

वार्षिक प्रतिवेदन Annual Report 2020-21



12Y x BFC1, an Improved Crossbreed (ICB) with high shell & neatness performed consistently wrt cocoon yield & other economic traits.

15-19% improvement over traditional Nistari crossbreeds in Tripura, West Bengal, Odisha, Jharkhand & NE states was recorded.

12Y x BFC1 is currently under hybrid authorization trials.

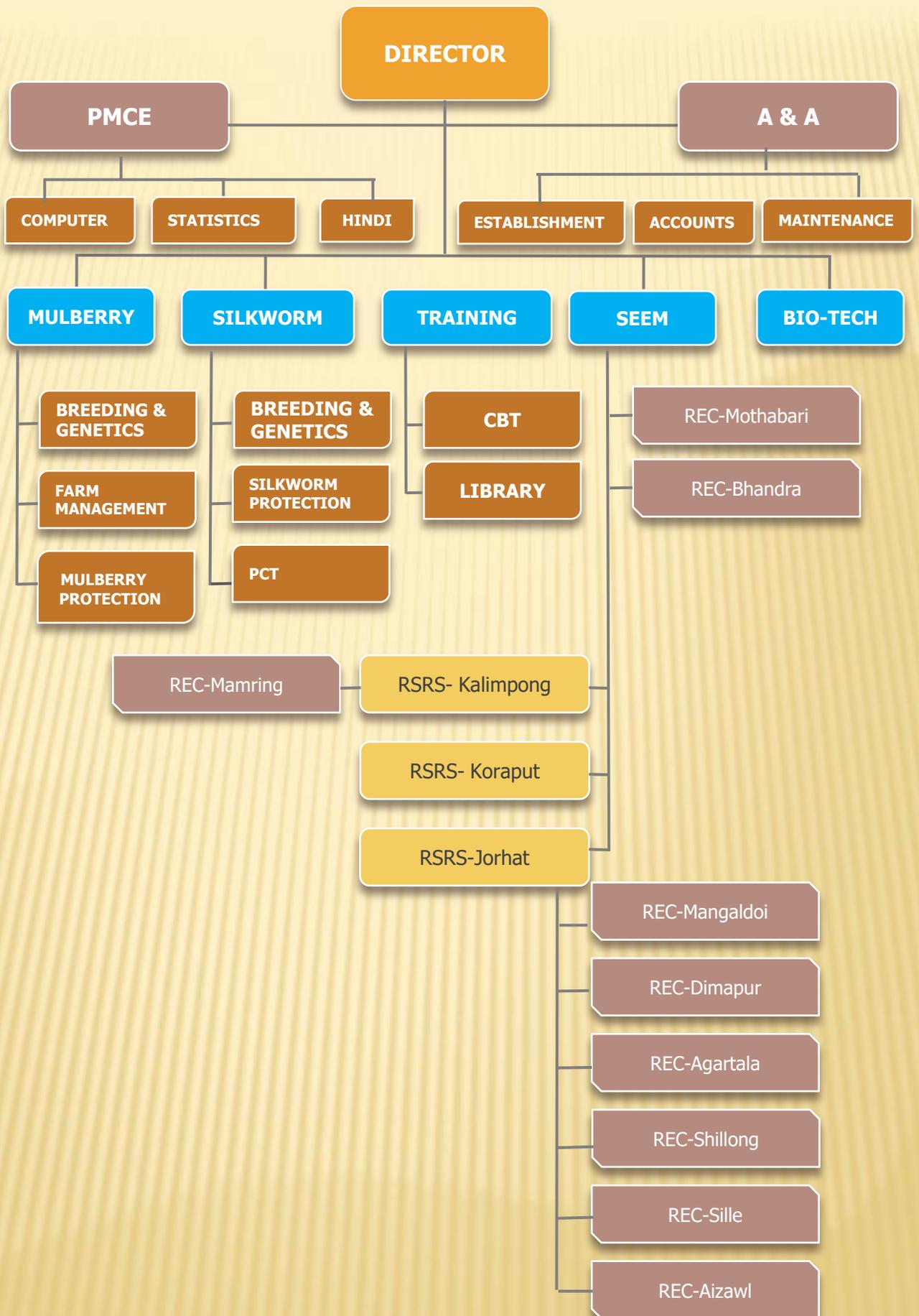


Central Sericultural Research & Training Institute

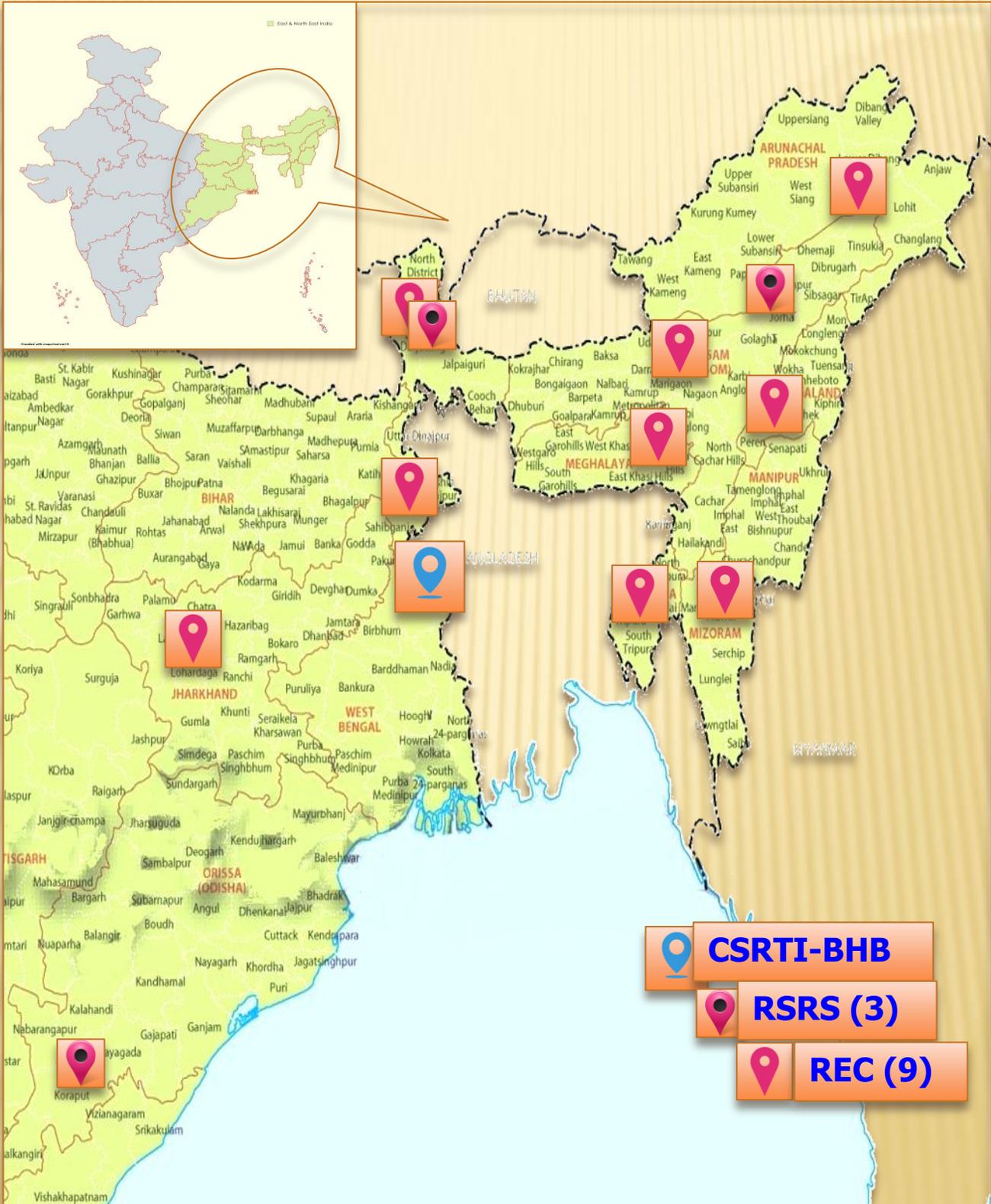
Central Silk Board

Ministry of Textiles : Govt. of India

Berhampore-742101, West Bengal



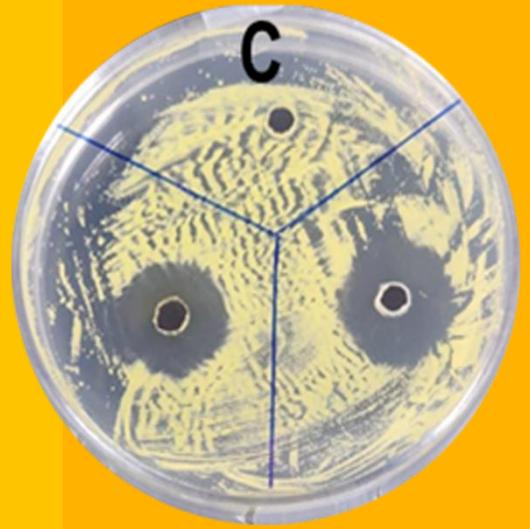
CSRTI-BERHAMPORE Extension Network



CSRTI-BHB

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REC (9)



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East North East Silk



CSRTIBerhampore

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2020-21



केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान
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प्रस्तावना

केंद्रीय रेशम बोर्ड के तत्वावधान में विभिन्न पूर्वी तथा उत्तर-पूर्वी राज्यों में काम कर रहे केरेउअवप्रसं-बहरमपुर (प.ब.) और इसकी अधीनस्थ इकाइयों में पिछले एक साल के दौरान सरकार द्वारा आदेशित कोविड-19 के दिशानिर्देशों का सफलतापूर्वक पालन करते हुए अपनी अनुसंधानात्मक एवं विकासात्मक गतिविधियों को जारी रखे हुए हैं। इस वैश्विक महामारी के दौरान, संस्थान द्वारा विशेष तौर पर अनुसंधानात्मक एवं विकासात्मक गतिविधियों जैसे उन्नत रेशमकीट नस्लों, उच्च उपज वाली शहतूत उपजातियों, सूचना एवं संचार प्रौद्योगिकियों के विकास पर अधिक जोर दिया गया। कोरोना महामारी को ध्यान में रखते हुए संस्थान के वैज्ञानिकों द्वारा स्वयं किसानों के प्रक्षेत्र तक न जाकर समय-समय पर एम-किसान एवं अन्य सोशल मीडिया प्लेटफार्म के माध्यम से किसानों तक संदेश पहुंचाने का हर संभव प्रयास किया गया।



केरेउअवप्रसं-बहरमपुर द्वारा लॉकडाउन अवधि के दौरान वैज्ञानिकों एवं सहायक पदधारियों के सक्रिय सहयोग एवं समन्वय के साथ अनुमोदित कार्य योजनानुसार अनुसंधान गतिविधियों को बहुत ही सावधानी पूर्वक संपन्न किया गया। सैपलिंग की आपूर्ति एवं नर्सरी रख-रखाव हेतु अनुसंधानात्मक एवं विकासात्मक इकाइयों कार्यरत थीं; मूल्यांकनार्थ संकर रोमुच का आंतरिक उत्पादन करने के साथ ही साथ किसानों को आवश्यक मात्रा में वितरित भी किया गया। हितधारकों से फसल की स्थिति/उपज पर डेटा संग्रहित करने का कार्य पूर्ण हो चुका है। तत्पश्चात, प्रक्षेत्र इकाइयों के माध्यम से किसानों को आवश्यक मार्गदर्शन दिया गया। एनएसएसओ-एसएसपीसी के साथ ही साथ विशेष तौर पर पश्चिम बंगाल में आरएसपी के वाणिज्यिक बीज उत्पादन में 30-40% तक नुकसान दर्ज किया गया। अधिकांश कृषकों को कोसा के विपणन में समस्याओं का सामना करना पड़ा तो वहीं दूसरी ओर धागाकारकों को गैर-कोविड-19 वर्षों की तुलना में कम लागत पर कोसे की प्राप्ति हुई। कोरोना महामारी एवं कोसे के कम कीमत प्राप्ति के वजह से पश्चिम बंगाल एवं अन्य पूर्वोत्तर राज्यों में बहुत सारे कृषकों द्वारा कोसे का शेल्फ-धागाकरण किया गया। केरेउअवप्रसं, बहरमपुर की अधीनस्थ इकाइयों प्रक्षेत्र फसलों की प्रत्यक्ष निगरानी को छोड़ नियत सभी गतिविधियों में संलग्न थीं। केरेउअवप्रसं-बहरमपुर संबंधित रेशम निदेशालयों के समन्वय से सभी राज्यों में अतिरिक्त फसल को आरंभ कर रेशम के उत्पादन को अधिक से अधिक करने के प्रयासों पर अपना ध्यान केंद्रित किए हुए हैं। केरेउअवप्रसं-बहरमपुर के नवीनतम प्रौद्योगिकीय इनपुट एवं क्षमता निर्माण कार्यक्रमों को नवीन रूप से (ऑफ एवं ऑनलाइन) डिजाइन किया गया। साथ ही, संकर कार्यक्रमों को प्रभावी ढंग से निष्पादित किया गया ताकि इसका लाभ प्रत्येक हितधारकों को प्राप्त हो सके। साथ ही, ताप-सहिष्णु डबल संकरों (डब्ल्यूबी-डीएच); अधि-उपज एवं जीवाणु पर्ण शीर्णता प्रतिरोधी शहतूत उपजातियां; निर्मूल-पर्यावरण के अनुकूल एक गृह रोगाणुनाशी एवं सेरी-विन-पर्यावरण के अनुकूल संस्तर रोगाणुनाशी के मूल्यांकन जैसी गतिविधियां जारी रखा गया। केरेउअवप्रसं-बहरमपुर का वैज्ञानिक दल कोविड-19 एवं वर्क फ्राम होम के तनाव के बावजूद संस्थागत गतिविधियों में सक्रिय रूप से संलग्न था; वास्तव में देखा जाए तो हमारे वैज्ञानिक दल द्वारा उक्त का लाभ उठाने हुए महत्वपूर्ण अनुसंधानात्मक एवं विकासात्मक दस्तावेजों (तीन पेटेंट की फाइलिंग; पूर्वी तथा उत्तर-पूर्वी राज्यों के शहतूत रेशम उत्पादन के लिए प्रौद्योगिकी वर्णिका; रेशम कृषकों की सफलता की कहानियां; रेशम उत्पादन पुस्तिका; गृह पत्रिका अनुसंधान बुलेटिन न्यूज व व्यूज का नियमित प्रकाशन) को तैयार करने में लगे रहें। वैज्ञानिकगण इस दौरान विभिन्न ऑनलाइन अंतर्राष्ट्रीय एवं राष्ट्रीय वेबिनार/ई-सम्मेलनों में भाग लेकर अपने-अपने कौशल/निपुणता को अद्यतित करने में सक्षम रहे। इसके अतिरिक्त, पूर्वी तथा उत्तर - पूर्वी भारत में रेशम के विकास हेतु डीएसटी-जेएसपीएस, डीबीटी-एस्पिरिटिनल, डीएसटी-एसईआरबी, नाबार्ड आदि बाहरी फंडिंग एजेंसियों से भी परियोजनाएं अर्जित की गईं।

केरेउअवप्रसं, बहरमपुर के बहु-विषयक दल का ठोस व समर्पित प्रयास, क्षेत्र में बड़ी संख्या में हितधारकों को प्रभावी प्रौद्योगिकियां मुहैया कराने व समर्थन के लिए अनवरत जारी रहेगा।

[डॉ. वी. शिवप्रसाद]
निदेशक

FOREWORD

CSRTI-Berhampore (WB) and its nested units working in different E&NE states under the aegis of Central Silk Board continuing its R&D activities during the past one year successfully by following the guidelines of COVID-19 by the Governments. During this pandemic situation, institute emphasized more on R&D activities particularly for developing improved silkworm breeds, high yielding mulberry varieties, information & communication technologies. More efforts were made for providing time-to-time messages to the farmers through m-Kissan & various methods of social media instead of physical visits.



CSRTI-Berhampore executed the research activities meticulously as per approved action plan with active co-operation and co-ordination of Scientists & Supporting Staff during the lockdown period. The R&D units were on-course with regard to the supply of saplings & nursery maintenance; in-house production and distribution of required quantities of hybrid dfls to the farmers for evaluation. The data collection on crop status/yield from stakeholders has been completed and necessary guidance was extended to the farmers through field units. The commercial seed production was hampered to an extent of 30-40% in NSSO-SSPCs and particularly with RSPs in West Bengal. Majority of the farmers had to encounter problems in marketing of cocoons and reelers obtained cocoons at lower prices as compared to the non-Covid-19 years. Several farmers also resorted to self-reel the cocoons in West Bengal & other NE states. CSRTI-BHP's nested units were also involved with the assigned activities, except for the direct monitoring of field crops. CSRTI-Berhampore further concentrated efforts to maximize the silk production by introducing additional crop(s) in all the states in coordination with respective DoSs. CSRTI-BHP's latest technological inputs and Capacity Building Programmes were innovatively designed (off- & online) and hybrid programmes were executed effectively to reach the door steps of stakeholders. Activities like evaluation of thermo-tolerant double hybrids (WB-DH); high yielding and bacterial leaf blight resistant mulberry varieties; NIRMOOL, eco-friendly room disinfectant and SERI-WIN, eco-friendly bed disinfectant. CSRTI-Berhampore scientific team was actively involved in the institutional activities, albeit COVID-19 & WFH stress; in fact engaged fruitfully in making important R&D documents (three Patent Filings; Technology Descriptor for E&NE mulberry sericulture; Sericulture Success Stories; Book Chapters in Sericulture; regular publication of in-house research bulletin, NEWS & VIEWS). Scientists were able to attend various online International & National webinars/E-conferences for upskilling/discipline specific knowledge. Besides, R&D projects were obtained from external funding agencies for sericulture development in E & NE India from DST-JSPS, DBT-Aspirational, DST-SERB, NABARD etc.

The concerted and dedicated multi-disciplinary efforts @ CSRTI-Berhampore continued to deliver and support large number of stakeholders in the region with impacting technologies.

Dr. V. Sivaprasad
Director

के रे उ अ व प्र सं - बहरमपुर का संक्षिप्त विवरण

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान (केरेउअवप्रसं) की स्थापना पूर्वी तथा उत्तर-पूर्वी भारत में (पूर्व: पश्चिम बंगाल, ओडिशा, बिहार, झारखंड, छत्तीसगढ़; उत्तर-पूर्व: अरुणाचलप्रदेश, असम, मणिपुर, मेघालय, मिजोरम, नागालैंड, सिक्किम एवं त्रिपुरा) रेशम उद्योग को अनुसंधान, विकासात्मक, तकनीकी, प्रौद्योगिकी, विस्तार सहायता प्रदान करने हेतु बहरमपुर में किया गया था। केरेउअवप्रसं, बहरमपुर का 78वाँ वर्ष जारी है तथा इस क्रम में, संस्थान द्वारा क्षेत्र हेतु उपयुक्त शहतूत उपजातियों का विकास, रेशमकीट नस्लों / संकरों, शहतूत कृषि के लिए पैकेज का अनुप्रयोग, रेशम कीटपालन व नवाचार/उत्पादों/प्रक्रियाओं के विकास में अपना महत्वपूर्ण योगदान किया गया है।

<p>दृष्टि पूर्वी तथा उत्तर-पूर्वी राज्यों को रेशम कृषि के क्षेत्र में उत्कृष्ट केंद्र बनना</p>
<p>मिशन</p> <ul style="list-style-type: none"> ❖ प्रमुख (श्रस्ट) क्षेत्रों में अनुसंधान व विकास परियोजनाओं को आरंभ करना ❖ अधि-उपज शहतूत उपजातियों को लोकप्रिय बनाना ❖ क्षेत्र और मौसम विशिष्ट रेशमकीट संकरों को लोकप्रिय बनाना ❖ उन्नत शहतूत पैकेज को लोकप्रिय बनाना ❖ प्रौद्योगिकी हस्तांतरण कार्यक्रम का क्रियान्वयन ❖ लाभकारी रोजगार के अधिक से अधिक अवसर पैदा करना
<p>उद्देश्य</p> <ul style="list-style-type: none"> ❖ भारतीय रेशम के उत्पादन, उत्पादकता एवं गुणवत्ता को समृद्ध करने हेतु वैज्ञानिक, तकनीकी व आर्थिक अनुसंधान का संचालन करना ❖ परपोषी पौधों, रेशम कीटपालन, कोसोत्तर प्रौद्योगिकी तथा इसके प्रचार-प्रसार के लिए पैकेज का विकास ❖ उत्पाद एवं प्रौद्योगिकी व उद्योग इंटरफेस का व्यावसायीकरण ❖ इनपुट लागत व कठिन परिश्रम को कम करने का प्रयास ❖ शुद्ध आय एवं उत्पादकता बढ़ाने हेतु उप-उत्पाद का उपयोग ❖ आयात प्रतिस्थापन तथा विदेशी मुद्रा के अर्जन हेतु अंतरराष्ट्रीय स्तर के रेशम का उत्पादन बढ़ाना ❖ मानव संसाधन विकास ❖ प्रजनकों के स्टॉक का रख-रखाव ❖ रोग एवं पीड़क की निगरानी तथा पूर्वानुमान व पूर्व-चेतावनी ❖ आईसीटी उपकरणों के माध्यम से ज्ञान, अनुसंधान एवं विकास नवाचारों व शहतूत पैकेज का प्रचार-प्रसार ❖ प्रतिष्ठित राष्ट्रीय और अंतरराष्ट्रीय अनुसंधान एवं विकास संस्थानों के साथ सहयोगात्मक अनुसंधान कार्यक्रम / परियोजनाओं का संचालन ❖ जारी अनुसंधान संबद्ध गतिविधियों एवं वैज्ञानिक व तकनीकी सेवाओं का समर्थन करने के लिए संस्थागत ढांचे को मजबूत करना ❖ बेहतर तालमेल के लिए अंतर-संस्थागत सहयोग ❖ रेशम कृषि प्रौद्योगिकियों की तकनीकी-आर्थिक व्यवहार्यता ❖ तकनीकी व परामर्श सेवाएं प्रदान करना

63 एकड़ के जीवंत परिसर में फल-फूल रहा यह संस्थान अनुसंधान एवं विकास के प्रमुख विषयों (शहतूत संवर्धन, रेशम संवर्धन, कोसोत्तर, विस्तार व क्षमता निर्माण) समेत सस्य विज्ञान व मृदा रसायन, प्रजनन व आनुवांशिकी (परपोषी पौध व कीट), फसल संरक्षण, कीटपालन प्रौद्योगिकी एवं जैव-प्रौद्योगिकी के साथ परियोजना मॉनिटरिंग

समन्वय व मूल्यांकन (पीएमसीई) कक्ष के अलावे प्रशासनिक इकाइयों से प्राप्त सक्रिय सहयोग से उत्कृष्टता की परिकल्पना कर रही है। संस्थान विभिन्न संस्थानों / संगठनों द्वारा प्रायोजित अनुसंधान एवं विकास परियोजनाएं भी संचालित करती है। साथ ही, केरेउअवप्रसं, बहरमपुर द्वारा हितधारकों के लाभार्थ प्रौद्योगिकी से जुड़े पैम्फलेट / पुस्तिकाओं का प्रकाशन विविध भाषाओं में नियमित रूप से किया जाता है। वैज्ञानिकगण राष्ट्रीय और अंतर्राष्ट्रीय पत्रिकाओं, वैज्ञानिक सेमिनार/संगोष्ठियों में शोध-लेख प्रस्तुत करते हैं।



हितधारकों में विकसित प्रौद्योगिकियों के प्रचार-प्रसार एवं उनसे नियमित तौर पर प्रतिक्रिया प्राप्त करने के लिए संस्थान के पास पूर्व एवं पूर्वोत्तर के क्रमशः पांच व आठ राज्यों में 3 क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र (क्षेरेउअके) एवं 9 अनुसंधान विस्तार केंद्र (अविके) का विस्तार नेटवर्क है। ये अधीनस्थ इकाइयां संबंधित राज्यों में रेशम कृषि विभाग के साथ घनिष्ठ समन्वय स्थापित कर हितधारकों को तकनीकी सहायता प्रदान करती हैं। केरेउअवप्रसं, बहरमपुर संबंधित सरकार तथा गैर - सरकारी एजेंसियों के साथ समन्वय कर सभी विकासात्मक कार्यक्रमों (क्लस्टर विकास, संस्थान-ग्राम लिंकेज, आदर्श रेशम ग्राम, सेरी-मॉडल गांव आदि) का क्रियान्वयन करती है।

कल्याणी विश्वविद्यालय, कल्याणी के तत्वावधान में, केरेउअवप्रसं, बहरमपुर में शहतूत रेशम कृषि में संपूर्ण भारत के छात्रों हेतु रेशम कृषि (PGDS) में 15 महीने का पोस्ट-ग्रेजुएट डिप्लोमा पाठ्यक्रम का संचालन किया जाता है। संस्थान कृषकों, रीलरों, केरेबो व गैर-केरेबो अधिकारियों, छात्रों आदि के लिए विभिन्न विषयों में कई प्रशिक्षण कार्यक्रम आयोजित किए जाते हैं। केरेउअवप्रसं, बहरमपुर द्वारा स्नातकोत्तर [M.Sc.] के छात्रों हेतु भुगतान आधार पर शोध प्रबंध की सुविधा प्रदान करने का भी कार्य किया जाता है। प्रशिक्षण प्रभाग में आधुनिक कक्षाएं, पुस्तकालय व छात्रावास की सुविधाएं भी उपलब्ध हैं।

ABOUT CSRTI-BERHAMPORE

Central Sericultural Research & Training institute (CSRTI) was established at Berhampore for rendering research, developmental, technical, technological, extension support to the silk industry in Eastern and North Eastern India (East: West Bengal, Odisha, Bihar, Jharkhand, Chhattisgarh; North-East: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura). CSRTI-Berhampore is on its 78th year and contributed to the development of mulberry varieties, silkworm breeds/hybrids, package of practices for mulberry cultivation, silkworm rearing and innovations/products/processes suitable to the region.

VISION

To become a Centre of Excellence in Sericulture in Eastern & North Eastern region

MISSION

- ❖ Undertaking R&D projects in thrust areas
- ❖ Popularizing of high yielding mulberry varieties
- ❖ Popularizing region & season specific silkworm hybrids
- ❖ Popularization of improved package of practices
- ❖ Implementing Transfer of Technology programmes
- ❖ To create greater opportunities for gainful employment

OBJECTIVES

- ❖ Conduct scientific, technical and economic research to enhance production, productivity and quality of Indian silk
- ❖ Development of package of practices for Host Plant, Silkworm rearing, Post Cocoon Technology and its dissemination
- ❖ Commercialization of Products & Technologies and industry interface
- ❖ Efforts to reduce input cost & drudgery
- ❖ By-product utilization to increase net income and productivity
- ❖ Enhance production of international grade silk for import substitution and earning foreign exchange
- ❖ Human Resource Development
- ❖ Maintenance of Breeders Stocks
- ❖ Disease & Pest Monitoring and Forecasting and Forewarning
- ❖ Dissemination of knowledge, R&D innovations and package of practices through ICT tools
- ❖ Undertake collaborative Research Programmes/Projects with reputed National and International R&D institutions
- ❖ Strengthening institutional framework to support ongoing research allied activities scientific and technical services
- ❖ Inter-institutional collaboration for better synergy
- ❖ Techno-economic feasibility of sericulture technologies
- ❖ Providing technical and consultancy services

The Institute thrives in 63 acre lively campus and envisages excellence in R&D major disciplines (moriculture, sericulture, post-cocoon, extension & capacity building) including Agronomy & Soil Science, Breeding & Genetics (host plant & insect), Crop Protection, Rearing Technology, and Biotechnology with active support from Project Monitoring Coordination & Evaluation (PMCE) cell besides Administration units. The institute undertakes R&D projects sponsored by various institutions/organizations. CSRTI-Berhampore regularly publishes technology pamphlets/booklets for the benefit of stakeholders in various languages. The scientists contribute research articles in national and international journals, scientific seminars/symposia.

For dissemination of developed technologies to the stakeholders and obtain regular feedback, the Institute has an extension network of 3 Regional Sericultural Research Stations (RSRSs), 9 Research Extension Centres (RECs) covering five Eastern and eight North-Eastern states. These nested units provide technological support to the stakeholders in the respective states in close coordination with Departments of Sericulture. CSRTI-BHP implements all the developmental programmes (Cluster development, Institute-Village Linkage, Adharsh Resham Gram, Seri-Model Village etc.) in co-ordination with the concerned government and non-government agencies.



Under the aegis of Kalyani University-Kalyani, CSRTI-Berhampore offers 15 months Post-Graduate Diploma in Sericulture (PGDS) for students across India in Mulberry Sericulture. The institute conducts several training programmes (upto 30 days) in various disciplines to the farmers, reelers, CSB & Non-CSB officials, students etc. CSRTI-Berhampore also facilitates M.Sc. students for Dissertation Works on payment basis. The training division has well-equipped classrooms, library and hostel facilities.

अनुसंधनात्मक एवं विकासात्मक उपलब्धियां

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर अपने तीन अधीनस्थ क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्रों [क्षेरेउअके] तथा नौ अनुसंधान विस्तार केन्द्रों [अविके] के साथ पूर्वी तथा उत्तर-पूर्वी राज्यों में रेशम उद्योग के विकास में उल्लेखनीय योगदान करते आ रहा है। शहतूत एवं रेशमकीट प्रजनन, फसल उत्पादन व संरक्षण, प्रौद्योगिकी के हस्तांतरण, विस्तार तथा प्रशिक्षण कार्य-कलापों में अनुसंधान व विकास गतिविधियों को आरंभ करने के परिणामस्वरूप पश्चिम बंगाल, ओडिशा, छत्तीसगढ़, झारखंड, बिहार, असम, नागालैंड, सिक्किम, मणिपुर, त्रिपुरा, मेघालय, अरुणाचल प्रदेश एवं मिजोरम राज्य के कृषकों के लिए उपयुक्त प्रौद्योगिकी विकसित की गई। मुख्य संस्थान एवं इसके अधीनस्थ केन्द्रों की वर्ष 2020-21 की प्रमुख उपलब्धियाँ निम्नानुसार हैं:

शहतूत फसल सुधार तथा संरक्षण

- ❖ आशाजनक सूखा सहिष्णु एवं अधि उपज शहतूत जीन प्रारूप (PYD-8, PYD-27, PYD-01 & PYD-07) का बहु स्थानिक परीक्षण कर C-2038 की अपेक्षा पूर्ण उपज में 8-23% सुधार दर्ज की गई
- ❖ अधि उपज शहतूत जीन प्रारूप (C-01 & C-11) का बहु स्थानिक परीक्षण कर ठंडे क्षेत्रों के S1635 की तुलना में 20-30% की सुधार देखी गई
- ❖ 29 अलग-अलग शहतूत जीन प्रारूप समेत पॉलीक्लोनल बीज का रोपण किया गया। साथ ही, 461 पीसीएच संकरों का भी मूल्यांकन किया जा रहा है
- ❖ शहतूत पारिस्थितिकी तंत्र में मृदा जैविक स्वास्थ्य हेतु एक नॉवेल, तीव्र व सरल मूल्यांकन पद्धति के पेटेंट हेतु आवेदन किया गया है (एनआरडीसी:नई दिल्ली के माध्यम से; No.TEMP/E-1/62723/2020-KOL दिनांक 24-12-20)
- ❖ शहतूत में मायरोथेसियम पर्ण चित्ती एवं फुसैरियम शुष्क मूल विगलन के कारण होने वाले फंगल रोगों के PRE/AFP-2 दमन प्रक्रिया हेतु पेटेंटिंग की कार्रवाई की गई है (एनआरडीसी –नई दिल्ली के माध्यम से; No.TEMP/E-1/10395/2021-KOL दिनांक 05-3-2021)
- ❖ पूर्व एवं पूर्वोत्तर भारत में रोटफिक्स के प्रक्षेत्र मूल्यांकन द्वारा मूल विगलन से प्रभावित शहतूत पौधों में 92% स्वास्थ्य लाभ दर्ज की गई
- ❖ एआईसीईएम-IV चरण में परीक्षण व जांच उपजातियों के लिए डेटा संग्रह आरंभ किया गया

रेशमकीट फसल सुधार व संरक्षण

- ❖ अधि कवच भार (28RY-MV) एवं अधि-उत्तरजीविता (29RND-BV) के साथ कॉन्जेनिक लाइन्स का विकास किया गया
- ❖ रलिंग FCs (SK6.7 & BCon1.4) की अपेक्षा ताप सहिष्णु द्विप्रज डबल संकर के ओएसटी KDH1(WB7.5 x WB1.3) के अंतर्गत उत्तरजीविता में >10% की सुधार दर्ज की गई
- ❖ पूर्वी तथा उत्तर-पूर्वी राज्यों में उन्नत संकर नस्लों 12Y x BFC1 का प्राधिकरण परीक्षण आरंभ किया गया
- ❖ कृषक स्तर पर द्विप्रज डबल संकर BHP 3.2 x BHP 8.9 का आशाजनक प्रदर्शन (65-70 किग्रा/100 रोमुच; धागाकरण क्षमता : 75%; कवच: 20%; रेंडिता:7.0-7.2)

- ❖ रेशमकीट एवं कीटपालन संस्तर के विसंक्रमण हेतु पर्यावरण के अनुकूल संस्तर रोगाणुनाशी सेरी-विन विकसित किया गया
- ❖ कीटपालन गृह एवं उपकरणों के विसंक्रमण हेतु पर्यावरण के अनुकूल एक सामान्य रोगाणुनाशी निर्मूल के पेटेंट के लिए आवेदन किया गया (एनआरडीसी – नई दिल्ली; No.TEMP/E-1/55625/2020-KOLdt.17-11-2020)
- ❖ बेसिलस फ्लेक्सस, रेशमकीट (38%) को संक्रमित करने वाली एक रोगजनक बैक्टीरिया की पहचान हार्मोनिया एक्सिरिडिस से हुई, जो शहतूत पारिस्थितिकी - तंत्र का एक कीट है
- ❖ उन्नत निस्तरी लाइनों (IN-M & IN-P) का विकास उत्कृष्ट उर्वरता, उत्तरजीविता, उच्च तापमान व उच्च आर्द्रता के प्रति सहिष्णुता, BmNPV व BmDNV1 के प्रति सहिष्णुता / प्रतिरोधी, कोसा की विशेषताओं तथा फिलामेंट लंबाई के साथ किया गया
- ❖ बॉम्बेक्स मोरी में सापेक्ष आर्द्रता के प्रति सहिष्णुता हेतु एसएनपी मार्कर (py3 व py4) का विकास किया गया (NCBI data base: MT221438 & MT221439)
- ❖ रेशमकीट जीव-संख्या की सहिष्णुता की जांच अधि-तापमान और अधि-सापेक्ष आर्द्रता के प्रति करने हेतु मल्टीप्लेक्स-पीसीआर तकनीक का विकास मार्कर असिस्टेड सेलेक्शन (एमएस) द्वारा किया गया
- ❖ उच्च सापेक्ष आर्द्रता एवं तापमान के प्रति सहिष्णु रेशमकीट नस्लों (BV: एन-5, एन-2, एचटीएच-10, डब्ल्यूबी-5 और डब्ल्यूबी-9; MV: निस्तारी, सिबी5, पीएम- डब्ल्यूबी, एम6डीपीसी व12वाई) का मार्कर असिस्टेड सेलेक्शन द्वारा रख-रखाव
- ❖ कम आणविक भार शहतूत पर्ण पेप्टाइड्स (<25kDa; PR1, मैनोस-बाइंडिंग लेक्टिन, WAP, गैलेक्टोज-बाइंडिंग लेक्टिन) की पहचान LC-MS के द्वारा की गई है। उक्त पेप्टाइड्स स्टैफिलोकोकस एसपीपी व बैसिलस एसपीपी की वृद्धि रोकने में सक्षम है (zone of inhibition: 15-40mm @ 200µg)
- ❖ संभावित गैर-वस्त्र प्रयोजन हेतु कम आणविक भार शहतूत रेशमकीट सेरिसिन पेप्टाइड्स का विशेषीकरण
- ❖ ROBEVA-Bm: रेशमकीट आनुवंशिक संसाधनों (R Programming) के चयन हेतु एक सुदृढ़ बहुभिन्नरूपी मूल्यांकन पद्धति

