Nadia | 2000 | 770000 | 1500 | 499000 | - | - | 3500 | 1269000 |
| Malda | 1500 | 238000 | 13100 | 3105000 | 1500 | 500000 | 16100 | 3843000 |
| Murshidabd | 4350 | 1291950 | 10750 | 3483000 | 1650 | 396000 | 15100 | 5170950 |
| Jalpaiguri | 650 | 87885 | - | - | - | - | 650 | 87885 |
| Birbhum | 1000 | 200000 | 15600 | 4411000 | 4250 | 1147500 | 20850 | 5758500 |

**Production of commercial DFLs (DoS & CSB) during 2023-24**

| Achvt. | Comm. Crop | Baisakhi Comm. 24 | Falguni Comm. 24 | Agrahayani Comm. 23 | Total |
|---|---|---|---|---|---|
| DoS | Bi x Bi | 63500 | 187500 | 99200 | **350200** |
| DoS | N x Bi | 265700 | 332000 | 310700 | **908400** |
| DoS | N x M12W | 252200 | - | - | **252200** |
| DoS | **Sub Total** | **581400** | **519500** | **409900** | **1510800** |
| CSB | N x Bi | 293350 | 443500 | 303700 | **1040550** |
| CSB | N x M12W | 185950 | - | - | **185950** |
| CSB | **Sub Total** | **479300** | **443500** | **303700** | **1226500** |
| | **Grand Total** | **1060700** | **963000** | **713600** | **2737300** |

**Other Activities:**

The Farm Management Section maintains 14.778 acres of mulberry plantation for propagation and the supply of quality leaves for silkworm rearing. During 2023–24, the unit supplied 35,961.40 tonnes of mulberry leaves comprising 4,674.9 tonnes of leaf and 31,286.5 tonnes of leaf with twig to support the rearing of 2,045 DFLs across various sections, including the Silkworm Breeding & Genetics Section, Rearing & Seed Technology Section, Silkworm Pathology Section, Biotechnology Division, and Training Division. Additionally, the section disposed of 26.70 quintals of mulberry cuttings to the Directorate of Sericulture (DoS), Government of West Bengal, generating revenue of ₹10,680.00.

## HOST PLANT PROTECTION

**Collaborative Research Projects**

**ARE01028MI: Recommendation of novel fungicidal and insecticidal application for mulberry (Collaboration with CSB-CSRTI, Mysore)**

**[May 2022 - April 2025]**

**Investigators (CSB-CSRTI, Berhampore):** Khasru Alam, Raviraj V. S.

**Objective:**

- Identification of novel fungicides and insecticides for mulberry crop protection

**Progress:**

Foliage loss due to mulberry diseases and pests has always been considered a serious problem for the production of good-quality mulberry leaves. Foliar diseases such as powdery mildew, brown leaf spot, black leaf spot, brown leaf rust (*Peridiospora mori*), and Cercospora leaf spot (*Cercospora moricola*) are capable of inflicting 10-15% loss, depending on severity. Similarly, mulberry pests like mealybugs, thrips, and whiteflies pose a serious threat to mulberry production. Existing recommendations for the control of foliar diseases and pests in mulberry crop protection were developed long ago and involve chemicals that are either banned or facing imminent bans. Therefore, the present project aimed to screen new chemicals that are effective at lower doses and have less toxicity to the silkworm and the environment.

Any chemical recommendation in sericulture must be highly judicious, as there is always concern regarding residual toxic effects on silkworms. Based on the results of *in vitro* evaluations, fungicides such as Hexaconazole, Fluxapyroxad, and Tebuconazole along with Bavistin as an existing recommendation at different concentrations (0.05%, 0.1%, and 0.2%) were evaluated under field conditions against brown leaf spot (*Myrothecium roridum*) and powdery mildew (*Phyllactinia corylea*) diseases of mulberry. The fungicides were further subjected to safety testing through a silkworm bioassay to determine the safe period for silkworm exposure. The fungicides evaluated for disease management were sprayed on labeled mulberry plants according to treatment and date, while synchronizing with the hatching of the silkworms to ensure leaves were fed to the larvae 5 and 7 days after spraying.

Silkworm rearing was conducted from egg to egg to monitor the residual toxicity's effect on the reproductive efficiency and survival rate of the silkmoths. Regarding the safe or waiting period for the fungicides, Hexaconazole at 0.05% showed the highest survival rate of 86.33%, which was on par with the control at 93% after 5 days of spraying. In contrast, Fluxapyroxad at 0.2% recorded the lowest survival rate of 24.67% (Refer Table).

**Effect of fungicides on the survival of silkworm 5 days after spraying**

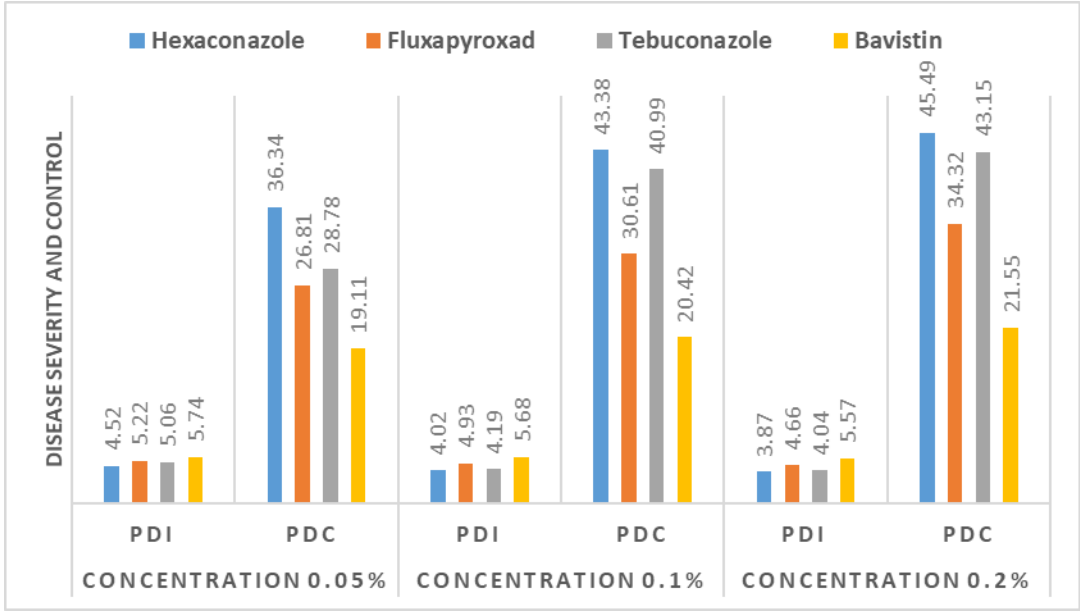
| Fungicides | Survival (%) | SCW (g) | SSW (g) | SR (%) | Fecundity |
|---|---|---|---|---|---|
| Hexaconazole 0.05% | 86.33 | 1.41 | 0.23 | 16.59 | 451.67 |
| Hexaconazole 0.1% | 81.33 | 1.43 | 0.23 | 16.11 | 435.00 |
| Hexaconazole 0.2% | 75.33 | 1.32 | 0.22 | 16.39 | 420.67 |
| Fluxapyroxad 0.05% | 79.67 | 1.27 | 0.19 | 15.30 | 417.67 |
| Fluxapyroxad 0.1% | 73.18 | 1.49 | 0.21 | 14.14 | 410.67 |
| Fluxapyroxad 0.2% | 24.67 | 1.32 | 0.21 | 16.17 | 0.00 |
| Tebuconazole 0.05% | 79.14 | 1.37 | 0.19 | 14.12 | 404.33 |
| Tebuconazole0.1% | 80.33 | 1.49 | 0.22 | 14.69 | 435.00 |
| Tebuconazole 0.2% | 45.33 | 1.22 | 0.18 | 14.73 | 421.67 |
| Control | 93.00 | 1.43 | 0.25 | 17.70 | 455.00 |
| **CD (*P*=0.05)** | **8.20** | **0.08** | **NS** | **NS** | **14.57** |
| **CV%** | **6.63** | **3.50** | **11.04** | **11.04** | **2.21** |

Similarly, the highest survival rate was again recorded with Hexaconazole 0.05%, showing 91.67% survival after 7 days of spraying, followed by the 0.1% concentration. This result was on par with the control (92%), while Fluxapyroxad 0.2% showed the lowest survival rate (Refer Table).

**Effect of fungicides on the survivality of silkworm 7 days after spraying**

| Fungicides | Survival (%) | SCW (g) | SSW (g) | SR (%) | Fecundity |
|---|---|---|---|---|---|
| Hexaconazole 0.05% | 91.67 | 1.45 | 0.25 | 17.36 | 460.00 |
| Hexaconazole 0.1% | 89.76 | 1.42 | 0.24 | 16.60 | 441.00 |
| Hexaconazole 0.2% | 62.05 | 1.41 | 0.22 | 15.64 | 426.67 |
| Fluxapyroxad 0.05% | 88.91 | 1.38 | 0.22 | 15.78 | 433.66 |
| Fluxapyroxad 0.1% | 76.67 | 1.41 | 0.22 | 15.33 | 414.66 |
| Fluxapyroxad 0.2% | 48.00 | 1.46 | 0.20 | 13.43 | 0.00 |
| Tebuconazole 0.05% | 81.33 | 1.31 | 0.20 | 15.50 | 417.33 |
| Tebuconazole 0.1% | 84.81 | 1.36 | 0.25 | 18.21 | 423.33 |
| Tebuconazole 0.2% | 55.96 | 1.11 | 0.19 | 17.21 | 422.66 |
| Control | 92.00 | 1.42 | 0.25 | 17.68 | 464.66 |
| **CD (*P*=0.05)** | **8.19** | **0.08** | **0.03** | **2.15** | **41.48** |
| **CV%** | **6.19** | **3.57** | **7.61** | **7.71** | **6.16** |

The data presented in the Figure revealed that all the fungicides, at different concentrations, were effective in reducing the intensity of Myrothecium leaf spot disease compared to the control. Among the various treatments, Hexaconazole was found to be the most effective fungicide at all three concentrations, achieving 36.34%, 43.38%, and 45.49% disease control, respectively, when compared to the existing fungicide Bavistin.




**Effect of fungicides against *Myrothecium* leaf spot disease under field conditions**

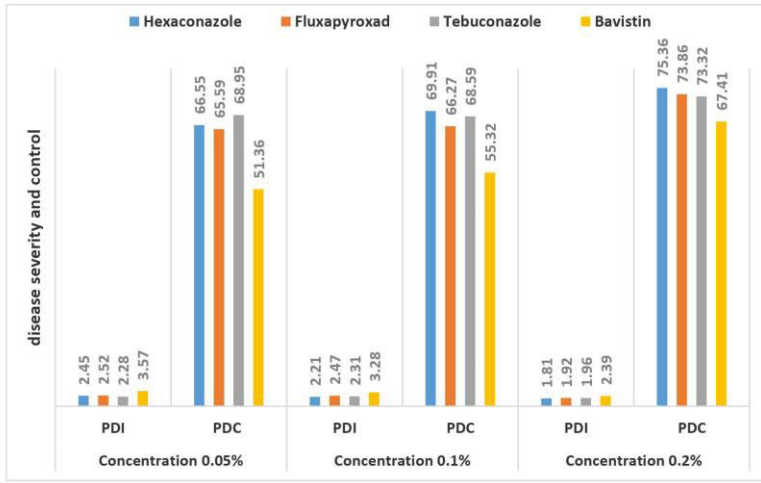
Screening of selected fungicides was also conducted against powdery mildew disease of mulberry through both *in vitro* and field evaluations. The *in vitro* evaluation was performed using the slide germination technique. Data indicated that all fungicides were effective in reducing spore germination compared to the control. Hexaconazole, at all three concentrations, was found to be the most effective, with a maximum spore inhibition of 95.01%. All other tested fungicides also showed effectiveness against *Phyllactinia corylea*, except Bavistin, which was only effective at the highest concentration (0.2%), as shown in the table below.

***In-vitro* evaluation of selected fungicides against *P. corylea***

| # | Treatments | 0.05% Conc. | | 0.1% Conc. | | 0.2% Conc. | |
|---|---|---|---|---|---|---|---|
| | | Spore germination (%) | Inhibition (%) | Spore germination (%) | Inhibition (%) | Spore germination (%) | Inhibition (%) |
| 1 | Hexaconazole 5% SC | 5.63 (12.28) | 89.11 (68.04) | 3.49 (10.70) | 91.05 (72.71) | 2.12 (8.40) | 95.01 (76.62) |
| 2 | Tebuconazole 25.9% EC | 8.18 (16.32) | 75.58 (62.94) | 4.56 (12.64) | 85.58 (70.46) | 2.42 (8.82) | 94.18 (75.72) |
| 3 | Fluxapyroxad 167GL | 5.54 (14.15) | 86.30 (70.42) | 2.66 (9.74) | 93.84 (75.31) | 2.11 (8.47) | 93.25 (76.85) |
| 4 | Bavistin 50% WP | 16.97 (24.04) | 57.85 (48.96) | 9.97 (17.90) | 75.27 (59.76) | 4.24 (11.84) | 89.48 (70.85) |
| 5 | Control | 39.77 (39.52) | 0.00 (0.00) | 39.77 (39.52) | 0.00 (0.00) | 39.77 (39.52) | 0.00 (0.00) |
| | SEm± | 0.83 | 1.70 | 0.56 | 1.22 | 0.46 | 0.60 |
| | CD (P=0.05) | 2.43 | 5.01 | 1.66 | 3.61 | 1.36 | 1.77 |
| | CV% | 8.68 | 7.59 | 6.95 | 4.91 | 6.67 | 2.23 |

*Mean of five replications; Figures given in parentheses are arcsine transformed values

The data on powdery mildew disease intensity in mulberry, recorded 28 days after fungicide treatment, were found to be statistically significant. All fungicide treatments significantly reduced disease pressure compared to the untreated control. Disease intensity data were recorded at weekly intervals for four weeks following the second spray. The maximum disease control (75.36%) was observed in plants treated with Hexaconazole 0.2%, followed by Fluxapyroxad (73.86%), Tebuconazole (73.32%), and Bavistin (67.42%). At the 0.1% concentration, Hexaconazole again provided the highest disease control (69.91%), followed by Tebuconazole (68.59%), Fluxapyroxad (66.27%), and Bavistin (55.32%). However, considering both the survival rate of silkworms and the extent of disease control, Hexaconazole was found to be the most effective fungicide among those tested.




**Effect of fungicides against powdery mildew disease under field conditions**

**Continuous/Other Activities:**

**Surveillance and forewarning of mulberry diseases in Eastern and Northeastern India**

**PI:** Khasru Alam

Officers in charge of trial units

**Objective:**

- To conduct surveillance of mulberry diseases in Eastern and Northeastern India and to provide forewarning services to farmers for the effective management of mulberry diseases in the region

**Progress:**

Data on mulberry disease incidence was collected at weekly intervals across Eastern and Northeastern India. The prevalence of major diseases *viz.*, Myrothecium Leaf Spot (MLS), Bacterial Leaf Spot (BLS), Cercospora Leaf Spot (CLS), Powdery Mildew (PMLD), Brown Leaf Rust (BLR), and Yellow Leaf Rust (YLR) was recorded, and disease severity was assessed in terms of the Percent Disease Index (PDI).

**Seasonal occurrence of mulberry diseases (2023-24)**

| State | Unit | MLS | BLS | CLS | PMLD | BLR | YLR |
|---|---|---|---|---|---|---|---|
| West Bengal | CSB-CSRTI-BER | 12.25 (Nov) | 6.28 (Jul) | | 6.31 (Dec) | | |
| | Malda | 3.98 (Sep) | 5.25 (Sep) | | 6.68 (Dec) | | |
| | Kalimpong | | | | 2.38 (Jul) | | 2.35 (Jul) |
| Odisha | Koraput | | | | 4.21 (Nov) | 2.44 (Jun) | |
| Mizoram | Aizawl | | | | 0.28 (Nov) | | |
| Manipur | Imphal | | | | 4.11 (Oct) | | |
| Agartala | Agartala | 2.20 (Aug) | | | | | |
| Assam | Jorhat | 6.58 (June) | | | | 6.71 (Aug) | |

**Surveillance and forewarning of mulberry pests in Eastern and Northeastern India**

**PI's:** Khasru Alam (upto Dec., 2023), Reshma R (from Jan., 2024); Officers in charge of trial units

**Objective:**

- To conduct surveillance of mulberry pests in Eastern and Northeastern India

**Progress:**

Data on pest incidence was collected from farmers' fields at various locations as well as from institute fields. Data collection was carried out using five randomly selected plants per sample. The seasonal incidence of major mulberry pests *viz*., thrips (*Pseudodendrothrips mori*), mealy bug (*Maconellicoccus hirsutus*), whitefly (*Dialeuropora decempuncta* and *Aleuroclava pentatuberculata*), and root mealy bug (*Paraputo* spp.) was recorded at weekly intervals, along with meteorological data. From each plant, three twigs (shoots) were selected for data recording. For each twig, the number of thrips per leaf was recorded from the 4$^{th}$, 5$^{th}$, 6$^{th}$, and 7$^{th}$ leaves from the top. The incidence of Tukra was determined based on the percentage of shoots damaged in ten plants per holding. Five affected shoots per holding were collected from the field to count egg masses, nymphs, and adults of mealy bugs. Whitefly incidence was recorded based on the adult and late nymph population observed on the top, middle, and bottom two leaves from three twigs per plant.

**Seasonal occurrence of major pests in mulberry ecosystem (2023-24)**

| Location | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Thrips (No./leaf) | | | | | | | |
| CSRTI- BER | 6.25 | 18 | 5 | 3 | 5 | 2 | 1 | | | 3.2 | 3 | 1.28 |
| Malda | | | | | 3.8 | | | | | | | |
| REC Agartala | 1.12 | | | 1.9 | | | | | | | | |
| RSRS Koraput | 4.15 | | | | | | | | | | | |
| | | | | | Tukra (%) | | | | | | | |
| CSRTI- BER | 2 | 5 | 8 | | | | | 2.5 | | | | 8.5 |
| Malda | | | | | 1.6 | | | | | | | |
| RSRS Koraput | 4.71 | | 4.3 | | | 4.08 | | | | | | |
| RSRS Jorhat | | | | | | | | | 10 | | | |
| RSRS Kalimpong* | 0.93 | 0.77 | 0.8 | 1.7 | | | | 0.56 | | | 0.85 | 0.75 |
| | | | | | Whitefly (No./leaf) | | | | | | | |
| CSRTI- BER | | 14 | | 5 | 3 | 4.5 | 10 | 11 | | 5.83 | 5.06 | |
| RSRS Koraput | 2.54 | | 1.7 | | | | 3.32 | | | | | |
| RSRS Jorhat | | | | | | | | | 10.5 | | | |

## SILKWORM PATHOLOGY

**Ongoing Research Project**

**BPP02024SIC: In vitro evaluation of potential health benefits of different botanical parts of mulberry**

**[March 2024 - February 2027]**

**PI:** K. Rahul

**CI's:** Pooja Makwana, Pradeep, S.D.

**Objectives:**

- To identify the phytochemical constituents of different botanical parts of mulberry by mass spectroscopy analysis
- To evaluate antimicrobial, antioxidant, anti-inflammatory, anti-tumour and osteo-protective properties of different botanical parts of mulberry (In vitro)

**Progress:**

Different botanical parts of the mulberry plant were collected and subjected to extraction using solvents of varying polarity, including aqueous-ethanol (polar) and hexane/chloroform (nonpolar). The resulting extracts were being analyzed for their phytochemical constituents using mass spectrometry.