प्रौद्योगिकी हस्तांतरण

- ❖ 5275 हितधारकों को उन्नत रेशम प्रौद्योगिकियों पर 107 ईसीपी के माध्यम से प्रशिक्षित किया गया
- ❖ कुल 1.20 लाख कृषकों को एम-किसान पोर्टल के माध्यम से विभिन्न भाषाओं (बंगला, हिंदी, ओड़िया, नेपाली) में 71 वैज्ञानिक परामर्श/संदेश संप्रेषित की गई
- ❖ पूर्वी तथा उत्तर-पूर्वी भारत में (8.19 लाख रोमुच; औसत उपज: 45-50 किग्रा/100 रोमुच) आठ मेगा क्लस्टर संवर्धन कार्यक्रम के द्वारा 46.37 मैट्रिक टन द्विप्रज कच्चे रेशम का उत्पादन किया गया
- ❖ पूर्वी तथा उत्तर-पूर्वी भारत में (17.18 लाख रोमुच; औसत उपज: 40-46 किग्रा/100 रोमुच) चार क्लस्टर संवर्धन कार्यक्रम के द्वारा 98.66 मैट्रिक टन आईसीबी कच्चे रेशम का उत्पादन किया गया
- ❖ पूर्व एवं पूर्वोत्तर राज्यों (ओड़िशा, असम, मेघालय, मिजोरम, नागालैंड, सिक्किम, त्रिपुरा और अरुणाचल प्रदेश) में अतिरिक्त फसलों का सफल आरंभ

दक्षता निर्माण व प्रशिक्षण

- ❖ 40 छात्रों को पीजीडीएस (2019-20) की डिग्री प्रदान की गई तथा 2020-21 के लिए 28 छात्रों का नामांकन किया गया
- ❖ शहतूत रेशम कृषि प्रौद्योगिकी पर 408 कृषकों (FST)173 कार्मिकगण (TOP) प्रशिक्षित किए गए
- ❖ रेशम कृषि प्रौद्योगिकियों पर 1200 कृषकों को रेशम संसाधन केन्द्रों (6) के माध्यम से प्रशिक्षित किया गया
- ❖ 55 कृषकों एवं छात्रों के लिए अभिनव रेशम कृषि प्रौद्योगिकी कार्यक्रम का आयोजन किया गया
- ❖ 92 एसएचजी महिलाओं को रेशम कोसा हस्तशिल्प (माला, बैज, ग्रीटिंग कार्ड, राखी आदि) पर प्रशिक्षित किया गया
- ❖ 100 कृषकों को व्यावहारिक प्रशिक्षण तथा 42 कर्मिकों को गहन रेशम उत्पादन कार्यक्रम के द्वारा प्रशिक्षित किया गया
- ❖ कौशल/अनुशासन विशिष्ट ज्ञान को अद्यतित करने हेतु वैज्ञानिकों को विभिन्न ऑनलाइन वेबिनार/ई-सम्मेलनों में प्रतिनियुक्त किया गया
- ❖ डीएसटी – एसईआरबी द्वारा प्रायोजित विज्ञान वर्तिका रिसर्च इंटरनशिप को "रेशम अनुसंधान में आर प्रोग्रामिंग टूल का उपयोग करके सांख्यिकी के अनुप्रयोग" (2 महीने) हेतु स्वीकृति प्रदान की गई

प्रौद्योगिकियां/उत्पाद/जारी प्रक्रियाएं/एकस्व-अधिकार प्रदत्त

- ❖ सेरीसिलिन – रेशमकीटों एवं रेशमकीट संस्तर को विसंक्रमित करने के लिए एक सहक्रियात्मक संरचना (दिनांक 31.07.2020 को पेटेंट # 342953 स्वीकृत की गई; No. 650/KOL/2012 दिनांक: 11.06.2012)

आवेदित पेटेंट

- ❖ निर्मूल (No. TEMP/E-1/55625/2020-KOL dated 17.11.2020)
- ❖ शहतूत पारिस्थितिकी - तंत्र में मृदा जैविक स्वास्थ्य के लिए एक प्रणाली (No. TEMP/E-1/62723/2020-KOL dated 24.12.2020)
- ❖ शहतूत में मायरोथेसियम पर्ण एवं फुसैरियम शुष्क मूल विगलन का दमन कवकरोधी पेप्टाइड के (AFP-2) माध्यम से करने की प्रक्रिया (No. TEMP/E-1/10395/2021-KOL dated 21-03-2021)

HIGHLIGHTS OF R & D ACTIVITIES

Central Sericultural Research & Training Institute, Berhampore along with three Regional Sericultural Research Stations (RSRSs) and nine Research Extension Centres (RECs) are rendering significant contributions for the development of sericulture industry in Eastern & North-Eastern region. R & D activities undertaken in mulberry & silkworm breeding, crop production & protection, transfer of technology, extension and training activities have resulted in developing improved technologies suitable for the farmers in the states of West Bengal, Odisha, Chhattisgarh, Jharkhand, Bihar, Assam, Nagaland, Sikkim, Manipur, Tripura, Meghalaya, Arunachal Pradesh and Mizoram. The salient achievements of main institute and nested units for the year 2020-21 are as follows:

MULBERRY CROP IMPROVEMENT PRODUCTION & PROTECTION

- ❖ Initiation of FYT of promising drought tolerant and high yielding mulberry genotypes (PYD-8, PYD-27, PYD-01 & PYD-07) with 8-23% leaf yield improvement over C-2038
- ❖ Initiation of MLT of high yielding mulberry genotypes (C-01 & C-11) with 20-30% improvement over S1635 for colder regions
- ❖ Established Polyclonal Seed Orchard with 29 divergent mulberry genotypes. 461 PCH hybrids are under further evaluation
- ❖ Patent application of a novel, rapid and simple assessment method for soil biological health in mulberry ecosystem (filed through NRDC-New Delhi; No. TEMP/E-1/62723/2020-KOL dated 24-12-2020)
- ❖ Process patenting for PRE/AFP-2 mediated suppression of fungal diseases caused by Myrothecium leaf spot and Fusarium dry root rot in mulberry (NRDC-New Delhi; No. TEMP/E-1/10395/2021-KOL dated 05-3-2021)
- ❖ Field evaluation of Rotfix recorded 92% recovery of root rot infected mulberry plants in E & NE India
- ❖ Initiation of data collection for test and check varieties in AICEM-IV phase

SILKWORM CROP IMPROVEMENT, PRODUCTION & PROTECTION

- ❖ Development of congenic lines with high shell weight (28RY-MV) & high survival (29RND-BV)
- ❖ OST of thermo-tolerant bivoltine double hybrid, KDH1 (WB7.5 x WB1.3) with >10% improvement in survival to ruling FCs (SK6.7 & BCon1.4)
- ❖ Initiation of authorization trials of improved crossbreed, 12Y x BFC1 in E & NE states
- ❖ Promising performance of bivoltine double hybrid, BHP 3.2 x BHP 8.9 at farmers level (65-70 kg/100 dfls; reelability: 75%; shell: 20%; renditta:7.0-7.2)
- ❖ Development of eco-friendly bed disinfectant, SERI-WIN for the disinfection of silkworm body and rearing bed
- ❖ Patent application of NIRMOOL, a general eco-friendly disinfectant for disinfection of rearing house & appliances (NRDC- New Delhi; No. TEMP/E-1/55625/2020-KOLdt.17-11-2020)

- ❖ *Bacillus flexus*, a pathogenic bacteria to cross-infect silkworm (38%) was identified from *Harmonia axyridis*, an insect in mulberry ecosystem
- ❖ Development of improved Nistari lines (IN-M & IN-P) with superior fecundity, survival, tolerance to high temperature & high humidity, tolerance/resistance to BmNPV & BmDNV1, cocoon characteristics and filament length
- ❖ Development of SNP markers (*py3* & *py4*) for tolerance to relative humidity in *Bombyx mori* (NCBI data base: MT221438 & MT221439)
- ❖ Development of Multiplex-PCR assay for screening silkworm populations for tolerance to high temperature and high relative humidity by Marker Assisted Selection (MAS)
- ❖ Maintenance of silkworm beeds tolerant to high relative humidity and temperature (BV: N-5, N-2, HTH-10, WB-5 & WB-9; MV: Nistari, CB5, PM-WB, M6DPC & 12Y) by MAS
- ❖ Low molecular weight mulberry leaf peptides (<25kDa; PR1, Mannose-binding lectin, WAP, Galactose-binding lectin) identified employing LC-MS. These peptides inhibited *Staphylococcus* spp. and *Bacillus* spp. (zone of inhibition: 15-40mm @ 200µg)
- ❖ Characterization of low molecular weight mulberry silkworm sericin peptides for possible non-textile purposes
- ❖ *ROBEVA-Bm*: A robust multivariate evaluation method for selecting silkworm genetic resources (R Programming)

TRANSFER OF TECHNOLOGY

- ❖ Sensitization of 5275 stakeholders with improved sericulture technologies through 107 ECPs
- ❖ 71 scientific advisories/messages to 1.20 lakh farmers through m-Kisan (Bengali, Hindi, Oriya, Nepali, Oriya)
- ❖ 46.37MT bivoltine raw silk production through eight mega clusters in Eastern & NE India (8.19 lakh dfls; avg. yield: 45-50 kg/100 dfls)
- ❖ 98.66 MT ICB raw silk production through four mega clusters in Eastern & NE India (17.18 lakh dfls; avg. yield: 40-46 kg/100 dfls)
- ❖ Successful introduction of additional crops in E & NE states (Odisha, Assam, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura & Arunachal Pradesh)

CAPACITY BUILDING & TRAINING

- ❖ 40 students awarded PGDS (2019-20) and 28 students enrolled for 2020-21
- ❖ 408 farmers (FST) and 173 personnel (TOP) trained on mulberry sericulture technologies
- ❖ Seri Resource Centres (6) trained 1200 farmers on sericulture technologies
- ❖ Organized exposure of recent sericulture technologies for 55 farmers & students

- ❖ Imparted training in silk cocoon handicrafts (garlands, badges, greeting cards, rakhees etc.) to 92 SHG women
- ❖ 100 farmers were trained through hands-on programme and 42 personnel in intensive sericulture programme
- ❖ Scientists were deputed to various online webinars/E-conferences to update skills/ discipline specific knowledge
- ❖ DST-SERB sponsored Vigyaan Vritika Research Internship was sanctioned for "Application of Statistics using R Programming Tool in Sericultural Research" (2 months)

TECHNOLOGIES / PRODUCTS / PROCESSES RELEASED/PATENTED

Patent Granted

- ❖ Sericillin - A synergistic composition for disinfecting silkworm body and silkworm bed (Patent # 342953 granted on 31.07.2020; No. 650/KOL/2012 Dated: 11.06.2012)

Patent Applications Filed

- ❖ Nirmool (No. TEMP/E-1/55625/2020-KOL dated 17.11.2020)
- ❖ A method for soil biological health in mulberry ecosystem (No. TEMP/E-1/62723/2020-KOL dated 24.12.2020)
- ❖ Process of Anti Fungal Peptide (AFP2) mediated suppression of Fusarium dry root rot & Myrothecium leaf in mulberry (No. TEMP/E-1/10395/2021-KOL dated 21-03-2021)

MULBERRY BREEDING & GENETICS

Concluded Research Project

PIB 3576: Evaluation of new mulberry genotypes for improvement in productivity and quality

[June 2016 - July 2020]

Suresh, K. (PI), MK Ghosh (Up to Dec 2016), Anil Pappachan (from July 2018), Deepika K. U. (from March 2019), G. S. Singh, K.C. Brahma (June 2016 - May 2018); SK. Misro (June 2018 - June 2019); K. Alam (from July 2019); SN. Gogoi (June 2016 - Nov 2018) & P. Kumaresan (from Dec 2018)

Objective: To evaluate high yielding mulberry genotypes with early sprouting during winter

Nine new promising genotypes (PIB3422 & PIB 3424: PYT) and popular variety, S1635 as check were evaluated at four test centers in Eastern & North-Eastern India for leaf productivity and quality in different seasons as FYT cum MLT.

Irrigated Conditions (CSRTI-Berhampore)

The Pooled analysis of variance revealed highly significant differences among genotypes for all the traits studied and influence of all the factors. Leaf parameters such as unit area (122 -188 cm²/leaf), unit weight (221-380 g/100 leaves), moisture content (73.25 - 77.58 %) and retention capacity (76.03–81.10%) had profound variation and C-11, C-01 & C-384 are significantly superior to check. Wide variability was observed for growth traits viz., days to sprouting (8 – 11 days), length of longest shoot (117 - 138 cm), total shoots length (751 - 886 cm) and leaf to shoot ratio (50.04 - 57.69 %) and C-11, C-01, C-384 & C-05 recorded higher growth.

Performance of Genotypes under Irrigated Condition (5 seasons)												
Rank	Genotype	DHS (N/W)	ULW (g)	LMC (%)	LLS (cm)	TSL (cm)	TSP (mg/g)	TSS (mg/g)	LYW (t/ha)	ALY (t/ha)	Gain (%)	
1	C-11	8	39*	321	77.47*	116	819*	25.86	38.58	10.54*	57.06*	35
2	C-01	10	42*	339	77.58*	138*	886*	31.89	36.49	10.30*	56.64*	34
3	C-384	9	41*	329	77.02*	124*	807*	33.17	36.77	9.97*	49.72*	18
4	C-05	10	46	321	75.95	138*	864*	32.09	38.40	9.98*	49.78*	18
5	C-45	9	37*	234	76.66	128*	853*	33.57	41.93*	6.95	35.26	-16
6	C-212	10	39*	306	76.94	118	751	35.29*	36.65	8.80*	46.08*	9
7	C-09	10	48	313	76.05	122	825*	30.91	32.77	7.55	47.24*	12
8	C-02	10	48	316	76.57	129*	764	33.57	37.59	9.59*	52.80*	25
10	C-108	11	42*	221	73.25	117	806*	35.74*	35.77	6.87	38.63	-8
9	*S1635	9	48	380	76.67	119	751	32.8	40.14	7.45	42.19	
	CD@5%	1	4	8	0.75	3	23	1.07	1.03	0.72	2.45	

DHS: Days to 100% sprouting in N: Normal; W: winter; ULW: Weight of 100 leaves; LMC: Leaf moisture; LLS: Length of longest shoot; TSL: Total shoots length; TSP: Total Soluble protein; TSS: Total Soluble sugars; LYW: Leaf yield in winter crop; ALY: Annual leaf yield

Leaf nutritional quality in terms of total soluble protein (25.86-35.29 mg g⁻¹), total soluble sugar (32.77- 41.93 mg g⁻¹) and leaves fall (14.55 - 17.46 %) recorded medium to higher content. Disease severity as percent disease incidence (PDI) of leaf spot (LS) diseases such as Bacterial LS (3.17 % - 6.40 %) Pseudocercospora LS (1.48 - 7.10 %), Myrothecium LS (1.80 - 7.01 %) along with Powdery Mildew (9.08- 12.58 %) was noticed during different seasons. Whiteflies (9-16 Nos/leaf) and Mealy bug infestation (tukra: 3.40 - 5.85 %) was observed. Most of test genotypes recorded significantly lower Pest & Disease severity compared to check. Silkworm bioassay with Bi × Bi hybrids (SK6 × SK7) during Feb – Mar 2020 crop revealed significant variation in mature larval weight (32.70 -37.33 g/ ten worms), single cocoon

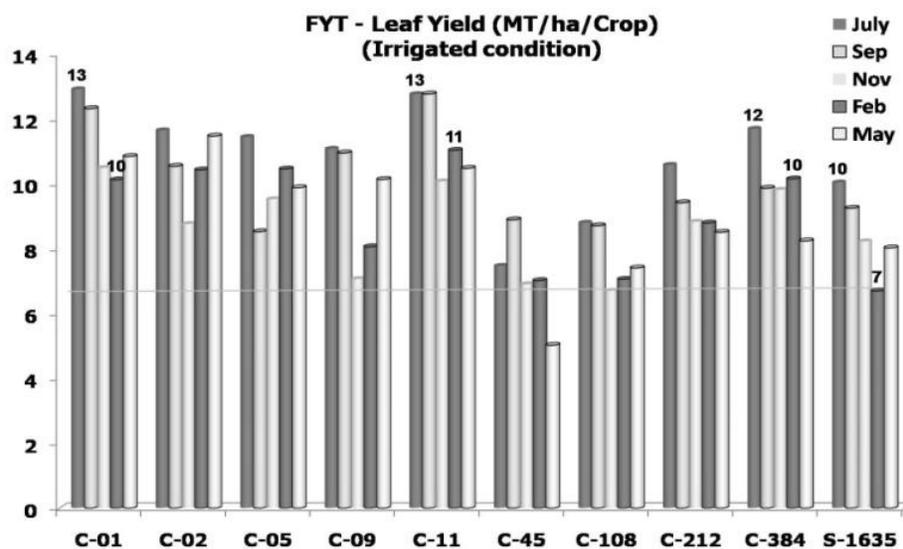
weight (1.265- 1.533g), single shell weight (0.191-0.251g), shell ratio (14.32 - 17.64%), Yield (ERR : 7973 - 8907 no's & 12.72 – 14.67 kg), leaf to cocoon ratio (18.45 - 24.45%) filament length (671- 836 m), reelability (70-74 %) and silk recovery (68-78%) among test genotypes fed and most were found to be superior in cocoon and reeling quality compared to variety S1635.

Leaf quality by silkworm bioassay and pest-diseases severity : Irrigated Conditions (SK6 × SK7; Feb - Mar 2020)

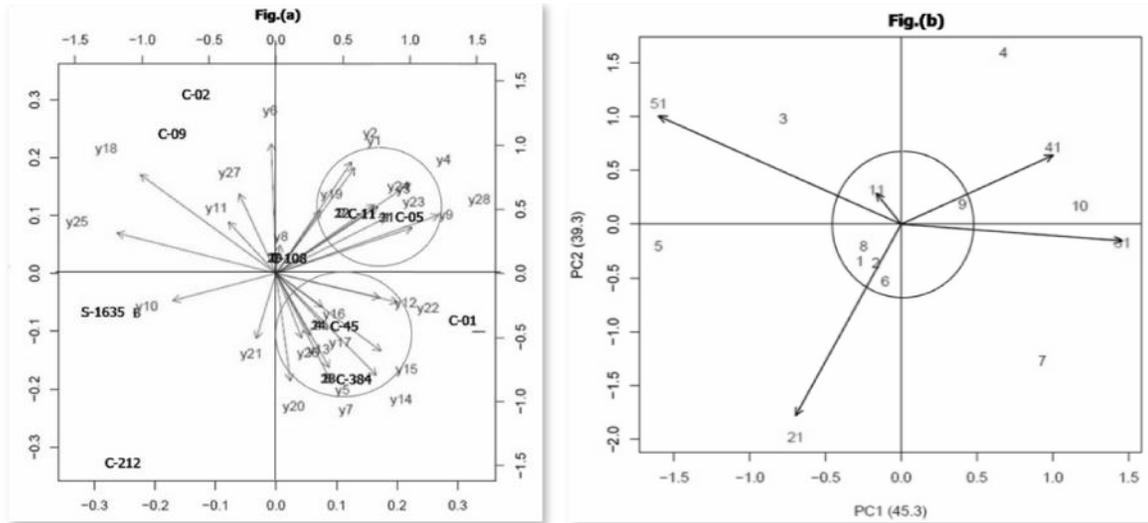
Genotype	Larval Wt. (g)	Cocoon Wt. (g)	SR (%)	ERR (g)	LCR	NBF (m)	Rend -itta	BLS (%)	PLS (%)	MLS (%)	Tukra (%)
C-11	37.00*	1.412*	17.64*	13.80*	18.45*	820*	8.34	3.96*	1.48*	1.80*	4.35
C-01	34.83	1.405*	15.29	14.37*	18.69*	637	8.62	3.70*	2.91*	3.84*	4.76
C-384	34.97	1.533*	16.36*	13.40*	24.38	700	8.65	4.35*	3.60*	3.38*	3.81*
C-05	32.7	1.285	15.47	13.72*	24.45	656	8.65	5.73	4.05	2.51*	3.40*
C-45	35.17	1.361*	14.32	14.30*	23.85	751*	8.94*	3.97*	4.45	3.87*	4.22
C-212	34.13	1.424*	16.04*	14.67*	18.83*	688	8.56	3.17*	5.26	3.99*	5.85
C-09	37.33*	1.265	17.38*	14.03*	20.22*	722	8.19	4.45*	3.69*	5.29	5.17
C-02	33.83	1.298	16.46*	13.31	20.44*	712	8.53	4.25*	4.04	2.82*	5.31
C-108	32.6	1.393*	16.61*	13.39	19.85*	671	8.40	6.4	7.10	7.01	5.03
S1635*	34.67	1.297	14.75	12.72	21.75	693	8.77	5.94	4.43	5.50	4.76
CD@5%	1.32	0.052	1.09	0.68	0.68	37	0.15	0.69	0.62	0.60	0.70

Mean seasonal yield varied from 7.05 (C-45) to 11.41 (C-11) t/ha/yr and C-11, C-01 and C-02 recorded more than 10 t/ ha/crop. Mean leaf yield during winter crops (Agrayani & Falguni) varied from 6.95 to 10.45 t/ha and C-11, C-01, C-384, C-05, C-212 and C-02 recorded significantly higher winter leaf yields over S1635. Annual leaf yield ranged from 35.26 – 57.06 t/ha/yr and seven genotypes recorded significantly higher yield with a yield advantage of 9 to 35 % over variety S1635 under irrigated condition.

PCA analysis of 28 parameters generated eight PCs and PC1 and PC2 having more than 3 Eigen values contributed 45.30 % and 39.30 % variation, respectively. The PC1 had higher contribution for leaf area, 100 leaf weight, leaf moisture, moisture retention, leaf to shoot ratio, days to sprout and leaf yield. PC2 had major contribution for length of



longest shoot, total soluble sugars and leaf to cocoon ratio. AMMI analysis of variance for leaf yield showed that 48 % of the total variation was attributable to genotypes, 39.53 % to season and 3.49 % to G x E effects. Genotypes C-01, C-02, C-45, C-212 and C-384 were identified highly stable and C-11 showed moderate stability compared to check S1635. Based on multi-trait selection index, C-11 and C-01 were identified as top ranking genotypes with highest annual leaf yield (56-57 t/ha/yr), which is 30% higher than S-1635 under irrigated condition along with better quality and less pest –diseases severity.

Principle Component Analysis (Fig. a) and AMMI Biplot (Fig.b) for leaf yield (Irrigated)

Parameters → y1: Leaf area (g), y2: 100 leaf weight(g), y3 : Leaf moisture (%), y4: Moisture retention aft 6hrs(%), y5: Leaves/mt. shoot, y6: longest shoot Length (cm), y7: No of primary shoots, y8: Total shoots length (cm), y9: Leaf to shoot ratio(%), y10: Total soluble protein, y11: Total soluble sugars, y12: Ten larval weight(g), y13:Single cocoon weight(g), y14: Single shell weight(g), y15: shell ratio (%), y16: ERR by no., y17: ERR by wt., y18: Leaf to cocoon ratio(%), y19: days to sprout in normal seasons, y20: days to sprout in winter season, y21: leaf fall (%), y22: Bacterial Leaf spot, y23: Pseudocercospora Leaf spot, y24: Myrothecium Leaf spot, y25: Powdery mildew, y26: whitefly(no/leaf); y27: Tukra, and y28: Leaf yield.

Seasons → 11: July, 21: September, 31: November, 41: February & 51: May Crop.

Genotypes → 1: C-01, 2:C-02, 3:C-05, 4:C-09, 5:C-11, 6:C-45, 7:C-108, 8:C-212, 9:C-384 & 10:S-1635.

Rainfed Conditions (RSRS-Koraput; RSRS-Jorhat; REC-Bhandra)

Nine test genotypes were evaluated for leaf productivity and quality under three rainfed conditions in different seasons. The combined analysis of variance revealed significant influence of all the factors and highly significant differences among the genotypes for all the traits studied except days to sprout, primary branches, leaf moisture and moisture retention capacity. Growth traits such as days to sprout (9 - 12 days), 100 leaves weight (250 - 289 g), leaf moisture (74.35 - 77.44 %), retention capacity (79.30 – 81.50 %), length of longest (124 - 147 cm), total shoots length (600 - 763 cm) recorded wide variation and C-11, C-01, C-384, C-108 & C-05 had higher growth than check.

Performance of Genotypes under Rainfed Condition (3 locations)										
Rank	Genotype	DHS	HLW (g)	LMC (%)	LLS (cm)	TSL (cm)	LFH (%)	LYW (t/ha)	ALY (t/ha)	Gain (%)
1	C-11	10	273	76.87	131	700*	12.61*	4.86*	13.03*	21
2	C-01	9	271	76.4	144*	763*	11.28*	5.52*	13.31*	24
3	C-384	12	290	77.01	138*	712*	12.77*	5.18*	12.85*	19
4	C-45	11	250	77.44	147*	686	12.55*	3.83	11.31	5
5	C-108	11	262	74.35	137	692*	11.46*	3.98	11.31	5
6	C-02	11	253	76.76	138*	671	11.80*	4.87*	11.66*	8
7	C-05	11	266	76.62	141*	704*	12.11*	3.77	11.5	7
8	C-09	11	263	75.86	125	600	13.37*	3.63	10.68	
10	C-212	12	254	76.54	138*	670	13.63*	3.34	10.49	
	S1635*	11	289	76.29	124	639	17.78	4.07	10.75	
	CD@5%	3	2	2.26	13	47	2.44	0.39	0.79	

Analysis of cocoon parameters of Bi × Bi hybrids (SK6 × SK7) revealed significant differences for Single cocoon weight (1.297-1.496g), Single shell weight (0.219-0.247), shell ratio (13.92 -15.34 %), Yield (ERR; 8251 - 9030 no's & 12.81 – 14.29 kg) under rainfed conditions. All test genotypes fed silkworm recorded better cocoon quality compared to S1635. Wide variation in percent disease incidence (PDI) was recorded for leaf spot diseases such as Bacterial LS (0.78 % - 16.15 %), Pseudocercospora LS (1.39 -8.24 %), Myrothecium LS (0 - 1.21 %), Powdery mildew (4.83 - 10.67 %) along with Mealy bug or tukra (3.40- 5.85%). Overall, most of the genotypes were observed to have less pest & disease severity compared to the check. Leaf yield of genotypes varied across three locations (10.49 – 13.31 t/ha/yr) and four genotypes recorded 8 to 24 % yield advantage over S-1635 under rainfed conditions. At REC Bhandra, annual leaf yield ranged from 10.28 – 12.98 t/ha/yr and C-11, C-384, C-01 recorded significantly higher yield (19 - 26 %) over S1635. Annual leaf yield varied from 9.42 – 11.95 t/ha/yr at RSRS Koraput and C-05, C-11, C-01 found to have significantly higher yield (14 – 22 %) over S1635. At RSRS Jorhat, C-01, C-384, C-02, C-01 recorded 19 - 36 % higher yield over S1635 with a range of 10.02 -16.57 t/ha/yr.

PCA analysis of 20 studied traits revealed that first two principal components (PCs) had higher contribution for all the traits except bacterial leaf spot, Myrothecium leaf spot and tukra. AMMI ANOVA revealed non- significant G × E interaction for leaf yield and existence of considerable variability of which 40.96 % of was attributable to environment, 9.79 % to genotypes and 4.92 % to G x E effects. The genotypes C-02, C-212, C-108 and C-45 were found to be more stable and C-01, C-11 are compared to check S1635. Based on multi-trait selection index, C-11 and C-01 were identified as superior genotypes with highest annual leaf yield (13-14 t/ha/yr), which is 20% higher than S-1635 under rainfed conditions along with better quality and less pest – diseases severity.

**Leaf quality by silkworm bioassay and pest-diseases severity : Rainfed Conditions
(SK6 × SK7; Oct-Nov 2019)**

Genotype	Cocoon Wt. (g)	Shell Wt. (g)	SR (%)	ERR (No)	ERR (g)	BLS (%)	PM (%)	PLS (%)
C-11	1.426*	0.245*	15.28*	9030*	14.29*	4.43	6.67*	7.83*
C-01	1.384	0.228	15.28*	8948*	13.61*	2.79*	5.72*	6.94*
C-384	1.446*	0.240*	14.50*	8513*	13.49*	5.79	5.7	5.83*
C-45	1.496*	0.247**	14.06*	8368*	13.10*	1.31*	8.00*	1.92*
C-108	1.41	0.246*	15.34*	8779*	13.82*	16.15	5.41*	3.08*
C-02	1.319	0.240*	14.74*	8251*	12.81*	0.78*	4.83*	8.24*
C-05	1.39	0.235*	15.00*	8505*	13.70*	2.04	9.08	7.79*
C-09	1.297	0.219	14.31*	8253*	13.21*	1.76*	7.60*	8.00*
C-212	1.392	0.231*	13.92	8287*	13.10*	2.92*	10.67	1.39*
S1635*	1.398	0.225	13.69	7996	12.34	5.01	8.93	14.49
CD@5%	0.021	0.004	0.23	124	0.21	1.22	0.85	1.04



Inference: C-01 and C-11 recorded significantly higher leaf yields (56-57 MT/ha/yr) over S1635 under irrigated (>30%) and rainfed (>20%) conditions along with better quality & stability.

Future work plan: Evaluation of C-01 and C-11 in different colder areas of subtropical region of E & NE and N & NW zones under MLT.

PIB 3610: Preliminary evaluation of newly evolved mulberry genotypes for mulberry improvement

[June 2017 - May 2020]

Suresh, K. (PI), D. Chakravarty, A. Pappachan and Yallappa H (from March 2019)

Objectives

- Evaluation of improved lines for foliage biomass and associated agronomic traits under PYT
- Qualitative assessment through biochemical, propagation and silkworm moulting test.

Twenty four test genotypes (PPY-1, 2, 3,...,24) and two checks (C-2038 & S-1635) were evaluated for leaf yield and yield component traits for five seasons under irrigated conditions at CSRTI-BHP. The Pooled analysis of variance revealed highly significant differences among genotypes and influence of all the factors except for leaf moisture retention & leaf fall over years. Morphological traits such days to sprouting (9 – 12 days & 21 - 52 days during normal and winter season), fresh leaf weight (1.863 - 4.112 g), moisture content (76 - 78 %) retention capacity (80 to 83 %), leaves in meter shoot (22 - 26 nos), length of longest shoot (96 - 122 cm), total shoots length (392 - 641 cm), leaf to shoot ratio (54 – 60 %) and leaf fall (15 - 22%) were highly varied and genotypes PPY-3, 6, 7, 8, 9, 10, 14, 16, 17, 18, 20, 21, 22 & 24 had significantly higher growth compared to C2038. Wide variation was observed for leaf area index (LAI: 70.76 - 151.91), relative growth rate (RGR:0.02 - 0.14 g/g/day), crop growth rate (CGR: 4.99 -12.38 g/m²/day), Biomass duration (BD:4.41 - 11.56 g/day) and Relative water content (71.33 - 87.72 %) and PPY-3, 6, 8, 10, 17, 19, 22 & 24 found to have significantly higher physiological growth over C2038.

Genotype	Morphological and Physiological Growth Traits under Irrigated Condition										
	DHS (N/W)	FLW (g)	LMC (%)	LLS (cm)	TSL (cm)	LAI (25 day)	CGR (g/m ² /day)	BMD (g/day)	LYP (g/cp)	LY (Kg/yr)	Gain (%)
PPY 8	10/40	3.183	77.15*	116*	641*	133.59*	11.20*	8.86*	407*	2.035*	35
PPY 10	9*/22*	4.112	77.15*	111*	602*	151.34*	9.64*	11.35*	390*	1.951*	28
PPY 24	10*/34	2.871	76.15	122*	637*	142.90*	8.77	9.76*	360*	1.800*	19
C-2038*	12/40	3.971	76.29	106	519	95.46	8.75	7.21	293	1.466	
S-1635	9/23	3.315	76.44	108	514	86.83	7.80	6.66	257	1.287	
CD@5 %	1/10	0.187	0.61	3	27	8.68	1.69	0.66	11	0.056	

Medium to higher nutritional content was recorded interm of total soluble protein (25.0-33.6 mg g⁻¹), soluble sugars (27.85-36.16 mg g⁻¹), total chlorophyll (2.18 – 5.05 mg g⁻¹) and chlorophyll content index (8.54-13.84). Silkworm moulting assay with Bi × Bi hybrid (SK6 × SK7) revealed significant difference for moultout ratio (57 - 91%: Ist instar and 83 - 96 %: IInd instar) and larval weight gain (0.084 -0.116 mg: Ist instar & 1.110 -1.883 g: IInd instar) and all the tested genotypes were found to have good leaf palatability except for PPY 9 & 21. Wide variation in the natural incidence of leaf spot (LS) diseases *viz.*, Myrothecium LS (5.32 - 14.69 %), Pseudocercospora LS (4.94 - 14.70 %), Bacterial LS (2.16 % - 6.75 %) and Mealy bug infestation/Tukra (4.13 to 8.12 %) was noticed and most of the genotypes found to have lower incidence of pest & diseases compared to both the checks. Propagation quality of genotypes was assessed by root and

shoot traits of sapling. Cutting survivability or rooting (62 - 92 %), fresh shoot weight (12.14 to 29.24 g), shoot length (25.08 to 49.16 cm), root length (11.62 - 24.82 cm) and root volume (10.30 – 24.96 cm³) varied among genotypes studied. Genotypes PPY 8, 10, 12, 14 & 15 recorded higher rooting and root length compared to C-2038.

Leaf Nutrition, Propagation, Silkworm Palatability & Pest-diseases severity Irrigated Condition											
Genotype	TSP	TSS	TCC	CSP	RL	SMO	SLW	MLS	PLS	BLS	Tukra
PPY 8	29.37	29.55	4.84	88.00*	18.84*	88.00	1.780	5.86*	6.35*	2.57*	4.13*
PPY 10	29.09	35.29*	3.98	84.00*	22.18*	90.67	1.747	5.67*	5.43*	3.32*	4.17*
PPY 24	27.81	30.59	4.68	80.50	19.71*	94.67*	1.883	7.60	7.99*	2.16*	4.78*
C-2038*	31.47	31.79	5.22	80.67	14.59	90.67	1.787	8.04	10.92	6.0	7.44*
S-1635	29.54	33.16	3.67	80	17.53	86.67	1.628	8.2	12.98	5.07	8.34
CD@5 %	1.12	1.11	0.41	2.52	1.06	3.06	0.11	1	1.06	0.49	0.51



Mean seasonal yield (209 - 407 g/plant) and annual yield (1.04 - 2.03 kg /plant) varied among the genotypes and 10 out of 24 recorded significantly higher leaf yield per plant (kg/yr) over the ruling variety C-2038 with yield advantage of 5 to 39 %. However, PPY 8, PPY 10, and PPY 24 recorded more than 20 % yield over ruling variety C-2038 or more than 40% over popular variety S-1635 under PYT. Principle component analysis of pooled values of 24 traits formed 18 components (PCs) and nine with more than one Eigen value explained 82.80% variability. Multi trait selection index was constructed based on PCA scores, the genotypes PPY-10, PPY-8 and PPY-24 were identified as top rankers and superior to C-2038. G x E interaction was determined by AMMI analysis of variance revealed 72.35 % of the total variation attributable to environment, 15.60 % to genotypic and 3.44 % to G x E effects. Genotypes PPY-10 and PPY-24 are highly stable and PPY-8 is moderately stable compared to check C-2038.

Inference: Three promising genotypes (PPY-8, 10 and 24) with >20% yield over ruling variety C-2038 along with better quality & stability under irrigated condition.

Future work plan: Evaluation of newly developed high yielding genotypes for leaf and silk productivity in E & NE India under FYT.

Ongoing Projects

PIB 3627: Development of superior mulberry (Morus spp.) genotypes through polyclonal seed orchard

[June 2018 - May 2021]

D. Chakravarty(PI) (up to Sept 20), Yallappa H. (from Oct 2020), Suresh, K., and Deepika, K.U.

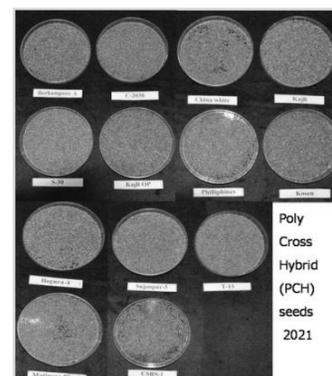
Objectives

- To establish polyclonal seed orchard for creating enormous genetic variability
- To identify promising mulberry seedlings for further utilization

To develop high yielding mulberry variety through polycross mating, seed orchard with twenty nine superior divergent parents was established at CSRTI-BHP (5'x5'; males centred-within the female genotypes; clonal plantation). Natural open pollinated, mature polycross hybrid (PCH) fruits were harvested (Feb-Mar 2021). Hybrid seeds were extracted by water soaking method and processed following standard procedures. Data on Hybrid fruits and seed parameters of 13 parents revealed significantly higher fruit and seed weight in C-2038, CSRS-1& Berhampore-A. Highest number of hybrid seeds was obtained in Berhampore-A followed by Kajli OP, Kajli, Bogura-4, T-13 and S-30.

Polycross Hybrid (PCH) : Fruit & seed parameters (2021)									
Genotype	Parentage/ Acc.No.	Fruit length (cm)	Fruit width (cm)	Fruit Wt. (g)	Achenes/ Fruit (Nos)	Seeds/ Fruit (No)	Seed Wt. /fruit (mg)	1000 Seed Wt.(g)	Total Seeds (No)
Kosen	ME-0066	1.40	0.91*	0.767	47.60	34.60	41.00	1.243	7089
China White	ME-0042	1.98	1.02*	1.024	57.60*	36.60*	43.00	1.110	3674
C-2038	CF1(10) × C-763	2.50*	1.10*	1.386*	40.00	26.00	49.50	1.782*	3492
S-30	MI-0046	2.40*	1.10*	1.474*	57.00*	41.40*	56.20*	1.299	15413
Kajli OP	OPH of Kajli	2.41*	1.25*	2.453*	56.00*	40.00*	62.80*	1.245	60528
Phillipines	ME-0011	1.72	0.98*	0.745	35.60	27.00	54.50	1.810*	3350
CSRS-1	MI-0084	2.64*	1.02*	1.392*	68.40*	44.60*	78.40*	1.578*	1482
Berhampore-A	MI-0054	2.60*	1.27*	2.318*	62.20*	48.00*	65.10*	1.531*	83071
Sujanpur-5	MI-0017	2.19	0.98*	0.897	47.80	41.80*	48.60	1.268	5966
Matigera Black	MI-0300	1.36	0.84	0.673	46.20	37.00*	48.50	1.657*	2079
Bogura-4	ME-0097	1.75	1.04*	0.835	48.60*	40.00*	81.00*	1.837*	20918
T-13	Elite clone	1.50	0.89*	0.654	40.30	32.50	46.50	1.500*	17778
*Kajli	MI-0068	2.03	0.85	0.933	46.20	33.40	53.60	1.443	46952
CD@5%		0.09	0.03	0.115	1.82	1.24	2.42	0.046	

PCH seedlings (4000 Nos) from Hybrid seeds collected during 2020 are raised in nursery and characterized for visual morphological traits (Sarkar & Fujita, 1993) viz., leaf lobation (Entire), size (large), colour (dark green), texture (smooth), thickness (thick), appearance (glossy), posture (acute) and lateral shoot (No.), Shoot posture (erect) along with Disease & pest incidence. Four hundred and six one hybrids were selected and established in progeny row trials (PRT) for further evaluation. Among desirable hybrids selected, C-2038 had highest PCH (134 Nos) followed by C-2036/RG-76 (108 Nos), C-2045/ CT-11 (79 Nos), Kajli (64 Nos), Matigera Black (16 Nos) & C-2060/C-01 (16 Nos).



PIB02007SI: Improvement of mulberry leaf longevity in E & NE states of India**[June 2020- May 2024]**

Deepika K.U., Yallappa H. and Harish Babu S.

Objectives:

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

Two senescence contrasting varieties (S-1635: early senescence & C-2038: late senescence) are established for pot culture studies. Floating leaf disc assay of 11 treatments (Control: water, NAA: Napthalene acetic acid, IAA: Indole acetic acid, BAP: Benzyl amino purine, AA: Ascorbic acid, SNP: Sodium nitroprusside, Sodium selenite, CAN: Calcium ammonium nitrate, Urea, KNO₃ and ZnSO₄) in 3 doses revealed higher chlorophyll retention in five treatments (IAA, AA, CAN, SNP & BAP). The studies are under progress to identify compound associated with leaf longevity in mulberry.

Treatment	Total Chlorophyll Retention : Leaf Disc Assay					
	S-1635			C-2038		
	Total Chl. (0 day)	Total Chl. (5 days)	Percent Chl. retention	Total Chl. (0 day)	Total Chl. (5 days)	Percent Chl. retention
IAA	3.06	2.19*	71.38*	2.69	2.00*	74.12*
AA	3.17	2.28*	71.82*	2.74	2.23*	81.46*
CAN	3.05	2.46*	80.60*	2.82	2.10*	74.40*
SNP	3.05	2.47*	81.00*	2.74	2.10*	76.62*
BAP	3.13	2.34*	74.65*	2.72	1.99*	73.16*
Control*	3.17	1.00	31.64	2.85	1.10	38.56
CD @ 5%	0.09	0.08	2.48	0.06	0.24	9.51

PIE 02002 SI: Evaluation of performance of mulberry genotype C-9 under red and laterite soils**[July 2019 - June 2023]**

Suresh K., (from Oct 2020), D. Chakravarty, (upto Sep 2020), G. S. Singh, K. Alam and Soumen Singh

Objective:

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

Test genotype (C-9 or C-2058) along with check varieties (S-1 & C-2038) are established in RBD with five replications at three test centers [RSRS- Korput, RSRS-

Genotype	Leaf Yield & Quality Parameters : Rainfed Red Lateritic Soils									
	FLW	LMC	LLS	NPS	TSL	PM	MLS	WF	LY	% gain
C - 9	4.652	76.50	174*	10.05*	912*	1.09*	0.66	4*	5.86*	12.80*
S - 1 [#]	2.750	75.19	163	8.64	764	1.35	0.69	11	3.66	60.37 [#]
C-2038*	4.849	77.01	151	8.95	748	1.30	0.55	8	5.20	
CD5%	0.118	0.21	14	1	42	0.12	0.12	2	0.48	

Imphal & REC-Bhandra] of E & NE India. Genotype C-9 recorded significantly higher mean values for length of longest shoot, total shoot length and primary shoots along with lower incidence of powdery mildew and whiteflies. C-9 found to have highest mean leaf yield (5.86 t / ha / crop) under rainfed red lateritic soils of E & NE India, which is 12 % higher than ruling variety C-2038.

PIB02010SI: Final yield trial of promising high yielding mulberry genotypes for E&NE India [Feb 2021 – Jan 2025]

Suresh K. (PI), Yallappa H. Deepika, K.U. and Khasru Alam

Objectives

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

The cuttings of seven test genotypes [PYD-01, PYD-07, PYD-08, PYD-27, PPY-8, PPY-10 & PPY-24] along with two check varieties (S-1635 & C-2038) are planted in nursery and maintained with recommended cultural practices.

Pilot Study: Development of mulberry crop schedule for optimal silk productivity in WB [October 2019 – July 2021]

Suresh, K and Deepika U.K.

Objective: To identify season-wise crop schedule in mulberry sericulture for West Bengal

Proposed Mulberry Silkworm crop schedules : West Bengal					
Silkworm Crop	Mulberry Crop	Date of Pruning		Date of Brushing	
		NS	ES	NS	ES
Falguni	Dec-Feb	15 th Dec	1 st Dec	19 th Feb	30 th Jan
Baishakhi	Mar-May	15 th Mar	25 th Feb	20 th Apr	30 th Mar
Shravani	May-Jul	15 th May	25 th Apr	20 th Jun	20 th Jun
Ashwina	Jul-Sept	14 th Jul	15 th Jul	25 th Aug	25 th Aug
Agrahayani	Sept-Nov	22 nd Sep	19 th Sep	31 st Oct	31 st Oct

NS: New Schedule; ES: Existing Schedule

New Mulberry Silkworm Crop Schedule – Performance											
Crop	Schedule	Pruning Date	LYP (g)	LLS (cm)	TSL (cm)	TSP (mg/g)	TSS (mg/g)	Cocoon Wt. (g)	Shell Wt.(g)	SR (%)	ERR (kg)
Feb 2021	New	15 ^h Dec	520*	89*	1233*	33.11*	33.10	1.396	0.227*	16.29*	12.98*
	Existing	1 st Dec	140	69	730	30.83	32.40	1.374	0.209	15.19	11.38
May 2021	New	15 th Mar	709*	116*	1465*	34.25*	35.64*	1.098	0.151	13.77	9.36
	Existing	25 th Feb	584	98	841	31.40	31.37	1.029	0.139	13.38	9.09
Jul 2020	New	15 th May	406	95	914	28.25	31.28	1.432*	0.227	15.64	14.96
	Existing	25 th Apr	422	115*	1039*	27.94	30.57	1.409	0.223	15.22	15.22
Sep 2020	New	14 th Jul	338	107	875	32.21	35.28	1.057	0.171	16.26	11.29
	Existing	15 th Jul	339	112	949	32.29	36.27	1.024	0.165	16.21	11.20
Nov 2021	New	22 nd Sep	270	98	753*	19.88	34.11	1.787*	0.272	15.22	15.13
	Existing	19 th Sep	264	95	729	25.63	29.40	1.765	0.269	15.27	14.98

New mulberry crop schedules for West Bengal along with farmers schedule are evaluated at CSRTI-BHP with the existing plantation (S-1635; 5-year old). The plantation was pruned and silkworm brushings were carried out under irrigated conditions during five seasons for assessing leaf and cocoon parameters. Significant differences were observed for leaf yield, growth and rearing performance between two pruning schedules during Feb 2021 & May 2021 seasons. The new schedule recorded ~21% higher leaf yield over existing schedule along with highly nutritive leaves. Rearing performance revealed higher cocoon and silk parameters in new schedule in other seasons (July, Sept and Nov).

Collaborative Projects

PRP 08002 MI: Identification of candidate genes based powdery mildew resistance for utilization in disease resistance breeding in mulberry (with SBRL-Bangalore)

[May 2019 – May 2022]

Suresh K., Ramesha, A. (PI), Dubey, H., and Vijayan, K

Objectives:

- To identify powdery mildew susceptibility genes Mildew Resistance Locus O (*MLO*) from mulberry
- To screen PM resistant mulberry genotypes for an association of non-functional mutation in the candidate *MLO* gene with disease resistance
- Validation of CAPS marker for chalcone synthase gene involved in PM resistance in diverse germplasm accessions/segregating progenies

Powdery mildew disease resistant mapping populations of Kajli OP × V-1 and S-1 × Vietnam-2 maintained at CSRTI-BHP were phenotypes for natural incidence of powdery mildew during November 2020 crop. Wider PDIs were recorded in the mapping populations as compared to parental genotypes (KOP: 5.15; V1: 20.14; S1: 17.16; Vietnam 2: 1.25). Genomic DNA from two populations and their parents were isolated for genotyping with *mlo* gene based markers and validation of CAPS marker.

Powdery Mildew Incidence (PDI) in Mapping Poulations (Nov 2020)						
Population	N=	PDI Range	PDI Class	n	R/S	Top resistant & susceptible progenies
Kajli OP × V-1	150	0 – 12.02	0-3	24	81	VK-146, 147, 180, 52 & 183
			3-5	57	(R)	
			5-7	40	69	VK-1, 170, 137, 70 & 73
			>7	29	(S)	
S -1 × Vietnam-2	120	0 – 33.11	0-5	54	89	SV-23, 53, 64, 71 & 75
			5-10	35	(R)	
			10-15	18	31	SV-7, 117, 8, 2 & 24
			>15	13	(S)	

AICEM-IV: All India Co-ordinated Experimental Trial for Mulberry varieties

[April 2019 – March 2025]

V. Sivaprasad, D. Chakravarty (upto Sep 2020), Soumen Chattopadaya, Suresh, K., GS Singh, K. Alam, Y. Debraj, P. Kumaresan, Subhashish Ghosh, Biswabasu Bagchi, Ram Mina, Yallappa, H., Mahesh, R., Deepika, KU., Anil Pappachan, Vijay, V., Aparna, K., T. Ranjitha Devi (From Mar 2021) and Manjunath G.R.

Objective:

- To identify & authorize suitable mulberry varieties for commercial use in agro-climatic zones

Mulberry varieties approved by MVAC along with two check varieties are planted in RBD design with six replications as per AICEM guidelines under the coordination of CSRTI-BHP. Initial soil nutrient status of AICEM plots was determined for 11 soil parameters using "Mridaparikshak" and classified the nutrient status in accordance with SHC portal. Shortfall in soil OC & other parameters were corrected by application of



required correction doses of fertilizers and FYM/vermicompost. The plantation was maintained with SOPs for establishment of low trunk bush plantation with annual pruning during June – July 2020. The micro irrigation system was installed at RSRS-Imphal & RSRS-Jorhat and it is under progress in other centers.

Soil Reaction & Nutrient Status @ AICEM test centers							
Parameters	CSRTI BHP	REC BND	DOS BSW	DOS BLP	RSRS KPT	BSF AMF	RSRS JHT
pH	7.70	5.30	6.13	7.80	4.60	5.30	4.56
OC (%)	0.87 ^M	0.70 ^M	1.09 ^H	1.05 ^H	0.87 ^M	0.96 ^M	0.57 ^M
N (kg/ha)	163.10 ^L	138.00 ^L	163.10 ^L	125.40 ^L	251.0 ^M	151.0 ^L	364.00 ^H
P ₂ O ₅ (kg/ha)	81.40 ^H	21.60 ^L	333.30 ^H	16.90 ^L	60.40 ^H	44.90 ^M	108.0 ^H
K ₂ O (kg/ha)	61.30 ^L	26.70 ^L	48.10 ^L	91.10 ^L	65.00 ^L	12.00 ^L	43.40 ^L
S (mg/kg)	30.00 ^H	16.00 ^H	14.00 ^M	32.00 ^H	9.70 ^D	4.31 ^D	15.10 ^H
Zn (mg/kg)	4.99 ^S	5.70 ^S	3.88 ^S	8.32 ^S	1.66 ^S	2.77 ^S	0.59 ^D
Mn (mg/kg)	2.05 ^S	27.80 ^S	4.05 ^S	9.89 ^S	2.70 ^S	1.80 ^I	0.66 ^D
Cu (mg/kg)	2.90 ^S	1.60 ^S	2.05 ^S	3.55 ^S	3.18 ^S	1.02 ^S	0.31 ^S
Fe (mg/kg)	16.10 ^S	15.00 ^S	28.40 ^S	15.50 ^S	25.40 ^S	11.80 ^S	41.50 ^S
B (mg/kg)	1.05 ^S	0.60 ^S	1.01 ^S	0.92 ^S	1.19 ^S	0.73 ^S	0.42 ^S

H: High; M: Medium; L: Low; S: Sufficient; D: Deficient & IS: insufficient
 < 4.5: Strongly acidic; 4.5 - 5.5: Moderately acidic; 5.6 - 6.5: Slightly acidic;
 6.6 - 7.5 = Neutral; 7.6 - 8.5: Slightly alkaline & > 8.5: Alkaline

AICEM centers : Survival (%) of saplings (after 2 months)						
Test Center	CBP-01 (C-1360)	CMY-01 (AGB-8)	CPP-01 (PPR-1)	C-2038* (NC)	S-1635 (ZC)	CD@ 5%
CSRTI-Berhampore (West Bengal)	98.35	96.30	95.27	96.09	96.50	ns
RSRS-Jorhat (Assam)	99.38*	90.33	97.94	95.68	99.18	2.49
RSRS-Imphal (Manipur)	93.83	84.77	95.06	93.83	95.47	ns
RSRS-Koraput (Odisha)	100.00	97.33	86.83	99.79	99.18	2.37
REC-Bhandra (Jharkhand)	100.00*	99.59*	91.77*	87.04	97.12	4.29
DoS – Bilaspur (Chhattisgarh)	78.60*	63.37	37.24	46.91	62.96	20.06
DOT(Seri)-Boswa (West Bengal)	99.18	97.74	92.39	99.59	100.00	3.49
P3-Ambarifalakata (West Bengal)	98.97*	84.36	89.92	86.83	97.33	5.72
Total	96.04*	89.22	85.80	88.22	93.47	4.80

Continuous/Other Activities

Maintenance of mulberry germplasm accessions

Suresh, K., Yallappa, H. and Deepika, K.U

A total of 354 mulberry genetic resources of twelve species are maintained with recommended cultural practices at CSRTI-Berhampore (WB) for utilization in different mulberry breeding programme.

Mulberry Genetic Resources: CSRTI, BHP			
Species/material	Sum	Indigenous	Exotic
<i>M. indica</i> Lin.	88	83	5
<i>M. alba</i> Lin.	71	32	39
<i>M. latifolia</i> Poir.	31	3	28
<i>M. bombycis</i>	14	-	14
<i>M. multicaulis</i>	2	-	2
Wild species	13	6	7
Elite clones	101	-	-
Tetraploids	34	-	-
Total	354	124	95

BIOTECHNOLOGY

Ongoing Project

AIC02004CN: Molecular characterization and assessment of the efficacy of low molecular weight peptides isolated from mulberry leaf against flacherie disease of silkworm [in collaboration with UNB, Siliguri]

[May 2019- May 2022]

Pooja Makwana (PI), Palash Mandal (PI, UNB), Soumen Chattopadhyay, K. Rahul (CIs); Suravi Ghosh JRF

Objectives:

- Purification and characterization of identified potential peptide(s) using HPLC – MS based approach
- Assessment of protection potential of identified low molecular weight peptide fractions against pathogen(s) of flacherie
- Validation of disease suppression ability and silkworm quality parameters by the synthesized specific peptide

Plants produce low molecular weight antimicrobial peptides (AMPs) of 3-10kDa mass (<50 amino acids) mainly cationic in nature and rich in cysteine or glycine residues. The study aims to identify LMW bioactive peptides from mulberry leaves with antimicrobial against pathogens causing flacherie disease in silkworms. Semi-purification of LMW peptides is achieved by a three-step process- (i) homogenisation of mulberry (S1635) leaves in extraction buffer (pH 7.2; 1:5 w/v); (ii) salt precipitation by ammonium sulphate (40%) and desalting; (iii) Gel filtration chromatography (Sephadex G-50 & Sephadex G-25).

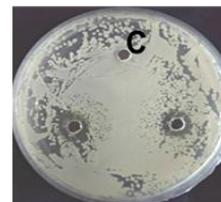
Purification and identification of low molecular peptides from mulberry leaves

The crude extract yielded 14mg/ml of protein. Further, protein yield was determined at each purification step. Crude extract was saturated with 40% ammonium sulphate to precipitate protein (~ 55% yield). Precipitated protein was subjected to two successive steps of Gel filtration (Sephadex G-50 and G-25) chromatography. Three elutes (I, II, III) were obtained after passing the sample through Sephadex G-50. Presence of protein in G-50 elutes was confirmed by SDS-PAGE and estimated the concentration of protein (28% yield). G-50 peaks II & III showed antibacterial activity against *Bacillus sp.* and *Staphylococcus sp.* These two fractions (II & III) were further purified with Sephadex G-25 gel filtration, which resulted in three elutes (I, II, III). Two fractions, G25-II & G25-III, cumulatively yielded 19% LMW peptide. Subsequently, confirmed presence of 6 polypeptide bands (10-25kDa) on 15% SDS-PAGE from G25-II/III fraction. All 6 polypeptide bands were analysed by LC-MS/MS (C-CAMP, Bangalore) which revealed 35 different polypeptides putatively associated with defense, antioxidants, lectins and other metabolism related proteins. Four potential peptides PR1, WAP, Mannose-binding lectin and Galactose-binding lectin were selected for thorough examination. The semi-purified peptide fractions (G25 peak II & III) were purified further by Ion-exchange chromatography using CM-Sepharose (Sigma; flow rate: 1 ml/ min). Collected 31 fractions and testing of antimicrobial activity using these elutes are under assessment.

**Antibacterial Activity
(G-25 fractions;
well-diffusion assay)**



Staphylococcus sp.



Bacillus sp.

Peptides identified by LC-MS/MS analysis of semi-purified protein		
Peptide	Accession	Function
Mannose-binding lectin	X5F158	Adhesion
Galactose-binding lectin	V5XWQ4	Adhesion
Calmodulin	C7EXG9	Calcium-binding
18kDa winter accumulating protein	A0A0B5GDL6	Defense response
Photosystem I psaE	D3KE88	Photosynthesis
Pathogenesis related protein (PR-1)	A0A0B4KXQ8	Defense response
NPR-3	A0A0B4KXP6	Regulatory
L-ascorbate peroxidase	A0A2P1EDR3	
Superoxide dismutase	A0A6G8IS20	Antioxidant response
Glutathione reductase	A0A6G8IU05	

Antibacterial activity of semi-purified mulberry (S1635) leaf protein			
S-1635	Protein fraction	Antibacterial activity	
		<i>Staphylococcus</i> sp. (2 isolates)	<i>Bacillus</i> sp. (2 isolates)
Crude	Buffer extract	+	+
	(NH ₄) ₂ SO ₄ precipitation	+	+
Gel filtration Chromatography	Sephadex G50		
	Elute I	-	-
	Elute II	++	+
	Elute III	++	+
	Sephadex G25		
	Elute I	-	-
	Elute II	+++	++
	Elute III	+++	++
G-25	MIC ₅₀	~200µg/ml	~300µg/ml

Assessment of antimicrobial potential of LMW peptide fractions against flacherie pathogens

Mulberry leaf extract (pH 7.2) was tested for antibacterial activity against pathogens (*Staphylococcus* sp., *Bacillus* sp.; 2 isolates each) causing flacherie disease in silkworm. Well-diffusion assay was used to determine the antibacterial activity. A clear zone of inhibition indicated the antibacterial activity of the mulberry protein. Crude extract produced a significant zone of inhibition in *Bacillus* sp. (40 mm), *Bacillus thuringiensis* (12 mm) and *Staphylococcus* sp. (35 mm) *in vitro* after 24-48h. Reconfirmed the efficacy of crude extract in inhibiting the growth of pathogens *in vitro* and found to be effective at >150 µg. Similarly, G50 peaks II & III produced a clear zone of inhibition in *Bacillus* sp. (11 mm) and *Staphylococcus* sp. (2.1 mm) *in vitro*. G25 peaks II & III produced zone of inhibition (12-20 mm) in *Bacillus* sp. and *Staphylococcus* sp. Minimum inhibitory concentration (MIC₅₀) of potential peptide fraction was determined utilizing different concentration range (50-500 µg/ml). MIC₅₀ was ~200µg/ml against *Staphylococcus* sp. and ~300µg/ml against *Bacillus* sp. Identification of pathogens (*Staphylococcus* sp., *Bacillus* sp.; 2 isolates each) causing flacherie through ITS profiling is under progress.

On Station Trial (OST)

Evaluation of high yielding and Bacterial Leaf Spot resistant mulberry variety C-7

[July 2020 – June 2023]

Soumen Chattopadhyay & Pooja Makwana

Recently developed mulberry variety C-7 (as the outcome of PIB3548) exhibited significant resistant response to Bacterial leaf spot (BLS) caused by *Xanthomonas campestris* pv. *mori* over the commercial cultivars like S1, C-2038 and S-1635. Moreover, the leaf biomass potential of C-7 was significantly higher (10458 – 11558 kg/ha/crop) than C-2038. Present OST aims to validate the obtained results of C-7 against the check varieties S-1635 (zonal check) and C-2038 (national check) in six BLS predominant locations of E & NE regions. Accordingly, adequate saplings of three planting materials were raised at the Institute and distributed for plantation in following details:

Location	Plantation (month)	First Pruning	First Harvest
CSRTI-Berhampore, WB	November 2020	June 2021	August 2021
RSRS-Koraput, Odisha			September 2021
REC-Mangaldoi, Assam			
DOS-Dimapur, Nagaland	March 2021	September 2021 December 2021	December 2021
REC-Mothabari, WB			March 2022
DOS-Mamring, Sikkim			

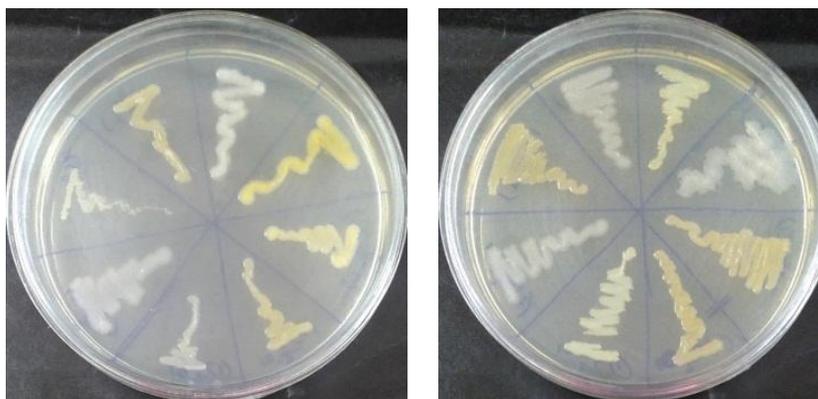
Plantations are under establishment in all six locations with recommended cultural practices.

Continuous / Other Activities

Wax degrading bacteria for management of mealybug in mulberry gardens

Aparna Kopparapu (PI), Pooja Makwana & Soumen Chattopadhyay (CIs)

Infestation of pink mealybug is a major problem in mulberry sericulture in Eastern India and responsible for leaf yield losses of 25-50% during March to August. Mealybug is a hardy pest and difficult to control even by the application of recommended chemical pesticides like 0.1% Dimethoate 30EC or 0.015% Thiamethoxam 25WG. This hardiness is mainly attributed by the waxy coating on its body. As an alternative, wax degrading bacteria which can degrade the waxy coating of the mealybug will be studied for their efficiency as potential candidates for mealybug biocontrol as a part of integrated pest management. Accordingly, ~20 bacterial cultures have been isolated from the surface of mealybugs collected from mulberry and *Hibiscus* spp. These isolates were preliminarily tested for degradation of bees wax on growth medium containing bees wax as the sole carbon source and results were significant. These isolates need to be further quantitatively tested for degradation of bees wax and mealybug wax with bioassays for the assessment of biocontrol ability against mealybug.



Microbial cultures isolated from surface/ wax of mealybug

AGRONOMY & FARM MANAGEMENT

Ongoing Projects

PPA02005SI: Optimization of spacing and nutrient dose for newly developed high yielding mulberry variety, C2038 under irrigated conditions

[Oct 2019 - Sep 2023]

R. Mahesh (PI) and Vijay, V

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, C2038

C-2038, high yielding mulberry variety is authorized by Mulberry Variety Authorization Committee in suitable for Eastern and North Eastern Regions of India. Field experiment was conducted at CSRTI-BHP with treatments of spacing (S_1 : 2'×2'; S_2 : 3'×3'; S_3 : (5'+3')×2'; S_4 : 6'×6') and fertilizer (F_1 : 75%; F_2 :100%; F_3 :110%; F_4 :120%; F_5 :130% on RDF) with an objective for developing a comprehensive package of practices for maximizing the potential of new variety (C-2038). A recommended dose of N-P₂O₅-K₂O=336-180-112 kg/ha/crop (RDF) was used for experimentation in two split doses on 15th and 30th day after pruning. C-2038 mulberry plantation was established with proper agronomic practices in experimental plots. Experiment was conducted for assessing the effects of spacing and fertilizer on yield and quality parameters of mulberry under irrigated conditions for two seasons (Oct-Dec, 20 & Jan-Mar, 21) and presented hereunder.

Effects of spacing and fertilizer on mulberry leaf yield and quality attributes								
Treatments	2'×2'				3'×3'			
	Leaf yield (g plant ⁻¹)	TSP (mg g ⁻¹)	TSS (mg g ⁻¹)	LMRC (%)	Leaf yield (g plant ⁻¹)	TSP (mg g ⁻¹)	TSS (mg g ⁻¹)	LMRC (%)
F_1 : 75% RD	316	26.0	24.1	61.8	446	27.8	30.0	61.9
F_2 : 100% RD	335	29.0	31.8	64.9	497	29.3	30.2	64.8
F_3 : 110% RD	396	29.9	33.2	68.7	517	33.1	32.5	64.2
F_4 : 120% RD	468	30.0	34.9	66.7	571	37.2	33.7	67.7
F_5 : 130% RD	454	30.1	34.4	69.3	525	38.4	34.5	67.2

Treatments	PRS				6'×6'			
	Leaf yield (g plant ⁻¹)	TSP (mg g ⁻¹)	TSS (mg g ⁻¹)	LMRC (%)	Leaf yield (g plant ⁻¹)	TSP (mg g ⁻¹)	TSS (mg g ⁻¹)	LMRC (%)
F_1 : 75% RD	421	26.3	30.3	62.6	637	31.4	33.2	65.5
F_2 : 100% RD	476	29.2	31.1	62.9	671	33.1	31.6	67.3
F_3 : 110% RD	485	29.1	31.3	65.3	692	36.7	34.1	69.9
F_4 : 120% RD	581	32.0	32.4	67.0	711	37.5	33.3	69.3
F_5 : 130% RD	535	39.2	35.2	69.0	694	38.8	35.1	70.8

Note: PRS: {150+90}×60 cm; RD: Recommended Dose; TSP: Total soluble protein;
TSS: Total soluble sugar; LMRC: Leaf moisture retention capacity

Among the fertilizer levels, significantly higher leaf yield (711 g/plant) was recorded in 120% RD which was on par with 130% RD (694 g/plant). Lowest leaf yield of 316 g/plant was noticed with 75% RD. Leaf yield improvement was 15% with 120% RD as compared to farmers' practice (100% RD). Among the spacing, 6'×6' spacing was recorded significantly higher leaf yield and this followed by 3'×3' and PRS. No significant variation was found between 3'×3' and PRS. Significantly lowest leaf yield was recorded with 2'×2' spacing.

OST: Lowcost drip fertigation system for mulberry**[July 2020 – June 2023]**

Mahesh R, K Alam, Kumaresan P & Karthik Neog

Efficient use of water and nutrients is principal factor in determining the optimum mulberry leaf productivity. To address these issues, experiments were conducted at CSRTI- Berhampore under the project of PPA-3588. Low-cost drip fertigation system was found have optimal leaf yield, high water use efficiency and nutrient use efficiency at 75% RD fertigation. Consequently, technology validation trails were conducted at different locations of E & NE zone (CSRTI-Berhampore, RSRS-Jorhat/Koraput & REC- Dimapur). Existing mulberry plantation was utilized for assessing leaf yield under low-cost drip fertigation system. Average leaf yield registered for low-cost drip fertigation system and farmers practice were 551 & 388 g/plant, respectively revealing that low-cost drip fertigation system could improve 42% leaf yield.

Station	Leaf yield (g plant ⁻¹)		
	Drip Fertigation	Farmers practice	% Improvement
CSRTI-BPC	653	471	39
RSRS-KPT	625	373	68
RSRS-JHT	412	337	22
REC-Dimapur	513	370	39
Average	551	388	42

Continuous/Other Activities**Farm Management**

The farm management unit maintains 24.70 acres mulberry plantations for experimental, propagation and silkworm rearing purposes. The unit also supplied 15000 C-2038 saplings to the mulberry farmers under ToT programme. Besides, the unit was supplied 5.7 MT mulberry leaf to rear 4080 dfls silkworm GRs in the institute across sesosons.

Mulberry Plantations								
Variety	Spacing	Type	Acres	Variety	Spacing	Type	Acres	
S1635	2'×2'	Low Bush	0.55	C2060	2'×2'	Low Bush	0.31	
	3'×3'		0.72		2'×2'	Medium Bush	0.10	
	4'×2'		1.99	C1730	(5'+3')×2'	Low Bush	0.16	
	4'×4'		0.53		3'×3'		0.24	
	(5'+3')×2'		0.28	BC ₂ 59	2'×2'/MB	Medium Bush	0.08	
	(5'+3')×4'		1.42		TR23	(5'+3')×2'	Low Bush	0.16
	8'×2'		1.25	C-776		3'×3'		0.04
	8'×4'		0.48		V1	5'×5'	High Bush	0.08
	5'×5'		0.08	Experimental Plots		2'×2'	Low Bush	0.64
	7'×7'		3.20		3'×3'	3.14		
	8'×8'	0.38	(5'+3')×2'		0.25			
	10'×4'	1.46	6'×6'		High Bush	0.25		
	C2038	2'×2'	Low Bush			0.14		5'×5'
(5'+3')×2'		0.29			Germplasm	2'×2'		Low Bush
2'×2'		Medium Bush	0.05	3'×3'		0.16		
5'×5'		High Bush	0.37	4'×4'		0.33		
6'×6'			0.20	5'×5'	High Bush	1.14		
C2028	2'×2'	Low Bush	0.14	Mapping Popln (ML×V1; PMr)	(5'+3')×2'	Low Bush	0.76	
	4'×4'		0.21		BLS-F1		2'×2'	0.20
S1	2'×2'		0.11	DUS	5'×5'	1.00		
	3'×3'		0.02		Nursery	-	1.00	
Vishala	2'×2'		0.40					
Ganga	2'×2'		0.14					
Total							24.70	

Soil Analysis Service provided during the year 2020-21

Vijay V and Soumen Chattopdyay

Soil samples of 604 sericulture farmer's fields of 11 Eastern and North Eastern states were collected following standard procedure. In brief, 0-30cm deep representative surface soil samples from four corners and centre were collected from each mulberry garden. Collected samples were mixed and reduced to 500g by quartering for obtaining composite sample. The composite samples with all the details were transported to soil testing laboratory at CSRTI-Berhampore for further processing. The air dried, powdered and sieved samples were analysed: available nitrogen (N) by Subbaiah and Asija, available phosphorous (P_2O_5) by Olsen and Bray, available potassium (K_2O) by neutral ammonium acetate method. Classification of soil nutrient status was conducted in accordance with Srivastava *et al.* (2015). Soil fertility status with regard to pH, available N, P and K were assessed by calculating nutrient index (NI) value for each parameter as described by Motsara *et al.* (1982). Descriptive statistical analysis was performed and state-wise data were documented. Mulberry growing fields in the E and N-E states are acidic (84.4%), non-saline (100%), low in available N (NI = 1.50), medium in available P (NI = 1.80) and medium in available K (NI = 1.76). Availability of nitrogen was lowest in Orissa (1.02) and Assam (1.02); phosphorous was lowest in Jharkhand (1.20) and potassium was lowest in Bihar (1.08).