**Continuous/Other Activities**

**Survey, surveillance, and monitoring of silkworm diseases in seed and commercial crops of Eastern and Northeastern India**

**PI:** Mihir Rabha

**CI's:** K. Rahul, Pooja Makwana, S. Chakraborty, A. R. Pradeep, Officers in charge of trial units of CSB and DoS

**Pebrine Monitoring Committee**: **Surveillance and control of pebrine disease in silkworm seed production**

**PI:** K. Rahul

**CI's:** M. Rabha, P. Makwana, S. Chakraborty, A. R. Pradeep, Officers in charge of trial units of CSB and DoS

**Objectives:**

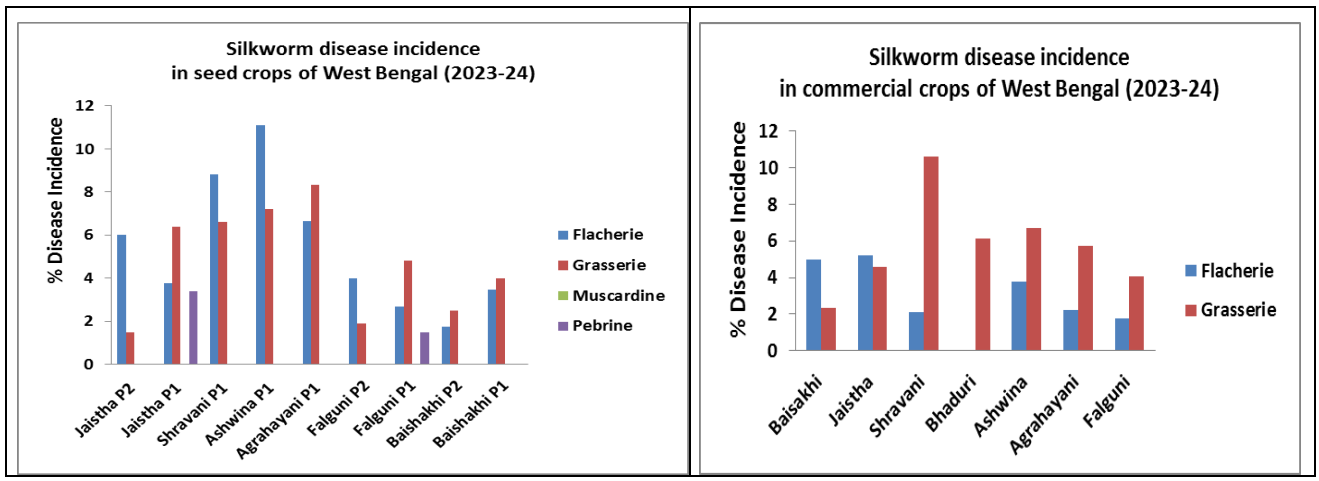
- To estimate the prevalence of silkworm diseases (seed & commercial crops) in Eastern and North-Eastern states
- To suggest remedial measures on spot to the farms/farmers for the management of silkworm diseases and prevent disease outbreak(s)

**Progress:**

As part of the aforementioned ongoing programs, efforts were made to manage the incidence of silkworm diseases across various commercial and seed crops. This initiative was carried out in coordination with the nested units of CSB-CSRTI-Berhampore, NSSO-Bangalore, and the Departments of Sericulture of the respective states.

A total of 954 samples from different seed crops in West Bengal, including those from seed farmers, DoS farms, and DoS grainages, were microscopically examined. The average incidence of pebrine was recorded at 0.54%. Farms and farmers were advised to immediately discard and destroy the infected lots following proper procedures and to implement the recommended disinfection measures. Additionally, the highest larval mortality rate due to flacherie was recorded in the Ashwina P1 crop (11.09%), followed by Shravani P1 (8.80%) and Agrahayani P1 (6.65%). The highest incidence of grasserie was observed during the Agrahayani P1 crop (8.32%), followed by Ashwina P1 (7.21%) and Shravani P1 (6.60%). The prevalence of flacherie and grasserie was reported throughout the year across different seed crops in West Bengal (Refer Figure), while muscardine disease was not reported in seed crops during the year.

During the commercial crops, field visits were conducted to supervise rearing activities and recommend best practices for disinfection and hygiene maintenance throughout the rearing period to minimize disease incidence. A total of 390 larval samples were collected from farmers during different crop seasons and subjected to microscopic examination. No incidence of pebrine or muscardine was reported in commercial crops during the year. The highest larval mortality due to grasserie was recorded during the Shravani crop (10.60%), followed by Ashwina (6.69%) and Bhaduri (6.15%). The highest incidence of flacherie was observed in the Jaistha crop (5.23%), followed by Baisakhi (5.00%), Ashwina (3.75%), and Agrahayani (2.25%) (Refer Figure).




In the Northeastern region, the average incidence of grasserie was reported at 6.74%, and flacherie at 2.43% during the year. The highest mortality rate due to grasserie was recorded in Kalimpong (10.05%), followed by Agartala (7.43%). The highest incidence of flacherie was also reported in Kalimpong (5.00%), followed by Imphal (2.30%). Muscardine was reported only in Imphal (0.50%). Stakeholders at the respective locations were advised on preventive and remedial measures by the concerned officials to minimize crop losses due to various silkworm diseases.

## REELING AND SPINNING

### Ongoing Research Project

### CFW02023MIC: Study the weaving and knitting performance of West Bengal and North East mulberry silk yarn and comfort value of its fabric

### [March 2024 - February 2026]

**PI:** Arun Kumar
**CI's:** D. Sargunamani, Sateesh Kumar (CSB-CSTRI-Bengaluru), Nishant Singhal, (CSB-RSTRS-Guwahati), Suparna Saha (CSB-RSTRS-Malda)

**Objectives:**

- To analyse the season-wise quality parameters of raw silk and its impact on aesthetic properties in woven and knitted fabric of different silk yarn
- To identify the best-performing process and best product based on E and NE silk
- To identify improvement in quality parameters of silk yarn with respect to fabric and process requirements

**Progress:**

As part of the project activities, two Google Forms were developed following discussions with the Co-Investigators, one to conduct a consumer survey and the other to assess the available reeling technologies. The consumer survey has been successfully completed, while the survey on reeling technology is currently ongoing. In addition, five silk yarn samples collected from various reelers in Berhampore is being tested at CSB-CSTRI-Bangalore.

## CAPACITY BUILDING & TRAINING

Systematic training was imparted to the respective stakeholders on various aspects of sericulture, supplemented by practical demonstrations and hands-on training programs. A structured 15-month Post Graduate Diploma in Sericulture (PGDS) is offered to participants across the country under affiliation with Kalyani University (Kalyani, West Bengal). Various Human Resource Development (HRD) programs are organized for the capacity building of stakeholders and the Transfer of Technology to support the development of sericulture in Eastern and Northeastern India. A total of 3,079 candidates were trained against a target of 2,190 through programs such as PGDS, FST, TOP, STEP, EDP, Exposure Visits, Non-CBT, and need-based training programs. Coordination of Seri Resource Centres (SRCs) (6 in total across West Bengal and Bihar), established under Silk Samagra to train farmers, was also undertaken.

| **PGDS in Mulberry Sericulture** | |
|---|---|
| I Semester<br>(6 Months; 200 h Theory & 200 h Practicals) | PGD 101: Introductory Sericulture and Mulberry Production<br>PGD 102 : Crop Protection<br>PGD 103 : Cocoon Poduction<br>PGD 104 : Silkworm Breeding, Genetics And Seed production<br>PGD 105 : Mulberry Production (Practical)<br>PGD 106 : Mulberry Crop Protection (Practical)<br>PGD 107 : Cocoon Production (Practical)<br>PGD 108 : Cocoon Crop Protection & Silkworm Breeding and Genetics (Practical) |

| | |
|---|---|
| II Semester<br>(6 Months; 200 h theory + 100 h Practicals) | PGD 201: Mulberry Breeding, Genetics & Physiology<br>PGD 202: Post Cocoon Technology and By Product Development<br>PGD 203: Extension Management and Seri Management<br>PGD 204: Computer, Economics and Statistics<br>PGD 205: Mulberry Breeding, Genetics & Physiology and Computer, Economics and Statistics (Practical)<br>PGD 206: Silkworm Seed Production and Post Cocoon Technology (Practical) |
| Dissertation/ Project works<br>(3 Months) | Various Disciplines |

| PGDS Admissions (2022-23 and 2023-24) | | |
|---|---|---|
| **State** | **2022-2023 Batch (24)** | **2023-2024 Batch(20)** |
| Arunachal Pradesh | 01 | - |
| Assam | 04 | 01 |
| Bihar | - | 01 |
| Manipur | 10 | 06 |
| Mizoram | 04 | 01 |
| Nagaland | 05 | 09 |
| Jharkhand | - | 01 |
| Himachal Pradesh | - | 01 |

The Post Graduate Diploma in Sericulture (PGDS) course comprises two semesters and a dissertation component, with a well-structured and comprehensive syllabus covering all aspects of mulberry sericulture, designed in coordination with Kalyani University. Each semester includes a 15-day exposure visit to major mulberry and non-mulberry sericulture regions. The majority of students are sponsored by the Departments of Sericulture (DoSs) of their respective State Governments, while a few are self-funded.

Students are taught by experienced scientific personnel from CSB-CSRTI-Berhampore, other Central Silk Board (CSB) units, and honorary faculty from reputed institutions. Evaluation is conducted through semester-end examinations, which include both theory and practical components. Students also undertake a three-month dissertation or practical course work under the supervision of experienced faculty in various disciplines. They are required to submit a dissertation/report, which is evaluated by examiners nominated by Kalyani University.

Candidates who successfully complete the course are awarded the PGDS. The top three students are felicitated by the Central Silk Board, Bangalore, with Gold, Silver, and Bronze medals, and the topper of the first semester is also eligible for a cash award of ₹15,000.

| | **PGDS Dissertation Studies (2023-24)** | | |
|---|---|---|---|
| **#** | **Student** | **Title** | **Supervisor** |
| 1 | Monjir Tokbipi | Assessment of leaf quality and protein profilling through SDS-PAGE in mulberry | Dr. Yallappa H<br>Sci-C |
| 2 | TH Bidyaluxmi Devi | Evaluation of biorational inorganic salt (GRAS) against *Myrothecium roridum* Tode ex. Fr. causing brown leaf spot of mulberry | Dr. K. Alam<br>Sci-C |
| 3 | Tsureto A | On-Station Trial of bacterial leaf spot resistant mulberry variety C-2070 | Dr. Deepika K U<br>Sci-C |
| 4 | V. Lalremruatpuia | The impact of ultraviolet radiation on silkworm *Bombyx mori* L: An investigation into physiological and molecular responses | Dr. Raviraj V S<br>Sci-C |
| 5 | Yumnam Daina Devi | Identification of superior bivoltine foundation cross as a male component to improve crossbreed productivity in Eastern India | Dr. S. Chakraborty<br>Sci-D |
| 6 | Vanlalzari | Evaluation of breeds and hybrids of mulberry silkworm for their tolerance to Densovirus | Dr. K. Rahul<br>Sci-C |
| 7 | KH Malemnganba Meitei | Evaluation of performance of some of the economic traits of M12W in West Bengal | Dr. Th Ranjita Devi<br>Sci-C |
| 8 | Lallawmkima Ralte | Physiological growth and productivity analysis of mulberry | Dr. K Suresh |

| | | | |
|---|---|---|---|
| | | varieties | Sci-C |
| 9 | Laishram Reaya Chanu | Genetic diversity and traits association analysis among parental genotypes of mulberry | Dr. Yallappa H<br>Sci-C |
| 10 | MS Dawngkima | Isolation and characterization of cellulose degrading microbes from silkworm *Bombyx mori* L. | Dr. Mihir Rabha<br>Sci-C |
| 11 | M. Sureshkumar Singh | Adoption and constraint of few improved sericultural technologies - A study in an area of Manipur | Dr. D. Pandit<br>Sci-D |
| 12 | Mangte Florence Kom | Impact assessment of seri-enterprises developed under DBT funded project in Manipur | Dr. P. Naik J<br>Sci-C |
| 13 | MD Farooque Ahmed | Studies on substrate colour as an oviposition attractant for *Chrysoperla zastrowi* sillemi (Esben-Peterson) | Dr. K. Alam<br>Sci-C |
| 14 | A Linthoingambi Chanu | Growth and instability analysis of raw silk production in India and North Eastern states | Dr. G. Srinivasa<br>Sci-D |
| 15 | Haidobabe Elu | Observation on heterosis in F1 generation developed from the Multi x Bi cross, Nistari x SK6 of the mulberry silkworm *Bombyx mori* L. | Dr. A R Pradeep<br>Sci-D |
| 16 | Jahnabi Nath | Effect of newly developed hormone based formulation on mulberry leaf longevity | Dr. Deepika K U<br>Sci-C |
| 17 | Imtirong | Molecular detection of diseases in silkworm *Bombyx mori* L. | Dr. Pooja Makwana<br>Sci-C |
| 18 | KH Lordish Singh | Assessment of perception and adaptation stretegies of seri-farmers towards climate change in Manipur | Dr. P. Naik J<br>Sci-C |
| 19 | Kenbom Lego | Adoption of technologies developed by CSB-CSRTI, Berhampore in Murshidabad district of West Bengal | Dr. Shafi Afroz<br>Sci-C |
| 20 | Khumring Sankhil | Seasonal performance of Nistari, a multivoltine breed in West Bengal | Dr. Th Ranjita Devi<br>Sci-C |

**Farmers Skill Training**

| Farmers Skill Training (FST) | |
|---|---|
| **Discipline** | **Farmers** |
| Chawki Silkworm Rearing (5 days) | 175 |
| Late Age Silkworm Rearing (5 days) | 225 |
| Mulberry Cultivation (5 days) | 25 |
| Integrated Disease & Pest Management | 20 |

The objective of the Farmers' Skill Training (FST) programme is to enhance the knowledge of sericulture farmers through theoretical and practical training, thereby improving the adoption of recommended practices. The duration of FST ranges from 5 to 10 days, during which 445 farmers were trained in various aspects of mulberry cultivation and silkworm rearing. FST programmes were also organized at REC-Dimapur (Nagaland), REC-Mothabari (West Bengal), RSRS-Kalimpong (West Bengal), REC-Agartala (Tripura), RSRS-Jorhat (Assam), and RSRS-Koraput (Odisha).

**Technology Orientation Programme**

Technology Orientation Programmes (TOP) are short-term courses of 1 to 3 days duration, aimed at upgrading or refreshing the knowledge of officers/officials from State Sericulture Departments and the Central Silk Board (CSB) on the latest technologies developed by the Institute. The primary objective of TOP is to promote seri-enterprises and support states in achieving their sericulture targets. A total of 94 personnel were trained across three batches under the Faculty Development Training Programme and Competency Enhancement Training for CSB and DoS officers/officials in various disciplines. One of the three TOP batches was conducted at REC-Agartala (Tripura), where 42 DoS officers/officials participated to update their knowledge on mulberry sericulture.

**Seri Resource Centres**

Seri Resource Centres (SRCs), established under Silk Samagra in West Bengal and Bihar, aim to impart basic training on various aspects of sericultural technologies developed by CSB-CSRTI-Berhampore. These programmes are conducted by the SRC owner or lead farmer in the village, in coordination with the respective Department of Sericulture (DoS) and CSB-CSRTI-Berhampore, to benefit local sericulture farmers. A total of 800 personnel were trained across 40 batches (each batch consisting of 20 farmers per year) at the six designated training venues.

| SRC | District/State | SRC Owner | Contact |
|---|---|---|---|
| Bankipur<br>Mollikpur | Murshidabad | Anisur Rahaman<br>Md Rejaul Seikh | 7407979087<br>9735403222 |
| Alinagar<br>B. Hazitola | Malda | Md Sufian Ali<br>Md. Kased Ali | 9734016330<br>9734046100 |
| Barbakpur | Nadia | Md K. Seikh | 7872870731 |
| Panishal | Kissanganj | Md Lukman Ali | 8768925133 |

**STEP Training Programme for Women Sericulture Farmers**

As per the guidelines of the Central Office, Bangalore, the Institute organized a STEP Training Programme for women sericulture farmers associated with NGOs in Nadia and Birbhum districts of West Bengal. The five-day intensive training included both theoretical and practical sessions on various activities of mulberry sericulture, conducted by the Institute's scientists and experts. A total of 52 trainees participated in the programme and expressed their satisfaction upon its completion.

**Exposure Visits (CBT Programme)**

Exposure visits of three days' duration were organized under the CBT Programme to expose farmers from different states to best-practicing areas and introduce them to the latest technologies in mulberry sericulture. A total of 194 farmers participated in 8 batches of exposure visits conducted by this Institute. These programmes were held both at the Institute and at its nested units located in Agartala, Shillong, Mamring, Mothabari, Dimapur, and Jorhat.

**Training on Seri-Business for Students**

The Institute also organized a two day Orientation and Awareness Training Programme on Sericulture and Seri-Business Opportunities for students, in collaboration with the Department of Zoology, Serampore College, Hooghly, Kolkata. Students from undergraduate and postgraduate programs, along with faculty members from various colleges, participated in the programme.

A sericulture exhibition was set up on the college premises as part of the event. Scientists and experts from the Institute, along with invited speakers, conducted theoretical and technical sessions covering different aspects of seri-business. A total of 110 students took part in the programme and expressed strong interest in pursuing careers as sericultural entrepreneurs.

**Other Training Programmes**

Non-CBT (5–7 days) and need-based training programmes were conducted on demand to provide training in the latest mulberry sericulture technologies. These programmes targeted officers, officials, students, stakeholders, and unemployed youth, primarily on a paid basis. A total of 618 personnel were

trained across 16 batches/programmes. Of the 618 participants, 380 stakeholders were sponsored by the Government of West Bengal and trained in 9 batches and 73 farmers were sponsored by the Government of Uttar Pradesh and trained in 2 batches.

**Exposure Visits (Non-CBT Programme)**

Non-CBT exposure visits (1–3 days) were conducted for farmers and students from various districts to showcase best practices and provide basic knowledge of mulberry sericulture and recent technologies. A total of 746 participants including students from non-CSB institutions and input suppliers from KVK organizations took part in 21 batches of exposure visits organized by the Institute.

**Some Photographs during the Training Sessions**

<table>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Hands on Training Programme</td><td>FST Programme</td><td>PGDS Students Practical</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>ECP</td><td>ECP</td><td>Induction Training for Newly Joined CSB Scientists</td></tr>
<tr><td colspan="3">  </td></tr>
<tr><td colspan="3">Training cum Awareness Programme on Sericulture & Seri-Business Opportunities</td></tr>
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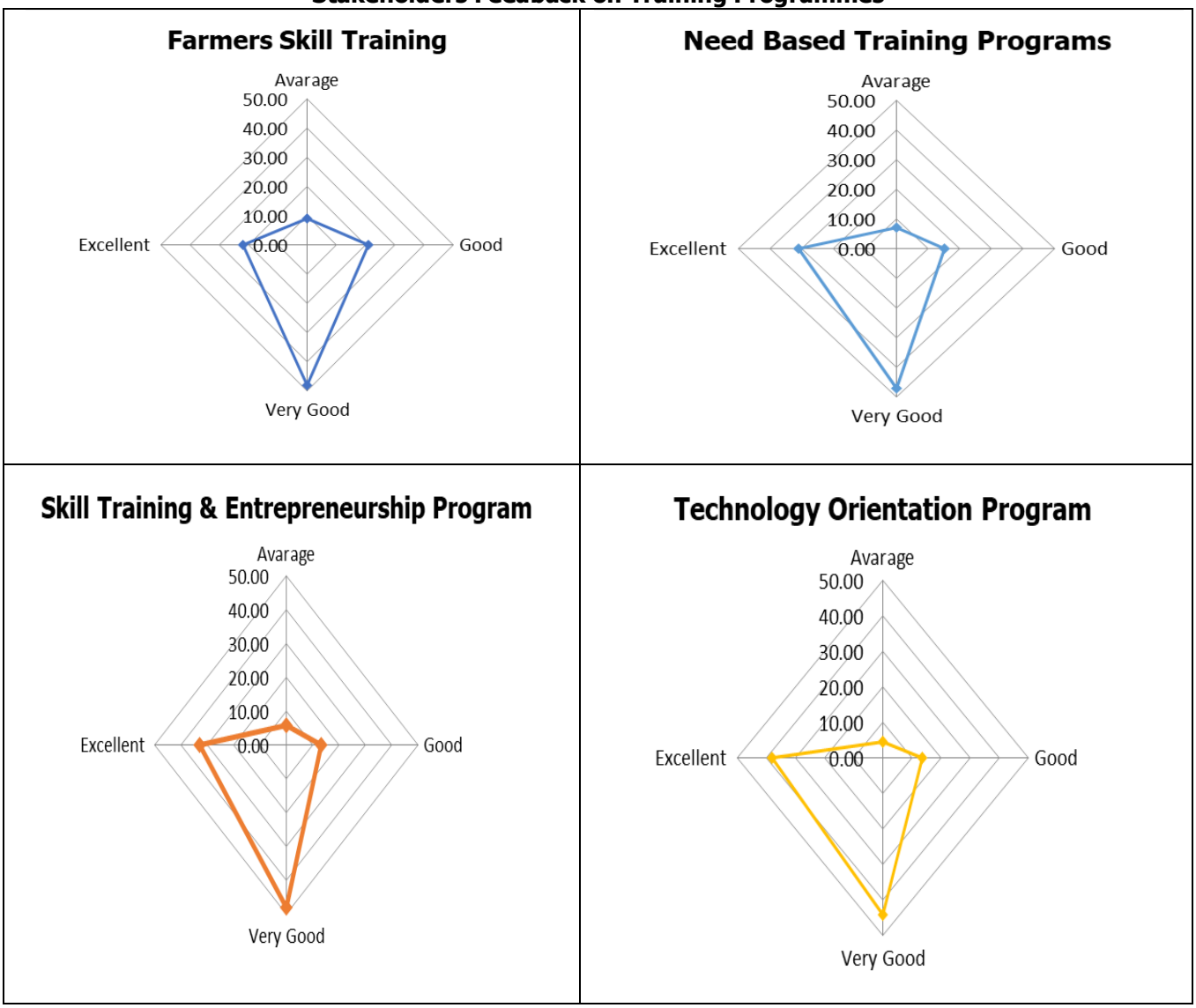
**Stakeholders Feedback on Training Programmes**




| Special Activities on Women Empowerment & Development of SC/ST/Weaker Sections for 2023-2024 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Program** | **Male** | | | | | **Female** | | | | | **Grand Total** |
| | **SC** | **ST** | **OBC** | **Gen.** | **Total** | **SC** | **ST** | **OBC** | **Gen** | **Total** | |
| **PGDS (2023-2024)** | - | 7 | - | 3 | 10 | 2 | 6 | - | 2 | 10 | 20 |
| **FST** | 82 | 65 | 60 | 35 | 242 | 48 | 72 | 56 | 27 | 203 | 445 |
| **TOP** | 13 | - | 29 | 38 | 80 | 3 | - | 6 | 5 | 14 | 94 |
| **STEP** | - | - | 02 | - | 02 | 25 | - | 15 | 10 | 50 | 52 |
| **EXPO.VISIT** | 26 | 38 | 40 | 13 | 117 | 10 | 36 | 16 | 15 | 77 | 194 |
| **SRC** | 119 | 19 | 208 | 131 | 477 | 48 | 08 | 196 | 71 | 323 | 800 |
| **SERI-BUSINESS** | 06 | - | 18 | 35 | 59 | 04 | - | 14 | 33 | 51 | 110 |
| **NBT (Training)** | 103 | 52 | 141 | 139 | 435 | 37 | 13 | 66 | 67 | 183 | 618 |
| **NBT(Expo Visit)** | 45 | 14 | 149 | 204 | 412 | 41 | 23 | 156 | 114 | 334 | 746 |
| **Total** | **394** | **195** | **647** | **598** | **1834** | **218** | **158** | **525** | **344** | **1245** | **3079** |

## Concluded Research Projects

### MOE02011EF: Development of seri-entrepreneurship through sericulture chawki business by setting up 02 chawki rearing centres (CRC) as demonstrative units in Murshidabad district, West Bengal

**[March 2021 - February, 2024]**

**PI's:** Parameswaranaik, J. (from October, 2023), Shafi Afroz (upto October, 2023)

**CI's:** Manjunatha G.R., Srinivasa, G., Dipesh Pandit, Parameswaranaik, J. (upto October, 2023)

**Objectives:**

- To initiate chawki business in sericulture villages of Murshidabad district
- To assess the impact of chawki Seri-business on the economic condition of the farmers

**Progress:**

A total of fifteen chawki crops were successfully taken up, and over 1,34,300 dfls were distributed to more than 1,500 sericulture farmers by the Chawki Rearing Centres (CRCs) in the district. To meet the growing demand, three additional chawki crops were also undertaken. This initiative aimed to support local farmers and ensure an adequate supply to meet market needs.