Fertility Status of Mulberry Growing Soils (%)

Parameters	States												
	NL	JH	BR	MZ	SK	MN	ML	OR	TR	AS	WB	Pooled	
pH	Acidic (<6.5)	94	100	100	100	98	100	96.8	100	90.2	100	40.7	84.4
	Neutral (6.5-7.5)	6	Nil	Nil	Nil	2	Nil	3.2	Nil	9.80	Nil	59.3	15.6
	Alkaline (>7.5)	Nil	Nil	Nil	Nil	Nil	Nil						
EC	Not Saline (<2)	100	100	100	100	100	100	100	100	100	100	100	100
	Low (<280)	80	96	Nil	82	14	66	24.2	98	94.1	98	23.6	51
N	Medium (280-560)	20	4	100	18	84	34	71.0	2	5.90	2	76.4	48.3
	High (>560)	Nil	Nil	Nil	Nil	2	Nil	4.80	Nil	Nil	Nil	Nil	0.7
P_2O_5	Low (<23)	64	80	Nil	36	34	78	72.6	60.8	47.1	22	23.6	44.7
	Medium (23-57)	24	20	Nil	58	22	10	27.4	21.6	39.2	50	34.3	30.5
	High (>57)	12	Nil	100	6	44	12	Nil	17.6	13.7	28	42.1	24.8
K_2O	Low (<145)	74	36	92	18	22	36	16.1	43.1	68.6	6	76.4	47
	Medium (145-337)	14	52	8	40	48	26	32.3	29.4	21.6	46	23.6	30
	High (>337)	12	12	Nil	42	30	38	51.6	27.5	9.80	48	Nil	23

Comprehensive Nutrient Index/Status of Mulberry Growing Soils in E & NE India

Parameters	Name of the states						
	NL	JH	BR	MZ	SK	MN	ML
pH	1.06; A	1.00; A	1.00; A	1.00; A	1.02; A	1.00; A	1.03; A
N	1.20; L	1.04; L	2.00; M	1.18; L	1.88; M	1.34; L	1.81; M
P	1.48; L	1.20; L	3.00; H	1.70; M	2.10; M	1.34; L	1.27; L
K	1.38; L	1.76; M	1.08; L	2.24; M	2.08; M	2.02; M	2.35; H

Parameters	Name of the states					
	ML	OR	TR	AS	WB	Pooled
pH	1.03; A	1.00; A	1.10; A	1.00; A	1.59; A	1.16; A
N	1.81; M	1.02; L	1.06; L	1.02; L	1.76; M	1.50; L
P	1.27; L	1.57; L	1.67; M	2.06; M	2.19; M	1.80; M
K	2.35; H	1.84; M	1.41; L	2.42; H	1.24; L	1.76; M

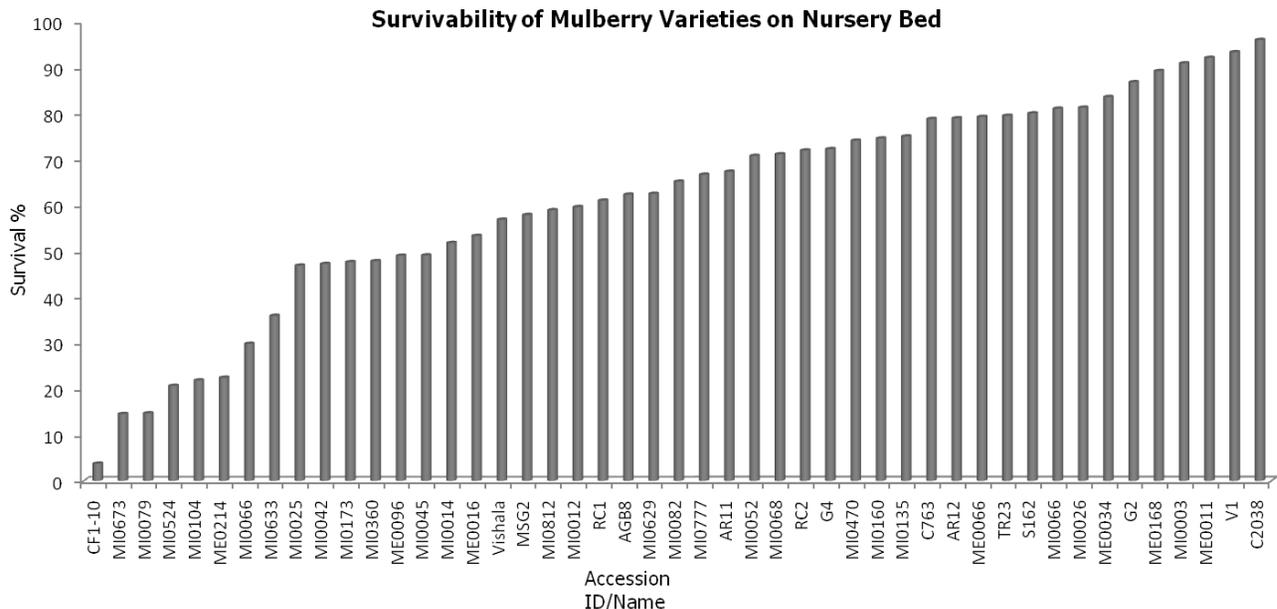
L: Low (NIV = <1.67); M: medium (1.67 – 2.33); H: High (>2.33); A: Acidic

Establishment of co-nodal DUS testing centre at CSRTI Berhampore

Vijay V and Yallappa H

Co-Nodal DUS testing centre with 47 mulberry varieties has been established at CSR&TI Berhampore. The plantation was done as per the guidelines given by Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA), Government of India, New Delhi. Cuttings of 49 and 7 mulberry varieties were collected from Nodal DUS Testing Centre, CSR&TI-Mysore and CSR&TI-Berhampore, respectively. The cuttings were raised on nursery beds and survival data were recorded. The survival percentage of the varieties varied from 0 – 96%. Nine varieties: MI0364, ME0075, MI0340, MI0454, MI0408, ME0120, MI0365, ME0090, MI0013, could not survive. The four months old saplings from the nursery were planted on experimental field as per the test plot design recommended by PPV & FRA: viz., pit system, 03 rows, 150 cm x 150 cm spacing, 03 replications and 08 plants per replication.

Mulberry Varieties Planted at Co-Nodal DUS Testing Centre		
#	Classification (n)	Accession ID/ Name
1	Reference varieties (8)	MI0066, MI0173, Vishala, AR11, MI0160, MI0012, MI0045, MI0025
2	Example varieties (27)	MI0003, MI0470, ME0066, ME0011, ME0168, MI0026, MI0014, MI0777, ME0016, ME0034, RC1, MI0470, MI0052, MI0812, MI0082, MI0068, MI0135, MI0629, MI0524, MI0673, MI0042, MI0633, ME0096, MI0360, MI0104, ME0214, MI0079
3	Candidate varieties (3)	C2038, TR23, G4
4	Parent varieties (5)	C763, CF ₁ -10, S162, ME0168, MI0012
5	Others (6)	AR12, AGB8, V1, RC2, MSG2, G2



Production of Vermicompost

Produced 5.86 tons of vermicompost using sericulture waste generated in the CSR&TI Berhampore campus. The vermicompost was applied as organic manure in the mulberry garden of Agronomy & Soil Science + Farm Management Section.

MULBERRY PATHOLOGY

Ongoing Projects:

PRP 02003 SI: Studies on the management of mulberry root rot disease in E & NE India

[May 2019-May 2021]

Anil Pappachan (PI), V. Vijay, G.C. Das

Objective: To validate effective mulberry root rot management practices under field conditions

Fusarium solani was isolated and identified from the root rot samples of Pipulkhola & Kanupur (West Bengal) while both *F. solani* and *Lasiodiplodia theobromae* were identified from the samples collected from Balashpur (West Bengal). Glasshouse studies revealed that application of eco-friendly formulation (ROTfix) was most effective for the management of root rot of mulberry. A total of 230 farmers' fields infected with root rot have been identified from different villages of West Bengal for taking up field trials. On an average Rotfix application resulted in 90.9 % recovery and survival in the infected fields of Kochubari, Sarbanagr & Milky villages. Field trials are under progress at Karjora (10), Ramchandrapur (15), Mallikpur (10), Poradanga (2), Bankipur (41), Balashpur (46), Deshalpur (9), Dangapara (3), Makrampur (18) and Kalyanpur (47) Villages.

Field evaluation of Rotfix for the management of root rot of mulberry					
#	Village	No. of Fields (no)	Av. Mortality (%)	Av. root rot incidence (%)	Recovery (%)
1	Kochubari, Rasalpur	17	1.8 (0.0-5.0)	19.9 (7.0-75.0)	91.1(75.0-100.0)
2	Sarbangar, panchgram	10	1.6 (0.0-3.0)	12.9 (5.0-22.0)	87.3 (77.8-100.0)
3	Milky, Panchgram	02	1.6 (0.0-5.0)	22.5 (5.0-67.0)	94.4 (90.0-100.0)
Avg.			1.7	18.4	90.9

Continuous/Other Activities:

Forewarning of mulberry disease of Eastern & North Eastern India

Anil Pappachan (PI), G. R. Manjunatha, I/C of RSRs & RECs of CSRTI-BHP

Objective: To develop data base for disease and meteorology of E & NE India

Data on disease incidence was collected at weekly intervals across Eastern and North Eastern India. Prevalence of major diseases viz., Bacterial Leaf Spot (BLS), *Myrothecium* Leaf Spot (MLS), *Pseudocercospora* Leaf Spot (PLS), Powdery Mildew (PMLD) Brown Leaf Rust (BLR) and Yellow leaf Rust (YLR) were recorded in terms of PDI.

		Maximum PDI (2020-2021)						
State	Unit	BLS	MLS	PLS	PMLD	BLR	YLR	
West Bengal	CSRTI-BHP	10.3 (Sep)	12.7 (Sep)	8.5 (Nov)	29.2 (Dec)			
	Malda	1.7 (Jul)	2.1 (aug)	0.6 (Aug)				
	Kalimpong				5.3 (Jun)	7.1 (Jun)	12.2 (Aug)	
Assam	Mangaldoi	3.5 (MLS)				4.9 (BLR)		
Odisha	Koraput	3.3 (May)			4.3 (Oct)	3.0 (Feb)		
Mizoram	Aizawl				0.4 (Sep)			
Manipur	Imphal				6.7 (Jun)			
Meghalaya	Shillong	1.9 (Oct)	2.8 (Oct)		4.6 (Aug)	4.2 (Nov)		

ENTOMOLOGY

Continuous/other activities

PRE 3508 (Phase II): Mass multiplication and maintenance of bio-control agent - *Scymnus pallidicollis* and its popularization at farmers' level

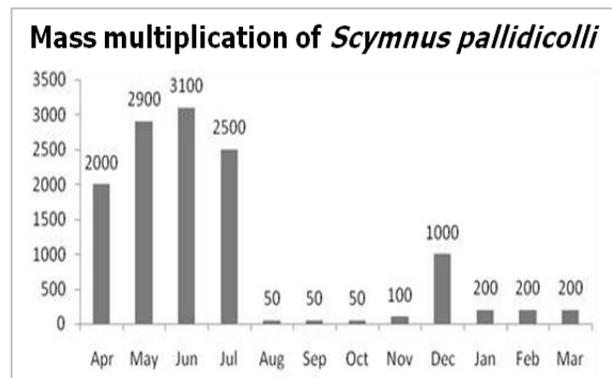
[June, 2018 - May, 2021]

Anil Pappachan (From Oct 2020), Radha.M.B. (till Feb 19 -Sept 20), S. Chanda (Upto 31.12.2018), S. Sarkar, and Manjunatha G.R.

Objectives:

- To conserve and multiply *Scymnus pallidicollis* for management of mealy bug on mulberry in a sustainable manner.
- To study the efficacy of *S. pallidicollis* in farmers' field for management of mealy bug in large scale.
- To impart training to the farmers on mass multiplication and maintenance of *S. pallidicollis*.

12,350 predators were mass multiplied during the year with mealy bug cultured on sprouted potatoes and pumpkins, of which 9,515 predators were released in different plots of the institute. Remaining predators were maintained as stock, and used for mass production. Mass multiplication peaked during the months of April to July which is also marks peak incidence time for the host Mealy bug. Release of *S. pallidicollis* in fields resulted in the reduction of pest by 76.7 % (egg mass); 69.0% (nymphs) and 78.0 % (adults).



Field Efficacy of *Scymnus* beetles for mealy bug management (Tukra)

Month	Pre release			Post release			Reduction in pest population (%)		
	Egg Mass	Nymph	Adult	Egg Mass	Nymph	Adult	Egg mass	Nymph	Adult
April	8.3	4.4	4.1	2.1	1.3	0.8	74.2	67.3	80.0
May	9.8	6.2	5.2	2.2	2.2	0.8	76.4	63.8	86.0
June	11.0	6.8	5.8	2.2	1.6	1.2	79.2	75.0	77.4
July	14.8	8.4	5.4	3.4	2.4	1.6	77.1	69.7	68.5
Avg.	11.0	6.5	5.1	2.5	1.9	1.1	76.7	69.0	78.0

Survey and Surveillance of Mulberry Pests in the Eastern and North Eastern regions of India

Anil Pappachan (From Oct 2020), Radha. M.B. (Up to Sept 2020), Manjunath G.R. and I/C RSRs & RECs of CSRTI-BHP

Objective: To generate and widen the database on pest incidence and climatic factors

Data on pest incidence was collected from the farmers' fields of different locations as well as Institute fields. Data were collected from ten randomly selected plants per sample and the. Seasonal incidence of major mulberry pests viz., thrips (*Pseudodendrothrips mori*), mealy bug (*Maconellicoccus hirsutus*) and whitefly (*Dialeuropora decempuncta* & *Aleuroclava pentatuberculata*) and root mealy bug (*Paraputo* spp.) in Kalimpong and Mamring were collected at weekly intervals along with meteorological data. From each plant three twigs (shoots) were selected for recording the data. From each twig, number of thrips per leaf (from top 4th, 5th, 6th, 7th, leaf) was counted. To record Tukra incidence, percentage of shoots damaged in ten plants per holding were assessed. Five affected shoots per holding were collected from the field for counting egg masses, nymphs & adults of mealy bug. Adult and late nymph population of whitefly were recorded from top, middle and bottom two leaves from three twigs/ plant. 8 forewarning messages in Bengali/Hindi/ English were submitted to be sent through mKissan portal for taking up prophylactic sprays for mulberry protection.

Seasonal occurrence of major pests in mulberry ecosystem (2020-21)													
Thrips (no./leaf)													
Location	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Range
Institute	5.1	4.6	0.3									5.0	0-6.2
Malda			7.2	8.8	8.8								0-10.7
Koraput	5.1	4.7		2.4	2.1	4.1							0-5.6
Agartala					1.3								0-3.0
Tukra (%)													
Institute	4.4	7.9	8.7	14.1	2.7	1.7							0-15.2
Malda					5.8								0-6.4
Kalimpong (RMG*)				5.0	4.7	4.0	4.1	3.1		1.5	1.5		0-5.2
Koraput	5.8	6.2		3.9	2.1	4.0							0-6.5
Agartala				1.5	1.3								0-3.0
Whitefly (no./leaf)													
Institute					4.3	6.1	7.4	11.4	1.8				0-14.4
Malda						2.9	2.5	14.9					0-19.5
Koraput	1.67	2.2				4.5							0-4.8
Agartala			2.2										0-2.3

*Root mealy bug

SILKWORM BREEDING & GENETICS

Concluded Project

AIB 3619: Development of Silkworm (*Bombyx mori* L) Congenic Breeds from a Gene Pool with higher Genetic Plasticity (Phase-II).

[July 2017 – June 2020]

V. Sivaprasad (Co-Ordinator), A.K.Verma (PI), N.Chandrakanth, Th. Ranjita Devi, N.B.Kar and G.Mitra

Objectives:

- Development of silkworm breeds for Converged Gene pool having Genetic Plasticity in tolerance and in high cocoon shell weight (completed in Phase I).
- Development of Congenic multivoltine breed from selected/ developed Converged Gene pool as parent for high cocoon shell weight and bivoltine breed for horizontal tolerance.

In Eastern India, humidity is 95% or above and the temperature is more than 36°C (rearing room temperature) during April to September that leads survival of bivoltine breeds to 10-15%. CSRTI-Berhampore developed a breeding method for introgression of multigenic trait to develop congenic bivoltine breed for high survival and multivoltine breed for high cocoon shell weight through earlier projects. These congenic hybrids include M.Con.4 x B.Con.4/B.Con.1; M.con.1 x B.Con.1/ B.Con.4; M.Con.1 x M.Con.4 and Nistari x M.Con.4 and their reciprocals, which showed better performance. In order to develop more productive and qualitatively superior breeds, breeding approach was followed to obtain genetic plasticity for survival and cocoon shell weight in the gene pool by aggregating genes from well-adapted strains from different zones followed by selection under adverse climate to evolve multivoltine and bivoltine silkworm breeds better than earlier ones.

Six Bivoltine and Six Multivoltine Breeds/Strains from different geographical zones of India are collected and assessed for quantitative and qualitative characters in West Bengal climatic condition. Thereafter, convergent breeding approach was adopted to make broad genetic base to bring genetic plasticity in bivoltine for high cocoon shell weight and high survival (pupation) in multivoltine.

The bivoltine Convergent Lines (Six ways cross) viz., (B.Con.4 x CSR2) x (Dun21 x KPG-A) x (RSJ14 x APS45) used as converged gene pool for high shell weight following selection and assimilation of target character for 12 generations. Two bivoltine lines with (1) Plain (*p*) Larvae, Faint Constricted, White (*c*) colour Cocoon and (2) Marked (+*p*) Larvae, Faint Constricted, White (*c*) colour Cocoon were used to develop further generations that showed 90% survival and ~18% silk ratio showing potential of the lines.

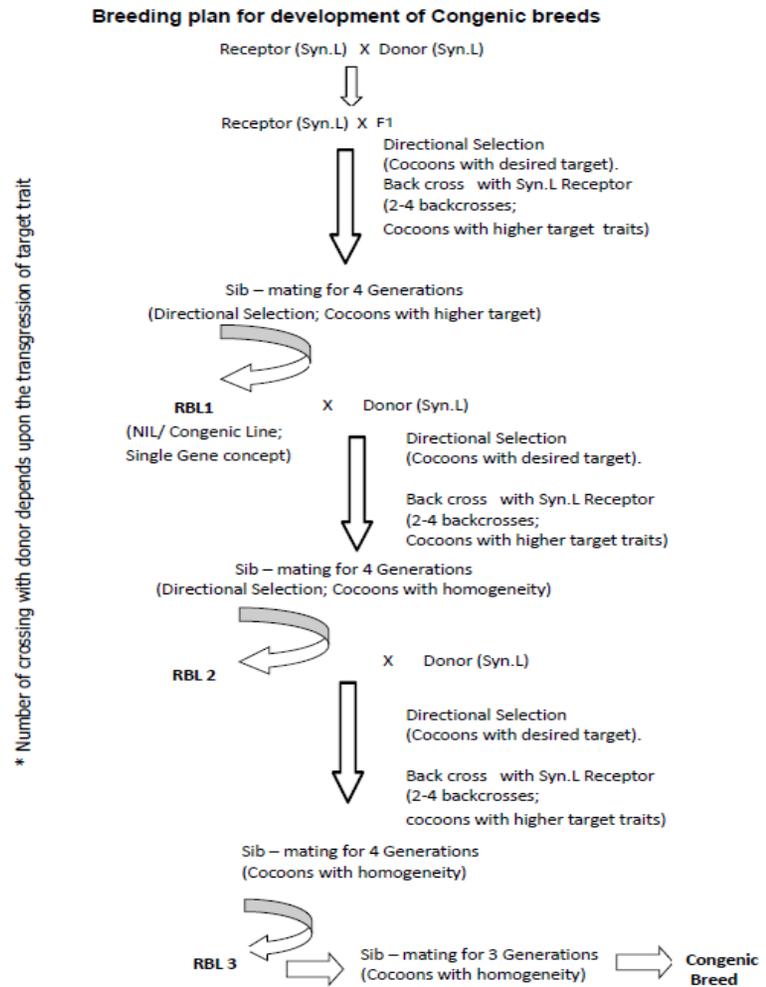
Rearing Performance of Bivoltine convergent lines (B.Con.4 x CSR2) x (DUN21 x KPG-A) x (APS45 x RSJ14)							
Character	Fec	Hatch (%)	Yield/ 10000 larvae (no.)	Yield/ 10000 larvae (wt.kg)	SCW (g)	SSW (g)	Shell (%)
Plain (<i>p</i>) Larvae , Faint Constricted, White (<i>c</i>) colour Cocoon	532	96	9100	14.13	1.565	0.288	18.40
Marked (+<i>p</i>) Larvae , Faint Constricted, White (<i>c</i>) colour Cocoon	542	94	9033	14.57	1.569	0.285	18.16

The multivoltine convergent line developed through six way cross was (Nistari +*p* x Cambodge) x (M.Con.4 x PM) x (MH1 x Sarupat) and was raised as converged gene pool for horizontal tolerance (survival) after strict selection and assimilation of target character for 15 generations. Three lines with the following characteristics were then isolated and used for further generations and were:

Rearing Performance of Multivoltine convergent lines							
Character	Fec	Hat (%)	Yield/ 10000 larvae (no.)	Yield/ 10000 larvae (wt. kg)	SCW (g)	SSW (g)	Shell (%)
Plain (<i>p</i>) Larvae, Yellow (<i>C</i>), Oval Cocoon	517	98	9433	12.03	1.306	0.208	15.92
Plain (<i>p</i>) Larvae, White (<i>c</i>), Oval Cocoon,	502	97	9467	11.70	1.399	0.211	15.08
Plain (<i>p</i>) Larvae, Light Greenish(<i>G</i>) OvalCocoon	525	95	9533	11.67	1.348	0.201	14.90

- Plain (*p*) Larvae, Yellow (*C*), Oval shape Cocoon
- Plain (*p*) Larvae, White (*c*), Oval shape Cocoon
- Plain (*p*) Larvae, Light Greenish (*G*) Oval shape Cocoon

These multivoltine convergent lines showed nearly 95% survival and 15% silk ratio showing better performance. The Bivoltine convergent lines (B.Con.4 x CSR2) x (DUN21 x KPG-A) x (APS45 x RSJ14) and the multivoltine convergent lines (Nistari +*p* x Cambodge) x (M.Con.4 x PM) x (Sarupat x MH1) were utilized as parents to develop multivoltine congenic lines with high shell weight (>0.24g) and bivoltine congenic lines with high survival (>90%). The breeding plan used is depicted in the following diagram:



Rearing Performance of Multivoltine Congenic Line (MV-CL; 28RY) developed for high Shell Weight									
Season	Fec. (No.)	Cocoon Wt.(g)	Shell Wt.(g)	Shell (%)	ERR (No.)	ERR wt.(kg)	Pupation (%)	FL (m)	Denier
MV6-way (Receptor)	404	1.097	0.146	14.22	8700	8.97	95.00	392	2.38
RBL1	492	1.331	0.228	16.98	9033	11.40	93.00	436	2.64
RBL2	477	1.370	0.260	18.98	9600	13.90	96.00	580	2.43
RBL3									
MV-CL (28RY)	458	1.262	0.224	17.75	9067	11.30	97.00	548	2.48
BV6-way (Donor)	439	1.216	0.213	17.52	8267	9.64	90.00	544	2.71
CV %	5.34	4.52	3.09	3.07	4.54	6.73	4.24		
CD @ 5%	29.80	0.02	0.01	0.63	58.37	0.63	2.54		

Hybrid Performance of 28RY during unfavourable seasons								
Multi xBi	Fec. (No.)	Cocoon Wt.(g)	Shell Wt.(g)	Shell (%)	ERR (No.)	ERR wt.(kg)	Avg.EI	Rank
28RY	384	1.135	0.159	14.05	4800	5.39		
28Y x N2	411	1.445	0.254	17.61	7492	10.29	63.04	I
28RY x B.Con.1x4	421	1.330	0.213	16.01	5316	6.30	48.73	
28RY x SK6x7	369	1.250	0.214	17.12	3996	4.71	45.19	
28RY x BHP3x2	376	1.225	0.197	16.08	5698	6.01	44.78	
28RY x BHP8x9	345	1.325	0.209	15.77	5201	6.26	45.40	
28RY x WB1x3	504	1.325	0.216	16.30	7467	9.24	57.20	III
28RY x WB7x5	423	1.365	0.221	16.19	4279	5.11	48.03	
28RY x WB7x9	438	1.415	0.244	17.24	6875	9.53	60.36	II
N x SK6x7	301	1.170	0.181	15.43	6933	8.13	42.43	
M6DPC x SK6x7	370	1.185	0.182	15.36	7043	8.16	44.83	
CV%	3.90	0.74	5.94	1.96	0.48	12.00		
CD @ 5%	19.44	0.01	0.02	0.29	34.72	1.02		

After fixation of the characteristics, the multivoltine congenic line, 28RY was crossed with two authorized foundation crosses viz., B.Con.1xB.Con.4 and SK6xSK7 along with few new FCs during Bhaduri (August) and late Aswina (October), both being unfavourable seasons. The performances of 28RY x N2, 28RY x WB7x9 and 28RY x WB1x3 were better than the control hybrids in both the seasons.

Reeling Performance of 28RY Crossbreeds Bi hybrids during unfavourable season									
Multi xBi	FL (m)	NBFL (m)	Fil. size (d)	Reel-ability(%)	Neat-ness	Rendi-tta	Reco-very %	Avg. EI	Rank
28Y x N2	559	480	2.51	72.02	88	9.35	67.36	57.50	I
28RY x B.Con.1x4	466	431	2.57	70.32	87	9.74	65.07	52.72	III
28RY x SK6x7	459	391	2.54	64.46	84	10.45	63.59	47.07	
28RY x BHP3x2	505	460	2.41	63.58	85	10.08	62.47	46.11	
28RY x BHP8x9	384	223	2.54	60.95	85	10.56	60.93	39.95	
28RY x WB1x3	469	393	2.62	69.03	88	9.81	63.09	52.03	IV
28RY x WB7x5	522	498	2.45	63.93	84	10.56	62.95	48.69	
28RY x WB7x9	528	452	2.68	70.52	87	9.83	64.86	56.75	II
N x SK6x7	434	279	2.67	66.16	84	10.97	62.24	47.61	
M6DPCx SK6x7	475	320	2.48	66.26	85	10.73	61.68	51.55	
CV%	1.19	1.35	0.32	1.45	1.40	1.75	1.64		
CD @ 5%	7.07	6.63	0.01	1.78	1.47	0.28	0.58		

The following three multi x bivoltine hybrids may be further tested in the field on the basis of their performance in unfavourable seasons.

- 28RY x N2: Shell%-17.61, ERR No.-7500, ERR Wt.(kg)-10.29 & Reelability%-72.02.
- 28RY x WB7x9: Shell%-17.24, ERR No.-6900 & ERR Wt.(kg)-9.53, Reelability%-70.52
- 28RY x WB1x3: Shell%-16.30, ERR No.-7467 & ERR Wt.(kg)-9.24, Reelability%-69.03

Rearing Performance of Bivoltine Congenic Lines							
Season	Fec. (No.)	Cocoon Wt.(g)	Shell Wt.(g)	Shell (%)	ERR (No.)	ERR wt.(kg)	Pupation (%)
BV6-way (Receptor)	439	1.216	0.213	17.52	8267	9.64	90.00
MV6-way (Donor)	404	1.097	0.146	14.22	8700	8.97	95.00
F1(Aug-Sep 2016)	581	1.560	0.313	20.06	9567	14.03	96.00
BC1(Oct-Nov 2016)	488	1.562	0.272	17.41	9033	13.37	93.00
BC2(Jan-Feb 2017)	482	1.517	0.246	16.22	8900	13.30	91.00
BC3(April-May 2017)	476	1.468	0.237	16.14	8800	12.70	94.00
BC3S1 (June-July 2018)	498	1.415	0.239	16.89	9000	12.52	94.00
BC3S2(Aug-Sep 2017)	472	1.375	0.234	17.02	9033	12.27	95.00
BC3S3(Nov 2017)	468	1.321	0.276	20.89	9167	11.89	94.00
BC3S4(Jan-Feb 2018) @ RBL1	525	1.245	0.252	20.24	8900	12.37	95.00
RBL1-F1 (April 2018)	521	1.590	0.281	17.67	9133	13.27	94.00
RBL1-BC1(June-Jul 2018)	489	1.431	0.252	17.61	9300	11.73	95.00
RBL1-BC2 (Aug-Sept 2018)	498	1.459	0.265	17.71	8833	12.27	93.00
RBL1-BC3 (Nov-Dec 2018)	556	1.510	0.280	18.54	9300	14.03	94.00
RBL1-BC3-S1(Feb-Mar 2019) @ RBL2	632	1.250	0.245	19.60	9567	13.45	96.00
RBL2-F1 (April-May 2019)	511	1.506	0.262	18.39	9267	13.68	93.00
RBL2-BC1 (June-July 2019)	512	1.309	0.210	16.04	9500	13.26	96.00
RBL2-BC2 (Aug 2019)	384	1.304	0.287	22.00	7533	9.58	82.00
RBL2-BC2-S1(Oct-Nov 2019)	342	1.656	0.340	20.53	6400	10.12	88.00
RBL2-BC2-S2(Jan-Feb2020)	591	1.373	0.280	20.39	9100	11.89	95.00
RBL2-S3(Mar-April 2020) @RBL3 (BV-CL)	458	1.305	0.268	20.54	8667	11.06	93.00
RBL3-S4(May- June 20)	492	1.286	0.248	19.28	8533	10.85	91.00

In the bivoltine congenic line, the pupation percentage was 93%, better than the target.

Rearing Performance of developed Bivoltine Congenic Line (BV-CL; 29RND) with high survival									
Season	Fec. (No.)	Cocoon Wt.(g)	Shell Wt.(g)	Shell (%)	ERR (No.)	ERR wt.(kg)	Pupation (%)	FL (m)	Denier
BV6-way (Receptor)	439	1.216	0.213	17.52	8267	9.64	90.00	544	2.71
RBL1	525	1.245	0.252	20.24	8900	12.37	95.00	598	2.82
RBL2	632	1.250	0.245	19.60	9567	13.45	96.00	603	2.60
RBL3 BV-CL; 29RND	458	1.305	0.268	20.54	8667	11.06	93.00	600	2.58
MV6-way (Donor)	404	1.097	0.146	14.22	8700	8.97	95.00	392	2.38
CV %	5.70	3.02	1.68	3.99	4.88	5.36	3.50		
CD @5%	34.16	0.11	0.01	0.68	93.64	0.71	2.79		

The performance of developed bivoltine congenic line was compared with existing authorised bivoltine lines during favourable (March-April) and unfavourable (October) seasons.

Rearing Performance of developed bivoltine congenic line & controls during favourable (March-April, 2020) season								
Name	Fec. (No.)	Cocoon Wt.(g)	Shell Wt.(g)	Shell (%)	ERR (No.)	ERR wt.(kg)	Pupation (%)	
BV-CL (29RND)	458	1.305	0.268	20.54	8667	11.06	93.00	
SK6	486	1.426	0.243	17.04	8240	11.56	87.00	
SK7	472	1.404	0.236	16.80	9010	12.36	93.00	
BCon1	502	1.489	0.249	16.65	8640	12.63	92.00	
BCon4	466	1.372	0.250	18.22	8060	11.09	88.00	
CV %	1.03	0.48	1.71	1.54	3.86	8.07	3.09	
CD @5%	6.51	0.01	0.01	0.37	439.21	NS	NS	

Rearing Performance of developed bivoltine congenic line and controls during unfavourable (October, 2020) season

Name	Fec. (No.)	Cocoon Wt.(g)	Shell Wt.(g)	Shell (%)	ERR (No.)	ERR wt.(kg)	Pupation (%)
BV-CL (29RND)	510	1.465	0.272	18.57	7200	9.36	85
SK6	462	1.08	0.172	15.91	6800	6.88	82
SK7	455	1.01	0.158	15.58	8000	8.08	84
BCon1	492	1.11	0.181	16.25	5044	5.24	81
BCon4	480	1.28	0.232	18.07	2960	3.28	78
CV %	3.37	1.23	3.74	1.75	1.86	2.71	1.19
CD @5%	23.75	0.02	0.01	0.39	149.04	0.24	1.30

Reeling Performance of developed bivoltine congenic line and controls during unfavourable (October, 2020) season

Name	FL (m)	NBFL (m)	F. size (d)	Reel-ability (%)	Neat-ness	Rendi-tta	Reco-very (%)
BV-CL (29RND)	768	768	2.53	75	89	7.69	67
SK6	551	440	2.87	73	88	9.17	66
SK7	568	316	2.59	75	90	9.74	66
BCon1	689	551	2.54	72	89	9.07	66
BCon4	525	476	2.79	72	88	8.29	67
CV %	2.00	2.11	0.41	0.84	1.04	2.04	0.59
CD @5%	16.64	14.37	0.01	0.82	NS	0.24	0.53

In the crop during favourable season (March-April 2020), it is observed that the BV-CL (29RND) performed better with respect to shell weight, shell (%), ERR by no. and pupation rate; however, during unfavourable season (Oct 2020), its performance was better than control breeds with respect to filament length (768 m), NBFL (768 m) and Rendita (7.69).

Inferences drawn

- Congenic lines including one multivoltine (28RY) and one bivoltine (29RC) have been developed with the targeted traits.
- The hybrid evaluation of developed multivoltine congenic line (29RY) showed that few crossbreeds (28Y x N2; 28RY x WB7x9; 28RY x WB1x3) hold promise for further evaluation as their performance was better even in unfavourable conditions.
- Based on the overall performance of bivoltine congenic line (29RC) during favourable and unfavourable seasons, it seems this line could become a source for further breeding as it has multivoltine blood and might have attained desired genetic plasticity for performing well under adverse conditions.



ARP 3605: Validation of the DNA markers in silkworm breed developed by introgression of DNA markers associated with NPV resistance using Marker Assisted Selection breeding and large scale field trial of the breed

(DBT Collaborative Project with SBRL-Bangalore, CSRTI-Mysore & CSRTI-Pampore)

[April 2017 - September 2020]

Coordinator: V. Sivaprasad,

CSRTI-Berhampore: Gopal Chandra Das (PI) & N Chandrakanth

CSRTI-Mysore: SM. Moorthy (PI) & B. Mohan

SBRL-Bangalore: A. R. Pradeep (PI) & K. M. Ponnuvel

CSRTI-Pampore: S. Singh (PI @ Jammu), P. Tiwari (PI @ Sahaspur) & Md. Aslam

Objectives

- Validation of DNA markers for NPV resistance and stress tolerance in selected lines in field
- Continuous maintenance of MAS-N lines
- Co-ordination and statistical analysis of observation from lines reared at different stations

Three BmNPV resistant bivoltine breeds viz., MASN4, MASN6 & MASN7 were evaluated across different seasons at CSRTI-Berhampore during 2017-2019. MASN4 was found to be the better performer. CSR2, the control breed could not survive at all during unfavourable seasons.

MASN hybrids viz., Bi x Bi: MASN4 x CSR4; Multi x Bi: Nistari x MASN4) were supplied by SBRL-Bangalore for evaluation at farmers' level in West Bengal during Oct-Nov2018; Feb 2019; April 2019; Oct-Nov 2019 and Feb-March 2020. A total of 24200 dfls of MASN4 x CSR4 and 25,850 dfls of N x MASN4 were evaluated with farmers in Nov 2018-Feb 2020. During the current year, 9,250 dfls of MASN4 x CSR4 and 21,850 dfls of N x MASN4 were tested in the field level. MASN bivoltine hybrids performed better than SK6 x SK7 with regard to cocoon yield with 9.7% improvement; while SK6 x SK7 hybrids recorded higher survival. In case of Multi x Bi hybrids, N x MASN4 performed better with regard to yield with 9.96% improvement and cocoon quality than the ruling crossbreed (N x SK6.7). Further field testing with the farmers would be undertaken in 2020-21 with MASN4 x CSR4 and Nistari x MASN4 for documenting the consolidated performance in West Bengal.

Performance of MASN lines

The evolved bivoltine MASN lines (MASN4, MASN6 & MASN7) were reared at four Central Sericultural Research Stations located in various agro climatic conditions during 2017-18 and 2018-19. In eastern zone, CSR&TI, Berhampore test centre conducted 06 trials to select best MASN lines for hybridization and subsequent field trial. MASN4 showed significantly higher fecundity and yield whereas other parameters did not vary significantly among the MASN lines. Based on the trials, survival rate, yield and cocoon traits, MASN4 was selected and subjected for hybrid development programme.

Pool Rearing Performance of MASN lines at Berhampore during 2017-18

Stability of MASN lines in different seasons on quantitative traits

	May-Jun 17	Jul-Aug 17	Oct.-Nov 17	Feb-Mar 18	Apr-May 18	Oct-Nov 18	Mean	SD	CV%
Fec (no)									
MASN-4	488	560	537	562	567	556	545.00	29.77	5.46
MASN-6	356	587	493	555	499	537	504.50	80.78	16.01
MASN-7	485	662	655	584	596	528	585.00	69.57	11.89
Hatching %									
MASN-4	96.39	97.67	95.27	98.21	98.83	97.83	97.37	1.30	1.34
MASN-6	89.60	98.98	87.88	98.92	98.62	96.27	95.05	5.02	5.28
MASN-7	95.65	97.56	74.00	97.22	96.57	97.39	93.07	9.37	10.06
ERR No.									
MASN-4	4422	6260	7160	7540	5480	8720	6597.00	1536.57	23.29
MASN-6	5211	7778	7280	6834	4840	8120	6677.17	1356.94	20.32
MASN-7	4978	6848	7760	6750	3160	7160	6109.33	1718.32	28.13
SCW (g)									
MASN-4	1.685	1.507	1.408	1.389	1.238	1.507	1.456	0.150	10.280
MASN-6	1.474	1.482	1.41	1.408	1.245	1.458	1.413	0.088	6.232
MASN-7	1.692	1.434	1.437	1.396	1.238	1.447	1.441	0.146	10.123
SSW (g)									
MASN-4	0.325	0.293	0.276	0.272	0.242	0.314	0.287	0.030	10.545
MASN-6	0.319	0.285	0.271	0.286	0.246	0.295	0.284	0.024	8.582
MASN-7	0.352	0.297	0.267	0.283	0.237	0.288	0.287	0.038	13.245
Shell %									
MASN-4	19.32	19.46	19.67	19.57	19.53	20.84	19.73	0.56	2.81
MASN-6	21.88	19.27	19.22	20.31	19.75	20.23	20.11	0.98	4.88
MASN-7	20.92	20.753	18.6	20.34	19.14	19.91	19.94	0.92	4.61
FL (m)									
MASN-4	718	726	760	758	671	763	732.67	35.70	4.87
MASN-6	738	700	767	780	711	740	739.33	30.89	4.18
MASN-7	726	754	777	743	635	731	727.67	48.91	6.72
Raw silk %									
MASN-4	11.70	10.66	11.70	11.65	11.49	11.50	11.450	0.398	3.479
MASN-6	11.75	10.19	11.75	11.70	12.12	11.27	11.463	0.680	5.930
MASN-7	11.61	10.51	11.61	11.05	11.6	11.39	11.295	0.442	3.913
Recovery %									
MASN-4	80.4	81.4	81.0	84.0	82.2	84.2	82.2	1.58	1.93
MASN-6	79.2	80.6	81.0	85.0	81.0	82.8	81.6	2.02	2.48
MASN-7	78.8	80.2	80.4	83.0	79.8	83.4	80.9	1.84	2.28

Observation on MASN lines:

- ❖ The evolved bivoltine MASN lines (MASN4, MASN6, MASN7) were reared at CSR&TI, Berhampore (Institute level) during 2017-18 & 2018-19.
- ❖ Six trials rearing were conducted to select best line for hybridization subsequent field trial.
- ❖ MASN4 showed significantly higher fecundity and yield whereas other parameters did not vary significantly among the MASN lines.

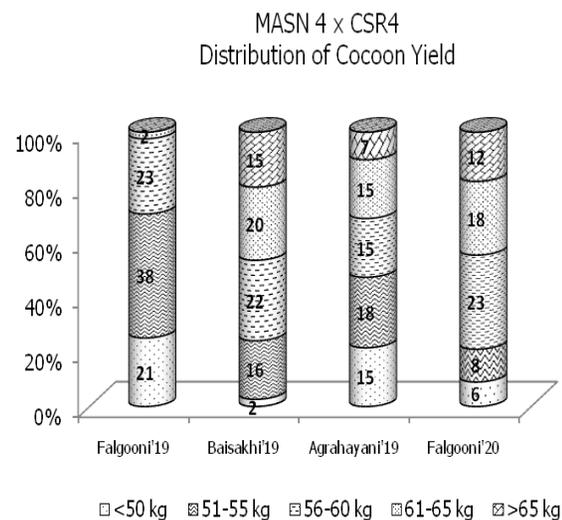
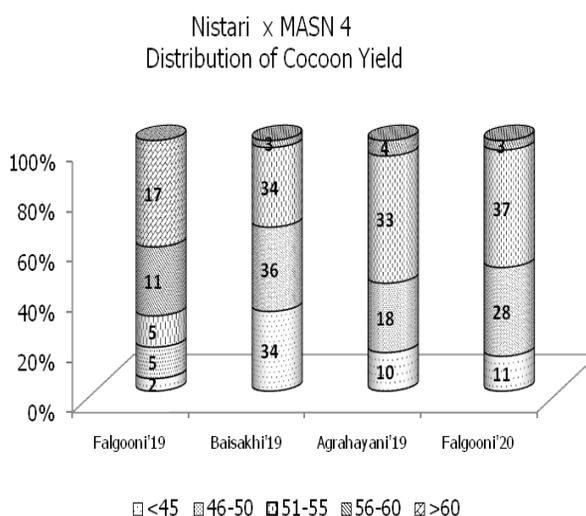
- ❖ Based on the trials, survival rate, yield and cocoon traits, MASN4 was selected for hybrid development programme.
- ❖ The performances of MASN lines during favourable seasons showed better cocoon parameters & survival % (as shown by 68 – 78% ERR) than its control CSR2 race (40-50%).
- ❖ During unfavourable season the control CSR2 did not survive in this region whereas MASN lines showed survival of 40- 50 %.
- ❖ Six trial rearing of MASN lines (4, 6 and 7) were performed at Berhampore Institute level, in different seasons [Favourable seasons (October to March) and Unfavourable seasons (April to September) of West Bengal] during 2017-2019.
- ❖ Under summer (May-June) conditions in West Bengal, high temperature combined with low humidity led to poor leaf quality and low moisture content. Under this condition, the MASN 4, 6 and 7 lines showed Shell % of 19 – 21% showing better adaptability of MASN lines.

MASN Hybrid Performance at farmers' level (2018-20)
Pool performance data of MASN hybrids (Bi x Bi) at farmers field

Hybrids (Bi x Bi)	Oct-Nov, 2018	Feb-Mar, 2019	Oct-Nov, 2018	Feb-Mar, 2019	Mean	SD	CV%
Dfls distributed (no.)	7750	8700	7100	4650			
Farmers (no)	87	87	90	77			
Yield/ 100 dfls (kg)							
MASN4xCSR4	52.7	60.7	55.3	59.8	57.13	3.273	5.729
SK6x7 (Ctrl)	50.0	56.7	52.5	52.4	52.90	2.411	4.558
SCW (g)							
MASN4xCSR4	1.889	1.813	1.629	1.605	1.734	0.120	6.940
SK6x7 (Ctrl)	1.487	1.464	1.508	1.506	1.491	0.018	1.190
SSW (g)							
MASN4xCSR4	0.382	0.350	0.346	0.340	0.355	0.016	4.590
SK6x7 (Ctrl)	0.274	0.251	0.278	0.253	0.264	0.012	4.585
Shell (%)							
MASN4xCSR4	20.22	19.33	21.24	21.18	20.493	0.784	3.825
SK6x7 (Ctrl)	18.43	17.19	18.44	16.80	17.715	0.733	4.138
FL (m)							
MASN4xCSR4	798	713	838	709	764.5	55.356	7.241
SK6x7 (Ctrl)	790	648	741	706	721.3	51.756	7.176
Recovery (%)							
MASN4xCSR4	76	77	66.1	76.7	74.0	4.547	6.148
SK6x7 (Ctrl)	76	65	68.5	77.3	71.7	5.123	7.145

MASN4 x CSR4 – Frequency distribution of cocoon yield at farmers' level
Pool performance data of MASN hybrids (Multi x Bi) at farmers field

Hybrids (M x Bi)	Feb-Mar, 2019	Apr-May, 2019	Oct-Nov, 2019	Feb-Mar, 2020	Mean	SD	CV%
Dfls distributed (no.)	4900	10900	6350	7800			
Farmers covered (no)	49	116	89	89			
Yield/ 100 dfls (kg)							
Nistari x MASN4	59.3	47.2	50.7	50.3	51.88	5.191	10.01
Nistari x SK6x7	49.7	44.6	46.0	48.5	47.20	2.319	4.91
SCW (g)							
Nistari x MASN4	1.795	1.750	1.834	1.678	1.764	0.067	3.796
Nistari x SK6x7	1.452	1.562	1.468	1.537	1.505	0.053	3.527
SSW (g)							
Nistari x MASN4	0.320	0.310	0.296	0.285	0.303	0.015	5.084
Nistari x SK6x7	0.237	0.262	0.234	0.244	0.244	0.013	5.139
Shell (%)							
Nistari x MASN4	17.86	17.82	16.14	16.98	17.20	0.815	4.74
Nistari x SK6x7	16.29	16.77	15.94	15.88	16.22	0.409	2.52
FL (m)							
Nistari x MASN4	707	609	726	654	674.00	52.972	7.86
Nistari x SK6x7	653	456	569	649	581.75	92.330	15.87
Recovery (%)							
Nistari x MASN4	76	67	72.8	75.3	72.78	4.088	5.62
Nistari x SK6x7	75	66.5	66.5	75.7	70.93	5.118	7.22



Overall performance of the hybrids at Farmer level (2018-20)

Hybrids	Dfls	Yield/ 100 dfls (kg)	SCW (g)	SSW (g)	Shell (%)	FL (m)	Silk Rec. (%)
Bi x Bi (MASN4 x CSR4)							
MASN4 x CSR4	24150	57.15	1.734	0.355	20.54	765	73.95
SK6 x 7 (Control)	5200	52.86	1.491	0.264	17.71	721	71.70
IOC (%)		8.12	16.30	34.47	15.98	6.10	3.14
Multi x Bi (Nistari x MASN4)							
N x MASN	25650	50.80	1.766	0.303	17.16	674	72.83
N x (SK6x7) Control	4600	47.20	1.552	0.257	16.48	571	69.18
IOC (%)		7.63	13.79	17.90	4.13	18.04	5.28

Yield of MASN hybrids (Bi x Bi & Multi x Bi) vs ruling hybrids at Farmer level (2018-20)

Bi x Bi hybrid	Dfls	Yield/ 100 dfls (kg)	Multi x Bi cross	Dfls	Yield/ 100 dfls (kg)
MASN4 x CSR4	24150	57.15	Nistari x MASN	25650	50.8
SK6 x 7 (Ruling hybrid)	5200	52.86	Nistari x (SK6x7) (Ruling hybrid)	4600	47.2
IOC (%)		8.12			7.63

Hybrid performance developed from MASN-lines during Feb.-Mar.2019 (Institute Level)

#	Name of Hybrid	Fec. (No.)	Hatching (%)	Wt. of 10 mature larvae (g)	ERR (No.)	SCW (g)	SSW (g)	Shell (%)	FL (m)	Recovery (%)
Bivoltine Hybrids										
1.	MASN x CSR4	595.0	93.28	43.60	8960	1.858	0.358	19.294	750.6	76.8
2.	SK6 x SK7	499.8	94.54	37.20	9160	1.472	0.240	16.324	643.0	76.8
3.	BCon1 x 4	485.4	89.06	43.18	8296	1.679	0.282	16.763	695.0	77.2
	CD @ 5%	55.255	N/A	1.427	465.498	0.091	0.025	1.066	56.953	N/A
	CV%	7.529	4.539	2.478	3.794	3.904	6.078	4.380	5.871	0.949
Multi x Bi Hybrids										
1.	N x MASN	488	95.41	44.99	9032	1.779	0.317	17.829	706.8	75.8
2.	N x (SK6.7)	453	94.22	36.94	9816	1.506	0.246	16.319	653.2	75.2
3.	M6DPC x Bi	441	94.88	39.54	9640	1.560	0.253	16.244	656.6	75.2
	CD @ 5%	24.198	N/A	1.787	428.679	0.082	0.014	0.581	16.810	N/A
	CV%	3.767	1.945	3.168	3.240	3.665	3.815	2.484	1.795	1.235

District wise avg. cocoon yield of Bv hybrids and M x Bi hybrids during Oct.-Nov., 2018 & Feb.- March and April 2019 crop at farmers' level

Overall Performance of MASN Hybrid at Farmers Level (2018-20)

- The developed MASN hybrids (bivoltine hybrid: MASN4 x CSR4) and cross breed Multi x Bi: Nistari x MASN4 were tested at 4 districts of West Bengal (Murshidabad, Malda, Birbhum & Nadia) at farmers' field during 2018-2020 (November, February & April crop). The hybrids were also tested at Institute level (CSR&TI, Berhampore).
- Five trials (Nov., 2018, Feb., 2019, April, 2019, Nov., 2019 & Feb., 2020) rearing were conducted at farmers' level to evaluate its potentiality & adaptability.
- The cocoons were with strong built up and cocoons, shell weight & shell % (19-20%) were significantly higher in the MASN hybrids / Cross breed than the ruling hybrids. Similar results were obtained in Institute level as well as field level.
- Survival of the bivoltine silkworm is a serious challenge for sericulture Industry. The lines which shows significant tolerance towards NPV is most desirable for bivoltine sericulture areas.
- In addition Eastern India does not have specific bivoltine lines suited to that area hence it is useful to synthesize bivoltine hybrids suitable for eastern India to improve sericulture.
- In addition it is recommended to identify alternate disease tolerant high yielding bivoltine races to the susceptible high yielding race CSR2.
- Testing of hybrids developed from MASN lines was initiated from Nov., 2018 in Agrahayani crop at farmers level.
- Total 24200 dfls of bivoltine hybrids (MASN x CSR4) & 25650 dfls of multi x bi (Nistari x MASN) cross breeds were tested w.e.f. Oct.-Nov 2018 to February - March 2020 crop at farmers' field in four seridistricts of West Bengal, Murshidabad, Malda, Birbhum and.
- In Agrhayani and Falgooni crops both (MASN x CSR4) and (Nistari x MASN) hybrids showed significantly ($P < 0.05$) higher yield than the ruling hybrids [(SK6 x SK7) and Nistari x (SK6 x SK7)] or at par with ruling hybrids/ cross breeds.

Ongoing Projects

AIB 02006 MI: Improvement of Nistari lines for survival and silk productivity

[June 2020- May 2024]

Coordinator: V. Sivaprasad, Th. Ranjita Devi (PI), A. K. Verma (till Dec 2020), Gautam Mitra (till Nov 2020), K. Rahul, Pooja Makwana, Mihir Rhaba and Chandra Shekar (PI, CSRTI-Mysuru)

Objectives:

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

Season-Wise variations in cocoon traits of different Nistari Lines (2020-21) Line							
Lines		Fec. (No.)	Pupation (%)	Cocoon Wt.(g)	Shell Wt.(g)	Shell (%)	Filament length(m)
	Benchmark Trait Values	392-400	81-83	0.9-1.1	0.1-0.115	11-12	300-350
	Expected Trait Values	410-450	> 90	1.2-1.3	0.15-0.16	13-14	400-450
IN-M1	May-June	501	96.00	1.00			384.00
	July –Aug	477	96.00	1.36	0.20	14.71	
	Oct- Nov	555	93.00	1.22			409.83
	Dec- Jan	544	95.00	1.23			442.00
	Mar-April	507	96.00	0.94	0.15	16.14	
	Mean	517	95.00	1.15	0.18	15.42	411.94
	SD	32.13	1.30	0.17	0.017	0.5	29.05
	CV (%)	6.22	1.37	15.10	9.93	3.29	7.05
IN-M2	May-June	531	97.00	1.00			438.90
	July –Aug	547	95.00	1.14	0.17	14.91	
	Oct- Nov	503	93.00	1.14			336.73
	Dec- Jan	502	94.00	1.50			367
	Mar-April	511	95.00	0.83	0.12	14.57	
	Mean	518.8	94.80	1.12	0.15	14.74	380.88
	SD	19.60	1.48	0.25	0.035	0.23	52.48
	CV (%)	3.78	1.56	22.02	23.33	1.56	13.78
	Benchmark Trait Values	382-390	86-88	0.9-1.21	0.1-0.125	11-12.5	300-350
	Expected Trait value	400-450	> 90	1.2-1.3	0.15-0.16	13 -14	400-450
IN-P1	May-June	450	97.00	1.05			370.00
	July –Aug	503	95.00	1.26	0.16	12.38	
	Oct- Nov	477	93.00	1.09			400.59
	Dec- Jan	455	95.00	1.23			425.00
	Mar-April	467	96.00	0.89	0.13	14.44	
	Mean	470	95.00	1.10	0.14	13.41	398.53
	SD	21.04	1.48	0.15	0.022	1.45	27.55
	CV (%)	4.47	1.56	13.36	15.71	10.81	6.91
IN-P2	May-June	477	96.00	1.00			379.00
	July –Aug	520	95.00	1.28	0.15	12.04	
	Oct- Nov	501	90.00	1.08			342.43
	Dec- Jan	469.00	94.00	1.22			404.00
	Mar-April	460	93.00	0.89	0.12	14.19	
	Mean	485	94.00	1.09	0.13	13.11	375.14
	SD	24.62	2.30	0.16	0.02	1.52	30.95
	CV (%)	5.07	2.46	14.63	13.41	11.59	8.25

Note: IN-M: improved Nistari marked; IN-P: improved Nistari plain

Marked and plain Nistari lines from various sources (CSRTI-BHP, CSGRC Hosur, NSSO-WB, DOS-WB & RSRS-KA) were reared in different seasons viz., Bhaduri (June-July 2020), Shrivani (Aug-Sep), Agrahayani (Oct- Nov), Falguni (Jan-Feb) & Baisakhi (Mar-Apr 2021) to evaluate rearing performance. Based on rearing performance, two best performing marked (IN-M1& IN-M2) and plain (IN-P1& IN-P2) Nistari lines were selected. The selected lines were further subjected to selection for better estimates of fecundity, cocoon shape, volume, built & uniformity; cocoon weight, shell weight, shell ratio & filament length without compromising the original qualitative characteristics of the lines. To enable the selection of male and female individuals with long filament as parent for next generation, mono cold reeling technique

is adopted to determine the filament length of single Nistari cocoon. The filament length was in the range of 380-412 meters. Shell ratio was higher in Nistari marked lines (~15%) than plain lines (13%).

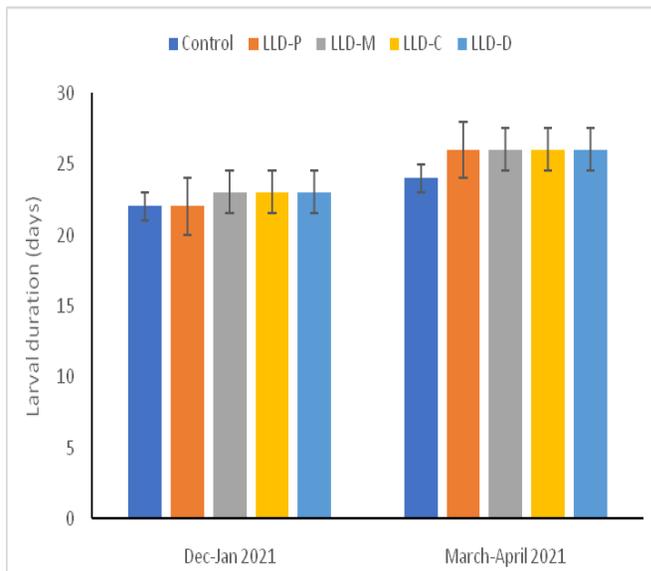
In order to test the tolerance of different Nistari lines against BmNPV infection, 3rd instar larvae of Selected Nistari Lines (marked & plain) were inoculated with BmNPV (per oral @ 60,000 PIBs / larvae). The survival of plain and Marked Lines was improved to ~70 % after five generations showing improvement on early generation.

Seasonal survival (%) of Nistari lines against BmPV infection (2020-21)					
Line	June-July	Aug- Sep	Oct- Nov	Dec-Jan	Feb-March
Marked	65-70	38-41	55-56	75-78	75-77
Plain	20-21	22-56	37-51	76-79	72-74

Marked and plain Nistari larvae were selected from stock for better quantitative traits and are segregated for selection to induce long larval duration (LLD) in each instar. Late moulting larvae are selected at each instar and maintained separately. The segregated population showed late moulting of larvae, late spinning and late emergence of moths. The DFLs are preserved as per standard protocol and will be utilized for next generation for further directional selection and to test for markers associated with long larval duration. The larval duration was extended by two days in LLD lines. The extension in larval duration corresponding to the selection was recorded in two seasons (Dec-Jan 21 & Mar-April 21) and is depicted below. The selected larvae spun the cocoons and observation is in progress.

Larval duration of different Nistari lines with extended larval duration (LLD=long larval duration)

Season	Plain Control	LLD-Plain	Marked Control	LLD-Marked	Chalsa Control	LLD-Chalsa	Debra Control	LLD-Debra
Dec-Jan 2021	22	22	22	23	22	23	22	23
Mar-April 2021	24	26	24	26	24	26	24	26



Markers for thermo-tolerance in Nistari lines

Markers for thermotolerance and high humidity derived from *Pyrexia* gene were screened in both Marked and Plain lines. The *Pyx* markers (*pyx3* & *pyx4*) were present in Marked Nistari lines and absent in Nistari Plain. The Thermotolerance SSR markers (*S0803* & *S0816*) are observed in all the Nistari lines.

AIT 02008 SI-Identification of markers for high humidity tolerance in silkworm breeds

[June 2020- May 2024]

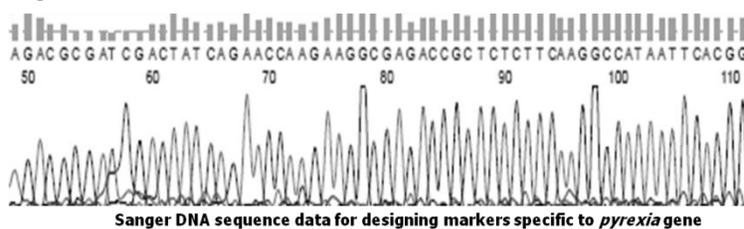
Coordinator- V. Sivaprasad, Raviraj V.S (PI), N. Chandrakanth and V. Lakshmanan

Objective: To identify markers for tolerance to high temperature and high humidity in silkworm

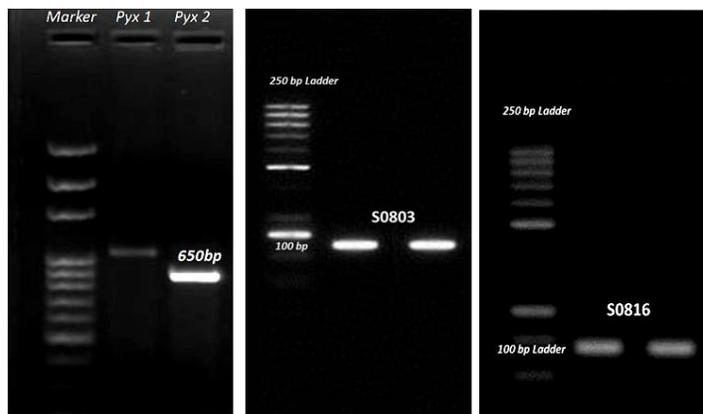
The growth of bivoltine silk production in E & NE India lags behind drastically in comparison to Southern states due to non-availability of suitable bivoltine hybrids and bivoltine foundation crosses (SK6 x SK7 & BCon1 x BCon4) are reared in limited quantities currently. The major constraints in bivoltine popularization are adverse adverse climatic conditions (high temperature & high humidity). DNA markers (*S0803* & *S0816*) for tolerance to high temperature were identified and are being utilized to develop silkworm hybrids tolerant to high temperature at CSRTI-Berhampore. Preliminary studies at CSRTI-Mysore shown that *pyrexia* gene (a transient receptor potential channel) might be associated with tolerance to high humidity in silkworm. To overcome these limitations and continuously rear bivoltine hybrids in these harsh climatic conditions throughout the year, studies needs were planned to integrate conventional breeding (directional selection) for improved productivity and advanced genome technologies such as MAS (marker assisted selection) at CSRTI-Berhampore.

Identification of markers for high humidity stress

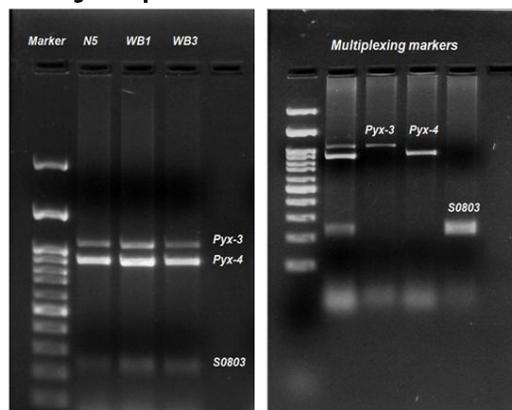
pyrexia gene sequence retrieved from repositories was utilized to match Sanger sequencing data by bioinformatics analysis. Potential gene markers i.e., specific markers/primers (*Pyx1* & *Pyx2*) have been designed for high humidity tolerance. These markers were validated with the populations which have survived at high humidity and high temperature. *Pyx1* & *Pyx2* gene sequences have been registered with NCBI (MT221438 & MT221439). These primers are being utilized further to select populations/broods with tolerance to high humidity.



PCR for gene markers for high humidity tolerance (*Pyx1* & *Pyx2*) and High temperature tolerance (*S0803* & *S0816*)



Development of PCR based multiplexing tool/kit for simultaneous identification of high humidity and high temperature markers in silkworm breeds



PCR based multiplexing assay were developed targeting two SNP markers (Pyx-1 & Pyx2) and a STR marker S0803 to make the detection of high temperature and high humidity silkworm breeds at one go. These assays can be used for in-house and commercial availability for detection of thermo tolerant and high humidity silkworm breeds.

Validation of markers for high humidity & high temperature

A total of 54 bivoltine breeds and 16 multivoltine breeds from different R&D institutes were screened for tolerance to high humidity (85±5%) & high temperature (35±5°C) in simulated conditions during June-July 2019, Aug-Sept 2019, Mar-April 2020, July-Aug 2020, Oct-Nov 2020, & Jan-Feb 2021. The populations survived from June-July 2019 season were utilized to produce next-generation layings. Marker assisted selection (MAS) was performed on all the rearing batches (male & female moths) utilizing markers for tolerance to high humidity & high temperature. Popular bivoltine foundation crosses parents *i.e.*, SK6, SK7, BCon1 & BCon4 were maintained as controls. Bivoltine breeds *viz.*, N2, N5, WB1 & WB3 expressed tolerance to both high humidity and high temperature. Sk6, SK7 and BCon1 showed tolerance to high temperature only. Tolerance to tolerance to high humidity (85±5%) & high temperature (35±5°C) was not recorded in CSR6, CSR26, CSR27, CSR51, CSR53, N1, MASN4, MASN6, HTH1, HTH3, HTH5, HTH6, HTH10, BHP1, BHP3, BHP8, BHP9, WB5, WB9 & BCon4. The broods with tolerance to high humidity (85±5%) & high temperature (35±5°C) are being maintained further for developing breeds/hybrids tolerant to high humidity & high temperature.

Performance of Bivoltine Silkworm Breeds with Tolerance to High Humidity (85±5%) & High Temperature (35±5°C)							
Breed	Season	Pupation (%)	Cocoon Wt.(g)	Shell Wt.(g)	Shell (%)	MAS	
						HH	HT
N2	Jul-Aug 2020	31	1.19	0.187	15.71	✓	✓
	Oct-Nov 2020	21	1.01	0.205	20.29	✓	✓
	Dec-Jan 2021	16	0.99	0.189	19.09	✓	✓
N5	Jul-Aug 2020	30	0.885	0.147	16.61	✓	✓
	Oct-Nov 2020	46	1.155	0.224	19.39	✓	✓
	Dec-Jan 2021	47	1.072	0.202	18.86	✓	✓
WB1	Jul-Aug 2020	21	1.337	0.248	18.54	✓	✓
	Oct-Nov 2020	22	1.458	0.224	15.36	✓	✓
	Dec-Jan 2021	31	10.72	2.02	18.86	✓	✓
WB3	Jul-Aug 2020	45	1.094	0.182	16.63	✓	✓
	Oct-Nov 2020	28	1.383	0.24	17.35	✓	✓
	Dec-Jan 2021	37	1.100	0.187	16.97	✓	✓
SK7 (Control)	Jul-Aug 2020	36	1.015	0.156	15.37		✓
	Oct-Nov 2020	40	0.94	0.16	16.65		✓
	Dec-Jan 2021	42	1.410	0.238	16.88		✓

AIB 3602: Development of thermotolerant bivoltine hybrids of silkworm through MAS

[November 2016 - April 2021]

N. Chandrakanth (PI), V. Lakshmanan, A. K. Verma, V. S. Raviraj, G. Mitra and Sahadeb Roy (JRF)

Objective: To develop the thermotolerant bivoltine silkworm breeds/hybrids through DNA marker assisted selection (MAS) and their evaluation.

By applying Marker Assisted Selection (MAS), eight thermo-tolerant silkworm breeds were developed. Out of them, 4 breeds (WB2, WB4, WB6 and WB8) were discontinued due to their low performance and non-uniformity in phenotypic traits. Five breeds (WB1, WB3, WB5 WB7 and KA19) were shortlisted for identifying foundation crosses (FCs) and double hybrids thereof. One dumbbell FC (WB1 × WB3) and two oval FCs (WB7 × WB5 and KA19 × WB5) were prepared and lab tested under normal and high temperature condition (from V instar 3rd day to till spinning at 36°C). As the FCs performance was noteworthy with >60% pupation at high temperature. Two productive thermo-tolerant double hybrids (WB 1.3 × WB 7.5 and KA19.WB5 × WB 1.3) were developed by utilized the selected FCs. The two double hybrids exhibited higher thermo-tolerance with >70% pupation and >45 kg of cocoon yield/100 dfls at high temperature (36±1°C). These hybrids were also evaluated further in different seasons in on-station trials (OST) at the main institute as well as five locations (RSRS-Kalimpong, RSRS-Koraput, RSRS-Jorhat, REC-Mothabari and REC-Dimapur). WB 1.3 × WB 7.5 performed significantly better than SK6 x SK7 and BCon1 x BCon4 with improvement in survival (14% @ 89%), shell ratio (10% @ 20.89%), filament length (5% @ 826m), reelability (5% @ 81%), raw silk recovery (7% @ 72%) and average cocoon yield (35% @ 72kg). The results of on-station trials clearly showed the dominant performance of

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double hybrid of the WB 1.3 × WB 7.5 both terms of thermotolerance and productivity. On-station trials conducted at 5 research stations revealed that WB 1.3 × WB 7.5 had higher thermotolerance and productivity (cocoon yield/ 10000 larvae) at RSRS-Kalimpong (90.36% and 17.52 kg), RSRS-Koraput (92.38% and 15.85 kg), RSRS-Jorhat (86.89% and 12.62 kg) and REC-Dimapur (85.58% and 13.04 kg) was superior while at REC-Mothabari, KA19.WB5 × WB 1.3 was superior (66.84% and 10.55 kg). The overall performance with respect to on-station trials spanning 15 seasons at different seasons and regions showed that WB 1.3 × WB 7.5 had higher thermotolerance with 82% pupation and cocoon yield of 13.04 kg per 10000 larvae. Not only in rearing traits but WB 1.3 × WB 7.5 was also superior in reeling parameters studied like reelability (71%), filament length (694 m) and silk

**Performance of thermo-tolerant breeds & FCs for the year 2020-21
Avg. Temp. (32.9°C; 27-38°C) & Relative Humidity (83.3%; 78-95%)**

Hybrids	dfls	Season	Fecundity (no.)	ERR (No.)	ERR Wt. (kg)	SCW (g)	SSW (g)	Shell %
WB1	10	FS	478	8850	12.54	1.363	0.272	19.92
	20	UFS	410	4077	5.82	1.218	0.213	17.33
		Average	444	6463	9.18	1.291	0.243	18.63
WB3	10	FS	469	6554	8.55	1.184	0.252	21.24
	20	UFS	432	4821	7.05	1.185	0.202	16.98
		Average	450	5687	7.80	1.185	0.227	19.11
WB5	10	FS	498	7600	10.32	1.307	0.260	19.92
	20	UFS	453	5037	7.52	1.333	0.237	17.72
		Average	475	6318	8.92	1.320	0.249	18.82
WB7	10	FS	506	7520	10.10	1.376	0.285	20.67
	20	UFS	491	4945	8.75	1.400	0.267	19.05
		Average	498	5732	8.93	1.388	0.276	19.86
WB1 x 3	10	FS	508	8990	11.12	1.489	0.299	20.08
	20	UFS	489	5756	7.92	1.328	0.243	18.06
		Average	498	7373	9.52	1.409	0.271	19.07
WB7 x 5	10	FS	510	8590	12.50	1.500	0.325	21.66
	20	UFS	487	4730	7.07	1.436	0.292	20.24
		Average	498	6660	9.79	1.468	0.309	20.95
KA19 x WB5	10	FS	504	8350	11.55	1.433	0.312	21.77
	20	UFS	476	4997	9.41	1.378	0.277	20.04
		Average	490	6673	10.48	1.406	0.295	20.91

Values represent data from

4 crops in Unfavourable Seasons (UFS: Jaistha, Shrivani, Aswina & Bhaduri)
& 2 crops in Favourable Seasons (FS: Agrahayani & Falguni)

recovery (68%). Therefore, thermo-tolerant double hybrid, WB 1.3 × WB 7.5 performance was superior to existing bivoltine hybrids/ foundation crosses and is suitable for rearing throughout the year in E & NE India.

Comparative Laboratory Performance of WB-DH hybrids (2020-21) Avg. Temp. (32.9°C; 27-38°C) & Relative Humidity (83.3%; 78-95%)										
Hybrid	WB-DH1		WB-DH2		SK 6 x 7		Bcon 1 x 4		Improvement of WB-DH1 (%) Over	
Crop/ Season	FS	UFS	FS	UFS	FS	UFS	FS	UFS	SK 6 x 7	Bcon 1 x 4
Fec. (No)	583	528	511	521	489	518	495	491	19.22 - 1.93	17.78 - 7.54
ERR (No.)	8900	6524	7800	6081	7850	5184	6533	4478	13.38 -25.85	36.23 - 45.69
ERR (Kg)	14.52	9.18	12.31	9.64	10.25	7.06	9.25	6.72	41.67-30.03	56.97 - 36.61
Cocoon Wt. (g)	1.661	1.505	1.517	1.447	1.303	1.240	1.314	1.283	27.48 -21.37	26.41 - 17.30
Shell Wt. (g)	0.347	0.282	0.301	0.271	0.217	0.207	0.215	0.217	59.91 -36.23	61.40 - 29.95
Shell (%)	20.89	18.69	19.84	18.71	16.65	16.65	16.36	16.84	25.47 -12.25	27.69 - 10.99
Reelability (%)	81	79	79	72	77	72	75	71	5.19 - 9.72	8.00 - 11.27
FL (m)	826	781	725	685	783	690	781	682	5.49 - 13.19	5.76 - 14.52
Silk Rec. (%)	78	72	72	70	76	69	73	69	2.63 - 4.34	6.84 - 4.34

Values represent data from
4 crops in Unfavourable Seasons (UFS: Jaistha, Shrivani, Aswina & Bhaduri)
& 2 crops in Favourable Seasons (FS: Agrayani & Falguni)

OST of thermo-tolerant silkworm double hybrids (2020-21)										
Centre	Hybrids (10/5dfis)	Crops (No.)	ERR (No.)	Yield/ 10K L (Kg)	Cocoon Wt. (g)	Shell Wt. (g)	Shell (%)	Reel-ability (%)	FL (m)	Silk Recovery (%)
CSRTI-BHP	WB13 x WB75	6	7712	11.85	1.583	0.314	19.79	80	803	75
	KA19.WB5 x WB1.3		6941	10.98	1.482	0.286	19.28	75	705	71
	SK6 x 7		6517	8.63	1.272	0.212	16.65	74	736	73
	BCon1 x 4		5506	7.986	1.299	0.216	16.6	73	732	71
RSRS-Koraput	WB13 x WB75	3	9238	15.85	1.725	0.317	18.41	61	757	61
	KA19.WB5 x WB1.3		8938	16.13	1.765	0.324	18.41	63	700	58
	SK6 x 7		8320	13.80	1.685	0.261	15.52	62	728	60
	BCon1 x 4		9150	17.56	1.802	0.291	16.23	63	741	66
RSRS-Kalimpong	WB13 x WB75	1	9036	17.52	1.995	0.413	20.69	56	502	47
	KA19.WB5 x WB1.3		8168	16.59	2.019	0.425	21.03	56	489	47
	SK6 x 7		9222	16.34	1.849	0.313	16.94	59	817	55
	BCon1 x 4		8843	16.37	1.717	0.292	17.00	64	654	56
RSRS-Jorhat	WB13 x WB75	1	8689	12.62	1.500	0.300	19.78	79	709	79
	KA19.WB5 x WB1.3		5700	8.62	1.510	0.310	20.38	75	635	78
	SK6 x 7		6433	8.52	1.400	0.250	17.80	76	624	80
	BCon1 x 4		8933	12.82	1.350	0.250	18.53	76	590	61
REC-Mothabari	WB13 x WB75	3	5964	8.89	1.484	0.289	19.53	81	700	80
	KA19.WB5 x WB1.3		6684	10.55	1.534	0.290	18.84	77	712	76
	SK6 x 7		6378	9.58	1.367	0.212	15.38	72	734	71
REC-Dimapur	WB13 x WB75	1	8558	11.51	1.430	0.301	21.04	Reeling sample was not collected due to pandemic COVID19		
	KA19.WB5 x WB1.3		7800	10.62	1.480	0.300	20.27			
	SK6 x 7		7436	9.22	1.400	0.288	20.57			
	BCon1 x 4		7888	9.92	1.350	0.260	19.25			
Mean	WB13 x WB75	15	8200	13.04	1.620	0.322	19.87	71	694	68
	KA19.WB5 x WB1.3		7372	12.25	1.632	0.323	19.70	69	648	66
	SK6 x 7		7384	11.02	1.496	0.256	17.14	69	728	68
	BCon1 x 4		8064	12.93	1.504	0.262	17.52	69	679	64

AIB 02009MI: Authorization trials silkworm hybrid, 12Y x BFC1 in E & NE India**[August 2020-July 2022]**

N Chandrakanth (From Jan-21), AK Verma (till Dec-20) & TR Devi; SSPC-BHP: SN Bagchi; CSTRI: A Reddy

Objective: To evaluate the newly developed Multi x Bi hybrid, 12Y x BFC1 for generating data for hybrid authorization with the farmers in Eastern & North Eastern India

Authorisation trials of 12Y × BFC1 was conducted in seven states of Eastern and North Eastern India. A total of 81000 dfls of 12Y × BFC1 was produced in collaboration of SSPC-Berhampore, NSSO unit. All the 81000 dfls were tested in the field conditions of West Bengal covering 4 crops and other Eastern (Jharkhand and Odisha) and North Eastern states (Assam, Arunachal Pradesh, Nagaland and Tripura) covering two crops. Irrespective of the seasons, 12Y × BFC1 has performed better than the control (N × SK6.7) in all the tested states. The highest potential for 12Y × BFC1 in terms of yield/100 dfls was observed in Arunachal Pradesh (57.11 kg) followed by West Bengal (50.11 kg) and Jharkhand (46.13 kg). Similarly, highest shell ratio for 12Y × BFC1 was recorded in Nagaland (17.72%) followed by Arunachal Pradesh (17.24%) and West Bengal (17.08%). The state-wise rearing performances of 12Y × BFC1.