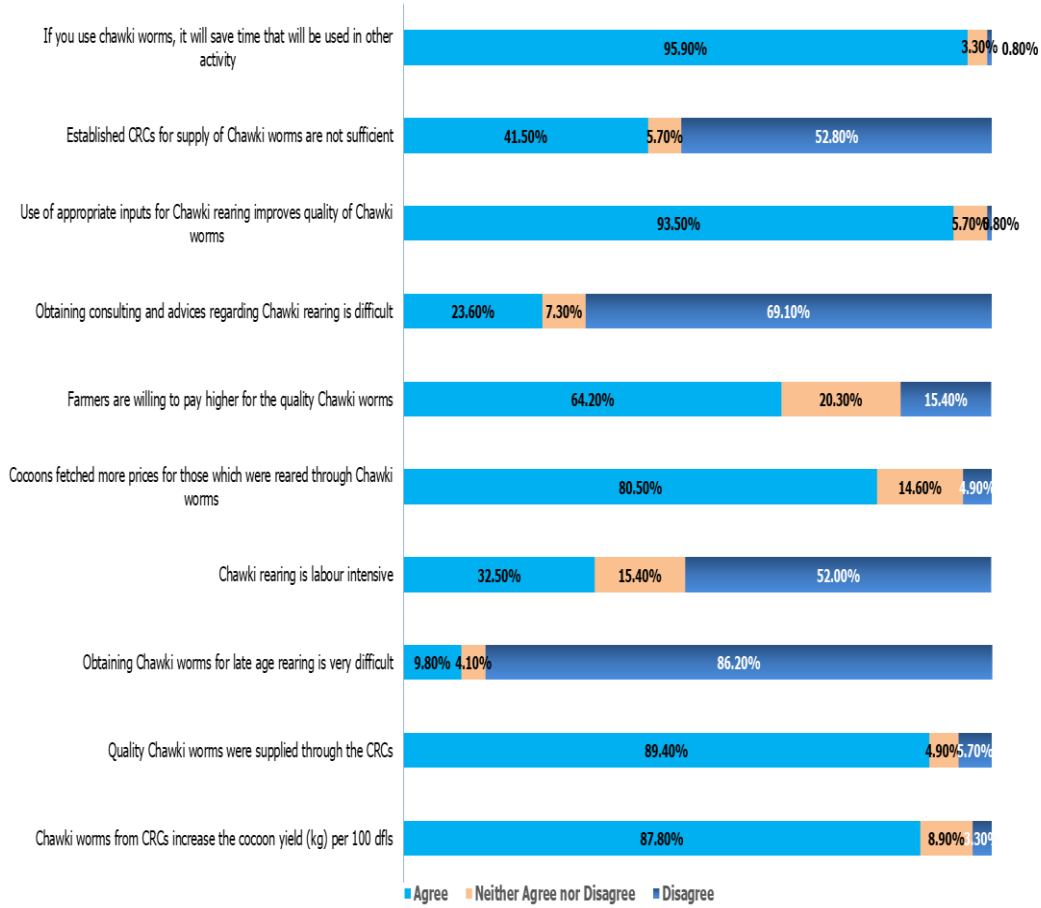
Silkworm eggs of the N × (SK6 × SK7) hybrid were procured from SSPC-Berhampore. These eggs were reared by chawki rearers and later sold to over 1,500 farmers at a rate of ₹1,200 per 100 dfls of chawki worms. Farmers typically purchase chawki worms in the range of 100 to 400 dfls per crop, allowing them flexibility according to their needs and available resources.

The average cocoon productivity for beneficiary farmers using chawki worms was 51.6 kg per 100 dfls, compared to 46.7 kg per 100 dfls for other farmers. This reflects a 10.7% increase in cocoon yield due to the use of chawki worms.

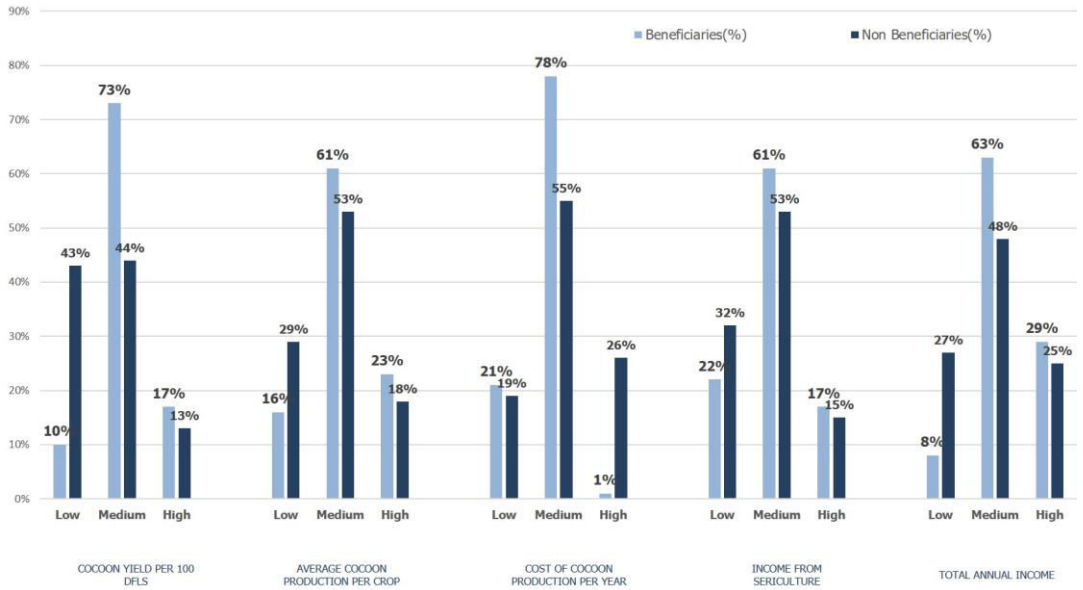
Two technical workshops on chawki rearing were organized in the Murshidabad and Malda districts to promote the use of commercial CRCs and chawki worms. An exposure visit for sericulture farmers from Murshidabad was also organized, with funding support from NABARD, to Mysore and other sericulture regions in Karnataka.

In Murshidabad district, two commercial CRCs have been established. Farmers are experiencing tangible benefits, including a significant increase in yield per 100 dfls compared to traditional silkworm-rearing methods. Over 1,500 farmers have directly benefited from using chawki worms, with demand continuing to rise indicating strong acceptance among the farming community. Despite the brushing capacity of each CRC being 5,000 dfls per crop, CRC owners have made alternative arrangements, such as taking up additional crops, to meet the growing demand without compromising on quality.

However, there is an urgent need to strengthen the capacity of CRCs and provide them with necessary support. Additionally, it is essential to replicate the CRC infrastructure in other blocks of the district and across the state to enhance agricultural development and promote rural prosperity.




**Economic benefits received by farmers in study area**



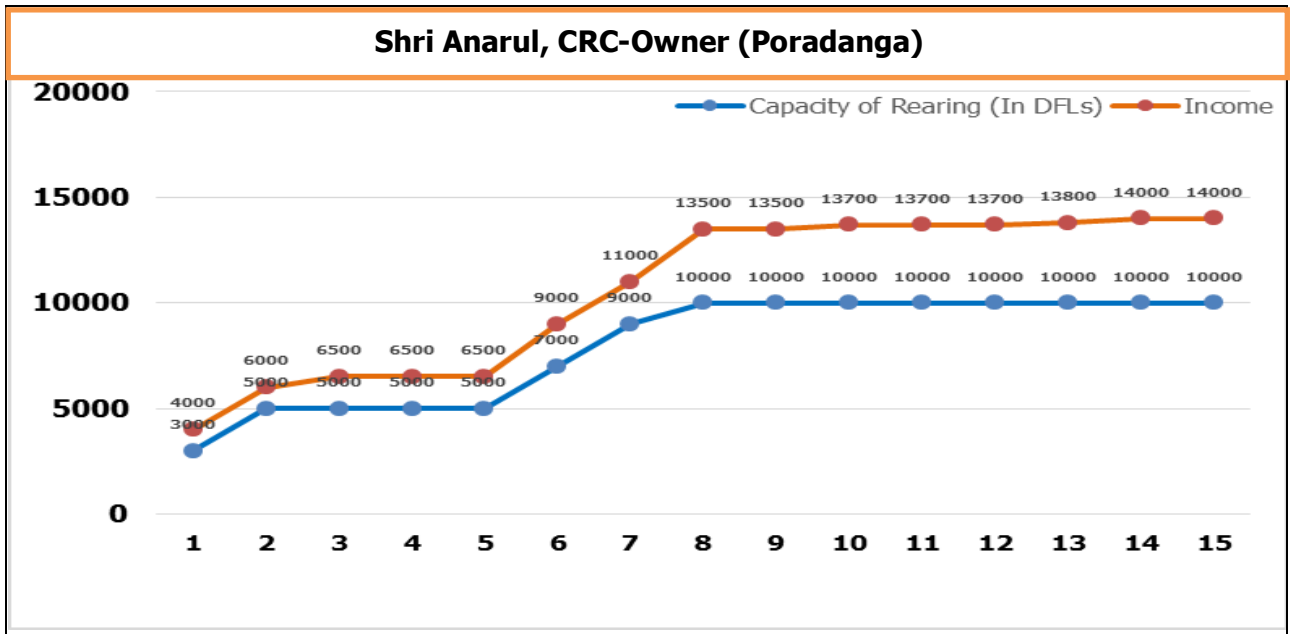

**Farmers feedback with respect to use of chawki worms**

**Benefits of CRCs:**

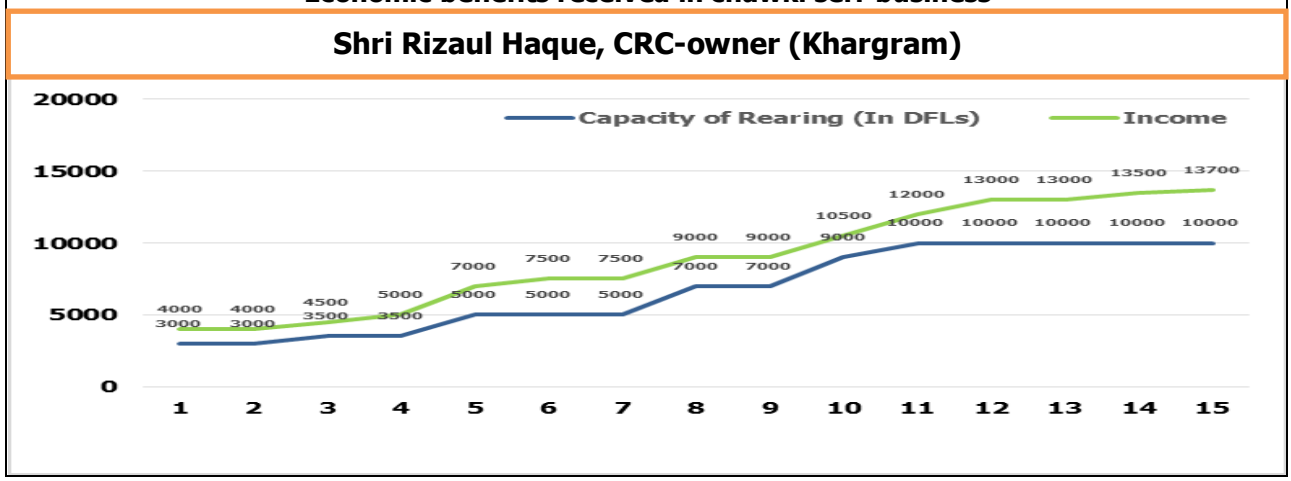
**Owners:**

- **Shri Anarul, CRC-Owner (Poradanga):** Shri Anarul, one of the CRC owners from Murshidabad district, has been successfully rearing chawki worms. He initially started with 3,000 dfls per crop, and has now expanded to 10,000 dfls per crop. His income per crop has increased from ₹4,000 to ₹13,700.

- **Shri Rizaul Haque, CRC-Owner (Khargram):** Shri Rizaul Haque, another CRC owner, has also been meeting the growing demand for chawki worms. He began with 3,000 dfls per crop and has similarly scaled up to 10,000 dfls per crop. His income per crop rose from ₹4,000 to ₹14,000, and in recent crops, he has consistently maintained earnings in the range of ₹13,700 to ₹14,000.




**Economic benefits received in chawki seri-business**




**Economic benefits received in chawki seri-business**

**Outcome:**

- Two commercial CRCs have been established in Murshidabad district
- Farmers are benefiting from increased yield per 100 DFLs compared to their previous silkworm rearing practices
- More than 1,500 farmers have benefited from the use of chawki worms
- Demand for chawki worms is steadily rising, indicating a continuous upward trend
- Farmer acceptance of chawki worms has increased within the study area
- Despite the brushing capacity of each CRC being 5,000 dfls per crop, owners are adopting alternative arrangements, such as taking up additional chawki crops, to meet demand without compromising quality

**Photographs of farmers involved in project implementation and related activities**

**Visit of Director to CRCs**

**Awareness program to promote chawki rearing**

**Transportation of chawki worms to the rearing houses**

**MOT02016EF: Seri-entrepreneurship development in aspirational districts of North-Eastern India**

**[February 2022 - January 2024]**

**PI:** Parameswaranaik J.

**CI's:** Shafi Afroz, Manjunatha G. R., Somen Singh, Swarup Ratan Saha, Amang Mangte Kom

**Objectives:**

- Promotion of 100 seri-enterprises in aspirational districts of NE India
- Assessment of socio-economic benefits of developed seri-enterprises

**Progress:**

To uplift traditional sericulture farming into commercial sericulture, initial handholding support is essential. Accordingly, as approved under the project, technological inputs such as high-yielding mulberry variety (C-2038), disinfectants, chawki rearing kits, plastic collapsible mountages, shelf-rearing racks, and improved reeling units were procured and supplied to selected beneficiaries. The details of the technologies provided are as follows:

**Technological support provided to the beneficiaries in the project**

| # | Hand-holding technologies | Supply status | Quantity supplied | Purpose of supply |
|---|---|---|---|---|
| 1 | Plastic collapsible mountages | Supplied | 50 /beneficiary | Provided for effective and quality cocoon harvest |
| 2 | Shelf rearing racks | Supplied | 1 /beneficiary | Supplied to reduce labor costs and ensure quality cocoon production |
| 3 | Motorized charka with water heating geyser unit | Supplied | 2 /each district | Provided to create a market hub for locally produced cocoon and convert perishable silkworm cocoon into storable raw silk |
| 4 | High yielding mulberry saplings/cuttings | Supplied | 250 to 400 saplings/ cutting per beneficiary | Supplied to increase leaf yield per unit area and enhance brushing capacity of DFLs as per leaf availability |
| 5 | Chawki reaing kit | Supplied | 01 kit/ beneficiary | Provided to reduce silkworm mortality and establish an effective system for young age silkworm rearing |
| 6 | Disinfectants: Labex | Supplied (1st year part) | 05 kg/ beneficiary | Supplied to prevent disease contamination and reduce crop loss due to silkworm diseases |
| 7 | Plastic trays | Supplied | 02/ beneficiary | Provided for efficient silkworm rearing |
| 8 | Leaf chopping knife | Supplied | 01/ beneficiary | Supplied for proper chopping of leaf to provide quality and required size of leaf pieces to silkworms |
| 9 | Green mesh | Supplied | 12 sq. mt. green mesh/beneficiary | Provided for shelf rearing racks to enhance effectiveness and ease of silkworm rearing operations at farmers' level |
| 10 | Nylon rope | Supplied | 03 bundle of 10 mt. each nylon rope/ beneficiary | Supplied for shelf rearing racks to enhance effectiveness and ease of silkworm rearing operations at farmers' level |
| 11 | Bed cleaning net | Supplied | 02 bed cleaning nets/ beneficiary | Provided for ease of bed cleaning process at late age instars of silkworms in shelf rearing racks to reduce labor costs and ease operations |
| 12 | Disinfectants: Labex | Supplied (2nd year part) | 05kg/ beneficiary | Supplied to prevent disease contamination and reduce crop loss due to silkworm diseases |

The implementation of project activities in aspirational districts has catalyzed a remarkable transformation in sericulture production parameters. Beneficiaries who were previously reliant on traditional methods have now embraced modern techniques, facilitated by Entrepreneurship Development Programmes (EDP) and comprehensive technical guidance. Notably, all beneficiaries transitioned to the high-yielding mulberry variety C-2038, resulting in a significant expansion of mulberry cultivation areas. This shift, coupled with the adoption of optimal cultivation practices, has substantially increased leaf yield potential from an average of 30–35 MT/Ha/Year to 50–55 MT/Ha/Year ensuring an abundant supply of healthy mulberry leaves critical for silkworm rearing.

Furthermore, the project's focus on optimal variety selection, improved cultivation techniques, and meticulous management strategies highlights a holistic approach to maximizing sericulture productivity. Before the project, 69% of farmers practiced only bush plantations, while 31% engaged in tree plantations. After implementation, all farmers adopted bush plantations, except for some in the hilly areas of Chandel district, Manipur, where tree plantations were maintained. A majority of beneficiaries adopted the recommended 3x3 spacing, with 83% implementing it post-project significantly improving mulberry cultivation practices. The substantial increase in leaf yield and cocoon production post-implementation stands as evidence of the project's success, with measurable improvements documented across all relevant metrics.

In Dhalai (Tripura) and Chandel (Manipur) districts, the project has led to significant economic gains. Prior to implementation, cocoon yields per 100 DFLs and total production per crop were relatively low. Post-project, both yield and quality improved, while production costs decreased resulting in increased annual income from sericulture. On average, income rose by approximately 32%, with Tripura beneficiaries seeing a 40% increase and Manipur beneficiaries reporting a 23% increase. These results highlight the effectiveness of EDPs in improving socioeconomic conditions in rural communities and align with prior studies emphasizing sericulture's potential for high returns with low investment.