Location wise performance of 12Y x BFC1							
State	Farmer (No.)	Crop (No.)	Dfls	Yield/ 100dfls (kg)	Cocoon wt. (g)	Shell wt. (g)	Shell (%)
*West Bengal	596	4	60550	50.11	1.475	0.252	17.08
Tripura	233	2	16300	41.08	1.283	0.204	15.89
Nagaland	20	2	1100	40.15	1.359	0.243	17.72
Assam	18	2	900	40.19	1.319	0.218	16.60
Odisha	8	2	800	41.88	1.456	0.217	14.96
Arunachal Pradesh	9	2	750	57.11	1.531	0.262	17.24
Jharkhand	12	2	600	46.13	1.516	0.254	16.74
Average/Total	896	16	81000	45.24	1.428	0.240	16.84
Control (N x SK6 . 7)				40.99	1.370	0.229	16.71
t-stat (p value)				0.0001	0.0001	0.0001	0.0001

*Data on cocoon traits were not collected during June-July 21 crop due to COVID19 pandemic in West Bengal

Seasonal variations in the grainage parameters of 12Y × BFC1 was also studied in comparison with control. In all the seasons, 12Y × BFC1 showed highest pairing percentage as well as egg recovery over the control. The highest egg recovery of 12Y × BFC1 was observed in the March-April 21 (52.11 g/kg) season followed by February-March 21 (46.89 g/kg). In addition to the field testing of the hybrid 12Y × BFC1 (12000 dfls), P1 dfls of 12Y (250 dfls) and BFC1 (250 dfls) were also supplied to the state sericulture departments of Tripura and Chattisgarh on demand.

Season-wise grainage performance of 12Y x BFC1									
Season	Sep-Oct 20		Feb-Mar 20		Mar-April 21		June-July 21		t-stat (p value)
	12Y x BFC1	N x SK6.7	12Y x BFC1	N x SK6.7	12Y x BFC1	N x SK6.7	12Y x BFC1	N x SK6.7	
Hybrid Pair %	28.04	20.17	30.05	31.96	32.16	32.04	27.55	26.98	0.001
Dfls recovery (No.)	23.04	11.11	21.04	20.11	24.27	22.47	18.68	18.56	0.001
Dfls recovery (g/kg)	46.94	25.4	46.89	45.04	52.11	50	41.18	42.5	0.001
Dfls by no.	2300		32900		41500		14100		
Dfls by wt.	575		8225		10375		3525		
C:D Ratio	5.65:1	9.0:1	4.75:1	4.97:1	4.12:1	4.45:1	5.11:1	5.23:1	

AIE 06002MI: Evaluation of bivoltine silkworm genetic resources for tolerance to abiotic stress in selected hot spots (Collaborative project of CSGRC-Hosur)

[March 2019 to March 2022]

CSRTI-Berhampore: N Chandrakanth (PI) & VS Raviraj; CSGRC-Hosur: M Maheswari (PI), Geetha N Murthy, G Lokesh & Jameela Khatoon; SBRL-Kodathi: KS Tulsi Naik; REC-Chitradurga: Sreenivasulu; RSRS-Jammu: Sardar Singh & Murali

Objectives:

- To screen and select Bv germplasm resources with presence of markers linked to thermo tolerance
- To evaluate selected Bv germplasm resources against abiotic stress and identify suitable Bv breeds to target selected hot spots

Central Sericultural Germplasm Resources Centre (CSGRC)-Hosur have screened the bivoltine silkworm germplasm resources for presence of markers linked to thermo-tolerance. Among the screened genetic resources, 10 bivoltine silkworm breeds with markers linked to thermo-tolerance and better economic traits were selected. These ten bivoltine silkworm breeds needs to be evaluated against abiotic stress by rearing them at different agroclimatic conditions and to identify a suitable Bv breed to the selected hot spots. Under this objective, CSRTI-Berhampore was selected as temperate zone for evaluation of selected breeds that will help the breeders for wider choice to include in suitable breeding programs. One trial has been conducted at CSRTI-Berhampore during Nov/Dec, 2020 with 10 bivoltine breeds (including controls). Selected silkworm breeds were reared at suitable temperatures and humidity along with the control breeds. The data on important rearing and reeling parameters were collected. The selected bivoltine breeds performed better than the controls in terms of survival as well as cocoon traits. Among all the breeds, BBI-301 (68.67%) exhibited highest survival followed by BBI-338 (67.87%) and BBI-343 (65%). Higher cocoon weight (1.407 g) and shell weight (0.248 g) were also recorded with BBI-301. Multiple trait evaluation index ranked BBI-338 (57.23) followed by BBI-301 and BBI-339 (54.61) in the top spots. Though, BBI-338 was not the top performer in the rearing traits but it had performed fairly well with above overall mean values in all the rearing traits. Hence, BBI-338 and BBI-301 could be suitable bivoltine breeds that can be reared in Eastern India in a hybrid form. After the second trial (Oct/Nov 2021), based on overall performances of the bivoltine breeds, better bivoltine performer tolerant to abiotic stress will be recommended for breeders to include in breeding programs for development of improved hybrids for commercial exploitation.

Performance of Selected Bivoltine Accessions (Nov/Dec, 2020)

Acc.	Breed	Cocoon shape	Fec (No.)	10 Larval wt. (g)	ERR (No.)	ERR (kg)	SCW (g)	SSW (g)	SR (%)	FL (m)	Mean EI
BBI-86	KPG-A	Oval	505	26.14	5347	6.356	1.234	0.204	16.50	662	48.65
BBE-184	CSGRC-2		612	22.74	1533	1.841	1.251	0.212	16.92	645	45.60
BBI-301	YS-7		385	30.04	6867	8.408	1.407	0.248	17.62	596	54.61
BBI-339	DD-2		664	16.61	1293	1.366	1.247	0.238	19.11	572	54.61
BBI-334	APS-4	Elongated	546	27.36	5040	6.324	1.242	0.233	18.76	678	53.88
BBI-336	APS-8		564	27.30	4467	5.848	1.191	0.229	19.22	581	50.53
BBI-338	DD-1		599	31.51	6787	8.942	1.266	0.234	18.48	627	57.23
BBI-343	NK-3		522	28.96	6500	8.041	1.317	0.220	16.67	736	53.88
Control	SK6	Dumbbell	535	25.39	4467	5.168	1.242	0.196	15.75	636	50.53
Control	SK7		579	20.32	4300	5.124	1.120	0.180	16.08	594	41.63
		Mean	551	25.64	4660	5.74	1.25	0.22	17.51	632.7	
		SD	74.91	4.58	1963.8	2.55	0.07	0.02	1.30	50.53	

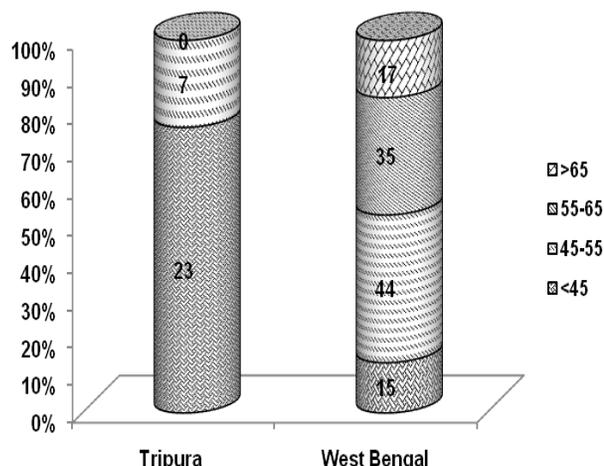
AIB 01009MI: Evaluation of new bivoltine double hybrid, TT21 x TT56 at farmers level for authorisation for commercial exploitation (Collobrative project of CSRTI-Mysore)

[April 2020 to March 2023]

CSRTI-Berhampore: N Chandrakanth (PI); CSRTI-Mysuru: SM Moorthy (PI), L Kusuma, MS Ranjini, KN Madhusudhan & MN Chandrasekar; RSRS-Kodathi: V.Chalapathy; RSRS-Ananthapur: Vijaya Naidu; RSRS-Salem: Dhahira Beevi; RSRS-Mulugu: Praveen Kumar; RSRS-Chamarajanagar: Sivasubramanyam; NSSO-Bengaluru: Sasidharan Nair & Sankar; RSRS-Sahaspur: RP Singh; RSRS-Jammu: Rita Singh

Objective: To evaluate the performance of bivoltine hybrid, TT21 x TT56 in field for productivity & silk

CSRTI-Mysuru has developed a robust thermo-tolerant bivoltine double hybrid, TT21 x TT56 through DNA marker assisted selection. After the successful on farm trials of TT21 x TT56, the double hybrid was recommended for authorization trials across India. As proposed part of the program, the field performance of TT21 x TT56 hybrid has to be done at eastern and North Eastern India. In this line, a total of 10500 and 1500 dfls of TT21 x TT56 hybrid was tested with the farmers of West Bengal and Tripura, respectively. As a result, the double hybrid TT21 x TT56 had an impressive and notable improvement over the control bivoltine combinations. The TT21 x TT56 has performed better in West Bengal (Eastern) and Tripura (North Eastern). Higher cocoon yield per 100dfls of 61.1 kg with an improvement 23.43% over control of during oct/Nov 2020 crop and 51.05 kg with an improvement of 5.8% over control during Feb/March 2021 while in Tripura it was 42.58 kg with 12.05% improvement over control. The performance of TT21 x TT56 hybrid was higher in all the economically important rearing traits when compared to the controls. Even the reeling performance of TT21 x TT56 was higher especially the filament length, renditta and raw silk were remarkable better than the control. So far, the TT21 x TT56 hybrid performance in Eastern and North Eastern India is satisfactory and acceptable.



Season-wise Performance of TT21 x TT56 Double Hybrid in West Bengal and Tripura

Hybrid	Crop	Dfls	Farmer (no)	Yield/ 100 dfls	SCW (g)	SSW (g)	SR (%)	FL (m)	Denier (d)	Reel-ability (%)	Ren-ditta (kg)	Raw silk (%)
TT21 x TT56	Oct/Nov 2020	5500	55	61.1	1.955	0.424	21.69	900	2.82	80	7.2	14
SK6 x 7		300	5	49.5	1.538	0.269	17.45	796	2.22	71	8.8	11.4
IOC %				23.43	27.11	57.62	24.30	13.07	27.03	12.68	-18.18	22.81
TT21 x TT56	Feb/March 2021	5000	57	51.05	1.619	0.296	18.28	878	2.72	74.34	7.53	13.27
SK6 x 7		100	2	48.25	1.522	0.254	16.68	838	2.66	82.14	8.16	12.25
IOC %				5.80	6.37	16.54	9.59	4.77	2.26	-9.50	-7.72	8.33
TT21 x TT56	Oct/Nov 2020	1500	30	42.58	1.579	0.36	22.79	901	2.82	80	6.9	14.5
BCon1 x 4		100	2	38	1.63	0.31	19.01	736	2.7	85	7.6	13.2
IOC %				12.05	-3.13	16.13	19.88	22.42	4.44	-5.88	-9.21	9.85

Continuous/Other Activities:

Multivoltine Germplasm: Multivoltine germplasm breeds of *B. mori* are maintained for five generations in the year. The rearing performance is documented below. The fecundity of the multivoltine accessions ranged from 377-514 whereas hatching in general was 97% and pupation ~93% in all germplasm accessions maintained showing better fitness traits under the rearing conditions employed.

Rearing performance of multivoltine germplasm accessions showing mean value from five crops								
Race/Breed	Stat	Fecundity (No.)	Hatching (%)	Cocoon Wt.(g)	Shell Wt. (g)	Shell (%)	ERR (kg)	Pupation (%)
Cambodge	Mean	429	95.04	1.11	0.20	10.83	10.24	97.00
	CV%	10.12	4.02	10.41	67.53	45.07	12.45	0.34
CB5	Mean	475.45	96.88	1.21	0.17	14.08	14.87	97
	CV%	2.77	0.57	17.12	20.15	7.18	72.48	0.78
M12W	Mean	452	96.95	1.13	0.14	12.53	10.63	97
	CV%	7.73	0.57	17.79	21.00	5.63	9.55	0.93
M6M81	Mean	461	96.12	1.18	0.17	14.15	11.30	97
	CV%	8.57	1.84	14.94	18.63	5.79	6.53	0.78
M6DPC	Mean	457	96.93	1.17	0.15	12.48	10.85	97
	CV%	6.16	0.75	11.87	12.58	5.17	7.57	0.86
OS-616	Mean	491	96.56	1.26	0.17	13.43	18.06	97
	CV%	2.24	0.89	22.24	29.55	10.31	69.91	0.36
M.Con4	Mean	500	96.89	1.25	0.19	14.72	11.81	97
	CV%	4.04	0.64	17.31	20.62	7.00	10.65	0.69
M2	Mean	427	96.45	1.14	0.16	13.80	17.57	98
	CV%	17.73	0.42	27.40	31.17	6.05	91.26	0.62
G	Mean	496	96.73	1.17	0.17	14.23	17.55	97
	CV%	5.27	0.90	24.02	25.31	4.96	80.47	0.93
PM	Mean	377	96.09	0.97	0.11	11.73	14.00	98
	CV%	21.29	2.75	18.94	21.58	7.88	76.92	0.51
M15	Mean	444.00	96.35	1.10	0.14	13.03	16.97	97
	CV%	8.74	0.45	26.25	28.94	5.87	85.28	1.79
M6DPC (Gr)	Mean	431	96.70	1.06	0.14	12.85	10.44	97
	CV%	16.27	1.01	17.00	17.32	6.61	1.26	0.76
Sarupat	Mean	382	91.65	1.08	0.14	12.80	10.79	97
	CV%	27.85	12.55	24.29	25.94	3.54	11.80	0.86
M12W	Mean	424	95.47	1.08	0.14	12.35	10.57	97
	CV%	13.90	3.30	24.36	31.44	9.20	11.40	0.86
MH1	Mean	490	96.50	1.23	0.20	16.98	11.80	98
	CV%	2.91	1.13	29.10	21.95	31.33	7.27	0.69
BL67	Mean	514	94.61	1.21	0.19	15.46	11.42	97
	CV%	4.24	1.10	23.00	24.49	7.67	13.51	1.12
Nistari (M)	Mean	466	93	1.18	0.143	12.13	10.33	95
	CV%	3.035	1.9	5.64	10.96	10.58	1.78	2.24
Nistari (P)	Mean	476	92	1.17	0.13	11.07	10.37	93
	CV%	9.97	10.09	4.10	11.45	10.76	1.69	3.0
Nistari (chalsa)	Mean	504	94	1.15	0.15	12.81	10.42	94
	CV%	9.01	5.69	5.53	4.68	5.21	1.78	3.52
Nistari (Debra)	Mean	514	96	1.16	0.15	13.01	10.46	94
	CV%	7.18	0.97	8.88	12.70	13.53	1.82	3.27

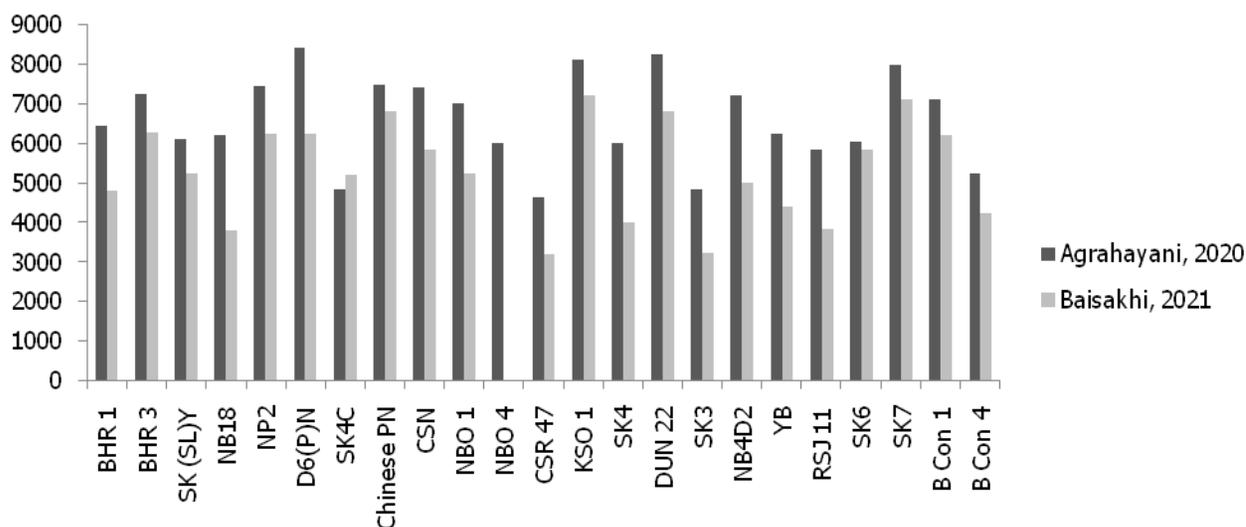
Bivoltine Germplasm:

Twenty four bivoltine silkworm germplasm stocks are maintained at CSRTI-Berhampore. These batches are reared in Agrahayani, 2020 and Baisakhi, 2021 (3 cellular batches; 300 larvae after III moult) following standard rearing conditions. The breeds NBO-4 [Baisakhi, 2020] was culled out due to poor performance. The cocoons confirming to original breed characteristics were selected for oviposition and dfls were produced. The layings were preserved under various hibernation schedules as per the requirement of all the experimental purposes.

The variations observed in ERR by number among the bivoltine germplasm breeds in Agrahayani, 2020 and Baisakhi, 2021 are presented in the graphical form revealing seasonal effects on survival. The breeds which are performing better in respective seasons could become resources for future breeding programmes.

Rearing performance of Germplasm Stocks (2020-21)

Race / Breed	Fec (No)	ERR (No)	ERR Wt (Kg)	Cocoon Wt (g)	Shell Wt (g)	Shell (%)
Oval Breeds						
KPG A	472	5230	6.670	1.216	0.228	18.75
Gen 3	486	3240	4.120	1.245	0.252	20.24
CSN	456	6650	8.820	1.306	0.270	20.67
NBO 1	412	6140	8.150	1.315	0.236	17.94
SK3	422	4055	5.110	1.242	0.228	18.35
KSO 1	492	7680	10.640	1.362	0.266	19.53
Dumbbell Breeds						
BHR 1	506	5635	7.630	1.302	0.238	18.27
BHR 3	518	6765	9.120	1.322	0.232	17.54
SK (SL)Y	432	5680	7.140	1.204	0.218	18.10
NB18	462	5020	6.745	1.318	0.225	17.07
NP2	452	6845	8.910	1.252	0.236	18.84
D6(P)N	406	7330	9.110	1.216	0.212	17.43
SK4C	432	5035	6.240	1.203	0.205	17.04
Chinese PN	472	7150	9.520	1.303	0.238	18.26
CSR 47	422	3925	4.840	1.206	0.215	17.82
SK4	426	5015	6.310	1.217	0.221	18.15
DUN 22	502	7550	9.750	1.253	0.220	17.55
NB4D2	481	6125	7.910	1.261	0.231	18.31
YB	415	5330	6.920	1.304	0.221	16.94
RSJ 11	403	4860	6.670	1.328	0.243	18.29
SK6	480	5955	7.280	1.202	0.201	16.72
SK7	452	7565	9.310	1.218	0.203	16.66
BCon1	506	6665	8.410	1.242	0.204	16.42
BCon4	424	4740	6.040	1.228	0.214	17.42

Seasonal performance (ERR by number) of Bivoltine Germplasm Stock (2020-21)

Exploratory studies on Identification of superior bivoltine foundation cross as a male component to improve cross-breed productivity in E & NE India (CSB/BER/RCN017)

Lakshmanan V and Sivaprasad V

Bivoltine male parents are utilized in Multi x Bi hybrids typically to exploit hybrid vigour and express better silk quality parameters the hybrid; in addition to improve productivity in mulberry silkworms. The agro-climatic conditions in East & NE India are not being conducive for bivoltine hybrids and as a result only crossbreeds are preferred by the farmers (>95%) especially in West Bengal. Currently, the foundation crosses, SK6 x SK7 and BCon1 x BCon4 are utilized to produce Nistari x Bivoltine hybrids. The productivity potential of SK6 x SK7 is very moderate and the resultant Nistari crossbreed is also with moderate productivity. For a longtime, West Bengal is unable to generate bivoltine seed cocoons due to limitations and still not being self-sufficient. Utilizing productive bivoltine breeds of southern origin is fraught with problems as their adoptability in East & NE India is not satisfactory till date. The improvement in the productivity of Nistari crossbreeds in this region is quite necessary and is a long standing demand from the stakeholders. To address this requirement a new breeding programme need to be undertaken to develop a suitable bivoltine male component for crossbreed purposes, utilizing breeds of new genetic background with higher fitness as well as productivity merits to improve the productivity in Nistari cross breeds. The popular bivoltine breeds in the region *i.e.*, SK6, SK7, BCon1 and BCon4 were utilized as maternal parental resources and productive bivoltine breeds from southern region (4S, BMFD1, CSR16, CSR51) for introgression of productive traits. The new breeding line such as BFC1 has shown good promise with better productivity with 12Y. Further hybrid evaluation is under progress with other multivoltine breeds. Fourteen new productive bivoltine lines are under breeding process. Analysis of F8 performance of Fourteen new lines indicates superior productivity merits in all new lines compared to popular breeds, as also a good survival in seven new lines (NFC6, 8, 11, 19(W), 19(Dull) & R). As an off-Shoot of experimentation, a quantity of 1650 P1 dfls of BFC1 were generated as male component for preparation of ICB (12Y x BFC1) under Authorisation trial.

Performance of NFCs @ F8 (Falguni 2021)							
Breed	Parentage	Larval Marking	ERR (No)	ERR by Wt	SCW (g)	SSW (g)	Shell (%)
NFC2	SK6 x 4S	Plain	7087	8.646	1.141	0.192	16.82
NFC6	SK7 x CSR51	Plain	7250	9.148	1.244	0.222	17.84
NFC6	SK7 x CSR51	Marked	5680	6.890	1.146	0.218	19.02
NFC8	BCon1 x CSR16	Plain	8075	10.670	1.290	0.235	18.21
NFC11	BCon1 x 4S	Plain	8100	11.210	1.357	0.262	19.27
NFC12 (W)	BCon1 x BMFD1	Marked	6250	9.120	1.427	0.256	17.93
NFC12 (Dull)	BCon1 x BMFD1	Marked	6600	9.840	1.427	0.253	17.72
NFC15	(SK6.BMFD1) x (SK7.BMFD1)	Plain	6980	9.610	1.335	0.246	18.42
NFC18	(BCon1.4S) x (BCon1.BMFD1)	Marked	7100	9.620	1.330	0.248	18.64
NFC18	(BCon1.4S) x (BCon1.BMFD1)	Plain	6880	9.320	1.342	0.238	17.73
NFC19 (Dull)	(BCon1.4S) x (BCon1.BMFD1)	Plain	7460	10.520	1.352	0.227	16.79
NFC19 (W)	(BCon1.4S) x (BCon1.BMFD1)	Plain	7240	9.920	1.341	0.230	17.15
NFCR (Dull)	-	Plain	8200	11.260	1.333	0.246	18.45
NFCR (W)	-	Plain	7640	10.130	1.319	0.243	18.42
SK6		Plain	7090	9.280	1.291	0.208	16.11
SK7		Plain	8240	10.750	1.297	0.206	15.88
BCon1		Plain	7180	9.120	1.261	0.202	16.01
BCon4		Plain	6460	8.110	1.244	0.205	16.47
CD @ 5%			346	0.545	0.039	0.010	0.53
CV (%)			9.67	11.39	5.94	9.11	6.00

Basic Seed Supply

A total of 6425 P1/P2 dfls of multivoltine (M6DPC: 750; M12W: 200; MCon4: 50 dfls; Nistari: 5425 dfls) and 7760 dfls of bivoltine (SK6, SK7, BCon1, BCon4, FCs) basic seeds were supplied to NSSO, DoSs and Registered Seed Producers in different seasons based on demand. A cocoon yield of 20-30Kg/100 dfls (multi) and 35-40 kg/100 dfls (Bi) were recorded and the seed cocoons generated were utilized for the production of multi x bivoltine hybrids for commercial purposes.

Bivoltine Dfls (2020-21)

#	Breed /Hybrid	Dfls	
		Free of Cost	Cost Basis
1	SK6	50	280
2	SK7	50	280
3	BCon1	-	275
4	BCon4	-	275
5	SK6.SK7	1950	4250*
6	BCon1.Bcon4	15850**	
7	BHP FC	400	
8	BHP DH (OFT)	11140	
9	BFC1 (P1)	1650	
10	WB FC	300	
11	WB DH	400	
Total		31790	5360
Grand Total			37150

Multivoltine Dfls (2020-21)

1	Nistari	5410	15
2	M6DPC	750	
3	M12W	200	
4	MCon4	50	
Total		6410	15
Grand total			6425

* P1 multiplication @ Institute for Arunachal Pradesh

** 15000 Dfls through REC, Mangaldoi

POST COCOON TECHNOLOGY

Lakshmanan V (From Dec 2020) and G Mitra (till Nov 2020)

Continuous /Other Activities

Evaluation of experimental cocoon lots

A total of 169 cocoon lots (Multi x Bi: 27 & Bivoltine: 135) received from different laboratories under various projects/ programmes evaluated for post cocoon parameters. Further single cocoon reeling analysis was carried out for 34 cocoon lots received for study filament length, denier etc. Cold single cocoon reeling was also carried out for above 350 lots of Nistari cocoon for assesment of filament length for the project of Silkworm Breeding Laboratory. The reports of reeling were submitted the concerned laboratories. Toto of 14.15kg of dry cocoons (Multi: 1.1kg; Multi x Bi: 6.5kg; Bivoltine: 6.5kg) was also carried out for commercial reeling. About 710 kgs of spun silk produced during the year. In house trial for productivity of New Suvarna Reeling Machine was carried out and productivity was noted as 1.74 kg/8hours. A total of 92 trainees was conducted practical training on post cocoon technology during the year.

Reeling Performance of Popular Hybrids: (Mean \pm SD) ; 2020-21											
#	Race	FL (m)	NBFL (m)	Denier	Renditta	Reel - ability (%)	Silk Recovery (%)	Neat - ness (%)	Cleanness (%)	Evenness (%)	Shell (%)
1	SK6 x SK7	716 \pm 110.11	635.15 \pm 157.91	2.53 \pm 0.29	8.879 \pm 0.981	70.31 \pm 5.92	69.37 \pm 7.27	88 \pm 1.99	89 \pm 1.72	89 \pm 1.56	16.69 \pm 1.39
	Range	502-982	292-982	1.66-2.99	7.00-11.84	54-79	51-83	85-95	85-93	85-92	14.58-19.69
	Potential (UnFav-Fav)	550-850	350-600	2.0-2.9	9.00-7.5	55-75	50-75	80-90	83-93	85-92	16-19
2	BCon1 x BCon4	740 \pm 156.6	628.75 \pm 271.76	2.82 \pm 0.28	8.59 \pm 5.53	71.25 \pm 5.32	69.54 \pm 5.26	90 \pm 1.29	89 \pm 1.00	89 \pm 1.25	16.85 \pm 1.59
	Range	590-960	295-960	2.64-3.24	8.09-9.31	64-76	61.84-72.95	88-91	88-90	88-91	14.7-18.53
	Potential (UnFav-Fav)	550-900	400-650	2.4-3.2	9.00-7.5	55-75	55-75	80-90	83-93	85-92	17-19
3	N x (SK6 x SK7)	443 \pm 38.18	240.5 \pm 7.775	2.79 \pm 0.127	10.17 \pm 0.063	69.76 \pm 0.33	70.06 \pm 2.743	87 \pm 2.12	88 \pm 1.41	89 \pm 1.41	15.18 \pm 0.94
	Range	416-470	235-246	2.70-2.88	10.12-10.21	70-68	68-72	85-88	87-89	88-90	14.51-15.85
	Potential (UnFav-Fav)	450-550	250-350	2.2-2.8	11-10	60-75	50-70	80-85	80-85	80-90	14.0-15.5
4	M6DPC x (SK6 x SK7)	527 \pm 151.03	421.66 \pm 246.5	2.63 \pm 0.22	9.94 \pm 1.041	71.02 \pm .965	65.34 \pm 3.79	88 \pm 2.51	89 \pm 0.57	89 \pm 1.73	15.51 \pm 1.02
	Range	378-680	189-680	2.59-2.88	8.94-11.02	70-72	61-68	85-90	89-90	88-91	14.88-16.7
	Potential (UnFav-Fav)	400-650	300-550	2.2-2.8	11-9.5	60-75	50-70	80-85	80-85	80-90	14.0-16.0

SILKWORM PATHOLOGY

Ongoing Projects

ARP3630: Evaluation of new room and silkworm bed disinfectants

[June 2018 - May 2021]

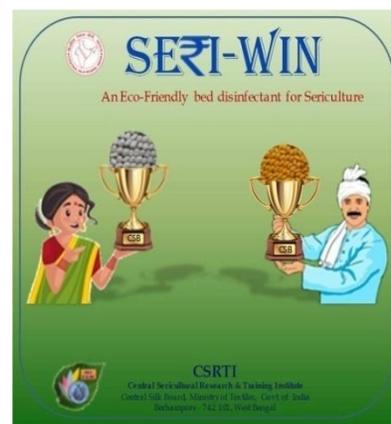
K. Rahul (PI) and M. Rabha (from March 2019)

Objectives

- To screen potential eco-friendly chemicals for their efficacy in controlling microbial diseases
- To develop broad spectrum room disinfectant for eradication of silkworm pathogens
- To develop bed disinfectant for the management of silkworm diseases

Silkworm rearing seat or bed disinfectants play a very prominent role in preventing the spread of silkworm diseases during the course of rearing. In India, especially in the E & NE regions, Labex, Sericillin & Vijetha are widely employed as bed disinfectants. Although, the aforementioned bed disinfectants are effective against all known major silkworm pathogens, they have certain disadvantages of being non friendly to the user and environment. In this context, quest to develop an alternative, user and environmentally safe bed disinfectant was undertaken.

The development of the bed disinfectant formulation initiated with evaluation and selection of a suitable carrier material. Three carrier materials (C1, C2 & C3) in solitude & combinations (CF4, CF5, CF6 & CF7) were evaluated for determining toxicity to healthy silkworms at every instar and slaked lime was maintained as control. Carrier material [CF-4: 75% C2 + 25% C3] was identified as the most promising component with 93% ERR. Although combination CF4 has resulted in better ERR%, C2 (didn't exhibit toxicity and ERR% is on par with CF4) was chosen for further experimentation taking into account the cost and also reports of the noxious effects exerted by a component of CF4 to humans during the recent times (Formulation I- X:Y:C2=0.5:0.5:99; Formulation II- X:Y:C2=1:1:98).



Evaluation of the formulations along with the existing bed disinfectants (Labex, Sericillin & Vijetha) against silkworm diseases through disease spread experiments was carried out across five seasons (May-June/July-Aug/Sep-Oct/Nov-Dec, 2020; Jan-Feb, 2021). Batches comprising fifty newly ecdysed second instar silkworm larvae each were infected with major silkworm pathogens (Bacteria: *Staphylococcus* sp. & *B. thuringiensis* at 1.7×10^7 cfu/ml; Fungi: *B. bassiana* at 2×10^7 conidia/ml; Microsporidia: *N. bombycis* at 1×10^7 spores/ml; Viruses: BmNPV at 1×10^7 Polyhedra/ml, BmDENV1 & BmIFV at 10^{-2} dilution). The inoculation was performed *per os* except for *B. bassiana*, where it was performed by spraying the inoculum onto the larvae. Five diseased larvae depicting the symptoms of specific disease were introduced into a healthy population of 95 larvae (Nistari) before the resumption of feeding after second moult to ensure a constant source of infectious agent and dusting of the developed formulations along with existing disinfectants was carried out as per schedule. The silkworm larvae and rearing seat was disinfected with the bed disinfectants @ 3-4 g/sq.ft once after each moult, half an hour before resumption of feeding and once on fourth day of fifth instar. Hundred larvae each (Healthy: Carrier-95:5) @ five replications/treatment were maintained.

Appropriate controls (inoculated without bed disinfection; healthy control; dusting of only base material) were also maintained. The ERR% data recorded across five seasons for each treatment was pooled for analytical purposes which indicated that both the formulations were as effective as the existing disinfectants in controlling the spread of silkworm diseases. However, the recorded data indicated formulation II to be effective over formulation I. Further experiments were performed with Formulation II and the same was named as Seri-Win.

Evaluation of bed disinfectant formulations against major silkworm pathogens by disease spread studies

Treatments	ERR%						
	BmNPV	BmDNV1	BmIFV	<i>B. bassiana</i>	<i>N. bombycis</i>	<i>Staphylococcus sp.</i>	<i>B. thuringiensis</i>
Formulation I	79.67	78.67	76.00	79.00	73.00	80.67	78.67
Formulation II	80.33	80.00	78.67	78.66	79.33	81.66	79.66
Labex	81.00	82.33	80.00	80.00	76.67	80.00	75.33
Sericillin	80.67	79.33	77.67	82.00	74.00	78.33	78.33
Vijetha	79.33	81.33	78.00	78.66	81.66	82.34	81.34
Base material	64.33	67.00	57.33	62.67	59.00	55.00	56.66
Inoculated Control	40.33	53.34	44.67	52.67	55.00	42.67	44.34
Healthy Control	60.67	60.67	60.67	60.67	60.67	60.67	60.67
CD@5%	3.72	5.25	5.26	5.64	9.60	6.46	6.27
SE(m)	1.21	1.71	1.72	1.84	3.13	2.11	2.04

The efficacy of the developed bed disinfectant Seri-Win in comparison with the existing bed disinfectants was also tested across three seasons by dusting of the disinfectants as per schedule (devoid of pathogen inoculation). Hundred larvae each @ five replications/treatment and a control batch devoid of bed disinfection were maintained. ERR% was recorded which indicated the on par effectiveness of Seri-Win with the existing disinfectants. Patenting and documentation of technical knowhow of Seri-Win is under progress. Seri-Win would be further evaluated under OST/OFT in future.

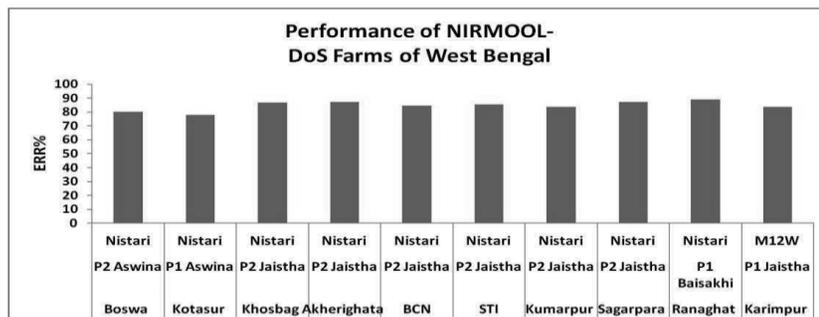
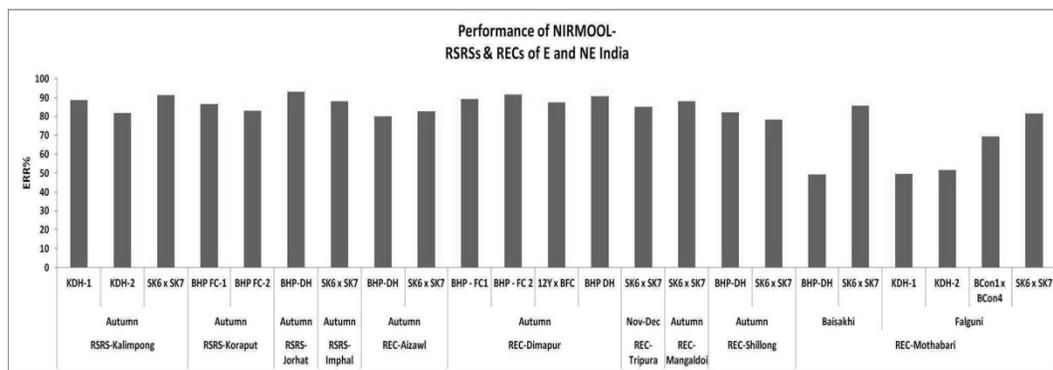
Laboratory trails on the efficacy of Seri-Win

Treatment	ERR%		
	NISTARI	N x (SK6.7)*	M6DPC x (SK6.7)*
Seri-Win	82.66	88.33	90.66
Labex	83.33	90.00	89.00
Sericillin	81.66	86.66	89.66
Vijetha	80.66	89.66	91.00
Control	67.33	71.00	72.00
CD@5%	7.00	2.27	4.77
SE(m)	2.19	0.71	1.49

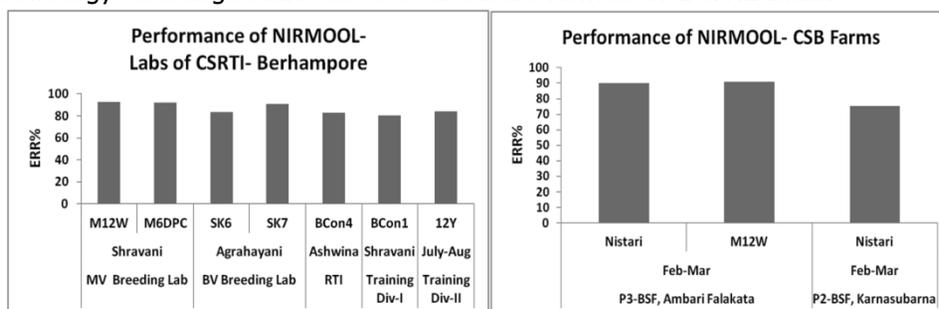
* experiments performed in a single season

On Station Trial (OST) – “NIRMOOL: An eco- & user- friendly room disinfectant”

Validation studies through On Station Trials of the newly developed broad spectrum, cost-effective, non-corrosive, eco- & user-friendly disinfectant formulation “NIRMOOL” suitable for disinfecting silkworm rearing house and rearing appliances was carried out at different CSB and DoS units across eight states of E & NE India. An average ERR% of 82.80 has been recorded across different seasons in 27 test locations. Three grainages and appliances involved in grainage activities (SSPC-Berhampore, Berhampore regional grainage, Kotasur Sericulture Complex) were thoroughly disinfected and effective grainage operations have been reported by the end users.