**Total Outcome:**

- 100 young women beneficiaries were successfully trained in sericulture entrepreneurship, enabling the transition from traditional to commercial sericulture in the aspirational districts of Dhalai (Tripura) and Chandel (Manipur)
- Beneficiaries have adopted improved sericultural technologies, including shelf-rearing racks, plastic collapsible mountages, and high-yielding mulberry variety (C-2038) gardens, showing a clear understanding of the value of modern techniques
- Two reeling centers, each equipped with motorized charkas, were established in both districts, serving as pivotal market hubs for locally produced cocoons
- Project intervention led to a 25–30% increase in cocoon yield and net income among the beneficiaries

**Feedback from beneficiaries:**

Feedback from respondents demonstrates the project's strong impact:

- 71% reported acquiring new skills and knowledge, while 29% improved existing skills
- 84% felt their specific needs were adequately addressed
- 80% reported improved socio-economic conditions due to the intervention
- 78% acknowledged increased community participation
- Impressively, 95% affirmed the project's long-term benefits, attributing its success to integrated approaches such as entrepreneurship training and continuous support

**Photographs of activities under the project**

**Ongoing Research Projects**

**MOEQ2022MIC: Vulnerability of sericulture to climate change in India**

**[March 2024 - August 2026]**

**PI:** Parameswaranaik, J.

**CI's:** Rahul K., Ravi Saini (CSB-CSRTI-Berhampore); Joycy Rani Dasari (CSB-CSRTI-Mysore); Plabani Roy (CSB-CSRTI-Pampore), Manjunatha G. R. (CO-CSB, Bengaluru)

**Objectives**:

- To assess the vulnerability and adaptation strategies of seri-farmers to climate change
- To explore the potential areas of sericulture based on climatic factors
- To build the climate resilience among seri-farmers through extension approaches

**Progress**:

The new ongoing project, initiated in March 2023, seeks to address the pressing challenges posed by climate change in the sericulture sector in India through a comprehensive approach encompassing vulnerability assessment, adaptation strategy identification, and the determination of potential sericulture development areas based on climatic factors. By systematically selecting mulberry silk-producing states and employing proportionate random sampling, the project aims to assess the vulnerability of sericulture

farmers to climate change and document their adaptation strategies. Through structured interviews and data analysis, insights into changing weather patterns, soil parameters, water availability, and resource constraints will be gathered, providing a foundation for informed decision-making.

Furthermore, the project will analyze historical climate data to identify potential areas for sericulture development based on climatic suitability at the district level. By comparing weather parameters with the optimal conditions for mulberry sericulture and mapping suitability zones, the project will guide targeted expansion efforts, thereby contributing to the sustainable growth of the sericulture industry across India.

## SERICULTURAL EXTENSION ECONOMICS AND MANAGEMENT (SEEM)

The SEEM Division, on behalf of CSB-CSRTI Berhampore, is entrusted with the responsibility of carrying out extension services across nine states in the Eastern and North-Eastern regions of India through three Regional Sericultural Research Stations (RSRSs) and eight Research Extension Centres (RECs) located in different states. The Transfer of Technology Programmes organized by the Division focus on technology assessment and the facilitation of technology adoption by farmers through state extension functionaries. The Division has undertaken new initiatives such as capacity building of farmers for profitable sericulture and doubling farmers' income by organizing demonstrations to impart practical skills, and field days through the extension units. The Division has organized four Resham Krishi Melas, 45 Front Line Demonstrations, 20 Awareness Programmes, 20 Field Days, and two Technology Workshops.

Additionally, five non-interactive virtual meetings were held with the Union Minister of Textiles in five different locations, with a total participation of around 200 farmers. One virtual interactive meeting was also organized between farmers from Southern and Eastern India. The Division also observed special events such as Silk Day and Swachhata Programmes at the village level. A seri-technology stall was showcased at the KVK campus in Sargachhi as part of the National Conference on Integrated Farming Systems.

The staff strength and in-charge officers engaged in these activities under the Regional Sericultural Research Stations and Research Extension Centres attached to the Institute are provided in the table below.

| State | Unit | Name of Scientist/Incharge | Tech.Staff / Field. Asst. (No.) | TSFW/ SFW (No.) | Farm Based Units | |
|---|---|---|---|---|---|---|
| | | | | | Total (Acre) | Mulberry (Acre) |
| West Bengal | RSRS-Kalimpong | Dr. Harish Babu S., Sci-C | 6 | 15 | 15.785 | 3.75 |
| | REC-Mothabari | Dr. B. Vijaya Naidu, Sci-D | 4 | 3 | 3.89 | 2.75 |
| Jharkhand | REC-Bhandra | Shri. Shankar Rai, STA | 2 | 12 | 11.35 | 5.65 |
| Odisha | RSRS-Koraput | Dr. S. Ranjith Kumar, Sci-B | 6 | 12 | 50.00 | 7.60 |
| Assam | RSRS-Jorhat | Smt. Junumoni Das, STA | 4 | 14 | 12.10 | 7.50 |
| | REC-Mangaldoi | Shri. Vijoy Das, FA | 2 | 1 | 7.00 | 5.50 |
| Sikkim | REC-Mamring | Shri. Bhanu Shilal, STA | 3 | - | - | - |
| Mizoram | REC-Aizawl | Dr. Dip Kumar Gogoi, Sci-D | 1 | - | - | - |
| Tripura | REC-Agartala | Shri. Salam B Meitei, STA | 3 | 1 | 1.50 | 0.50 |
| Meghalaya | REC-Shillong | Shri. Tikaram, FA | 1 | 1 | - | - |
| Nagaland | REC-Dimapur | Shri. Intimokchung, STA | 3 | 4 | 10.00 | 8.50 |

**Ongoing Research Projects**

**MOE02025SIC: Identification of seri-based IFS model for enhancing productivity and income at farmers level in West Bengal, Assam and Manipur**

**[March 2024 - February 2025]**

**PI:** G. Srinivasa; **CI:** Khasru Alam

**Objectives:**

- To work out the complete budgeting by collecting costs and returns of different crops/enterprises practiced by the farmers in the study area
- To identify the efficient seri-based crop combinations for different study areas

**Progress:**

The project has just been initiated with preliminary groundwork underway, including identification of target villages and baseline planning. Initial interactions with farmers have begun to understand the prevailing farming practices and to collect primary data on existing crop and enterprise combinations. The team is currently in the process of developing survey tools and engaging with local stakeholders to facilitate smooth implementation of subsequent project activities.

**Extension Communication Programmes (ECP)**

The SEEM Division, on behalf of CSB-CSRTI-Berhampore, is actively involved in organizing various Extension Communication Programmes across different parts of West Bengal. In addition, it coordinates the implementation of similar programmes through the nested units of the Institute located in various Eastern and North-Eastern states. These units are also engaged in need-based extension activities aimed at technology transfer in mulberry and silkworm crop production, crop protection, and post-cocoon operations in their respective states. The extension activities carried out during the year in different states are summarized in the table below.

| State | Unit | AP | | FFD | | TD | | WSE | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | E | F | E | F | E | F | E | F | E | F |
| West Bengal | CSRTI-BER | 4 | 400 | 5 | 500 | 2 | 40 | 7(1+*6) | 561(130+431) | 18 | 1501 |
| | RSRS-Kalimpong | 2 | 100 | 3 | 150 | 2 | 40 | | | 7 | 290 |
| | REC-Mothabari | 9 | 900 | | | 9 | 211 | - | - | 18 | 1111 |
| Jharkhand | REC-Bhandra | 3 | 187 | | | 3 | 61 | | | 6 | 248 |
| Odisha | RSRS-Koraput | 2 | 139 | 5 | 300 | 2 | 101 | | | 9 | 540 |
| Assam including BTC | RSRS-Jorhat | 2 | 204 | 3 | 285 | 1 | 42 | 1 | 109 | 7 | 640 |
| | REC-Mangaldoi | 3 | 152 | | | 3 | 58 | | | 6 | 210 |
| Sikkim | REC-Mamring | 3 | 176 | | | 3 | 91 | | | 6 | 267 |
| Mizoram | REC-Aizawl | 3 | 150 | 2 | 100 | 4 | 80 | | | 9 | 330 |
| Tripura | REC-Agartala | 6 | 300 | | | 6 | 120 | | | 12 | 420 |
| Meghalaya | REC-Shillong | 3 | 160 | | | 4 | 92 | | | 7 | 252 |
| Nagaland | REC-Dimapur | 3 | 288 | | | 3 | 68 | | | 6 | 356 |
| Arunachal Pradesh | REC-Sille | 2 | 182 | | | 2 | 46 | | | 4 | 228 |
| | Total | 45 | 3338 | 18 | 1335 | 44 | 1050 | 8(2+*6) | 670(239+431) | 115 | 6393 |

E: Events; F: Farmers; AP: Awareness Program; FFD: Farmers' Field Day; TD: Technology Demonstration; WSE: Workshop/ Expo [*Other-6 (Video conference-1 (20); Silk day at field level-1 (17); 26th National Textiles Exhibition- 1(64); Swachhta program- 1 (55); Virtual interaction with Hon'ble Minister- 200 (5 units); Awareness Program-1 (75)]

**PHOTOGRAPHS OF ECPS ORGANIZED BY CSB-CSRTI, BER**

Technology Demonstration (Malda)

TD at Sahebnagar

Chawki Crop Supervision (W.B.)

Awareness Programme (Malda)

Awareness Programme at Digha


RKM (Malda)

EO Meeting, CSB-CSRTI, Berhampore

FFD at Kashipur

SRC Training

## Resham Krishi Mela (RKM):

The advantages of new varieties or technologies over existing/traditional practices were demonstrated to a large group of farmers through Krishi Melas. During the programme, farmers were invited to visit the station and observe firsthand the benefits of the new technologies. In this context, four Resham Krishi Melas were organized in the Eastern and North-Eastern regions, one each at REC-Mothabari (West Bengal), REC-Aizawl (conducted at RSRS-Jorhat, Assam), REC-Agartala (Tripura), and RSRS-Koraput (Odisha). A total of 1,171 farmers and other stakeholders benefited from the Melas. Important technologies were showcased through a small technology exhibition organized during the events.

**Photographs of Resham Krishi Mela (Malda, West Bengal)**

**Cluster Promotion Programme (CPP) in East and North-East India:**

The Central Silk Board, in association with the Departments of Sericulture in various states, has introduced the concept of the Cluster Promotion Programme with the ambitious goal of enhancing bivoltine raw silk production. The Institute administered eight mega clusters through its nested units across six Eastern and North-Eastern states (West Bengal – 2; Assam & Nagaland – 2; Manipur – 2; and one each in Mizoram and Tripura).

Accordingly, a group of villages was selected by each Cluster Development Facilitator (CDF) based on the potential of the area for practicing bivoltine sericulture. Various improved technologies were introduced in these cluster villages and were managed and supervised directly by scientists, jointly with Department of Sericulture counterparts, especially with the cooperation and participation of farmers.

Under each of these clusters, farmers were supported in adopting bivoltine sericulture technologies through an effective Research–Extension–Farmer linkage. As a result, cocoon productivity levels in the cluster areas and consequently, farmers' incomes have increased significantly.

**State and cluster wise list of Cluster Development Facilitators in E & NE clusters**

| Mega Clusters | CSB | DoS |
|---|---|---|
| **West Bengal** | | |
| Malda | Boya Vijaya Naidu, Sci-D, REC-Mothabari; recmothabari@gmail.com; 9441984340<br>Dr. Harishkumar J, Sci-B, SSPC- Berhampore | Smt. Usha Das, DD(S) [I/C], Malda; malseri2@gmail.com;<br>Sri. Bidyut Layek, DD(S) [I/C], Birbhum; birseri@gmail.com; 7001360163 |
| Murshidabad | Dr. Srinivasa G., Sci-D, CSRTI-Berhampore; extn.csrtiber@gmail.com; bvcell.csrti@gmail.com; 9907547467 | Shri S. Chowdhury, DD [I/C], BER; berseri1@gmail.com; 8617224647<br>Mr. Supratim Das, AD(T), Nadia; nadiseri@gmail.com; 9830105014 |

| | | |
|---|---|---|
| **Assam & Nagaland** | | |
| Assam-Lower | Sri. Vijoy Das, FA, REC-Mongaldoi, Bd725549@gmail.com; 9365241181 | Mr. Jagesh C. Talukder, ADS-Mangaldoi, adsofficemld@gmail.com; 9101407835<br>Shri Anjan Kumar Chakraborty, AD (Seri) - Udalgiri; 9435181586 |
| Assam-Upper | Mrs Junumoni Das, STA, RSRS-Jorhat; rsrsjor.cdsb@nic.in; 8876668773<br>Shri Intimokchung, STA, REC-Dimapur; recdimapur.nagaland@gmail.com; 9436430311 | Mrs Dipanjali Das, ADS-Jorhat; 9706067884;<br>Shri Meyase, DSO-Dimapur;7005527030 |
| **Manipur** | | |
| Manipur-Plain | Dr. L. Somen Singh, Sci-D, RTRS-Imphal; somenlaishram@yahoo.com;9612021635 | Ms Js Ngalangaml, AD-Ukhrul; ngalangamjajo@gmail.com; 7628019930 |
| Manipur-Hill | | Ms Lalnunthar, AD-Churachandpur; mangtovang@gmail.com; 8413853111 |
| **Mizoram** | | |
| Aizawl | Dr. Dip Kumar Gogoi, Sci-D, REC-Aizawl; recaizawl2017@gmail.com; 9957034432 | Mrs. Lalmuan Sangi, District Sericulture Officer, Aizawl, dsoproject@gmail.com, 9612125542 |
| **Tripura** | | |
| West Tripura | Shri Salam Bijoy Meitei, STA, REC-Agartala; sgbcrsti@rediffmail.com; 9615179959 | Shri Sanjit Debbarma, Supritendent; sanjitspurty2014@gmail.com; 7005710950 |

**Performance of clusters:** Eight (08) mega clusters in the Eastern and North-Eastern zones produced 1,448.88 MT of cocoons and recorded 161.61 MT (78.07%) of raw silk production (Bivoltine: 64.14 MT & ICB: 97.47 MT) against the target of 207 MT. During 2023–24, a total of 31.26 lakh DFLs (Bivoltine: 10.37 lakh & ICB: 20.89 lakh) were reared against the target of 34.30 lakh DFLs (Bivoltine: 26.30 lakh & ICB: 8.00 lakh), achieving 91.14% of the target.

**Performance of Improved Cross Breed (ICB) under CPP in E & NE Zone (2023-24)**

| Mega Cluster | Dfls (Lakh) | | Cocoon Production(MT) | Yield/100 dfls (kg) | Raw Silk (MT) | | |
|---|---|---|---|---|---|---|---|
| | Target | Ach. | | | Target | Ach. | % Ach. |
| **West Bengal** | | | | | | | |
| Malda | 4.0 | 9.51 | 426.383 | 44.84 | 16.0 | 42.638 | 266.49 |
| Murshidabad | 4.0 | 9.48 | 475.721 | 51.19 | 16.0 | 47.572 | 297.33 |
| **Tripura** | | | | | | | |
| West Tripura | -- | 1.90 | 66.80 | 35.16 | -- | 7.26 | -- |
| Total/Avg. | 8.0 | 20.887 | 968.904 | 43.73 | 32.0 | 97.47 | 304.59 |

**Performance of Bivoltine Hybrids under CPP in E & NE Zone (2023-24)**

| Mega Cluster | Dfls (Lakh) | | Cocoon Production (MT) | Yield/ 100 dfls (kg) | Raw Silk (MT) | | |
|---|---|---|---|---|---|---|---|
| | Target | Ach. | | | Target | Ach. | % Ach. |
| **West Bengal** | | | | | | | |
| Malda | 3.5 | 3.20 | 142.860 | 44.64 | 28.4 | 20.409 | 71.86 |
| Murshidabad | 3.25 | 2.234 | 130.011 | 58.64 | 26.60 | 18.716 | 70.36 |
| **Manipur** | | | | | | | |
| Manipur-Plain | 2.75 | 0.40 | 19.26 | 48.15 | 17.50 | 2.40 | 13.71 |
| Manipur-Hill | 2.75 | 0.95 | 46.71 | 49.17 | 17.50 | 5.80 | 33.14 |
| **Assam & Nagaland** | | | | | | | |
| Assam-Lower | 4.5 | 0.83 | 35.96 | 45.51 | 30.0 | 4.34 | 14.47 |
| Assam-Upper | 4.25 | 0.244 | 8.547 | 34.99 | 24.0 | 1.01 | 4.20 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Mizoram** | | | | | | | |
| Aizawl | 2.80 | 2.03 | 76.84 | 48.02 | 16.0 | 9.14 | 57.12 |
| **Tripura** | | | | | | | |
| West Tripura | 2.5 | 0.516 | 19.79 | 38.35 | 15.00 | 2.33 | 15.53 |
| **Total/Avg.** | **26.3** | **10.404** | **479.978** | **45.93** | **175.0** | **64.145** | **36.65** |

**Silkworm hybrids distributed under CPP of Eastern and Northeastern zone**

| State / Mega Cluster | Bivoltine | ICB |
|---|---|---|
| **West Bengal** (Malda & Murshidabad) | • SK6×SK7<br>• BHP-DH<br>• TT21xTT56 | • N×(SK6×SK7) |
| **Assam & Nagaland**<br>(Assam-Lower & Assam-Upper) | • SK-Hybrids<br>• Double Hybrids | |
| **Manipur**<br><br>(Plain & Hill) | • FC1×FC2<br>• C×J<br>• CSR2×CSR4<br>• SK-Hybrids | |
| **Mizoram**<br>(Aizawl) | • SK-Hybrids<br>• J112 | |
| **Tripura**<br>(West) | • FC1×FC2<br>• SK-Hybrids | • 12Y x BFC1<br>• PM × FC2<br>• N × (SK6×SK7) |

**Multimedia Activities**

| Units | Topics | Language & Channel |
|---|---|---|
| Facebook Programme | | |
| CSRTI-BER | Extension communication Programmes i.e Farmer's Field-day, Awareness Programme, Technology Demonstration Programme, Swachhata Programme, Workshop, Virtual Interaction with farmer to farmer, through 58 social media sites | Bengali |
| REC-Agartala | Resham Krishi Mela | English |
| RSRS-Jorhat | Resham Krishi Mela telecasted on local news | Assamese |
| Twitter @ CsrtiBerhampore | | |
| Instagram @ CSRTIBERHAMPORE | | |
| Facebook @ East North East Silk | | |
| WhatsApp @ CSRTI-Berhampore and Sub-units of CSRTI-Berhampore | | |

## Project Monitoring, Co-ordination and Evaluation (PMCE)

**MOE02014SI: Popularization of improved sericultural technologies for Eastern and North-Eastern India**

**[February 2022 - January 2025]**

**Co-ordinator:** Dipesh Pandit (upto 31.12.2023), K. Rahul (from 01.01.2024)

**Component-I: Popularization of new mulberry varieties in Eastern and North-Eastern India**

**PI:** Suresh K

**CI's:** Deepika K U, Dip Kumar Gogoi, Ranjith Kumar, Officers in charge of trial units

**Objectives:**

- Popularization of new mulberry varieties among the farmers in E & NE India
- Impact assessment with regard to cocoon crop productivity

**Progress:**

An on-farm trial (OFT) is an adaptive research approach conducted on farmers' fields within their existing farming systems and management practices. The purpose of on-farm testing is to validate research findings under real-world conditions and refine technologies to suit local needs, ensuring better adoption by farmers. The Central Silk Board recently authorized two high-yielding mulberry varieties, C-2038 (for plains) and Tr-23 (for hills) along with two stress-tolerant varieties: C-2028 (for waterlogged areas) and C-776 (for coastal saline soils) in the Eastern and North-Eastern regions of India. These four new mulberry varieties (C-2038, Tr-23, C-2028, and C-776) are being promoted through field establishment and evaluated for leaf and cocoon yield across different states in these regions. This is a technology transfer program carried out by scientists in farmers' fields to evaluate new technologies under diverse agro-climatic conditions, aiming to enhance productivity and farmer income over time.

Implementation in 2023–24: In 2023–24, OFTs were conducted for three new mulberry varieties (C-2038, Tr-23, and C-2028) across sericulture districts in six states of the East and North-East. Mature stem cuttings were collected from established stock gardens at CSB units, and the required saplings were raised in nurseries prior to the planting season. At CSB-CSRTI Berhampore, mature saplings were produced for Southern West Bengal as follows, C-2038: 35,000 saplings, Tr-23: 2,000 saplings, C-776: 1,000 saplings and C-2028: 4,000 saplings. Beneficiaries were selected in consultation with state sericulture officials. Each beneficiary received healthy saplings, 900 for irrigated plots and 400 for rainfed gardens during the planting season. Planting was done as per recommended practices, and establishment status was verified after three months.

Verified farmers were also provided with inputs such as vermicompost, fertilizers, and fungicides. The newly established mulberry gardens were managed using the recommended agronomic package of practices.

**Area of establishment and survival rates:**

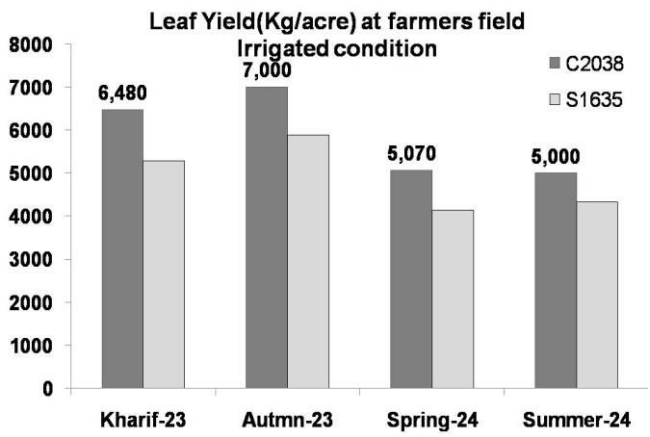
- C-2038 was planted over 8.08 acres by 101 farmers across four states, achieving 85–90% survival
- C-2028 was established by 10 farmers in waterlogged areas of Assam with over 80% survival
- Tr-23 was established by 9 farmers in hill regions of West Bengal with over 80% survival
- Inputs were supplied to ensure proper establishment of the plantations

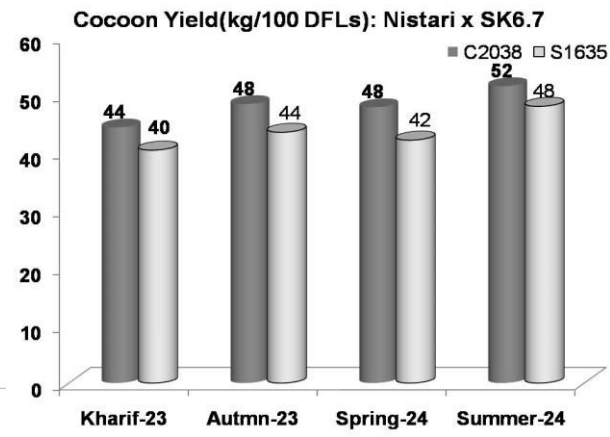
**Yield Performance:**

Leaf and cocoon yield data were collected from ten farmers with newly established C-2038 irrigated gardens across different seasons. For comparison, data from existing plantations of the popular variety S1635 were also recorded. C-2038 recorded 15–23% higher leaf yield than S1635 (which yields 4,909 kg/acre) under irrigated conditions. The multi-bivoltine silkworm hybrid (Nistari × SK6.7) fed on C-2038 leaves recorded 7–14% higher cocoon yield than that from S1635 leaves (which yield 44 kg/100 DFLs). Overall, C-2038 outperformed S1635 with approximately 20% higher leaf yield and 10% higher cocoon yield in on-farm trials. Based on OFT results, C-2038 has proven to be a promising and suitable variety for irrigated conditions in the Southern Irrigated Zone of West Bengal, offering a significant advantage over the existing variety S1635.

**Establishment and OFT of new mulberry varieties at farmers field**

| CSB units | Target | | Achievement | | Saplings Survival (%) |
|---|---|---|---|---|---|
| | Farmers (No.) | Area (Acres) | Farmers (No.) | Area (Acres) | |
| CSRTI, Berhampore | 40 | 3.20 | 31 | 2.48 | 95 |
| REC, Mothabari | 20 | 1.60 | 20 | 1.60 | 90 |
| RSRS, Koraput | 10 | 0.80 | 10 | 0.80 | 85 |
| REC, Bhandra | 10 | 0.80 | 10 | 0.80 | 80 |
| RSRS, Jorhat | 10 | 0.80 | 10 | 0.80 | 90 |
| REC, Mangaldoi | 10 | 0.80 | | | |
| REC, Shillong | 5 | 0.40 | | | |
| REC, Dimapur | 10 | 0.80 | 10 | 0.80 | 80 |
| REC, Agartala | 10 | 0.80 | 10 | 0.80 | 80 |
| REC, Sille | 5 | 0.40 | | | |
| RSRS,Kalimpong | 10 | 0.80 | 3 | 0.24 | 78 |
| REC, Dimapur | 5 | 0.40 | 5 | 0.40 | 85 |
| REC, Shillong | 5 | 0.40 | | | |
| REC, Agartala | 5 | 0.40 | | | |
| REC, Aizawl | 10 | 0.80 | | | |
| REC, Sille | 5 | 0.40 | | | |
| RSRS, Jorhat | 10 | 0.80 | 10 | 0.80 | 85 |
| CSRTI, Berhampore | 5 | 0.40 | 1 | 0.08 | 85 |
| | **180** | **14.80** | **120** | **9.60** | **85** |



## Component-II: Popularization of bio-control agents for the management of mulberry pests

**PI:** Khasru Alam (upto December 2023), Reshma R (from January 2024), Officers in charge of trial units

**Objectives:**

- Popularization of bio-control agents at field level for eco-friendly management of thrips and mealy bugs in mulberry
- Impact assessment with regard to cocoon crop productivity

**Progress:**

During the year, a total of 1,58,070 *Chrysoperla zastrowi sillemi* eggs were mass-produced in the laboratory, of which 24,300 were released in farmers' fields across four locations in West Bengal for the biological control of mulberry thrips. The releases were carried out in 45 farmers' fields in Murshidabad, 23 in Birbhum, 44 in Nadia, and 10 in Kalimpong, covering approximately 50 acres. The introduction of this biological control agent resulted in average pest population reductions of 57.65%, 59.44%, and 55.41% in Murshidabad, Birbhum, and Nadia respectively, when compared to control plots, and reductions of 39.59%, 38.44%, and 31.63% when compared to pre-release pest populations. In Kalimpong, pest reduction was 66.50% compared to control plots and 30.39% compared to pre-release levels. The remaining eggs were used for continuous culture multiplication throughout the year.

**Efficacy of *Chrysoperla zastrowi sillemi* against thrips under field conditions in E & NE India**

**Alinagar, West Bengal**

| Farmers | Pre count thrips /leaf | Post count thrips /leaf | P value (pre vs post) | Significance level | Reduction over pre-count (%) | Control thrips count /leaf | P value (Post vs Control) | Significance level | Reduction over control (%) |
|---|---|---|---|---|---|---|---|---|---|
| Farmer-1 | 10.53 | 6.27 | < 0.00001 | HS | 40.51 | 13.67 | < 0.00001 | HS | 54.15 |
| Farmer-2 | 10.87 | 6.27 | < 0.00001 | HS | 42.33 | 15.73 | < 0.00001 | HS | 60.17 |
| Farmer-3 | 12.07 | 6.2 | < 0.00001 | HS | 48.62 | 17.13 | < 0.00001 | HS | 63.81 |
| Farmer-4 | 10.27 | 7.00 | < 0.00001 | HS | 31.82 | 15.13 | < 0.00001 | HS | 53.74 |
| Farmer-5 | 11.73 | 6.8 | < 0.00001 | HS | 42.05 | 17.8 | < 0.00001 | HS | 61.80 |
| Farmer-6 | 11.80 | 7.27 | < 0.00001 | HS | 38.42 | 16.67 | < 0.00001 | HS | 56.40 |
| Farmer-7 | 10.67 | 7.67 | < 0.00001 | HS | 28.13 | 15.83 | < 0.00001 | HS | 51.58 |
| Farmer-8 | 12.13 | 7.67 | < 0.00001 | HS | 36.81 | 17.03 | < 0.00001 | HS | 54.99 |
| Farmer-9 | 12.33 | 6.8 | < 0.00001 | HS | 44.86 | 16.07 | < 0.00001 | HS | 57.68 |
| Farmer-10 | 10.27 | 6.13 | < 0.00001 | HS | 40.26 | 15.67 | < 0.00001 | HS | 60.85 |
| **Average** | **11.27** | **6.81** | | | **39.59** | **16.07** | | | **57.65** |

**Birbhum, West Bengal**

| Farmers | Pre count thrips /leaf | Post count thrips /leaf | P value (pre vs post) | Significance level | Reduction over pre-count (%) | Control thrips count /leaf | P value (Post vs Control) | Significance level | Reduction over control (%) |
|---|---|---|---|---|---|---|---|---|---|
| Farmer-1 | 7.00 | 5.33 | >0.01 | NS | 23.81 | 10.93 | < 0.00001 | HS | 51.22 |
| Farmer-2 | 8.17 | 4.40 | < 0.00001 | HS | 46.12 | 11.20 | < 0.00001 | HS | 60.71 |
| Farmer-3 | 7.87 | 4.07 | >0.01 | NS | 48.31 | 12.60 | < 0.00001 | HS | 67.72 |
| Farmer-4 | 7.73 | 4.67 | >0.01 | NS | 39.66 | 12.47 | < 0.00001 | HS | 62.57 |
| Farmer-5 | 6.77 | 4.13 | >0.01 | NS | 38.92 | 15.67 | < 0.00001 | HS | 73.62 |
| Farmer-6 | 7.83 | 4.67 | <0.01 | S | 40.43 | 11.47 | < 0.00001 | HS | 59.30 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Farmer-7 | 8.13 | 5.67 | < 0.00001 | HS | 30.33 | 11.53 | < 0.00001 | HS | 50.87 |
| Farmer-8 | 8.8 | 5.73 | < 0.00001 | HS | 34.85 | 11.33 | < 0.00001 | HS | 49.41 |
| Farmer-9 | 9.1 | 5.53 | < 0.00001 | HS | 39.19 | 12.43 | < 0.00001 | HS | 55.50 |
| Farmer-10 | 8.73 | 5.13 | <0.01 | S | 41.22 | 14.07 | < 0.00001 | HS | 63.51 |
| **Average** | **8.01** | **4.93** | | | **38.44** | **12.37** | | | **59.44** |

## Nadia, West Bengal

| Farmers | Pre count thrips /leaf | Post count thrips /leaf | P value (pre vs post) | Significance level | Reduction over pre-count (%) | Control thrips count /leaf | P value (Post vs Control) | Significance level | Reduction over control (%) |
|---|---|---|---|---|---|---|---|---|---|
| Farmer-1 | 6.33 | 4.53 | >0.01 | NS | 28.42 | 13.20 | < 0.00001 | HS | 65.66 |
| Farmer-2 | 10.40 | 5.87 | < 0.00001 | HS | 43.59 | 13.10 | < 0.00001 | HS | 55.22 |
| Farmer-3 | 7.87 | 6.93 | >0.01 | NS | 11.86 | 13.60 | < 0.00001 | HS | 49.02 |
| Farmer-4 | 9.00 | 5.33 | <0.01 | S | 40.74 | 11.03 | < 0.00001 | HS | 51.66 |
| Farmer-5 | 7.07 | 6.27 | >0.01 | NS | 11.32 | 14.87 | < 0.00001 | HS | 57.85 |
| Farmer-6 | 11.07 | 5.93 | <0.01 | S | 46.39 | 13.70 | < 0.00001 | HS | 56.69 |
| Farmer-7 | 9.00 | 5.33 | >0.01 | NS | 40.74 | 13.93 | < 0.00001 | HS | 61.72 |
| Farmer-8 | 8.67 | 6.73 | >0.01 | NS | 22.31 | 13.27 | < 0.00001 | HS | 49.25 |
| Farmer-9 | 10.33 | 6.00 | >0.01 | NS | 41.94 | 11.87 | < 0.00001 | HS | 49.44 |
| Farmer-10 | 8.27 | 5.87 | >0.01 | NS | 29.03 | 13.30 | < 0.00001 | HS | 55.89 |
| **Average** | **8.80** | **5.88** | | | **31.63** | **13.19** | | | **55.41** |

## Kalimpong, West Bengal

| Farmers | Pre count thrips /leaf | Post count thrips /leaf | P value (pre vs post) | Significance level | Reduction over pre-count (%) | Control thrips count /leaf | P value (Post vs Control) | Significance level | Reduction over control (%) |
|---|---|---|---|---|---|---|---|---|---|
| Farmer-1 | 1.87 | 1.07 | >0.01 | NS | 42.85 | 3.40 | < 0.00001 | HS | 68.63 |
| Farmer-2 | 2.27 | 1.33 | < 0.01 | S | 41.17 | 2.80 | < 0.01 | S | 52.38 |
| Farmer-3 | 1.87 | 1.13 | >0.01 | NS | 39.28 | 3.20 | < 0.00001 | HS | 64.58 |
| Farmer-4 | 1.93 | 1.47 | >0.01 | NS | 24.13 | 4.00 | < 0.00001 | HS | 63.33 |
| Farmer-5 | 2.00 | 1.40 | >0.01 | NS | 30 | 4.00 | < 0.00001 | HS | 65.00 |
| Farmer-6 | 1.80 | 1.53 | >0.01 | NS | 14.81 | 4.53 | < 0.00001 | HS | 66.18 |
| Farmer-7 | 1.87 | 1.67 | >0.01 | NS | 10.71 | 4.47 | < 0.00001 | HS | 62.69 |
| Farmer-8 | 2.13 | 1.07 | < 0.01 | S | 50 | 4.60 | < 0.00001 | HS | 76.81 |
| Farmer-9 | 1.73 | 1.27 | >0.01 | NS | 26.92 | 5.00 | < 0.00001 | HS | 74.67 |
| Farmer-10 | 1.67 | 1.27 | >0.01 | NS | 24 | 4.33 | < 0.00001 | HS | 70.77 |
| **Average** | **1.91** | **1.32** | | | **30.39** | **4.03** | | | **66.50** |

**Participation of mulberry farmers of different regions in release of biocontrol agents**

**Component-III: Popularization of eco-friendly disinfectant, NIRMOOL®**

**PI:** Rahul K
**CI:** M. Rabha, Officers in charge of trial units

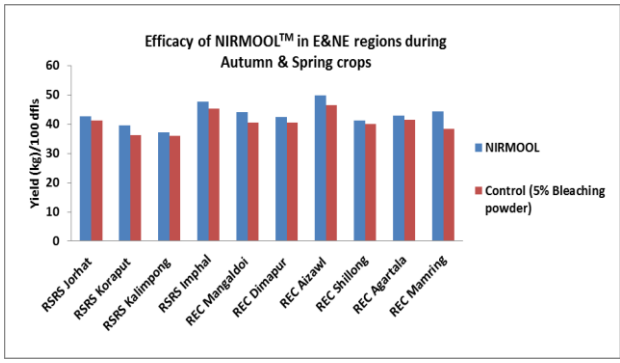
**Objectives:**

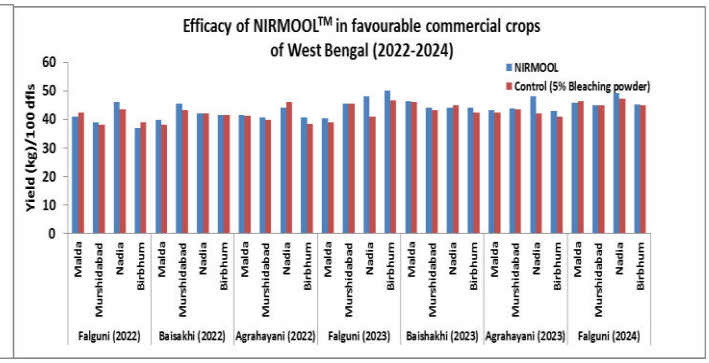
- Popularization of NIRMOOL®, a general disinfectant with sericulture farmers of E & NE India
- Impact assessment at farmers' level

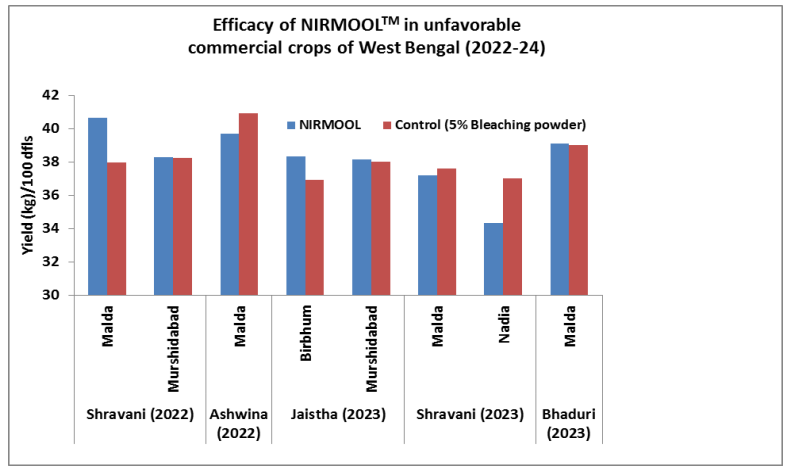
**Progress:**

NIRMOOL® is an eco- and user-friendly, broad-spectrum room disinfectant effective against all major silkworm pathogens. It is non-corrosive and non-chlorinated. The trademark 'NIRMOOL®' was accepted by the Trade Marks Registry, Government of India, and registered under Class 5. The popularization of NIRMOOL® was carried out at the farmers' level during both autumn and spring crops in the Northeastern region through nested units, including RECs and RSRSs. In West Bengal, the initiative was implemented across five crop cycles in a year. In the Northeastern states, NIRMOOL® and 5% bleaching powder (as the control treatment) were distributed to 289 farmers, yielding satisfactory results. The average cocoon yield recorded was 43.14 kg per 100 DFLs for NIRMOOL® users and 40.60 kg per 100 DFLs for users of 5% bleaching powder (bivoltine hybrids). In West Bengal, during favorable commercial crops (Falguni, Baisakhi, and Agrahayani, 2022–2024), the average yield was 43.44 kg per 100 DFLs for

NIRMOOL® users and 42.14 kg per 100 DFLs for the control group (Multi × Bi cross breeds). During unfavorable crops (Jaistha, Shravani, Bhaduri, and Ashwina), the average yield per 100 DFLs was 38.21 kg for NIRMOOL® users and 38.19 kg for the control group (Multi × Bi cross breeds). Overall, the performance of NIRMOOL® was found to be comparable to that of 5% bleaching powder in both the Eastern and Northeastern regions across different crops and seasons.




**Component-IV: Popularization of chawki, shoot/shelf rearing and Plastic collapsible mountages**

**PI:** Srinivasa G

**CI's:** Shafi Afroz, Officers in charge of trial units

**Objectives:**

- Popularization of proven silkworm cocoon production technologies like Chawki and Shoot feeding/ Shelf rearing and usage of Plastic collapsible mountages among the farmers' in E and NE India
- Impact assessment on cocoon productivity at farmers' level

**A. Popularization of chawki rearing**

**Progress:**

Visualizing the success of rearing young-age silkworms and distributing them at the second moult stage, the Institute is promoting this concept under a project in the Eastern and Northeastern regions. Under the project, seven Chawki Rearing Centres (CRCs), each with a capacity of 1,000 DFLs per crop were identified as beneficiaries and supported for two crops during 2023–24 in West Bengal (2), Assam BTC (1), Tripura (1), Nagaland (1), Mizoram (1), and Meghalaya (1). Each beneficiary was provided with

1,000 DFLs, along with necessary supplies including bed and room disinfectants, paraffin paper, incubation frames, black cloth, foam pads, brushing nets, and lime to support chawki rearing. Additionally, CRC owners were given ₹6,000 per crop as chawki charges. The chawki worms were distributed to farmers after the second moult. Cocoon production per 100 DFLs from chawki worms was compared with that from direct brushing. The unit-wise yields and cocoon parameters are provided in the table below. It was observed that this technology resulted in a higher cocoon yield ranging from 3.0% to 11.0% across different sub-units, with an average yield increase of 8.12% over the control.

| Unit | CRC | Season | Hybrid | Hatching (%) | Larval weight* (g) | Missing larvae (%) | Unequal larvae (%) | Yield/100 dfls (kg) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | CRC | Direct | Gain (%) |
| CSRTI-BER | 1 | AGR'23 & FAL'24 | N x (SK6.7) | 97.0 | 2.95 | 1.50 | Nil | 50.75 | 47.5 | 6.84 |
| REC-Mothabari | 1 | | N x (SK6.7) | 93.0 | 2.15 | 3.375 | 1.125 | 46.50 | 42.00 | 10.71 |
| REC-Mangaldoi | 1 | Autumn'23 & Spring'24 | SK Hybrid | 93.0 | 3.00 | 4.00 | 3.00 | 46.00 | 41.50 | 10.84 |
| REC-Agartala | 1 | | PM x SK6.7 | 92.0 | 3.05 | 4.50 | 1.50 | 45.5 | 43.5 | 4.60 |
| REC-Dimapur | 1 | | BHP-DH | 85.0 | 3.00 | 1.80 | 1.0 | 44.00 | 40.00 | 10.00 |
| REC-Aizawl | 1 | | SK6.7 | 91.50 | 3.55 | 3.75 | 2.74 | 49.5 | 45.00 | 10.00 |
| REC-Shillong | 1 | | SK Hybrid | 94.0 | 2.90 | 3.5 | 5.00 | 40.5 | 39.00 | 3.85 |
| | | | | | | | **Average** | 46.11 | 42.64 | 8.12 |
| *Weight of hundred larvae under 2nd moult; AGR-Agrahayani; FAL-Falguni | | | | | | | | | | |