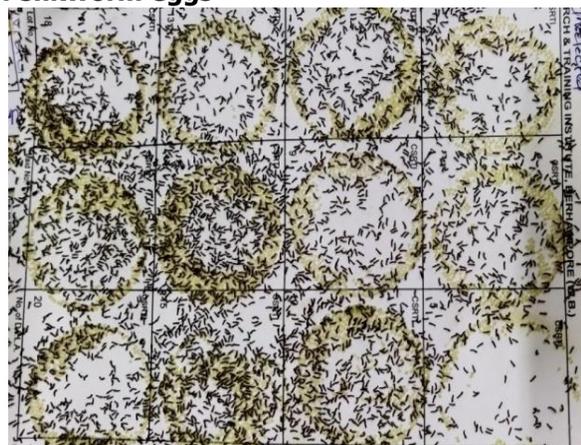


The lucid and rapid preparation; non-corrosive properties of NIRMOOL was appreciated by the end users in their feedback. OFT of NIRMOOL will be initiated to further popularize the eco- and user friendly disinfection technology on a large scale with the sericulture farmers of E & NE India.



Eco-friendly formulation for surface sterilization of silkworm eggs

An eco-friendly disinfectant formulation [0.5% of X (oxidizing agent) + 0.5% of Y (wetting agent)] effective and suitable for surface sterilization of silkworm eggs was developed. At the outset, the formulation was evaluated at large for determining its effect on hatching of silkworm eggs and further growth and development of silkworms. Five thousand dfIs pertaining to fifteen silkworm breeds/hybrids in the blue egg stage were treated with the aforementioned formulation for five minutes, dried, incubated under standard conditions and monitored for hatching. The formulation didn't deter hatching and ~92% hatching was recorded. Five DfIs of N x (SK6 x SK7) were surface sterilized with the above formulation and silkworm



rearing was performed following standard conditions during Nov-Dec, 2020. The formulation neither hindered the hatching nor growth/physiology of the silkworms and an ERR of 86% was recorded.

The formulation was also tested for its efficacy against all known major silkworm pathogens by spread studies. Egg surface (one dfl each) of silkworm breed Nistari were smeared individually with the silkworm pathogens (*Staphylococcus* sp. & *B. thuringiensis* @ 1.7×10^7 cfu/ml; *B. bassiana* @ 2×10^7 conidia/ml; *N. bombycis* @ 1×10^7 spores/ml; BmNPV @ 1×10^7 Polyhedra/ml; BmDENV1, BmIFV @ 10^{-2} dilution). One set of pathogen smeared dfls were treated with developed formulation and the other set with formalin; air dried and incubated under standard conditions. Hatching percentage and disease incidence till second instar were recorded. Necessary controls (uninoculated & inoculated) were also maintained. The formulation was found effective against the pathogens tested and the efficacy is on par with 2% formalin. However, the developed formulation has wider advantages than 2% formalin in being eco- and user-friendly, odourless, non irritant of skin & eyes. The efficacy of the formulation would be evaluated at a larger scale in future.

Laboratory trials on silkworm egg surface disinfection with the developed formulation		
Season	Breed/Hybrid	DFLs (No.)
Baisakhi	12YCR	339
	12Y	548
Bhaduri	Nistari Chalsa	564
	Nistari Debra	231
	Nistari Mark	226
	Nistari Plain	402
	SK6	12
	SK7	23
Falguni	1221Y	96
	12Y	60
	M6DPC	402
	Nistari Chalsa	470
	Nistari Debra	58
	Nistari Mark	148
	Nistari Plain	300
	M12W	18
	19M	3
	B142	2
Agrahayani	Nistari Chalsa	428
	Nistari Debra	312
	Nistari Mark	207
	Nistari Plain	109
	N x (SK6.7)	48
	M6DPC x (SK6.7)	56

Evaluation of the egg surface disinfectant against major silkworm pathogens by disease spread						
Pathogen	Treatment	Fecundity	No. of larvae hatched	Hatching (%)	No. of larvae @ III Instar	
BmNPV	T1	298	278	93.3	260	
	T2	277	260	93.9	243	
	T3	290	276	95.2	186	
BmDENV	T1	293	273	93.2	251	
	T2	305	274	89.8	254	
	T3	289	271	93.8	250	
BmIFV	T1	289	265	91.7	252	
	T2	291	274	94.2	252	
	T3	307	288	93.8	202	
<i>B. bassiana</i>	T1	294	273	92.9	258	
	T2	290	271	93.4	249	
	T3	303	276	91.1	122	
<i>N. bombycis</i>	T1	293	274	93.5	259	
	T2	270	248	91.9	232	
	T3	290	265	91.4	201	
<i>Staphylococcus</i> sp.	T1	291	272	93.5	257	
	T2	308	283	91.9	270	
	T3	260	237	91.2	219	
<i>B. thuringiensis</i>	T1	293	275	93.9	265	
	T2	308	287	93.2	274	
	T3	260	245	94.2	154	
Uninoculated controls	T1	298	278	93.3	261	
	T2	305	278	91.1	272	

T1: Formulation; T2: 2% Formalin; T3: Inoculated control

AIT08005MI: Development and evaluation of Bidsenovirus resistant silkworm hybrids developed from marker assisted breeding lines Phase II (Coll. with SBRL-Kodathi)

[March 2020 – Feb 2023]

K.S. Tulsi Naik (PI-SBRL-Kodathi), A. Ramesha (CI-SBRL-Kodathi); M.N. Chandrashekar, M.S. Ranjini (CIs-CSRTI-Mysore); K. Rahul, M. Rabha (CIs-CSRTI-Berhampore)

Objectives:

- Evaluation of BmBDV resistant lines/hybrids at respective locations with virus exposure studies
- BmBDV marker inheritance analysis in hybrids
- Maintenance of BmBDV lines at breeding units with MAS

BmBDV resistant lines/hybrids developed by SBRL-Bangalore are being collected for evaluation at CSRTI-Berhampore with virus exposure studies and to generate data for determining their utilization in Eastern and North Eastern zone.

Continuous/Other Activities

Silkworm disease monitoring of seed and commercial crops in East & NE states

Executive Authority: Dr. V. Sivaprasad, Director-CSRTI-Berhampore

Investigators: CSRTI-Berhampore: K. Rahul, M. Rabha & Manjunatha G R; Incharges of RSRs @ Kalimpong, Koraput & Jorhat; Incharges of RECs @ Mothabari-West Bengal, Shillong-Meghalaya, Dimapur-Nagaland, Agartala-Tripura, Aizawl-Mizoram, Imphal-Manipur, Mangaldoi-Assam & Bhandra-Jharkhand
NSSO-Bangalore: Incharges of SSPCs @ Berhampore & D.B.Pur; Incharges of BSFs @ Ambari falakata, Karnasubarna & Dhubulia

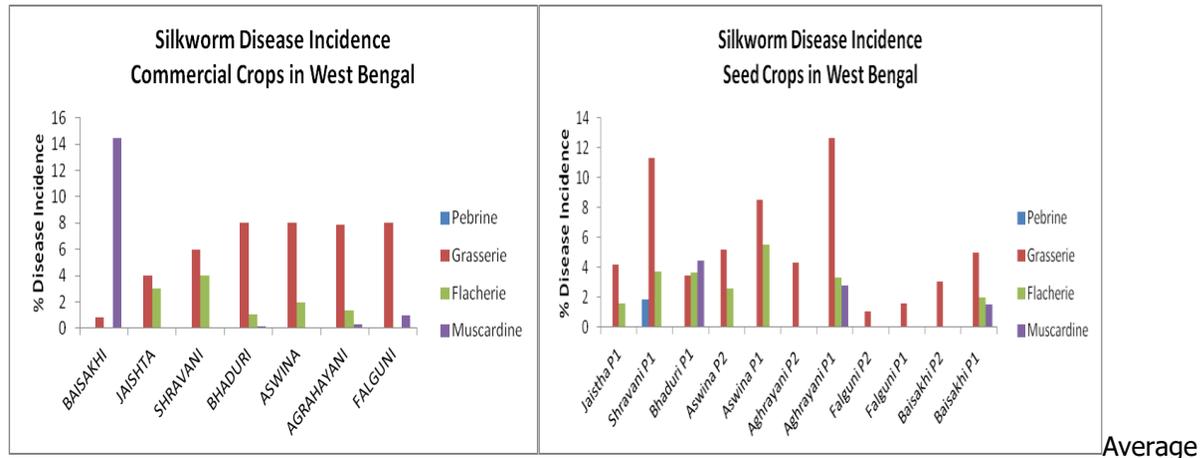
DoT(Seri)-West Bengal: Swapan Kr. Maity (Murshidabad), Biplab Sarkar (Birbhum), Debasis Chanda (Nadia), Abhijit Goswami (Malda), Sujit Saha (U & D Dinajpur), Probodh Kr. Sahu (Jalpaiguri), Sanjib Kr. Barman (Cooch behar), Prahlad Lama (Darjeeling) & Sajal Roy (Midnapore)

Objectives

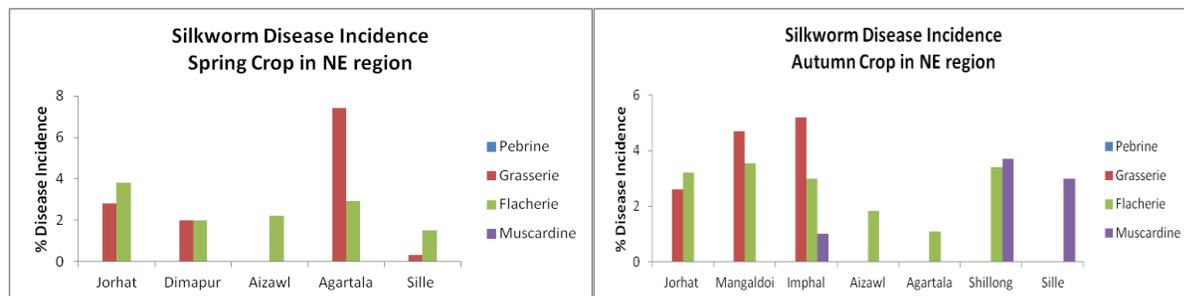
- To estimate the prevalence of silkworm diseases (seed & commercial crops) in Eastern & North-Eastern states
- To suggest remedial measures on spot to the farms/farmers for the management of silkworm diseases and prevent disease outbreak(s)

Silkworm disease monitoring programme across Eastern and NE India was undertaken with an aim to manage incidence of silkworm diseases co-ordinated by Central Silk Board (CSRTI-Berhampore & NSSO-Bangalore) and respective state DoSs. A total of 341 seed crop samples were examined during the year in West Bengal and pebrine incidence was recorded in 1 sample. Mortality recorded due to grasserie and flacherie was highest in all the crops with an average incidence of <7%. Muscardine incidence was recorded during P1-Bhaduri (4.48%); P1 & P2-Baisakhi and P1-Agrahayani (<3%). The basic seed farms were suggested with appropriate preventive and remedial measures to minimize disease incidence/spread and prevent outbreak(s) in the particular crop as well as next crops.

The disease incidence recorded in commercial cocoon crops in West Bengal across all the seasons was <10% except during Baisakhi (15%) where there was a surge in muscardine incidence (14.48%). Mortality due to grasserie followed by flacherie at high temperature (>35°C) coupled with high humidity (>85%) conditions was observed. Incidence of muscardine was recorded especially during Agrahayani, Flaguni and Baisakhi crop seasons, when low temperatures and high humidity prevailed.



Average incidence of silkworm diseases in different states (Assam, Nagaland, Manipur, Mizoram, Tripura & Meghalaya) were also recorded during spring and autumn crops. The mortality due to silkworm diseases was <5% during spring crop, except in Tripura (10.3%) and Jorhat (6.6%). Crop losses to a tune of ~9% majorly due to grasserie and flacherie in Mangaldoi and Imphal during autumn crop; <5% in Agartala, Aizawl and Sille were recorded. Preventive/remedial measures to minimize/control the crop losses due to silkworm diseases were regularly advocated to the stakeholders for the effective management of disease



Pebrine monitoring in West Bengal

Pebrine monitoring was regularly and stringently undertaken at CSRTI-Berhampore with each and every crop including silkworm genetic resources (Bivoltine & Multivoltine) and RSRs-Kalimpong, Seed multiplication units (14 BSFs; CSB & DoS) and other laboratory rearings following prescribed methodology. Besides, samples received from DoS farms & seed/commercial rearers were also examined for pebrine incidence. Only a single sample was found infected with *N. bombycis* during the current year. Necessary eradicated and preventive measures were suggested to the concerned units/stakeholders for further monitoring and management.

Pebrine Monitoring in West Bengal

Sources	Samples Examined	Samples (+ve)
P2 farms (NSSO & DoT-S)	150	0
P1 farms (NSSO & DoT-S)	191	1
Commercial Crops	126	0
Farmers/RSPs	24	0
CSRTI-Berhampore	112	0
Total	603	1

EXTENSION

T. D. Biswas, G. C. Das and Shafi Afroz

Unit	Scientists	Tech. staff	TSFW/SFW	Farm based units	
				Total (Acre)	Mulberry (Acre)
REC-Mothabari (West Bengal)	Dr. S. Chakrabarty Sci-D (I/C)	5	5	3.89	2.75
REC-Bhandra (Jharkhand)	Dr. Ghanshyam Singh Sci-D (I/C)	4	22	7	4.5

Extension Communication Programmes (ECP)

CSRTI-Berhampore and its nested units conducted need-based extension activities for technologies in mulberry and silkworm crop production, management and marketing in Eastern and North Eastern states.

State	Unit	AP		FFD		TD		Total	
		#	F	#	F	#	F	#	F
West Bengal	CSRTI-BHP	11	555	6	300	5	91	23*	986*
	RSRS-Kalimpong	2	100	5	296	2	40	9	436
	REC-Mothabari	4	437			4	121	9 [§]	568 [§]
Jharkhand	REC-Bhandra	3	176			3	74	6	250
Odisha	RSRS-Koraput	2	87	4	214	2	49	8	350
Assam incl. BTC	RSRS-Jorhat	2	117	5	251	2	44	10 [§]	428 [§]
	REC-Mangaldoi	4	210			4	96	8	306
Sikkim	REC-Mamring	3	152			3	71	6	223
Mizoram	REC-Aizwal	3	150			5	90	8	240
Tripura	REC-Agartala	5	240			4	80	9	320
Meghalaya	REC-Shillong	3	154			4	81	7	235
Nagaland	REC-Dimapur	4	251			4	134	8	385
Arunachal Pradesh	REC-Sille	3	241			3	69	6	310
Total		49	2870	20	1061	45	1040	117	4997
#: Events; F: Farmers; AP: Awareness prog.; FFD: Farmers' Field day; TD: Technology demos; *Workshop (#1; 40 P); [§] Group Discussion									

Resham Krishi Mela

RSRS-Koraput had conducted RKM by dividing the programme into 02 RKM (16-17.03.2021) and covered 238 farmers for updating the awareness of new technologies developed in mulberry sericulture. Due to COVID19 pandemic guidelines of the Government, CSRTI-Berhampore, RSRS-Kalimpong and RSRS-Jorhat not able to conduct Resham Krishi Mela in their region.

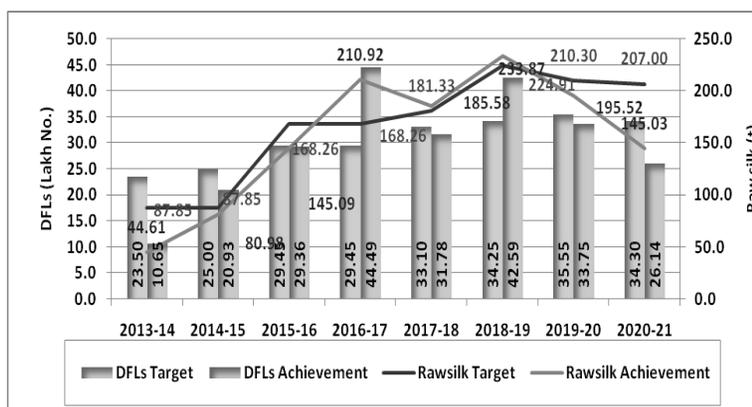
Cluster Promotion Programme (CPP) in East & North-East India

Bivoltine Cluster Promotion Programme (BV-CPP), a nation-wide mulberry sericulture development programme is implemented by Central Silk Board in collaboration with state sericulture departments of Eastern & North Eastern states (2012-2017) was extended up to 2021 with an objective to produce 8500 MT import substitute silk. In Eastern and North Eastern Zone, CPP is being implemented in 8 mega-clusters covering seven states (West Bengal-2; Assam & Nagaland-2; Manipur-2; one each in Mizoram & Tripura).

Particulars of CPP-CDFs in E & NE clusters (2019-20)		
MEGA CLUSTERS	CSB	DoS
West Bengal		
Malda	Dr. S. Chakraborty, Sci-D, REC-Mothabari; satadal.chak@gmail.com; 9474580417 Dr. S.N. Bagchi, Sci-D, SSPC- BHP bagchisnb5@gmail.com, 8900383227	Shri Santosh Kumar, DD(T)[I/C], Malda; malseri2@gmail.com; 9732119762 Dr. T. Mukherjee, DD(T)[I/C], Birbhum; birseri@gmail.com; 8250893776
Murshidabad	Dr. T.D. Biswas, Sci-D, CSRTI-Berhampore; tdattabiswas@rediffmail.com; 9126331586 Mr. G. C. Das, Sci-D, CSRTI-Berhampore; gopaldascsb@rediffmail.com; 9434229425	Shri S. Goswami, DD(T)[I/C], BHP; berseri1@gmail.com; 9434723095 Mr. Supratim Das, AD(T), Nadia; nadiseri@gmail.com; 9830105014
Assam & Nagaland		
Assam-Lower	Dr. B. K. Basumatary, Sci-D, REC-Darrang, basumatary.bene@yahoo.com; 9435304453 Mr. B.N. Chowdhuri, Sci-D, RO-Guwahati (upto Apr'19); bidyutnc10@yahoo.com; 9435054191	Mr. Jagesh C. Talukder, ADS-Mangaldoi, adsofficemld@gmail.com; 9101407835 Shri Anjan Kumar Chakraborty, AD(Seri)-Udalgiri; 9435181586
Assam-Upper	Dr. P. Kumaresan, Sci-C, RSRs-Jorhat; rrsrjor.cdsb@nic.in; 8903264292 Dr. Kartick Neog, Sci-D, REC-Dimapur; recdimapur.nagaland@gmail.com; 7085055608	Shri Kishore Sharma, ADS-Jorhat; kishores armabordoloi@gmail.com; 9435518260 Mr. Yashimeren, DSO-Dimapur, yashilongchar@gmail.com; 9436436237
Manipur		
Manipur-Plain	Dr. L. Somen Singh, Sci-D, RTRS-Imphal; somenlaishram@yahoo.com; 9436033596	Sri C. M. Paul, DD-Ukhrul; 7085164519
Manipur-Hill	Dr. L. Somen Singh, Sci-D, RTRS-Imphal; somenlaishram@yahoo.com; 9436033596	Mr. G. Vunglian, AD-Churachandpur; 9862113806
Mizoram		
Aizawl	Dr. L. Pachuau, Sci-D, REC-Aizawl; thlatea@rediffmail.com; 9435087588	Shri V. Zothansanga, DS Officer, Aizawl, dsoproject@gmail.com, 878752415
Tripura		
West Tripura	Dr. N. Biswas, Sci-D, REC-Agartala; sgbcrcsti@rediffmail.com; 9615179959	Mr. Jyoti Bikash Chakma, SS-Agartala; 9436509681

Performance of clusters:

Eastern & North Eastern zone having 08 Mega clusters recorded 145.03 MT (70.076%) raw silk productions (BV-46.37 MT & ICB-98.66 MT) against the target of 207.0 MT; which was 56.50 MT (45.08%) less as compared to the previous year, 2019-20 (annual target-210.30 MT) due to COVID-19 pandemic situation. During



2020-21, a total of 26.139 Lakh dfls (BV: 8.195 & ICB: 17.944) were reared against the target of 34.30 Lakh dfls (BV: 26.30 & ICB: 8.00). The overall achievement in dfl brushing was 76.21%. A total of 1188.22 MT of cocoons were produced by 08 Mega clusters including 145.03 MT raw silk production out of which 46.371 MT bivoltine and 98.656 MT ICB silk.

ICB Raw Silk Production in East & North East Zone (2020-21)							
Mega Cluster	Dfls(Lakh)		Cocoon Production (MT)	Yield/ 100 dfls (kg)	Raw Silk (MT)		
	Target	Ach.			Target	Ach.	% Ach.
West Bengal							
Malda	4	12.39	558.4	45.50	16	68.76	429.75
Murshidabad	4	4.2	198.88	47.72	16	23.14	144.63
Mizoram							
Aizawl	0.0	0.30	13.95	46.50	0.0	1.74	
Tripura							
West Tripura	0.0	1.05	45.10	47.47	0.0	5.01	
Total/Avg.	8.25	17.94	816.33	45.75	32.8	98.65	308.30

Bivoltine Raw Silk Production in East & North East zone (2020-21)							
Mega Cluster	Dfls (Lakh)		Cocoon Production (MT)	Yield/ 100 dfls(kg)	Raw Silk (MT)		
	Tar.	Ach.			Tar.	Ach.	% Ach.
West Bengal							
Malda	3.5	0.6	25.28	45.52	28.4	3.56	12.54
Murshidabad	3.25	0.72	41.55	57.31	26.6	5.57	20.94
Manipur							
Manipur-Plain	2.75	1.55	73.30	47.01	17.50	8.89	13.86
Manipur-Hill	2.75	1.59	76.60	48.91	17.50	9.37	53.55
Assam & Nagaland							
Assam-Lower	4.5	1.53	69.03	45.09	30.0	8.84	29.47
Assam-Upper	4.25	0.32	8.36	35.52	24.0	1.01	4.21
Mizoram							
Aizawl	2.80	0.53	25.93	48.72	16.0	3.24	20.25
Tripura							
West Tripura	2.50	1.35	51.85	38.40	15.0	5.88	39.19
Total/Avg	26.3	8.19	371.88	45.81	175.0	46.37	26.50

Silkworm hybrids for Raw Silk Production in E&NE zone (2020-21)		
Mega Clusters	Bivoltine	ICB
West Bengal	SK6×SK7; BHP-DH; TT21×TT56	12YxBFC1; N×(SK6×SK7)
Assam & Nagaland	SK-hybrids; Double hybrids	
Manipur	FC1×FC2; C×J; CSR2×CSR4; SK-hybrids	
Mizoram	SK-hybrids; J112	N×J112
Tripura	FC1×FC2; SK-hybrids	12YxBFC1; PM×FC2; M6DPC×(SK6×SK7); N×(SK6×SK7)

Multimedia Activities (2020-21)

Units	Topics	Language & Channel
Radio programme		
CSRTI-BHP	Packages of practices of Silkworm Rearing	Bengali (Kishan Bani Prachar Taranga-MSD)
	Improved silkworm Breeds/ Hybrids	
	Improved mulberry Varieties and its plantation and maintenance technique	
REC-Shillong	Advantages of Moutage with special referrance to Rotary moutage	Khasi (AIR-Shillong)
RSRS-K'pong	Training Programme For Mahila Resham Karmi	News 99 Channel, Kalimpong
	Sericulture Bishaye Alochana Chakra	Nepali
	Resham Kethi Bishaye Jankarimulak Kajakarm	(AIR-Gangtok)
TV programme		
REC-Aizawl	Chawki worms distribution Prog. (Distributed by Dep. Commissioner)	Mizo, (ZONET cable-Saitul)
RSRS-Jorhat	Integrated Sericulture	Assamese, Ishan News
Video Films		
CSRTI-BHP	Kisan Nursery 'Sonartari Sayambar Ghosti (SHG)	Bengali
REC-Agartala	Application of Vermicompost in Mulberry field	
YouTube		
CSRTI-BHP	White Fly Management in Mulberry Garden	Bengali
REC-Shillong	Jaintia Hills village now on the silk map	Khasi
Twitter @ CsrtiBerhampore		
Instagram @ CSRTIBERHAMPORE		
Facebook @ East North East Silk		
Whatsapp @ CSRTI-Berhampore and Sub-units of CSRTI-Berhampore		

M-Kisan

M-Kisan portal is being used to communicate with the farmers on mulberry sericulture technologies, pre-and post-crop measures to be adopted and forecasting/forewarning of pests/diseases. The farmer's database was enhanced by 822 against the target of 800 during the year and 71 calendar-specific sericulture related messages covering silkworm rearing and mulberry cultivation were communicated to a total of 5470 farmers in 5 languages (Bengali, English, Hindi, Nepali, Odia).



CAPACITY BUILDING & TRAINING

S. Sarker and Parameswara Naik J

Systematic training was imparted to the respective stakeholders on different activities of sericulture along with practical demonstrations and hands-on programmes. A structured course, 15-months Post Graduate Diploma in Sericulture (PGDS) is offered to the participants across the country under affiliation to Kalyani University (Kalyani, West Bengal). Different HRD programmes are organized for capacity building of the stakeholders and transfer of technology for the development of sericulture in Eastern and North Eastern India. A total of 2299 candidates were trained against the target of 2100 through PGDS, FST, TOP, STEP, PCT, EDP, intensive training, exposure visit, non-CBT & need based programmes etc. Coordination of Seri Resource Centres (SRCs; 6 Nos in West Bengal) established to train farmers under Silk Samagra were undertaken.

PGDS in Mulberry Sericulture	
<p><i>I Semester</i> (6months; 200 h theory + 200 h practical)</p>	<p>PGD 101: Introductory Sericulture and Mulberry Production PGD102 : Crop Protection PGD103 : Cocoon Poduction PGD104 : Silkworm Breeding, Genetics And Seed production PGD105 :Mulberry production (Practical) PGD 106 :Mulberry crop protection (Practical) PGD107 :Cocoon production (Practical) PGD108 :Cocoon crop protection & silkworm breeding and genetics (Practical)</p>
<p><i>II Semester</i> (6 months; 200 h theory + 100 h practical)</p>	<p>PGD201:Mulberry Breeding,genetics & physiology PGD202:Post cocoon technology and by product development PGD203:Extension management and seri anagement PGD204:Computer, economics and statistics PGD 205: Mulberry breeding, genetics & physiology and computer, economics and statistics (practical) PGD 206:Silkworm seed production and post cocoon technology(practical)</p>
<p>Dissertation/ Project works (3 months)</p>	<p>Various Disciplines</p>

PGDS Admissions (2019-20 & 20-21)		
State	Sept 2020 Batch (40)	July 2020 Batch (28)
Arunachal Pradesh	08	02
Assam	10	09
J&K	-	04
Manipur	05	-
Mizoram	07	03
Nagaland	09	09
West Bengal	01	-
Meghalaya	-	01

The PGDS course includes two semesters and dissertation work with well-planned and comprehensive syllabus covering all aspects of mulberry sericulture in coordination with Kalyani University. It also includes 15-day exposure visit in each semester to major mulberry & non-mulberry sericulture areas. Majority of the students are sponsored by DoSs of respective state governments and few self-funded individuals. The students are taught by experienced scientific personnel working at CSRTI-Berhampore, CSB units and honorary faculties from reputed institutions. The students are evaluated through semester-end examinations including theory and practicals. Students undertake dissertation/practical course work for three months under the supervision of experienced faculty in

various disciplines. The students need to submit a dissertation/report, which is evaluated by a set of examiners nominated by the Kalyani University. Those who successfully complete the course are awarded PGDS. Top three students are also felicitated by Central Silk Board (Bangalore) by conferring Gold, Silver & Bronze medals, besides Rs. 15,000 cash award provision to the toppers in 1st Semester.

#	PGDS Dissertation Studies (2020-21)		
	Student	Title	Supervisor
1	Angona Handique	Comparative analysis on effect of prevailing climate/ season on performance of bivoltine silk worm breeds of <i>Bombyx mori</i>	Dr. V. Lakshmanan
2	C. Lalhrualtuanga	Role of climate factors in successful silkworm corp	Dr. A.K Verma
3	Chukhu Abo	Filament size variation in cocoon of silk worm, <i>Bombyx mori</i>	Mr. G. Mitra
4	Dorothy Vanlalhmangaihi	Assessment of genetic variability in mulberry using MAS	Dr. Yallappa, H
5	Easterla Ao	Performance of shelf rearing & tray rearing at Nagaland	Dr. T.D. Biswas
6	Emmanuel Lawmsangzuala	Evaluation of multivoltine silkworm germplasm maintained at CSRTI-BHP to identify potential GRs for breeding	Dr. G. C. Das
7	Habung Dukhung	Survey and surveillance of silkworm diseases in Malda	Dr. S. Chakrabarty
8	Hania Taw	Different <i>Nosema bombycis</i> strains causing pebrine disease in <i>Bombyx mori</i>	Dr. Pooja Makwana
9	Hupuakbo Nchang	Mulberry sericulture under NERTPS & challenges of cocoon marketing in Nagaland	Dr. Shafi Afroz
10	Joya Chetri	Effect of COVID-19 on supply chain of Mulberry sericulture	
11	Jummin Chisi	Breeding achievements and genomic resources in mulberry	Dr. Suresh, K
12	Kabyajyoti Das	PCR-based early detection of bacterial leaf spot pathogen (<i>Xanthomonas campestris pv. mori</i>) of mulberry	Dr. S. Chattopadhyay
13	Laishram Chanu Bindiya	Effect nutrient management in mulberry	Dr. R. Mahesh
14	Lalhriatmawii	Bio-pesticides for control of major mulberry pests	Smt. Radha M.B
15	Lalhriatpuii	MAS for developing thermotolerant breeds in silkworm	Dr. N. Chandrakanth
16	Lalhruaizeli	Role of heat shock proteins in thermotolerance of silkworm	
17	Likha Sonia	Role of hemocytes in immune mechanism of silkworm	Dr. Pooja Makwana
18	Linky Thoudam	Study of BmNPV tolerance in polyvoltine silkworm breeds	Dr. T. Ranjita Devi
19	Luit Protim Borah	Quality seed cocoon generation in rainy season of WB condition and its impact in grainage for seed production	Dr. S. Sarkar
20	Manju Borpatra Gohain	An effect of COVID-19 in Mulberry sericulture in Karnataka	Dr. Manjunatha, G.R
21	Medophrenuo	Role of viral specific rhizoplanar microorganisms in plant growth promotion and disease tolerance.	Dr. Aparna Koppurapu
22	Moachuba Kichu	Factors affecting Gut microbiome in <i>Bombyx mori</i> larvae	
23	Mouchumee Aktara	Gut Bacteriome dynamics of <i>Bombyx mori</i>	Dr. K. Rahul
24	Niharika Kalita	Role of SSPCs in mulberry silkworm seed production in WB	Dr. S.N. Bagchi
25	Nilufar Easmin	Bio control agents for control of major mulberry pests	Smt. Radha M.B
26	Nyanbeni M Kikon	Seasonal incidences of major foliar diseases on mulberry at Dimapur & peren in Nagaland	Dr. Anil Pappachan
27	Oinam Sadananda Singh	Analysis on sericultural enterprise (Cocoon handicraft)	Dr. Parameswaranaiik, J
28	Ojing Tayeng	Association of seed and seedling characters in mulberry	Mr. Yallappa, H

29	Oming Tayeng	Introduction of sericulture in lingka village of Arunachal	Dr. Deepika K. U
30	Parash Pratim Barman	Analysis on sericultural enterprise (Kissan nurasary)	Dr. Parameswara-naik, J
31	Popoi L.	Sericulture in Nagaland: Prospects & Challenge	Dr. Deepika K. U
32	Priya Boro	Morphological characterization of triploids mulberry	Dr. Yallappa, H
33	Rinsophy Lanahmai	Study of larval duration in Nistari	Dr. T. Ranjita Devi
34	Sar bani Sarkar	Study on research methology in social science: Conventional vs. Participatory research approach	Dr. Dipesh Pandit
35	Shilurenem Longkumer	A report on role of nitrogen in mulberry crop	Dr. Vijay, V
36	Sinam Sanahenba Singh	A report on role of phosphorus in mulberry	
37	Sungmochumden. Y. Chang	Diferent aspects of IDM in mulberry sericulturef	Dr. Mihir Rabha
38	Toko Yall	A review on different disinfectants developed for mulberry	
39	Vanlalruata	Physical and chemical properties of mulberry silk	Dr. Raviraj, V.S
40	Verilu Vero	Influence of high temperature and high humidity on bivoltine silkworm breeding & rearing	

Farmers Skill Training (FST)	
Discipline	Farmers
Chawki Silkworm Rearing(10d/5d)	268
Late Age Silkworm Rearing(10d/5d)	126
IDPM (5d)	14
Post Cocoon Technology (5d)	92

The objective of Farmers' Skill Training programme is to enhance the knowledge of sericulture through theoretical and practical training and improve the income level. FST duration is 5-10 days and 500 farmers were trained in different aspects of mulberry cultivation, silkworm rearing and post-cocoon processes. FST programmes were also organized in REC-Dimapur (Nagaland), REC-Mothabari (W.B), REC-Mamring (Sikkim), REC-Agartala (Tripura) , REC-Shillong, REC-Aizawl in addition to CSRTI-BHP.

Technology Orientation Programme

Technology Orientation Programmes (TOP) is of 3-5 days duration, which aim to upgrade the knowledge of officers/officials from CSB/DoS to the recent technologies developed by the Institute. The main purpose of TOPs is to promote enterprises to achieve the set targets in different states. A total of 173 personnel were trained against the set target of 200 in various disciplines. Out of 173, 97 personnel who are under control of CSB, different DoS and NGOs were trained through online training programme.

Hands on Training Programme

Hands on Training Programmes were conducted with an objective to update the practical knowledge to farmers in silkworm rearing both in chawki and late age stages. Total 05 nos of training programme were conducted in northeastern states of the country. The duration of the programme was for 10 days having 20 participants in each batch; therefore total 100 farmers were benefitted from the programme.

Intensive Training Programme

Intensive training programmes (30 days or more) are scheduled with an objective to impart basic training on overall aspects of mulberry sericulture to officials/officers. Forty two (42) personnel were trained out of set target 20 on all aspects of mulberry sericulture.

Post Cocoon Technology

PCT programmes (3 days/5 days) aim to impart practical training to the stakeholders on latest aspects of post cocoon technologies and 92 personnels were trained during the year out of a target of 100. Apart from CSRTI-BHP, programmes were also organized at REC-Mothabari, REC-Agartala (Tripura) and REC-Aizawl.

Seri Resource Centre

SRCs established under Silk Samagra in West Bengal and Bihar aims to impart basic training on different aspects of sericultural technologies developed by CSRTI-BHP. These programmes are conducted by the SRC owner/lead farmer in the village in co-ordination with DoS/CSRTI-BHP for the benefit of other seri-farmers. A total of 1200 personnel in 60 batches (60 batches @ 20 farmers per batch/year) were covered at the six training venues.