**B. Popularization of shoot rearing and plastic collapsible mountages:** As part of the popularization process, shoot-rearing technology was extended to 140 farmers across West Bengal (Agrahayani 2023 and Falguni 2024 crops), Odisha, Assam BTC, Tripura, Nagaland, Mizoram, and Meghalaya during Autumn 2023 and Spring 2024. For rearing 100 DFLs, each beneficiary was supported with: shelf preparation cost of ₹8,500, 7 kg of bed disinfectant per crop, 7 kg of lime per crop, 2 kg of bleaching powder per crop, 50 bed-cleaning nets, and 50 collapsible plastic mountages. The number of beneficiaries, hybrids reared, season, yield, and cocoon parameters recorded under the technology are provided in the table below. The average cocoon yield obtained through shoot rearing was 42.71 kg per 100 DFLs, compared to 38.32 kg per 100 DFLs in tray rearing, registering an overall yield increase of 11.53%. Furthermore, a 35.34% reduction in labor requirement was observed compared to tray rearing.

| Unit | Season | Hybrid | Beneficiary | Avg. Yield (kg/100 dfls) | | | Reduction in labour | | | Mkt rate (Rs.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Shelf | Dala | Gain (%) | Shelf | Dala | Red. (%) | |
| CSRTI-BER | AGR'23 & FAL'24 | Nx(SK6.7) | 25 | 51.08 | 47.10 | 8.45 | 46 | 34 | 35.29 | 450 |
| REC-Malda | | Nx(SK6.7) | 30 | 44.48 | 40.17 | 10.47 | 38 | 34 | 11.76 | 400 |
| RSRS-KPT | | | 10 | 36.13 | 29.5 | 17.24 | 14 | 11 | 27.27 | 300 |
| RSRS-Jorhat | Autumn' 23 & Spring '24 | TT hybrids | 10 | 32.80 | 28.22 | 16.23 | 41 | 35 | 17.14 | 300 |
| REC-MLI | | DH-Hybrid | 20 | 44.9 | 39.96 | 12.36 | 31 | 22 | 40.91 | 300 |
| REC-Agartala | | SK6.7 | 15 | 40.03 | 37.7 | 6.18 | 19 | 11 | 72.73 | 320 |
| REC-Dimapur | | DH-Hybrid | 10 | 43.32 | 42.19 | 2.68 | - | - | - | 400 |
| REC-Aizawl | | SK6.7 | 10 | 49.36 | 44.80 | 10.18 | - | - | - | 350 |
| REC-Shillong | | SK Hybrid | 10 | 42.30 | 35.25 | 20.00 | 37 | 26 | 42.31 | 500 |
| | | | **Avg.** | **42.71** | **38.32** | **11.53** | **32.29** | **24.71** | **35.34** | |

**Component-V: Popularization of Sampoorna**

**PI:** K. Rahul

**CI's:** M. Rabha, Somen Singh, Officers in charge of trial units

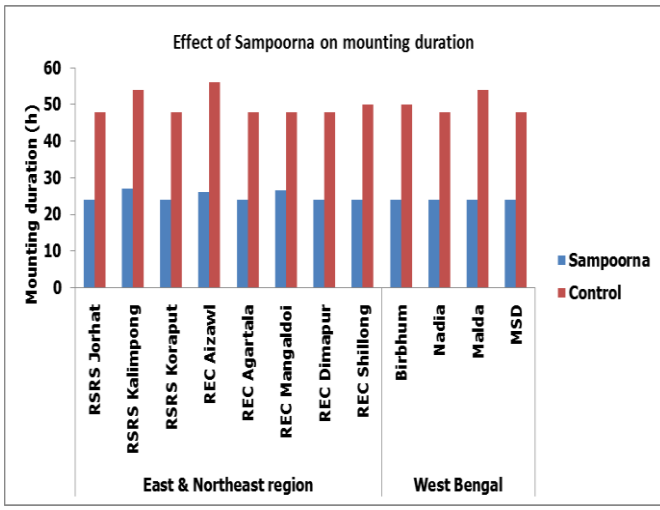
**Objectives:**

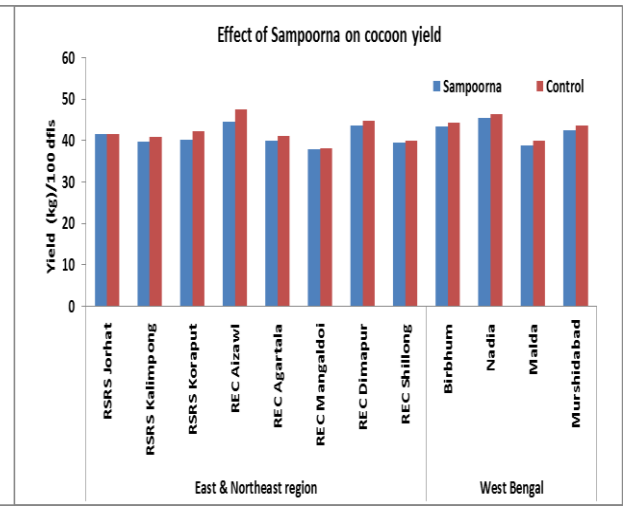
- Popularization of Sampoorna, a phytoecdysteroid formulation in E & NE India
- Impact assessment of Sampoorna on cocoon productivity at farmers' level

**Progress:**

'Sampoorna' is a phytoecdysteroid formulation developed by CSRTI-Mysore to ensure uniform larval maturity and synchronized spinning. In the East and Northeast regions, farmers often face challenges such as delayed spinning, non-uniform maturation, and non-spinning syndromes during winter crops, leading to increased mulberry consumption and higher labor costs. This study aims to analyze the impact of Sampoorna on promoting uniform larval maturity and improving cocoon productivity, thereby addressing these issues at the farmers' level in these regions.

The popularization programme covered 350 farmers during the spring and autumn crops in the Northeast region, monitored by nested units (RSRSs and RECs). In West Bengal, Sampoorna was distributed to 820 farmers across three crop seasons: Agrahayani, Falguni, and Baisakhi. Reports from the concerned units indicated that treating 7$^{th}$ and 8$^{th}$-day larvae (fifth instar) with Sampoorna resulted in uniform maturity and induced spinning within 24 hours, significantly reducing the mounting period and ensuring successful cocoon formation. There was no significant variation in cocoon yields compared to the control group of larvae not treated with Sampoorna.



# REGIONAL SERICULTURAL RESEARCH STATIONS (RSRSs) AND REGIONAL EXTENSION CENTERS (RECs)

RSRSs are established to address the regional problems of sericulturists through research and extension support in varied agro-climatic regions. In addition, RSRSs undertake the validation of new technologies developed by the institute. Proven technologies are further transferred to the field through Research Extension Centres (RECs). CSB-CSRTI-Berhampore has three RSRSs including RSRS-Kalimpong, covering the hilly districts of West Bengal and the state of Sikkim; RSRS-Koraput (Odisha), covering the state of Odisha; and RSRS-Jorhat (Assam), covering the North Eastern states. The main institute coordinates all R&D, extension, and capacity-building programmes in the command states.

**Mandate of the RSRSs:**

- Conduct validation trials of new sericulture technologies developed by the main institute and transfer proven technologies to the field through RECs
- Organize ECP and CBT programmes in collaboration with the Department of Sericulture (DoS) and popularize proven technologies at field level
- Co-ordinate with the DoS and allied departments for extension activities, collect feedback on technologies and monitor crop performance at field level for continuous improvement

**Mandate of the RECs:**

- Serve as field-level units to implement validated technologies and demonstrate their application to sericulture farmers
- Facilitate frontline demonstrations, promote technology adoption through extension programs and engage with local sericulture clusters and farmer groups
- Collect data on field performance, gather farmer feedback, and report findings to institutes to refine and improve sericulture practices

## RSRS-KALIMPONG

RSRS-Kalimpong is situated at an elevation of 3,550 feet above mean sea level (MSL) in the sub-Himalayan belt. The climatic conditions are ideal for bivoltine sericulture. The rearing seasons in this region are spring, summer, and autumn. The station maintains bivoltine mulberry silkworm germplasm.

**Concluded Research Project**

**MTL02017CN: Study on sericulture based IFS in hilly region of West Bengal**

**[March 2022 - February 2024]**

**Objectives:**

- To study the present status of IFS in hilly region of West Bengal
- To estimate the returns and costs of various farm enterprises individually as well as on aggregate level
- To popularize the suitable IFS models through CBT programmes

**Progress:**

A suitable sericulture-based Integrated Farming System (IFS) model was popularized through Capacity Building and Training (CBT) programmes. Two training programmes were conducted, sensitizing 50 farmers to the benefits and practices of the IFS model. Additionally, a total of four extension programmes including awareness programmes and technology demonstrations were organized, reaching over 100 farmers. Four CBT programmes were also conducted in collaboration with KVK Kalimpong. Through these efforts, the sericulture-based IFS model was successfully promoted among local farming communities.

**IFS Models:**

**High Hill Region:**
• Sericulture + Paddy + Maize + Vegetables (Peas, Potato, Tomato) + Piggery + Dairy + Poultry
• Benefit-Cost Ratio (B:C) = 1.24

**Mid Hill Region:**
• Sericulture + Maize + Large Cardamom + Vegetables (Cabbage, Cauliflower, Potato, Tomato) + Piggery + Dairy + Poultry
• B:C = 1.30

**Low Hill Region:**
• Sericulture + Large Cardamom + Vegetables (Tomato, Spinach, Potato, Peas) + Piggery + Dairy + Goatery + Poultry
• B:C = 1.40

**Regional Initiative and Impact**

The Regional Sericultural Research Station (RSRS), Kalimpong, under the aegis of the Central Sericultural Research and Training Institute (CSRTI), Berhampore, and administered by the Central Silk Board, Ministry of Textiles, Government of India, is spearheading a transformative initiative to revolutionize sericulture in the hilly regions of West Bengal. After two years of rigorous research, the station has developed sericulture-based IFS models tailored specifically to the unique agro-climatic conditions of these regions. These comprehensive models integrate various components, including sericulture, dairy, poultry, piggery, and crop farming (with both vegetables and staple crops like maize and paddy).

The station has launched a series of extension and capacity-building training programmes to disseminate these innovative IFS models to local farmers. Over 200 farmers have already benefited from these initiatives, gaining critical insights into the profitability and sustainability of adopting such models. These models are specifically designed for the low hill, mid hill, and high hill zones, enabling farmers to enhance their livelihoods and boost income. Through dedicated research and collaborative implementation, these pioneering IFS models are poised to foster sustainable livelihoods and economic prosperity in the region.

**Other R&D Programmes:**

**Maintenance and evaluation of Bivoltine/Multivoltine germplasm breeds**

**Objective:** Maintenance of Bivoltine germplasm under temperate conditions

**Progress:**

RSRS, Kalimpong maintains a collection of bivoltine germplasm and also conducts trial rearings of bivoltine breeds and hybrids received from the institute for testing purposes. During the Spring 2023 crop season (April–May), these breeds and hybrids were reared under controlled cellular conditions, following standard rearing protocols and environmental parameters. Rearing performance and cocoon characteristics were thoroughly documented and compared against the respective passport data. Selected cocoons were used for seed production. Additionally, during the Summer and Autumn 2023–24 seasons, both germplasm stocks and project-based rearings (including pure breeds and hybrids) were undertaken.

Disease-Free Layings (dfls) were prepared from each germplasm race/breed, and also from project rearings involving both pure and hybrid lines. The rearing reports, data, and prepared dfls were submitted to CSB-CSRTI-Berhampore.

**Field Surveillance and Outreach Programmes at RSRS Kalimpong (2023–24):**

As part of ongoing efforts to monitor and manage mulberry pest and disease dynamics in the Eastern and North Eastern regions of India, RSRS-Kalimpong conducted regular survey and surveillance activities during the year. Periodic monitoring of the mulberry root mealy bug in the Kalimpong hills revealed moderate incidence levels throughout the year, with peak infestation observed in August (average 2.82). Concurrently, data on mulberry disease incidence including Brown Leaf Rust, Yellow Leaf Rust, and Powdery Mildew were recorded fortnightly from both RSRS farm plots and farmers' fields. Notably, Yellow Leaf Rust showed higher incidence during the post-monsoon months, peaking in October with a PI of 5.66. In addition, silkworm disease surveillance was carried out in rearing fields and grainage units to monitor seasonal disease occurrence. Timely observations and data collection on grasserie, flacherie, muscardine, and pebrine supported early management interventions and enhanced seed cocoon quality.

In parallel, technology transfer and outreach activities were actively pursued. On-station trials on low-cost drip fertigation were conducted during the Spring Crop 2024, with data on leaf yield and moisture submitted to the relevant investigators. The station maintained strong collaboration with the KVK for extension communications and initiated efforts to expand sericulture in neighboring Sikkim. As part of farmer outreach, five mKisan SMS advisories in Nepali were disseminated, offering guidance on crop management. Additionally, RSRS-Kalimpong observed the Swachhata Pakhwada from 1$^{st}$ to 15$^{th}$ March 2024 and organized a one-day educational visit and awareness session for college students, fostering community engagement and environmental awareness.

**Implementation of Official Language (OL):**

Four Official Language Implementation Committee (OLIC) meetings were conducted on 13.06.2023, 29.09.2023, 22.11.2023, and 04.03.2024. The Town Official Language Implementation Committee (TOLIC) meeting was held on 11.04.2023. Hindi Fortnight was observed from 14.09.2023 to 29.09.2023. One competition involving staff members of the centre was organized during the Hindi Fortnight on 27.09.2023.

**Photographs of different activities under ECP**

**Nursery bed preparation (FFD)**


**Technology demonstration programme**

**Farmers field day**

**Awareness programme**


**Training programme conducted at Kalimpong**

**One day exposure visit of farmers at REC-Mamring**


**FST Programme on chawki rearing**


**FST Programme on late age rearing**

## RSRS-KORAPUT, ODISHA

RSRS-Koraput, Odisha, was established to provide R&D support for mulberry sericulture in Odisha. It offers technical services to mulberry sericulture farmers in coordination with the Department of Textiles and Handlooms, Government of Odisha. Apart from R&D support, it also undertakes extension activities and provides training to sericulture farmers in the region to promote improved practices in mulberry cultivation and silkworm rearing.

### Research and Development Projects Implemented

RSRS-Koraput, Odisha has been actively involved in implementing multiple research projects aimed at enhancing mulberry sericulture practices in the region. Under the projects titled "Final yield trial of promising high-yielding mulberry genotypes for Eastern and North-Eastern India" and "All India Coordinated Experimental Trial for Mulberry Varieties (AICEM-IV)", experimental plots were meticulously maintained with nearly 100% plant survivability through regular intercultural operations, fertilizer application, and plant protection measures. Data from three crop seasons (August–September 2023, October–November 2023, and February–March 2024) were recorded and submitted to the Investigators at CSB-CSRTI, Berhampore, as per the project guidelines.

Under project MOE02014SI, improved sericultural technologies were disseminated across the region. Notably, trials of NIRMOOL®, an eco-friendly rearing room disinfectant, demonstrated its effectiveness and non-hazardous nature, earning positive feedback from beneficiaries. Additional extension activities included the popularization of collapsible plastic mountages, shoot/shelf rearing, and Sampoorna, a phyto-ecdysteroid solution promoting uniform silkworm maturation. Under MOE02015MI, multiple evaluations were conducted, including trials of the C-2070 mulberry variety for BLS resistance, drip fertigation techniques, and Seriwin, an eco-friendly bed disinfectant, all aimed at enhancing productivity and sustainability in the mulberry sector.

### Extension Communication Programmes:

One Resham Krishi Mela, two Technology Awareness Meets, five Farmers' Field Days, and two Technology Demonstrations were conducted as per the Annual Action Plan 2023–24. These programmes were aimed at disseminating improved sericultural technologies and best practices among farmers to enhance productivity and awareness.

| # | Programme | Target | Achievement | | No. of farmers |
|---|---|---|---|---|---|
| | | | Date | Place | |
| 1 | Technology Awareness Programme | 02 | 23.02.2024 | Petpoda | 63 |
| | | | 07.03.2024 | Boriguda | 76 |
| | | | | | **139** |
| 2 | Technology Demonstration | 02 | 09.11.2023 | Narang | 73 |
| | | | 05.01.2024 | Kartash | 28 |
| | | | | | **101** |
| 3 | Field Day | 05 | 03.11.2023 | Challanput | 60 |
| | | | 15.11.2024 | Parjasilla | 62 |
| | | | 16.02.2024 | Nuagaon | 60 |
| | | | 26.02.2024 | Kauguda | 55 |
| | | | 11.03.2024 | Bademarenga | 73 |
| | | | | | **310** |
| 4 | Resham Krishimela | 01 | 05.03.2024 | RSRS Campus, Landiguda | 220 |
| | **TOTAL** | **10** | | | **770** |

**Capacity Building and Training Programmes:**

A five-day Farmers' Skill Training Programme on "Chawki and Late Age Rearing Technology" was conducted in two batches, each comprising 25 farmers, from 16.10.2023 to 20.10.2023 and from 20.11.2023 to 24.11.2023 at the unit. The farmers were sponsored by ADS, Koraput, and ITDA, Koraput.

**Maintenance of Bivoltine and Multivoltine Silkworm Races:**

Bivoltine and multivoltine silkworm breeds/races, collected from various sources, are being maintained at RSRS-Eri BSF, Koraput. Maintenance is carried out through cellular rearing by following standard procedures.

**Maintenance of Eri Silkworm Races/Breeds:**

The Eri silkworm breed C-02 was maintained at RSRS-Eri BSF during 2023–24. Maintenance was carried out through cellular rearing by following established standard procedures. Rearing performance data were recorded across seven different crop seasons during the year.

**Other Major Activities:**

- Various activities under the Swachhata Mission were conducted in the office premises, neighboring villages, schools, and community centres during October 2023.
- One Vigilance Awareness Programme was observed by the office as per guidelines received from the CO. All employees took the vigilance pledge, and senior advocates Sri Gupta Prasad Panigrahi and Sri Ranjit Patnaik were invited to deliver talks on vigilance-related issues.
- A Vigilance Awareness Programme was also organized at the village Goudaguda, where a rally with vigilance slogans was conducted during the occasion

**Photographs of Different Activities**




**FST programmes**



**TD at Kortash on 05.01.24** | **TD at Narang on 09.11.23** | **FD at Challanput on 03.11.23**

FD at Nuagaon on 16.02.24

AWP at Petpoda on 23.02.24

FD at Parjasilla on 15.11.23


RKM 2023-24

**Photographs of R&D Activities**

AICEM (Phase-IV) Trials

FYT of HY Mulberry Genotypes

BLS resistance C2070 Mulberry Variety

Evaluation of Seri-win bed disinfectant

Popularization of Shoot feeding, collapsible mountage and Shelf rearing

Plantation of Mulberry Varieties

MLT of Biocontrol agents


Eri silkworm race maintenance

**RSRS-JORHAT, ASSAM**

Regional Sericultural Research Station, Jorhat, is engaged in R&D activities in mulberry sericulture under the technical and administrative control of CSB-CSRTI-Berhampore. The station is actively involved in technology trials, extension activities, and capacity-building training (CBT) programmes aimed at improving mulberry sericulture in Eastern and North-Eastern India.

**Research Projects Implemented**

**MOE02014SI: Popularization of improved technologies developed in the field of mulberry sector for Eastern and North-Eastern India**

**Popularization of new mulberry varieties (C-2038, Tr-23/BC$_2$59 and C-2028):** During the reporting period, 0.8 acre of plantation was established using 8,000 saplings of newly developed mulberry varieties C-2028 and C-2038. These were planted in 10 farmers' fields across Jorhat and Golaghat districts.

**Popularization of shoot feeding (shelf rearing) with collapsible plastic mountages:** Ten farmers were selected and provided with necessary inputs to conduct silkworm rearing using the shoot feeding method. Each farmer reared 100 disease-free layings (dfls) using shelf rearing with collapsible plastic mountages.

**MOE02015MI: Evaluation of improved technologies developed in the field of mulberry sector for Eastern and North-Eastern India**

**Evaluation of high yielding and low temperature stress-tolerant varieties (C-2060 and C-2065):** Mulberry plantations were maintained as per the recommended schedule. Experimental data were collected during the spring 2024 crop season.

**Low-cost drip fertigation system for mulberry:** Routine maintenance of the mulberry plantation was carried out. Pruning was done in March, followed by the initiation of fertigation. Experimental data were recorded.

**All India co-ordinated experimental trial for mulberry varieties:** The plantation was maintained with routine intercultural operations. A nursery for propagation studies was also maintained. Experimental data were recorded.

**Extension Communication Programme (ECPs):**

During 2023–24, RSRS-Jorhat successfully conducted eight extension communication programmes, surpassing the targeted number. These included two Technology Awareness Programmes, one Technology Demonstration, three Farmers' Field Days, one Workshop, and one Resham Krishimela, benefiting a total of 886 farmers across various locations in Jorhat and Golaghat districts.


**Technology Demonstration Programme**

**Awareness Programme**


**Resham Krishi Mela**

**Resham Krishi Mela**

**Capacity Building and Training:** The station successfully conducted all Capacity Building and Training (CBT) programmes as per the annual schedule. A 10-day Farmers' Skill Training Programme was organized in two batches, training a total of 50 farmers. Additionally, an exposure visit was conducted for 25 farmers. Another training programme was organized for KVK scientists, with 10 participants trained.

| | |
|---|---|
|  |  |
| **FST** | |

# राजभाषा अनुभाग की उपलब्धियाँ (वर्ष 2023- 2024)

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान,बहरमपुर (प.बं.) में वर्ष 2023-24 के दौरान संघ की राजभाषा नीति का सम्यक अनुपालन किया गया। राजभाषा अधिनियम की धारा-3(3) एवं राजभाषा नियम-5 जैसे अनिवार्य प्रावधानों का शत-प्रतिशत अनुपालन सुनिश्चित किया गया है। राजभाषा हिन्दी के अन्य महत्वपूर्ण कार्यान्वयन बिन्दुओं/प्रावधानों पर भी कार्रवाई की गई। संस्थान में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगति/कमियों की समय-समय पर समीक्षा, हिन्दी कार्यशाला का आयोजन हिन्दी पखवाड़ा/दिवस का आयोजन,हिन्दी भाषा प्रशिक्षण, हिन्दी पुस्तक/पुस्तिकाओं का संपादन,हिन्दी प्रतियोगिता का आयोजन एवं प्रोत्साहन योजनाओं का कार्यान्वयन किया गया।

संस्थान द्वारा आलोच्य अवधि के दौरान विभिन्न कार्यान्वयन बिन्दुओं पर की गई कार्रवाई का ब्यौरा निम्नवत है:

**1.धारा-3(3) का अनुपालन**:

राजभाषा अधिनियम की धारा-3(3) के अर्न्तगत आने वाले सभी कागजात यथा सामान्य आदेश,निविदा,नियम,सूचना,अधिसूचना एवं संविदा करार विज्ञप्ति तथा प्रशासनिक एवं अन्य रिपोर्ट आदि अनिवार्य रुप से द्विभाषी में जारी किए गए।

**2.हिन्दी पत्राचार:**

वर्ष के दौरान 'क', क्षेत्र में स्थित केन्द्र/ राज्य सरकार को क्रमश: 86.55%,तथा 'ग' क्षेत्र में स्थित केन्द्रीय सरकार के कार्यालयों को 80.49% पत्र हिन्दी में भेजें गए। इस प्रकार पत्राचार के मद में निर्धारित लक्ष्य से अधिक पत्राचार किया गया।

**3.हिन्दी प्रशिक्षण:**

आलोच्य अवधि के दौरान अधिकारियों/कर्मचारियों को हिन्दी शिक्षण के योजना के अधीन प्रशिक्षण कार्य जारी है। अब तक संस्थान के कुल 97.95% अधिकारी/कर्मचारी इस योजना के अन्तर्गत प्रशिक्षित हो चुके है।

**4. राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन**

राजभाषा नियम/अधिनियम के प्रावधानों के सम्यक अनुपालन एवं समय-समय पर राजभाषा कार्यों की प्रगति/कमियों की समीक्षा हेतु संस्थान में प्रत्येक तिमाही के दौरान विभागीय राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन कर कार्यान्वयन की दिशा में आने वाली कठिनाइयों का निदान किया जाता है। वर्तमान वर्ष 2023-24 के अंतर्गत राजभाषा कार्यान्वयन समिति की चार बैठकों का नियमित आयोजन क्रमश: दिनांक 17.05.2023, 26.08.2023, 07.12.2023 एवं 15.03.2024 को किया गया तथा बैठक में लिए गए निर्णयों पर अनुवर्ती कारवाई की गई।

**5. हिन्दी कार्यशाला का आयोजन**:

संस्थान में कार्यरत अधिकारियों/कर्मचारियों को हिन्दी में कामकाज करने में सुगमता हेतु प्रत्येक वर्ष हिन्दी कार्यशाला का आयोजन किया जाता है। कार्यशाला का आयोजन कर्मचारियों की कार्य प्रकृति के अनुसार अलग-अलग समूहों में किया जाता है। तकनीकी तथा प्रशासनिक संवर्ग के अधिकारियों/पदधारियों के लिए राजभाषा के विविध पहलुओं पर

क्रमशः 03.05.2023,10.07.2023, 02.12.2023 एवं 12.02.2024 को हिंदी कार्यशाला आयोजित कर संस्थान के कुल 109 पदधारीगण राजभाषा हिन्दी में प्रशिक्षितकिए गए तथा आगे भी यह क्रम जारी है।

**6. अधीनस्थ कार्यालयों/केन्द्रीय रेशम बोर्ड के अन्य कार्यालयों आंबटित कार्यालयों में हिन्दी कार्यशाला**:

संस्थान की संबद्ध इकाइयों में भी संघ की राजभाषा नीति के सफल कार्यान्वयन हेतु हिन्दी कार्यशालाओं का आयोजन किया जाता है। इस क्रम में संस्थान के कुल 04 अधीनस्थ केन्द्रों में भी हिन्दी कार्यशालाओं का आयोजन किया गया।

**7.राजभाषा प्रोत्साहन योजना का कार्यान्वयन:**

संस्थान एवं इसके संबद्ध/अधीनस्थ केन्द्रों में कार्यरत अधिकारियों तथा कर्मचारियों में राजभाषा हिन्दी के प्रति अभिरूचि जगाने हेतु समय-समय पर विभिन्न राजभाषा कार्यक्रम/प्रतियोगिता का आयोजन किया जाता है। इन कार्यक्रमों द्वारा कर्मचारियों को प्रोत्साहित/पुरस्कृत करने के अलावा हिन्दी में मूल रूप से टिप्पण-आलेखन करने वाले अधिकारियों/कर्मचारियों के लिए केन्द्रीय रेशम बोर्ड की उदारीकृत प्रोत्साहन योजना को भी लागू किया गया है जिसके अन्तर्गत निर्धारित शब्द संख्या हिन्दी में लिखने पर अनुपातत: नगद प्रोत्साहन राशि (महत्तम रू 5000.00) प्रदान की जाती है। हिन्दी दिवस/पखवाड़ा,2023 के अवसर पर वर्ष 2022-23 के दौरान मूल रूप से हिन्दी में कामकाज करने हेतु कुल 07 पदधारियों को पुरस्कृत किया गया।

**8.हिन्दी पुस्तक/ पुस्तिकाओं का प्रकाशन:**

संघ की राजभाषा नीति के अनुसार संस्थान में अंग्रेजी प्रकाशनों के अनुरूप वैज्ञानिक एवं तकनीकी/प्रशासनिक प्रकाशनों का हिन्दी रूपांतरण तथा मूल रुप से हिंदी में लिखित पुस्तकें आवश्यकतानुसार प्रकाशित की जाती है। वर्तमान वर्ष के अंर्तगत संस्थान की वार्षिक वैज्ञानिक एवं प्रशासनिक रिपोर्ट वर्ष 2022-23 का सारांश हिंदी में प्रकाशित करने के अतिरिक्त आलोच्य अवधि के दौरान न्यूज एंड व्यूज [जुलाई-दिसम्बर, **2022**] का द्विभाषी संस्करण**,** पश्चिम बंगाल में वाणिज्यिक चॉकी कीटपालन पुस्तिका का हिन्दी संस्करण**,** रेशम उत्पादन में उद्यमिता विकास नामक पुस्तिका हिंदीं में प्रकाशित की गई।

**9. नगर राजभाषा कार्यान्वयन समिति का गठन एवं उसकी बैठकों का आयोजन**:

वर्ष 1997-98 के शुरूआत में ही राजभाषा विभाग, भारत सरकार,नई दिल्ली द्वारा संस्थान के निदेशक की अध्यक्षता में नगर राजभाषा कार्यान्वयन समिति के गठन,बैठकों के नियमित आयोजन तथा बहरमपुर नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों आदि में संघ की राजभाषा नीति के सफल कार्यान्वयन का अतिरिक्त दायित्व निहित किया गया। समिति के प्रयास से नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनोंआदि में भी राजभाषा गतिविधियां बढ़ी है। इसके अतिरिक्त,नगर के सदस्य कार्यालय अपने-अपने कार्यालयो में हिन्दी दिवस, प्रतियोगिता,संगोष्ठी कार्यशाला एवं बैठकों का आयोजन कर रहे है। समिति की उक्त गतिविधियों के संचालन से संस्थान में राजभाषा कार्यान्वयन संबंधी कार्यमात्रा में भी अत्याधिक वृद्धि हुई है।

**10.राजभाषा नियम 10(4) के अन्तर्गत अधीनस्थ कार्यालयों को अधिसूचित किया जाना:**

संस्थान के संबद्ध/अधीनस्थ केन्द्रों में कार्यरत 80% कर्मचारियों को हिन्दी प्रशिक्षण दिलाने के पश्चात ऐसे कार्यालयों को मंत्रालय द्वारा राजभाषा नियम-10(4) के अधीन अधिसूचित करने की कार्रवाई की जाती है। इस क्रम में संस्थान के 05 संबद्ध कार्यालयों को अधिसूचित कराया जा चुका है।

**11.हिन्दी प्रतियोगिता का आयोजन**:

वर्ष 2023-24 के दौरान दिनांक 01.09.23 से 30.09.23 तक आयोजित हिन्दी पखवाड़ा के अन्तर्गत विभिन्न हिन्दी प्रतियोगिता एवं मुख्य समारोह का आयोजन किया गया। इन प्रतियोगिता में संस्थान के अधिकारियों/ कर्मचारियों ने उत्साह से भाग लिया। इस दौरान कुल 04 हिन्दी प्रतियोगिताओं क्रमश: शब्दावली 01/09/2023, हिंदी टिप्पण व आलेखन प्रतियोगिता 02/09/2023, निबन्ध 04/09/2023 तथा सुलेख व श्रुतिलेख 05/09/23 का आयोजन किया गया। प्रत्येक प्रतियोगिता के सर्वश्रेष्ठ प्रतिभागियों को प्रथम,द्वितीय,तृतीय एवं सांत्वना पुरस्कार से पुरस्कृत किए गए।

**12. कंप्यूटर पर हिन्दी में कार्य:**

राजभाषा अधिनियम-1963 की धारा 3(3) का अनुपालन,फार्म/प्रपत्र का द्विभाषीकरण,संबद्ध/अधीनस्थ केन्द्रों की तिमाही रिपार्ट का समेकीकरण एवं अनुभागीय प्रगति रिपोर्ट के तुलनात्मक विवरण आदि के संकलन एवं पत्रिका के प्रकाशन/संपादनका कार्य तथा नगर राजभाषा कार्यान्वयन समिति की गतिविधियों संबंधी कार्य को कंप्यूटरपर सुचारू रूप से किया जा रहा है। राजभाषा कार्यान्वयन के विभिन्न पहलुओं में कंप्यूटर के प्रयोग की शुरूआत से राजभाषा कार्यान्वयन के कार्य में गति आई है। साथ ही साथ संस्थान की राजभाषा कार्यान्वयन समिति की बैठको में हिन्दी प्रगति से संबंधित आकड़ों का प्रस्तुतीकरण पावर-प्वाइंट के जरिये किया जा रहा है। ज्ञातव्य है कि संस्थान में बहुभाषी पैकेज "यूनिकोड" का संस्थापन कंप्यूटर पर किया गया है जिससे शब्द प्रक्रमण के अलावा आकड़ों के प्रक्रमण, आरेखीय निरूपण,आंकड़ों के समेकीकरण में सहुलियत एवं गति आई है।

## AWARDS AND RECOGNITIONS

- Dr. Satadal Chakrabarty, Scientist-D, was awarded first position for Outstanding Paper Presentation in Zoology (Scientific Discipline) at the 6th Regional Science & Technology Congress 2023–24, held on 18–19th January 2024, jointly organized by the Government College of Engineering and Textile Technology, Berhampore, and the Department of Science and Technology and Biotechnology, Government of West Bengal.
- Dr. Suresh K., Scientist-D, was awarded for Outstanding Research Paper Presentation at the National Conference on 'Science and Technology in Disaster Management', organized during the 6th Regional Science and Technology Congress by the Department of Science and Technology and Biotechnology, Government of West Bengal, on 18–19th January 2024 at Berhampore.
- Dr. Yallapa Harijan, Scientist-C, received the Outstanding Paper Award at the 6th Regional Science and Technology Congress (Region-2), organized by the Department of Science and Technology and Biotechnology, Government of West Bengal, held at Government College of Engineering & Textile Technology, Berhampore, on 18–19th January 2024.
- Dr. Parameshwara Naik J, Scientist-C, received the Best Poster Presentation Award at the National Seminar on Advancing Extension Science for Secondary Agriculture, contributing to Sustainable Development Goals. The event was organized by ISEE, in association with ICAR-New Delhi and other partners, and held at UAS, Bengaluru from 22-24th June 2023.
- Dr. Parameshwara Naik J, Scientist-C, was awarded a 'Letter of Appreciation' from the Deputy Commissioner of Chandel, Manipur, acknowledging the successful execution of DBT-funded project activities in the aspirational districts of Manipur.
- Dr. Parameshwara Naik J, Scientist-C, received the Best Oral Presentation Award at the International Conference on Advancement in Plant Health Research – Retrospect & Prospect, held on 7–8th December 2023 at Visva-Bharati University, West Bengal
- Dr. Kamidi Rahul and Dr. Pooja Makwana, Scientist-C, received the Best Paper Award for their research paper titled "Silkworm Pupal Extracts: Anti-inflammatory & Chondro-Protective Properties" presented at the International Conference on Silk Fibroin & Sericulture Resources (IC-SFSR-24), held at N. B. Navale Sinhgad College of Engineering, Solapur, in collaboration with PAH Solapur University, from 16-19th February 2024.


GOVERNMENT OF MANIPUR
OFFICE OF THE DEPUTY COMMISSIONER, CHANDEL
ASPIRATIONAL DISTRICT PROGRAMME
CHANDEL DISTRICT, MANIPUR

Certificate of Appreciation

I take pleasure in expressing appreciation to the entire team of the project titled "Seri-Entrepreneurship Development in Aspirational Districts of North-Eastern India," funded by the Department of Biotechnology (DBT), Government of India. The project is implemented by the Central Sericultural Research and Training Institute, Berhampore, Central Silk Board, in coordination with the Department of Sericulture, Manipur, for the outstanding implementation.

Your commitment to transforming traditional sericulture farming into a thriving commercial sericultural enterprise has brought substantial benefits to the marginalized Scheduled Tribe women farmers in the Chandel district of Manipur. The innovative approach of instilling entrepreneurial characteristics among the Scheduled Tribe farmers with structured EDP training, coupled with providing hand-holding support through improved sericultural technologies and continuous monitoring and supervision, has had a profound and positive impact on the livelihoods of the district's farmers. The active participation of the team in successfully executing all project activities is commendable.

We express our sincere appreciation and gratitude on behalf of the district administration for your team's significant contribution. We look forward to your continued efforts and success in the future.

(Mayanglambam Rajkumar)
Deputy Commissioner, Chandel
Deputy Commissioner, Manipur
Chandel District, Manipur

## TECHNOLOGIES / PRODUCTS / PROCESSES RELEASED / PATENTS GRANTED / APPLICATIONS FILED FOR PATENTING

- **New Mulberry Variety Released: C-9 (Ratna)** — suitable for rainfed, low-fertility environments (rainfed red & laterite soil), with over 15% higher leaf yield compared to the regional check C-2038 (14.03 t/ha/year), and tolerant to low-nutrient stress. Released during Resham Krishi Mela at RSRS, Koraput, on 04.03.2024.

- **Patent Granted: Ghar Sodhon** — a novel, slow-volatile, broad-spectrum, user-friendly composition for disinfecting rearing houses and appliances.

  - Patent No.: 440850
  - Date: 27.07.2023

**Technology Commercialized: Labex** — a bed disinfectant licensed to M/s. Happy Enterprises, Nabagram, Murshidabad District.

- Lump Sum Premium: ₹1,00,000
- Recurring Royalty: 3% on sales
- License Period: 10 years
- Nature of License: Non-exclusive

## DISTINGUISHED VISITORS AT INSTITUTE / UNITS

- Shri Subrata Maitra (Kanchan), Hon'ble MLA, Berhampore Assembly, West Bengal, visited the Institute on 16th September 2023.

**STAFF PROFILE (2023-24)**
**As on 31st March, 2024**

| Designation | MI | RSRSs | RECs | Total |
|---|---|---|---|---|
| **Director** | **1** | - | - | **1** |
| **Scientists** | | | | |
| Scientist-D | 5 | - | 2 | **7** |
| Scientist-C | 8 | 1 | - | **9** |
| Scientist-B | 9 | 1 | - | **10** |
| **Total** | **22** | **2** | **2** | **26** |
| **Technical** | | | | |
| Deputy Director (Computers) | 1 | - | - | **1** |
| Sr. Technical Asst. (STA) | 28 | 13 | 12 | **53** |
| Junior Engineer | 1 | - | - | **1** |
| Sr. Field Asst. | - | - | 1 | **1** |
| Field Asst. | 2 | 3 | 5 | **10** |
| Technician | 6 | 1 | - | **7** |
| Multi Tasking Staff | 6 | 9 | 6 | **21** |
| Skilled Farm Worker | 29 | 3 | 1 | **33** |
| Skilled Farm Worker (TS) | 10 | 24 | - | **34** |
| **Total** | **83** | **53** | **25** | **161** |
| **Accounts & Administration** | | | | |
| Asst. Director | 1 | - | - | 1 |
| Superintendent | 2 | - | - | 2 |
| Asst. Superintendent | 9 | - | - | 9 |
| Sr. Translator (Hindi) | 1 | - | - | 1 |
| Staff Car Driver Grade-I | - | 2 | - | 2 |
| UDC | 2 | - | - | 2 |
| Cook | 1 | - | - | 1 |
| **Total** | **16** | **2** | **-** | **18** |
| **GRAND TOTAL** | **122** | **57** | **27** | **206** |

**बजट / Budget**
**2023-24**

| शीर्ष /Head | राशि/ Amount (रु. लाख़ में/ Rs. in lakh) |
|---|---|
| प्लान-सामान्य / **Plan-Gen (PLG)** | 379.26 |
| उत्तर-पूर्वी-सामान्य (पीएल-जी) / **NE-Gen (NE-G)** | 52.00 |
| प्लान-कैपिटल (पीएल-सि) / **Plan-Cap (PLC)** | 50.30 |
| उत्तर-पूर्वी - कैपिटल (एनईसि) / **NE-Cap (NEC)** | 15.79 |
| **कुल /Total** | **497.35** |

## R & D PERSONNEL

**CSB-CSRTI-BERHAMPORE**

**Director**

Dr. Kishor Kumar C.M. (upto July, 2023)
Dr. Jula S. Nair (from August, 2023)

**Scientist-D**

Dr. Dipesh Pandit (upto December, 2023)
Dr. Pradeep A.R.
Dr. Satadal Chakraborty
Dr. Srinivasa G.

**Scientist-C**

Dr. Chandrakanth, N.
Dr. Pooja Makwana
Dr. Rahul K
Dr. Shafi Afroz
Dr. Suresh K
Dr. Deepika Kumar Umesh
Mr. Khasru Alam
Dr. Mihir Rabha
Dr. Parameshwaranaik J
Dr. Raviraj V.S
Dr. Thangjam Ranjita Devi
Dr. Yallappa Harijan

**Scientist-B**

Mr. Arun Kumar
Dr. Y Nagaraju
Ms. Harshitha B. S.
Dr. Oshin
Ms. Sanghmitra Aditya
Ms. Reshma Ram
Mr. Pradeep S.D.
Dr. Javid Ur Rahman

**ADMINISTRATIVE PERSONNEL**

Shri Prasad P K., DD (Computers)

Shri Khemraj Nishad, AD (A&A) (upto January 2024)

Shri Ashim Roy Choudhury, AD (A&A)

Shri Sohan Lal Sahu, AD (A&A)

**RSRS-KALIMPONG**
Dr. S. Harish Babu, Sci-B

**RSRS-KORAPUT**
Smt. Padmavati Raju, STA (upto 21.11.23)
Dr. S. Ranjith Kumar, Sci-B (from 22.11.23)

**RSRS-JORHAT**
Smt. Junumoni Das, STA

**REC-MOTHABARI**
Dr. Boya Vijaya Naidu, Sci-D

**REC-BHANDRA**
Mr. Shankar Rai, STA

**REC-MAMRING**
Mr. Bhanu Shilal, STA

**REC-DIMAPUR**
Mr. Intimokchung, STA

**REC-MANGALDOI**
Mr. Ujjal Kanti Paul, STA

**REC-SHILLONG**
Mr. Dwijen Chandra Das, STA

**REC-AIZAWL**
Dr. Dip Kr. Gogoi, Sci-D

**REC-AGARTALA**
Mr. Salam Bijoy Meitei, STA

## RESEARCH ADVISORY COMMITTEE (RAC)

The Research Advisory Committee (RAC) is a body responsible for evaluating research projects at the institute level, comprising subject matter specialists from reputed institutes and universities. The tenure of the committee is three years (six meetings), with meetings held once every six months to review the R&D activities of the institute.

**CHAIRPERSON**

Dr. Swarup Kumar Chakrabarti, Former Vice-Chancellor
Uttar Banga Krishi Viswavidyalaya
59A/4, Bose Pukur Road, Flat No. 202
Santanu Apartment, Kolkata - 700 042
West Bengal *[email: skc_cpri@yahoo.co.in]*

**MEMBERS**

| | |
|---|---|
| Dr. Sailesh Chattopadhyay<br>Professor-cum- Chief Scientist & Head<br>Dept. of Forest Biology & Tree Improvement<br>Faculty of Forestry, Birsa Agricultural University<br>Kanke, Ranchi-834006, Jharkhand<br>*[email: saileshranchi@gmail.com]* | Dr. Prabir Kumar Bhattacharyya<br>Professor in Genetics & Plant Breeding<br>Department of Genetics & Plant Breeding<br>Bidhan Chandra Krishi Viswavidyalaya<br>Mohanpur-741252, Nadia, West Bengal<br>*[email: bhattacharyya.prabir@bckv.edu.in/ bhattacharyya.pk@gmail.com]* |
| Dr. Siddhartha Deb Mukhopadhyay<br>Professor & Head, Department of Agricultural Extension, Agril. Economics and Agril. Statistics<br>Palli Siksha Bhavana (Institute of Agriculture)<br>Visva-Bharati University, Sriniketan - 731236<br>Birbhum,West Bengal<br>*[email: sdmukhopadhyay@gmail.com]* | Dr. Sukhen Roy Chowdhary<br>Former Director, Central Silk Board<br>#2B/2C, Sonar Bangla Apartment, 16/1<br>Swarnamoyee Road, Berhampore-742101<br>Murshidabad, West Bengal<br>*[email: drsukhenrc@gmail.com]* |
| Dr. Atul Kumar Saha<br>Former Scientist-D, Central Silk Board<br>Chuanpur Sukantapllay Ghosh Para<br>Chalita- 742407, Berhampore, West Bengal<br>*[email: sahaatul@rediffmail.com]* | The Director<br>National Silkworm Seed Organization (NSSO)<br>Central Silk Board, Madiwala,<br>BTM Layout, Bengaluru -560068, Karnataka<br>*[email: nsso.csb@nic.in]* |
| The Director<br>Dept. of Handlooms Handicrafts & Sericulture<br>Govt. of Tripura, Indra Nagar,<br>Kunjaban- 799 006, Agartala, Tripura<br>*[e-mail: directorthhs@gmail.com]* | The Commissioner, Textiles & Sericulture<br>Govt. of West Bengal, Directorate of Sericulture<br>#45, Ganesh Chandra Avenue, 2nd Floor<br>Kolkata-700013, West Bengal<br>*[email: cotwestbengal@gmail.com; kolseri1@gmail.com, seridev20@gmail.com]* |
| The Director, Department of Sericulture<br>Govt. of Assam, **Khanapara -781022** Guwahati, Assam, *[email: kaiori.rajkhowa@qmail.com / nertps.assam@qmail.com]* | The Director, Dept. of Sericulture, Govt. of Manipur<br>Project Management Complex<br>Sangaipat, Imphal East, Imphal - 795004, Manipur<br>*[e-mail: dosmanipur@gmail.com]* |
| Md. Abdur Rashid<br>Rearer representative<br>Vill.-Milki Dangapara, P.S.-Nabagram<br>Murshidabad, West Bengal<br>Mobile: 9734815503 | Mr. Ansarul Shaikh<br>Reeler Representative<br>Vill. -Agamilki, Shershahi<br>P.S.-Kaliachak, Malda, West Bengal<br>Mobile: 6006413873 |
| Director (Technical), Central Silk Board<br>CSB Complex, BTM Layout<br>Madiwala, Bengaluru - 560 068, Karnataka | Scientist-D & Head, Research Coordination Section,<br>Central Silk Board, CSB Complex, BTM Layout,<br>Madiwala, Bengaluru - 560 068, Karnataka |

**MEMBER CONVENOR**

The Director, Central Sericulture Research & Training Institute
Central Silk Board, Berhampore -742101, West Bengal
*[Email: csrtiber.csb@nic.in / csrtiber@gmail.com]*

## केंरेबो-केरेउअवप्रसं-बहरमपुर / CSB-CSRTI-Berhampore

## आभारी-विदाई / Farewell

| # | पदधारी /Employee | पदनाम /Designation | सेवानिवृत/ Retirement |
|---|---|---|---|
| 1. | डॉ. किशोर कुमार सी.एम./ Dr. Kishor Kumar C.M. | निदेशक / Director | 31.07.2023 |
| 2. | श्री श्यामल कुमार विश्वास /Shri Shyamal Kr. Biswas | सहा. तक. /Asst. Technician | 31.07.2023 |
| 3. | श्रीमती सुजा थॉमस मैथ्यू /Smt. Suja Thomas Mathew (Late) - Sad Demise | वरिष्ठ तकनीकी सहायक / Sr.Tech. Asst. | 31.07.2023 (RSRS-Koraput) |
| 4. | श्री वनलाल डिंगा / Shri Vanlal Dinga | मल्टी-टास्किंग स्टाफ / Multi-Tasking Staff | 30.11.2023 (REC-Aizawl) |
| 5. | डॉ. दीपेश पंडित / Dr. Dipesh Pandit | वैज्ञानिक-डी/ Scientist-D | 31.12.2023 |
| 6. | श्री द्विजेन चंद्र दास/ Shri Dwijen Chandra Das | वरिष्ठ तकनीकी सहायक / Sr.Tech. Asst. | 31.12.2023 (REC-Shillong) |
| 7. | श्री खेमराज निषाद/Shri Khemraj Nishad | सहा. निदेशक (ए एवं ए)/ Asst. Director (A&A) | 31.01.2024 |
| 8. | श्री असीम रॉयचौधरी/Shri Ashim Roy Choudhury | सहा. निदेशक (ए एवं ए)/ Asst. Director (A&A) | 31.03.2024 |

# PUBLICATIONS

**Research Papers (International):**


- Kalyani, D., Varghese, A., Prabhuling, S. H., Makwana, P., Ponnuvel, K. M. and Pradeep, A. N. R. (2023). Uncharacterized protein with amino acid deletions from *Bombyx mori* illustrates divergence from *Bombyx mandarina* hemocytin and showed modulated gene expression after infection by *Nosema bombycis*. International Journal of Tropical Insect Science, 43(5): 1623-1632.
- Makwana, P., Rahul, K., Ito, K. and Subhadra, B. (2023). Diversity of antimicrobial peptides in silkworm. Life (Basel), 13(5): 1161.
- Shambhavi, H. P., Makwana, P. and Pradeep, A. N. R. (2023). LP30K protein manifested in hemocytes of *Bombyx mori* larva on *Nosema bombycis* infection and showed functional evolution based on glucose-binding domain. 3 Biotech, 13(8): 264.
- Rahul, K., Kweon, H.Y. and Lee, J.H. (2023). Silkworm pupal extracts attenuate interleukin-1β-induced expression of matrix metalloproteinases and inflammatory mediators in the SW1353 human chondrosarcoma cell line. International Journal of Industrial Entomology, 46(2): 55-61.
- Subrahmanyam, G., Ponnuvel, K.M., Arun Kumar, K.P., Rahul, K., Moorthy, S.M. and Sivaprasad, V. (2023). Molecular methods for diagnosis of microbial pathogens in muga silkworm, *A. assamensis* Helfer (Lepidoptera: Saturniidae). International Journal of Industrial Entomology, 46(3): 1-11.
- Alam, K., Jiaul H. P., Saha, S. and Raviraj V. S. (2024). TAR: A highly accurate machine-learning model to predict the cocoon shell weight of tasar silkworm *Antheraea mylitta*. Agricultural Research, 13: 375-380.
- Ramesha, A., Rao, M., Dubey, H., Naleen, Shukla, P., Ponnuvel, K.M., Sivaprasad, V. and Suresh, K. (2024). Analysis of expression, mutation and alternative splice variants of candidate genes, MLO2 and MLO6A involved in powdery mildew susceptibility in mulberry (*Morus* spp.). Plant Molecular Biology Reporter, 42: 784-793.
- Gundi, R., Vanitha, C., Tulsi, K.S.N., Lakshmanan, V., Ramesha, A., Ponnuvel, K.M., Rabha, M., Sivaprasad, V., Pradeep, A.R. and Mishra, R.K. (2023). Molecular marker assisted breeding and development of bidensovirus resistant and thermo tolerant silkworm (*Bombyx mori*) hybrids suitable for tropical climatic conditions. Agricultural Research, 12: 428-438.
- Rabha, M., Das, D., Konwar, T., Acharjee, S. and Sarmah, B.K. (2023). Whole genome sequencing of a novel *Bacillus thuringiensis* isolated from Assam soil. BMC Microbiology, 23(91): 1-14.


**Research Papers (National)**


- Deb, S., Sinha, A. K., Saha, A.K. and Chakrabarty, S. (2023). Superiority of Azadirechtin over other biochemical active compounds in controlling Nuclear Polyhedrosis (Grasserie disease) of silkworm, *Bombyx mori* Linnaeus. Journal of Agricultural policy, 6(1): 18-35.
- Gundi, R., Vanitha, C., Naik, K.S.T., Ramesha, A., Rabha, M., Kumar, R.G., Nongthomba, U. and Ponnuvel, K.M. (2023). Development and evaluation of cross breed hybrids for BmBDV resistance through molecular marker assisted selection. Asian Journal of Microbiology, Biotechnology and Environmental Sciences, 25(3): 580-589.
- Kurmi, D., Rabha, M. and Rahul, K. (2023). Extraction of sericin protein from *Bombyx mori* L. cocoon (Race Nistari). Pharma Innovation, 12(2): 270-274.

- Suresh, K., Manjappa, Yallappa, H., Luwang, N.L., Deepika, K.U. and Kishor Kumar, C.M. (2023). Genetic inter-relationship and principal component analysis for determination of the selection criteria in mulberry genotypes. International Journal of Current Microbiology and Applied Sciences, 12(07): 83-96.
- Yallappa, H., Deepika, K.U., Suresh, K., Chakravarty, D., Pappachan, A. and Kishor Kumar, C.M. (2023). Assessment of polycross hybrids of mulberry for fruit and seed traits. Mysore Journal of Agricultural Sciences, 57(2): 416-423.

**Books/ Book chapters/ Hand Book**

**Hand Book:**

- परमेश्वर नायक जे, शफी अफरोज, दीपेश पंडित, सुष्मिता देवी, किशोर कुमार सी. एम. (2023). कृषक पुस्तिका रेशम उत्पादन में उद्यमिता विकास. केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, केन्द्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार, बहरमपुर, मुर्शिदाबाद, पश्चिम बंगाला – 742101, भारत. ISBN: 9781234567897
- Afroz, S., Naik, P., Manjunatha, G.R., Alam, K., Srinivasa, G., Pandit, D. and Kishore Kumar, C.M. (2023). Handbook on Commercial Chawki Rearing in West Bengal. Pulished by CSB-CSRTI-Berhampore.

**Book Chapter:**

- Rahul, K., Makwana, P., Ghosh, S. and Pappachan, A. (2023). Why biotechnology needed in insects? In D. Kumar & S. Shukla (Eds.), Introduction to Insect Biotechnology, Springer Nature, Cham, Switzerland pp. 17-44.

**Success Story:**

- Parameswaranaik, J., Afroz, S., Devi, S., Baraik, S. C. and Jula S. Nair (2024). 75- Silk Stories: Seri-preneurial prosperity from Aspirational districts of Tripura and Manipur. Central Sericultural Research and Training Institute, Berhampore, Central Silk Board-Bengaluru, Ministry of Textiles., India. ISBN: 9789359168586

**Popular articles:**

- Alam, K., Deepika, K. U. and Harijan, Y. (2023). Applicability of image processing and computer vision in mulberry diseases recognition. Agrobios News Letter, Vol. XXII: Issue-06.
- Deepika, K.U., Harijan, Y. and Alam, K. (2024). Green synthesis of metal nanoparticles using mulberry leaf extracts: A paradigm shift in sustainable nanotechnology. Agrobios News Letter, Vol XXII: Issue-09.
- Mardi, L. and Afroz, S. (2023). Shelf Rearing improves the lifestyle of a sericulture farmer. Vigyan Varta, 4(8): 123-125.
- Yallappa, H., Pappachan, A and Deepika K. U. (2023). Mulberries: A promising fruit for human benefits. Agrobios Newsletter, 22(2): 63-65.
- Yallappa, H., Pappachan, A and Deepika K. U. (2023). Mutation breeding for accelerated improvement of mulberry. Agrobios Newsletter, 22(2): 65-67.

**Papers Presented in Conferences/Seminars/Symposia:**

**National Seminar on Evolving Extension Science – UAS Bengaluru (June 22–24, 2023)**

- Parameswaranaik, J. et al. (2023). Seri-preneurship development in Aspirational Districts of North-Eastern India.

**XVI Agricultural Science Congress – Kochi, Kerala (Oct 10–13, 2023)**

- Suresh, K. et al. (2023). Development of drought tolerant mulberry genotypes for rainfed sericulture.

**International Conference on Advancement in Plant Health Research – Visva-Bharati, Santiniketan (Dec 7–8, 2023)**

- Suresh, K. et al. (2023). Genetic assessment for biotic stress tolerance and foliage yield components in nitrate reductase and chalcone synthase segregating clonal population of mulberry.

**International Conference on Silkworm Seed Industry – Bengaluru, Karnataka (Jan 30–31, 2024)**

- Alam, K. et al. (2024). Studies on substrate colour as oviposition attractant for *Chrysoperla zastrowi sillemi*, a generalist predator of mulberry pests.
- Chakrabarty, S. et al. (2024). Improvement of seed crop productivity for production of commercial hybrid DFLs in West Bengal.
- Devi, Th. R., Chakrabarty, S. and Jula S. Nair (2024). Study of effect of selection on cocoon traits of Nistari for productivity improvement of its crossbreed in West Bengal.
- Deepika, K.U. et al. (2024). Impact of plant hormones and bioactive substances on leaf yield and quality of mulberry.
- Harijan, Y. et al. (2024). Evaluation of triploids and promising recombinants for leaf yield and quality traits in mulberry.
- Manjunatha, G.R. et al. (2024). Characterizing mulberry sericultural regions in India using technology adoption rates.
- Parameswaranaik, J. et al. (2024). Sericultural Entrepreneurship for Empowerment of Distinctive Stakeholders (SEEDS).
- Raviraj, V.S. et al. (2024). High temperature and humidity tolerant bivoltine silkworm breeds: A boon for high reproductive fitness.
- Srinivasa, G. et al. (2024). Young age silkworm rearing for socio-economic upliftment in rural West Bengal.
- Suresh, K. et al. (2024). Improvement of mulberry silkworm seed cocoon production in subtropical region of India.

**6th Regional Science & Technology Congress – Berhampore, West Bengal (Jan 18–19, 2024)**

- Chakrabarty, S. et al. (2024). On-station trial of superior bivoltine foundation cross to improve crossbreed productivity in Eastern India.

- Harijan, Y. et al. (2024). Development of polycross hybrids and genetic analysis for morpho-physiological traits in mulberry.
- Alam, K. et al. (2024). Potential applications of computer vision in mulberry pests and diseases.
- Ranjita, D. Th. et al. (2024). Improvement of economic traits of Nistari through selection.
- Suresh, K. et al. (2024). Powdery mildew resistance and leaf yield analysis in mulberry.

**National Seminar on Economic Zoology – Berhampore Girls College (Feb 2–3, 2024)**

- Hossain, S. et al. (2024). Field efficacy of *Chrysoperla zastrowi sillemi* against mulberry thrips under Murshidabad conditions.

**National Official Language Technological Conference – SBRL Bengaluru (Feb 15, 2024)**

- Deepika, K.U. et al. (2024). Shahatut ki patti ki dirgayu, gunabatta, utpadakta aur pudhe ko hormone ke bich sambandh.
- Raviraj, V.S. et al. (2024). Development of high-temperature and humidity-tolerant silkworm breeds.
- Suresh, K. et al. (2024). Genetic improvement of mulberry for foliage productivity and quality.
- Harijan, Y. et al. (2024). Genetic diversity analysis among parental mulberry genotypes.

**International Conference on Silk Fibroin & Sericulture Resources (IC-SFSR-24) – Solapur, Maharashtra (Feb 16–19, 2024)**

- Makwana, P. et al. (2024). Antibacterial activity of synthetic antimicrobial peptides (AMPs) against bacteria causing flacherie disease in *Bombyx mori*.
- Rahul, K. et al. (2024). Silkworm pupal extracts: Anti-inflammatory & Chondroprotective properties.

**International Conference on Global Scenario and Sustainable Solutions in Silk Industry – New Delhi (Feb 28, 2024)**

- Makwana, P. et al. (2024). Mass spectrometry analysis of silk proteins from Bombyx mori (Nistari) cocoon.
- Parameswaranaik, J. et al. (2024). Threads of Prosperity: Micro-Reeling Units Transforming North-Eastern Sericulture.
- Rahul, K. et al. (2024). Cosmeceutical properties of silkworm pupal extracts.

**31st West Bengal State Science & Technology Congress – Kolkata (Feb 28–29, 2024)**

- Chakrabarty, S. et al. (2024). On-station trial of superior bivoltine cross in Eastern India.
- Harijan, Y. et al. (2024). Development of polycross hybrids in mulberry.

**Workshop Conducted/ Participated:**

- **Conducted:** One-day workshop on "Feedback Information from Stakeholders and District Officers" held at Matigara Sericulture Complex, Matigara, Siliguri, West Bengal on 21st March 2024.
- **Participated:** Dr. Dip Kr. Gogoi, Scientist-D, participated (virtually) in the workshop on "Development of Diversified Seri-biproducts: Recent Achievements and Future Perspectives" organized by Central Sericultural Research & Training Institute, Central Silk Board, Mysuru on 20th May 2023.
- **Participated:** Dr. Dip Kr. Gogoi, Scientist-D, attended the workshop on "Activities of NERTPS and Silk Samagra-02" organized by the Department of Sericulture, Government of Mizoram, held at Aizawl on 25th May 2023.

**Scientists Participated in Training:**

- Dr. K. Suresh, Scientist-D: Participated in the training programme on "Gene Editing and Technology Management in Agriculture" organized by ICAR-NAARM, Hyderabad, held from 10-14th July, 2023.
- Mr. Sabyasachi Gangopadhyay, STA: Participated in the online training programme on "Extension Techniques" organized by MANAGE, Hyderabad, held from 12-14th July, 2023.
- Dr. K. Suresh, Scientist-D: Participated in the online training programme on "ICT in Plant Protection" organized jointly by ICAR-NCIPM, New Delhi and MANAGE, Hyderabad, held from 6-10th November, 2023.
- Dr. Pooja Makwana, Scientist-C: Attended a five-day training programme on "Data Visualization using R" organized by ICAR-NAARM, Hyderabad, from 4-8th March, 2024.

## METEOROLOGICAL DATA

| Months | CSRTI-Berhampore(WB) | | | | | |
|---|---|---|---|---|---|---|
| | Temp (°C) | | RH% | | Rainfall | |
| | Max | Min. | Max | Min. | mm | Days |
| Apr, 23 | 37.96 | 24.51 | 77.3 | 67.80 | 17 | 5 |
| May, 23 | 37.07 | 26.22 | 82.16 | 70.39 | 82 | 9 |
| Jun, 23 | 36.77 | 27.86 | 82.43 | 72.77 | 161 | 10 |
| Jul, 23 | 34.54 | 27.91 | 90.26 | 78.23 | 45 | 9 |
| Aug, 23 | 33.56 | 27.64 | 92.39 | 84.52 | 164 | 10 |
| Sep, 23 | 33.33 | 27.57 | 91.93 | 81.20 | 146 | 10 |
| Oct, 23 | 32.02 | 26.00 | 90.42 | 85.58 | 49 | 5 |
| Nov, 23 | 29.76 | 20.14 | 83.60 | 73.48 | 0 | 0 |
| Dec, 23 | 25.08 | 16.70 | 87.10 | 79.42 | 0 | 0 |
| Jan, 24 | 21.19 | 11.63 | 83.90 | 71.77 | 0 | 0 |
| Feb, 24 | 25.60 | 16.12 | 84.83 | 67.69 | 2 | 1 |
| Mar, 24 | 33.47 | 18.01 | 73.94 | 62.90 | 33 | 4 |
| Total | | | | | 699 | 63 |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