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

Exposure Visits

Exposure visits (1-3 days) to best practising areas with an aim to impart basic knowledge on mulberry sericulture on latest technologies to the farmers of different states. A total of fiftyfive (55) personnel undertaken exposure visits organized by REC-Aizawl (Mizoram), REC-Shillong (Meghalaya) & RSRS-Koraput (Orissa).

Other Training Programmes

Non-CBT (5-10 days) and need based training programmes have been conducted on demand for imparting training on latest technologies in mulberry sericulture to the officers/ officials/ students/ stakeholders/ unemployed youth on payment basis. A total of 165 personnel were trained in 09 batches/programmes.

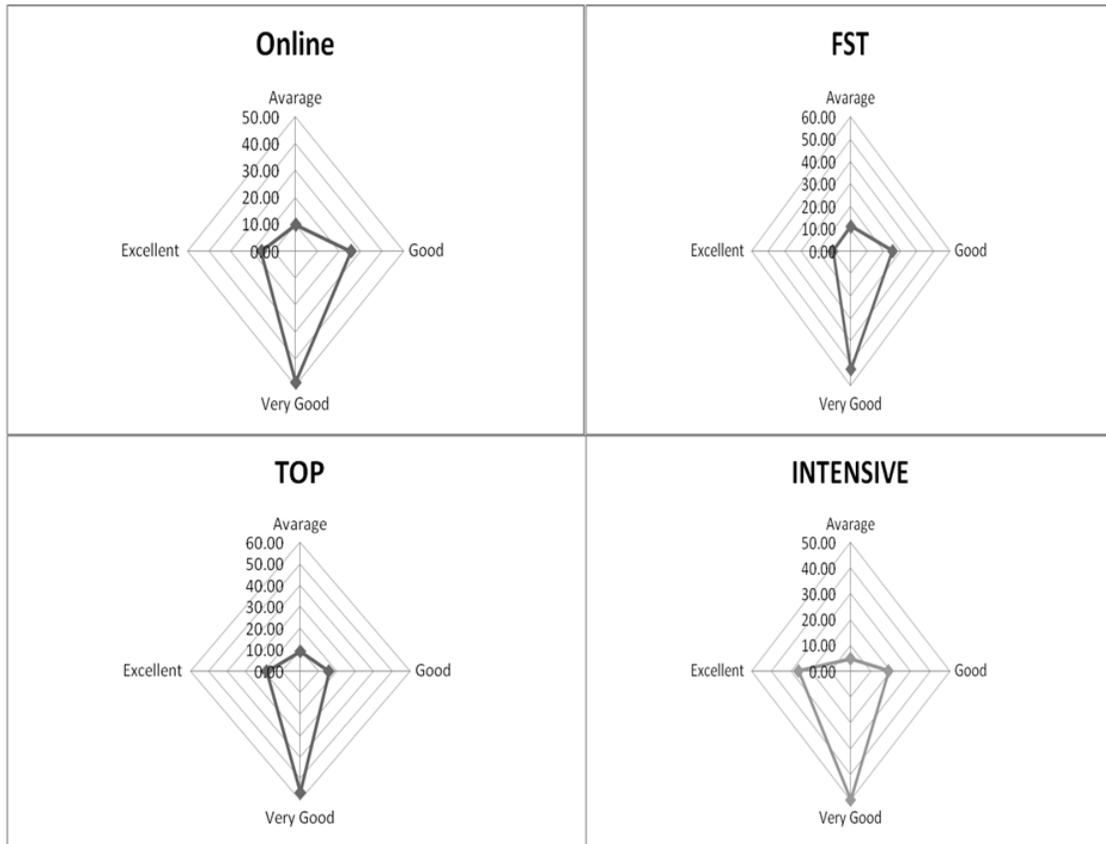
Collabrative Online Training Programme

The collaborative online training programme was organized by CSR&TI, Berhampore in collabartaion with National Institute of Agricultural Extension Management (MANAGE), Hyderabad on "**Extension Management Approaches for Promotion of Sericulture Industry**". The training programme was organised from 24/03/21 to 26/03/21 with 36 officials for reskill/upskill the extension skills required in promotion of sericulture in Eastern and northeastern India.

Orienataion Training to U.P Farmers

The orientation training programs were conducted under Need Based Training (165) to Uttar Pradesh sericulture farmers as per the demand of state sericulture department, Uttar Pradesh. Total 67 farmers were trained in 4 batches (out of 9 batches). Participants were from the different zones of U.P viz, Basti, Kushinagar, Banaras, Balarampur Gonda and Baharaich.

Stakeholders Feedback on Training Programmes



Special Activities on Women Empowerment & Development of SC/ST/Weaker Sections											
Prog.	Male					Female					Grand Total
	Gen	SC	ST	OBC	Total	Gen	SC	ST	OBC	Total	
PGDS (2020--21)	06	-	10	01	17	03	01	06	01	11	28
FST	47	82	15	53	197	34	69	70	38	211	408
PCT	25	-	-	06	31	19	-	25	17	61	92
TOP	75	29	14	21	139	13	12	05	04	34	173
HOT	-	-	02	-	02	-	-	98	-	98	100
EXPO.VISIT	-	-	15	-	15	-	-	40	-	40	55
ITP	22	10	-	04	36	05	-	01	-	06	42
SRC	360	137	24	252	773	224	64	-	139	427	1200
NBT (Non-CBT)	55	7	14	44	120	6	5	7	63	81	201
Total	590	265	94	381	1330	304	151	252	262	969	2299



REGIONAL SERICULTURAL RESEARCH STATIONS (RSRS)

Regional Sericultural Research Stations (RSRSs) are established to address the regional problems of sericulturists through research & extension support of sericulture technologies in varied agro-climatic regions. Their main objective includes undertaking validation trials & demonstration of new sericulture technologies evolved by the main institute to the sericulturists. The proven technologies are transferred further to the field through Research Extension Centres (RECs). CSRTI-Berhampore has three RSRSs viz., RSRS-Jorhat (Assam) covering North Eastern states; RSRS-Koraput (Odisha) covering Odisha state; RSRS-Kalimpong covering hilly districts of West Bengal & Sikkim state. The main institute coordinates all the R&D, Extension and Capacity building programmes in the command states.

RSRS-JORHAT

Units & Command Area	Scientists	Tech. Staff	Admin. & supp. Staff	TSFW/SFW	Farm based Units	
					Total Area (Acres)	Mulberry (Acres)
RSRS-Jorhat (Assam)	Mr. P. Kumaresan Sci-C	3	4	20	12.10	7.5
RECs						
Agartala (Tripura)	Dr. Narayan Biswas Sci-D	3		3	1	0.5
Aizawl (Mizoram)	Dr. L. Pachuau Sci-D	3	1			
Dimapur (Nagaland)	Dr. Kartik Neog Sci-D	6		4	10	3.5
Mongaldoi (BTC)	Mr. B. K. Basumatary Sci-D	6		1	7	5.1
Shillong (Meghalaya)	Dr. Collins Z Renthil Sci-D	3		1	1.7	1.5
Sille (Arunalchal Pradesh)	Mr. Lohit Sonowal Sci-C	4		5		
REC-Imphal (Manipur)	Dr. L. Somen Singh Sci-D	2				

Ongoing Project

PRE02001SI: Management of Pink Mealy Bug - *Maconellicoccus hirsutus* (Green) of mulberry with barrier system

[July 2018 - June 2021]

P. Kumaresan (PI) and Manjunatha G R

Objectives:

- To increase the silk production by reducing the mulberry crop loss due to infestation of pink mealy bug
- To find out the minimum strategy to combat against mealy bug without adverse effect on environment

Various barrier combinations were evaluated for the management of pink mealy bug in experimental layout (RBD; S1635; 3mt x 4mt plots; 20 plants/plot; four replications/ treatment). Mealy bug population density (nymphs & adults) was recorded at weekly intervals (5 plants-10 leaves/treatment).

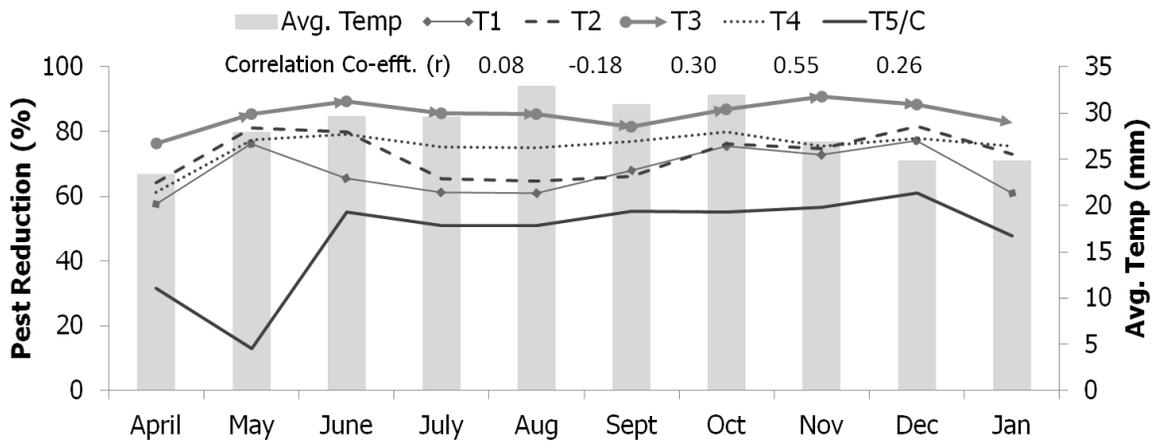
Chloropyriphos 20 EC was replaced with Spinosad and experimental trial was conducted The LC50 of Spinosad45%SC was finalized as 0.720% or 160ml/10 lit. On an average the Higher Pest Reduction % was recorded in Barrier with Neem cake (T3) 88.63% in 15 days interval observation, followed by T4 (78.17%), T2(77.22%), T1(76.12%) compared to control/T5(56.17). Bio assay study for efficacy of Spinosad sprayed leaves on rearing with Sk6,7 in Autumn and KDH-1, SK6,7 and BCon1,4 in Spring were done, the results revealed that there is no any significant variation found between Treatment vs. control when reared 30 days after spray. Hence the safety period of Spinosad 45% SC was confirmed as 30 days.

Performances of barrier systems against pink mealy bug across seasons

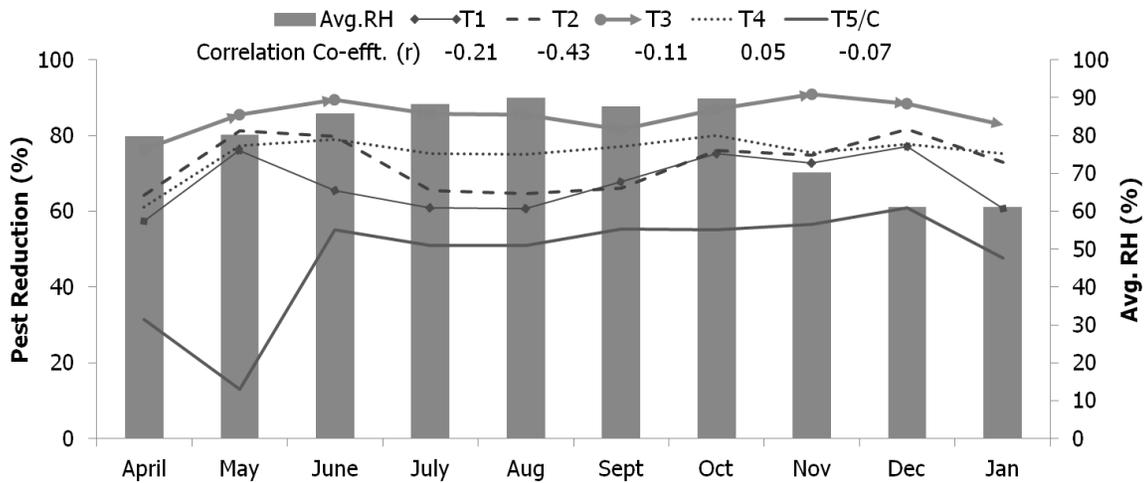
Treatments & Seasons	% Incidence	PIOC	% Damage Index	PDOC	% Reduction	PROC
T1	58.93	-6%	33.91	13%	68.24	43%
T2	61.78	-1%	35.61	18%	72.70	52%
T3	59.69	-5%	36.80	22%	85.60	79%
T4	56.61	-10%	31.04	3%	75.35	58%
T5 (Ctrl)	62.69		30.07		47.73	
SEm±	0.566		0.348		0.407	
CD@5%	1.649		1.013		1.184	
Summer (S)	62.73	0%	45.10	50%	66.20	39%
Rainy (R)	53.96	-14%	23.43	-22%	68.22	43%
Winter (W)	63.13	1%	31.92	6%	75.35	58%
SEm±	0.731		0.449		0.525	
CD@5%	2.129		1.307		1.529	



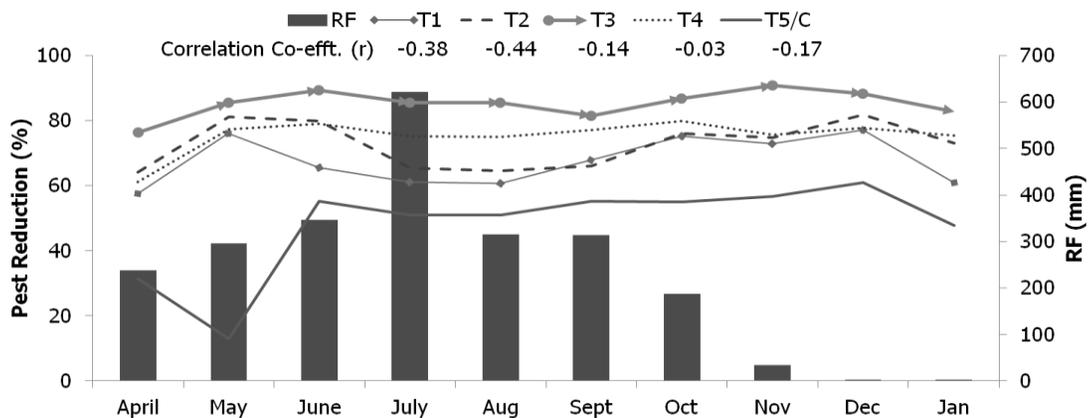
Correlation of pink mealy bug reduction pattern with average temperature across months



Correlation of pink mealy bug reduction pattern with average RH across months



Correlation of pink mealy bug reduction pattern with rainfall across months



Bio-assay Performances with SK6xSK7 between treated & untreated pesticide sprayed mulberry leaves			
Parameters	Treatment	Control	P-value (t-stat)
Fecundity (No)	529	531	0.932
Hatching (%)	97.60	96.10	0.085
10 matured Larval Wt. (g)	31.53	31.9	0.703
ERR by 10k larvae (No)	6800	6766	0.906
Cocoon Yield/ 100 dfls (kg)	45.01	44.78	0.902
Cocoon Wt. (g)	1.401	1.403	0.766
Shell Wt. (g)	0.251	0.25	0.633
Shell (%)	17.90	17.80	0.496

Note: P<0.05 signals the significant at 5%

BPP 05014 CN: Standardization of processing and production of consumable beverage from mulberry leaves and blending with green tea (Collaborative with TTRI-Jorhat and AAU-Jorhat)

[March 2020 – June-2021]

Co-ordinator: Mishra R.K.; CSB: Chutia M, Satyanarayana K, Parashnath S & Kumeresan P; AAU-Jorhat: Gogoi A S, Barua S C, M Deka & P Das; TTRI-Jorhat: R C Gogoi & D J Hazarika

Objectives:

- To standardize protocol for preparation of mulberry leaf for production of Herbal Tea with Mulberry leaf and mulberry green Tea.
- Organoleptic properties will be evaluated by the professional Tea tasters based on their scores on the sample.
- Samples recommended by the tasters will be subjected to biochemical evaluation and customer acceptance.

Role of RSRS-CSB-Jorhat-Assam:

The role of RSRS-Jorhat in the project is to supply mulberry leaf to TTRI-Jorhat and AAU-Jorhat for production of mulberry Tea and mulberry green tea and necessary evaluation. Different mulberry varieties of saplings *viz.*, G4 (113 no.), G2 (81 no.) and V1 (110 no.) were planted in Paired row system @3'x2'+5' spacing at RSRS, Jorhat during Aug 2019. Cultural operation is being maintained. Two mulberry varieties *viz.*, S-1635 (T1) and K2 (T2) considered as test varieties and supplied to TTRI and AAU on 6 spells @ 1kg of each tender leaves. Preliminary observation has been recorded that the K2 (T2) & T3 (BC₂59) varieties shown promising results. So far till March 2021, a total of 128.50kg leaf [comprised of 40.5 Kg T1(S-1635), 63.5 kg T2 (K2), 13.0 kg, T3 (BC₂59) and 8.0kg T4(C-2038)] supplied from RSRS-Jorhat in 32 spells.

Collaborative R&D Projects/Activities

RSRS-Jorhat has the following two collaborative projects and other continuous activities with the main institute. The unit is involved in the collection of data from experiments/farmers/DoS and the respective information is reported discipline wise.

- PIB 3576: Evaluation of new mulberry genotypes for improvement in productivity and quality
- AICEM-IV (All India Co-ordinated Experimental Trial for Mulberry varieties)

- Forewarning of mulberry/silkworm pest & diseases of Eastern and North Eastern India
- Implementation of Official Language

New Nursery plantation Technologies:

- Nursery cuttings planted by using polythene sheet to prevent weeds and curtail frequent irrigation
- Survey, surveillance and monitoring of silkworm diseases in seed and commercial crops
- Extension, Training & Transfer of Technologies (OST & OFT)

EXTENSION ACTIVITIES

Activity	Achievement
ToT	Popularization of new improved mulberry varieties: Saplings: 22000; Varieties: C2028 & C2038; Popularization of new silkworm hybrid (ToTs-OFT): 1700 dfls Popularization of Shelf rearing: 16 farmers; Autumn: 48 to 56kg/100 dfls; Spring: 70 kg/100 dfls Validation of Nirmool: 8 farmers; Treat: 36 kg to 56 kg/100 dfls; Ctrl: 30 to 34kg/100 dfls Validation of drum kit fertigation: 2 trials; Improvement: 1.63% to 20.65% Soil Health card (SHC): 50 Nos.
ECPs	ECPs: 62 Events (2447 farmers)
CPP	6 Clusters I NE states in India BV: 16900 dfls; 325 farmers ECPs: 9 Events (150 farmers)
NERTPS	Technical guidance of mulberry sericulture (ISDP & IBSDP) in NE states
Training	Programmes viz., FST, TOP, PCT, EDP, Exposure visit & Seed Act

RSRS-KORAPUT

Units (State)	Scientists	Tech. Staff	Admin. & Supp. Staff	TSFW/ SFW	Farm Based Units	
					Total Area (Acres)	Mulberry + Vanya (Acres)
RSRS-Koraput (Odisha)	Mr. Khasru Alam, Sci-B	15	3	20	50	10 + 3.5

Collaborative R&D Projects/Activities

RSRS-Koraput is associated with the collection of data from experiments/farmers/DoS in the following R&D projects/programmes/activities.

- PIB 3576: Evaluation of new mulberry genotypes for improvement in productivity and quality
- PIE 02002 SI: Evaluation of performance of mulberry genotype C-9 under red & laterite soils
- AICEM-IV (All India Co-ordinated Experimental Trial for Mulberry varieties)
- Forewarning of mulberry/silkworm pest & diseases of E & NE India
- Evaluation of the performance of high yielding bacterial leaf spot resistant mulberry variety C7
- Evaluation of thermotolerant bivoltine double hybrids/ low cost drip fertigation system on mulberry
- Validation of ecofriendly disinfectant "NIRMOOL"
- Implementation of Official Language

EXTENSION ACTIVITIES

RSRS-Koraput undertook various extension/capacity building/developmental activities/ programmes in Odisha.

Activity	Achievement
ECPs	10 Events (588 farmers)
Training	One need based training with 10 beneficiaries & 4 ITDA, Officials for introduction of sericulture as livelihood activity
ToT	Popularization of new improved mulberry varieties: 0.48 acre; C-2038; 6 farmers
	Promotion chawki rearing: 1700 dfls
	Popularization of shoot rearing: 12 farmers; 42.20% gain/100 dfls
Egg production	A total of 7848 dfls of different breeds prepared and supplied to main institute

RSRS-KALIMPONG

Units & Command area	Scientists	Tech. Staff	Admin & Supp. staff	TSFW/ SFW	Farm based units	
					Total Acreage	Plantation Acreage
RSRS-Kalimpong (Hilly - West Bengal)	Mr. Zakir Hossain, Sci-D Dr. Harish Babu, S, Sci-B	10	9	19	30.37	4.00 (@Mulberry) 2.00 (@Muga)
REC-Mamring (Sikkim)	Incharge of RSRS	3	2			

Continuous/Other Activities

Maintenance of Bivoltine Silkworm Germplasm Breeds

Objective: Maintenance of bivoltine germplasm under temperate conditions

Bivoltine germplasm breeds collected from various sources maintained at RSRS-Kalimpong were reared during Spring crop (April-May). The cellular rearings were conducted following standard rearing technology/conditions. Data on rearing performance and cocoon characteristics were documented and verified against the passport data. The selected cocoons were utilized for seed production and dfls were preserved in different hibernation scheduls. During Spring season, 43 germplasm breeds and 17 bivoltine breeds and hybrids (14 breeds & 3 hybrids) received from CSR&TI BHP were reared for evaluation. During the year, a total of 1299 dfls (bivoltine hybrid / double hybrid / BHP FC1/ BHP FC2) were supplied to CSR&TI, BHP for field evaluation and another 13 dfls utilized for FST conducted at DoS Farm/REC Sikkim.

Performance of Bivoltine Silkworm Genetic Resources - Spring 2020							
#	Race	Fec.	ERR (No.)	Wt (kg)	Cocoon Wt. (g)	Shell Wt. (g)	Shell (%)
1.	B. Con-1	532	9325	17.118	1.726	0.300	17.38
2.	B. Con-4	548	8400	16.378	1.733	0.298	17.20
3.	BHR-1	519	8800	15.878	1.694	0.273	16.12
4.	BHR-2	497	8725	13.508	1.582	0.230	14.54
5.	BHR-3	545	7970	12.385	1.662	0.243	14.62
6.	BHR-13	533	8450	14.985	1.829	0.298	16.29
7.	B. Con-14	545	8475	15.565	1.914	0.301	15.73

8.	BJ	535	8000	15.398	1.835	0.304	16.57
9.	BJ (W)	605	8800	16.308	1.925	0.307	15.95
10.	BBHR (W)	560	8525	16.378	1.935	0.318	16.43
11.	Changnang	582	8625	16.260	1.930	0.295	15.28
12.	CSR-2	433	4300	7.938	1.900	0.359	18.89
	CSR-6	599	6200	10.553	1.824	0.320	17.54
13.	D-4	583	7850	12.7	1.757	0.273	15.54
14.	D6 (M)	509	8700	13.910	1.757	0.261	14.85
15.	D6 (P)	487	8100	13.435	1.852	0.306	16.52
16.	J122	591	8825	15.910	1.879	0.307	16.34
17.	JD6	506	4550	8.338	1.793	0.283	15.78
18.	KDH-1	570	9600	16.865	1.865	0.301	16.14
19.	KA-19	618	8275	14.490	1.846	0.298	16.14
20.	KA-19 (W)	564	9575	16.310	1.745	0.281	16.10
21.	KPG-A	501	8750	15.299	1.766	0.274	15.52
22.	KPG-B	495	9150	15.513	1.694	0.288	17.00
23.	KPG-3	456	7575	13.013	1.727	0.273	15.81
24.	KPG-4	493	6325	9.355	1.609	0.242	15.04
25.	KPG-5	541	6725	11.673	1.590	0.263	16.54
26.	KPG-7	447	6350	11.640	1.917	0.332	17.32
27.	MC-1	507	8600	13.245	1.603	0.261	16.28
28.	MC-2	530	7450	14.178	1.882	0.278	14.77
29.	NB4D2	510	8425	14.32	1.728	0.262	15.16
30.	NB18	524	10550	18.275	1.844	0.286	15.51
31.	P5	538	7825	12.730	1.597	0.272	17.03
32.	Pam 105	543	8700	14.713	1.788	0.237	13.26
33.	SK 67	542	8125	14.378	1.715	0.273	15.92
34.	SK67J	532	8625	13.728	1.861	0.300	16.12
35.	SK67J(W)	486	8650	15.863	1.821	0.276	15.16
36.	SF19	543	5850	11.083	1.816	0.297	16.35
37.	SH6	503	5900	11.975	1.909	0.346	18.12
38.	SK4(II)	567	6600	12.083	1.901	0.313	16.47
39.	SK6	513	9150	15.878	1.832	0.272	14.85
40.	SK7	491	9100	15.555	1.805	0.275	15.24
41.	SBK-5	558	8575	14.939	1.886	0.297	15.75
42.	SBK-7	532	8100	15.155	2.065	0.365	17.68
	<i>Pure lines</i>						
43.	WB-1	626	2750	4.723	1.513	0.311	20.56
44.	WB-3	538	9475	16.173	1.670	0.265	15.87
45.	WB-5	594	7475	12.528	1.872	0.278	14.85
46.	WB-6	568	2350	16.340	1.813	0.298	16.44
47.	WB-7	546	8925	16.193	1.902	0.282	14.83
48.	WB-7 (W)	605	9025	16.943	1.776	0.256	14.41
49.	WB-8	437	9550	15.360	1.715	0.279	16.27
50.	WB-9	537	8925	14.758	1.791	0.291	16.25
51.	WB-9 (W)	582	8475	13.590	1.943	0.321	16.52
52.	BHP-1	518	8875	15.870	1.787	0.288	16.12
53.	BHP-2	521	8175	14.465	1.707	0.264	15.47
54.	BHP-3	525	7050	12.995	1.775	0.268	15.10
55.	BHP-8	541	7600	12.760	1.639	0.260	15.86
56.	BHP-9	510	6825	12.005	1.866	0.298	15.97
57.	<i>Hybrids</i>						
58.	WB-3 x WB-1	452	8150	14.830	1.787	0.298	16.68
59.	WB-7 x WB-9	557	9025	17.500	1.958	0.321	16.39
60.	SBK-5 x SBK- 7	494	7550	14.690	1.820	0.286	15.71

Season	Performance of Bivoltine Breeds/Hybrids							
	#	Race	Fec.	ERR (No.)	Wt (kg)	Cocoon Wt.(g)	Shell Wt. (g)	Shell (%)
	A.	<i>Pure Breeds</i>						
Summer 2020	1.	B.con-1	614	7966	17.759	1.890	0.338	17.90
	2.	B.con-4	600	7299	13.076	1.850	0.337	18.22
	3.	BHP-2	476	4633	7.903	1.820	0.333	18.29
	4.	BHP-3	361	7766	15.389	1.900	0.384	20.25
	5.	BHP-8	407	7333	12.763	1.840	0.326	17.68
	6.	BHP-9	527	7633	14.650	1.940	0.342	17.59
	7.	SK-6	646	8133	14.589	1.890	0.291	15.40
	8.	SK-7	562	8433	14.253	1.810	0.309	17.12
	9.	WB-1	501	7766	14.033	1.820	0.305	16.78
	10.	WB-3	538	7666	13.993	1.750	0.355	20.26
	11.	WB-5	538	7066	12.353	1.680	0.297	17.68
	12.	WB-7	525	5466	10.783	2.021	0.397	19.64
	13.	WB-9	506	6833	12.746	1.750	0.306	17.48
	B.	<i>Hybrids</i>						
	14.	B.con-1 x B.con-4	506	8766	16.300	1.840	0.285	15.46
	15.	SK-6 x SK-7	518	8599	16.540	1.820	0.319	17.52
	16.	WB-3 x WB-1	480	8899	17.013	1.970	0.382	19.39
	17.	WB-9 x WB-7	555	6933	13.739	1.840	0.389	21.14
	18.	WB-7 x WB-9	556	6533	12.909	1.930	0.366	18.96
	19.	WB-1 x WB-3	502	8866	18.446	2.060	0.395	19.17
	20.	WB (3x1) x WB (7x9)	659	8233	17.203	2.140	0.400	18.69
	21.	WB (7x9) x WB (3x1)	556	6665	13.959	2.010	0.397	19.78
Autumn 2020	22.	BHPFC-1	424	5500	8.98	1.915	0.372	19.42
	23.	BHPFC-2	522	9414	9.15	1.801	0.339	18.82

Collaborative R&D Projects/Activities

RSRS-Kalimpong is associated with the collection of data from experiments/farmers/DoS in the following R&D projects/programmes/activities.

- PIB02007SI: Improvement of mulberry leaf longevity in E & NE states of India
- AIT02008SI: Identification of markers for high humidity tolerance in silkworm breeds
- Forewarning of mulberry/silkworm diseases of Eastern & North Eastern India
- Evaluation of thermotolerant/BHP by double hybrids/ low cost drip fertigation system on mulberry
- Validation of ecofriendly disinfectant "NIRMOOL"

EXTENSION ACTIVITIES

RSRS-Kalimpong and REC-Mamring have undertaken various extension/capacity building/ developmental activities/ programmes in hilly region of WB & Sikkim

Activity	Achievement
Training	10 day FST; Late age silkworm rearing

TRANSFER OF TECHNOLOGY

The following ToT rogrammes were undertaken for popularizing the recently developed sericultural technologies into the field in E & NE zone through on farm trails (OFT) during 2020-21. The programmes were implemented as per the specific guidelines and the beneficiaries were selected by the extension units in consultation with respective DoS.

OFT	Stakeholders (Target)	Findings/Achievement
Popularization of Authorized Mulberry Varieties C-2038 including C-2028, Tr-23/BC ₂ 59	180 farmers (14.40 acres)	23.30 acres of plantations were undertaken with 196 farmers (C-2038:76F & 7.74 acres; BC ₂ 59: 80 F & 15.30 acres; C2028: 28 F & 0.56 acres)
Evaluation of BHP double hybrids	100 farmers (10000 dfls)	11440 dfls were tested in comparision to ruling FCs SK6.7 and BCon1.4 BHP DH and fund superior with higher cocoon traits
Popularization of new silkworm hybrids	200 farmers (20,000 dfls)	23750 dfls were tested with farmers (BCon1.4: 19250 dfls with 52-55 kg; M6DPC x SK6.7: 4500dfls with 50-52kg; Control 46- 48kg/100dfls)
Popularization of Chawki Rearing	10 CRCs	10 CRCs were enrolled for conducting BV hybrids and ICB rearing (10000 dfls)
Demonstration of bio-control agent	150 Farmers	BCA has been released in 78 famers' field identified from Kanupur, Kalyanpur, Purapara & Senpara villages
Popularization of Collapsible plastic mountages & Shoot feeding (shelf rearing)	200 (20000 dfls)	Assistance for collapsible mountage and shelf rearing provided to 183 farmersin Eastern & Nort-Eastern States and recorded 11% higher cocoon yield and 25 labour savings.
Demonstration of modified charka (Suvarna) + Souroneer	10 Units	Nine beneficiaries were identified from Malda & Murshidabad (WB). Procurement is under progress.

Popularization of Newly Authorized Mulberry Variety C-2038 including C-2028 & Tr-23/BC₂59

Suresh, K., D. Chakravarty (Sep-20), T.D. Biswas, P. Kumaresan, G.S Singh, K. Alam, B.K Basumatary, C.Z. Renthlei, L. Pachuau, N. Biswas, K. Neog, S. Chakraborty, Z. Hossain, Deepika KU, Yallappa H & Mahesh R

Units	Beneficiaries identified and Sapling Production				
	Beneficiary farmers (Nos.)		Mulberry Variety	Saplings production (Nos.)	
	Target	Achievement		Target	Achievement
CSRTI, BPH	30	30	C-2038	35000	45000
			BC ₂ 59	5000	8000
RSRS, Jorhat	8	28	C-2028	-	1000
					3200
REC, Mothabari	8	8		7200	7200
RSRS, Koraput	8	6		3200	2400
REC, Bhandra	8	7		3200	2800
REC, Mangaldoi	10	10	C-2038	7200	4400
REC, Aizwal	10	10			
REC, Agartala	10	11			
REC, Shillong	8	8			
REC, Dimapur	80	80		22000	22000
RSRS, Kalimpong			BC ₂ 59	5000	5500
	180	197		91000	98400

The project aimed at transfer of newly authorized varieties in to selected farmers field at ten locations of E & NE zone. Planting materials (saplings) were produced by nested units or supporting units from the seed cutting garden established from cuttings of nucleus seed plot of CSRTI-BHP. The saplings were distributed to selected farmers /beneficiary by respective REC units during planting season Jul-Dec 2020. Around 80-90% survival was recorded and the plantations were monitored by the extension units. Three authorized varieties were established in 24.30 acres of 197 farmers field at 10 locations/states which includes 7.44 acres of C-2038, 15.30 acres of BC₂59 & 0.56 acres of C-2028.

Sapling Distributed and Area of Plantation							
Units	Mulberry Variety	Saplins distribution (Nos.)		Area of plantation (Acres)		Expenditure (lakh)	
		Target	Achievt.	Target	Achievt.	Target	Achievt.
CSRTI, BPH		27000	27000	2.40	2.40	1.287	0.72
REC, Mothabari	C-2038	7200	7200	0.64	0.64	0.343	0.17
RSRS, Koraput		3200	2400	0.64	0.48	0.215	0.05
REC, Bhandra	C-2028	3200	2800	0.64	0.56	0.215	0.05
RSRS, Jorhat		3200	2800	0.64	0.56	0.215	0.28
	C-2038		1200	-	0.24		
REC, Mangaldoi		4000	4000	0.80	0.80	0.269	0.09
REC, Aizwal	C-2038	4000	4000	0.80	0.80	0.269	0.37
REC, Agartala		4000	4000	0.80	0.88	0.269	0.32
REC, Dimapur	BC ₂ 59	31000	36806	6.40	15.30	2.160	0.96
REC, Shillong	C-2038	3200	3200	0.64	0.64	0.215	0.15
Others(Bihar)				2000		1.00	1.436
Total		91000	97406	14.40	24.30	7.20	3.2 lakh

Popularization of Chawki Rearing

Tapati Datta Biswas, Shafi Afroz and Incharges of RSRs/RECs of CSRTI-Berhampore

Ten CRCs with a capacity of 1000 dlfs/crop were identified as beneficiaries during Agrahayni/Autumn 2020 in West Bengal (2), Odisha (1), Assam BTC (2), Tripura (1), Nagaland (1), Mzoram (1), Meghalaya (1), and Arunachal Pradesh (1). The beneficiaries were assisted with chawki rearing cost @Rs.6000.00 per CRC. The chawki worms reared were distributed to the farmers after 2nd moult. The CRCs were monitored for chawki worms' quality.

Unit	CRCs	Season	Hybrid	Hatching (%)	Larval growth* (g)	Missing larvae (%)	Unequal larvae (%)
CSRTI-BHP	1	Agrahayani 2020& Falguni 2021	TT21xTT56	91.0	3.18	4.56	2.55
REC-Mothabari	1		Nx(SK6xSK7)	91.0	2.35	4.25	1.0
RSRS-Koraput	1	Oct-Nov'20	FC1xFC2	90.0	3.65	2.7	3.93
REC-Mangaldoi	2	Autumn crop'20	SK Hybrid	94.0	6.0	4.0	Good
			FC 1	96.0	7.0	4.0	Good
REC-Agartala	1		TT21xTT56	82.0	2.3	2.0	3.83
REC-Dimapur	1		DH-BHP; 12YxBFC	82.0	1.33	0.67	NA*
REC-Aizawl	1		SK6xSK7; DH-BHP	95.0	2.06	7.0	Good
REC-Shillong	1		SK hybrid	96.0	2.53	5.0	3.65
REC-Sille	1		M6DPCxSK6.7; BHP-DH	93.0	2.51	3.90	0.72

*weight of hundred larvae under 2nd moult;

Popularization of Collapsible Plastic Mountages & Shoot Feeding (Shelf Rearing)

Tapati Datta Biswas, Shafi Afroz and Incharges of RSRs/RECs of CSRTI-Berhampore

Shelf rearing (shoot feeding) technology was extended to 183 farmers against the target of 200 farmers during Agrhayani & Falguni crop in West Bengal , /Autumn 2020 crop in Odisha , Assam BTC , Tripura , Nagaland , Mizoram , Meghalaya and Arunachal Pradesh . The beneficiaries were assisted with shelf-preparation cost @ Rs. 8500.00 per beneficiary, and other basic input materials for late age rearing.

Unit	Season	Hybrid	Farmers	Avg. Yield (kg/100 dfls)		
				Shelf	Dala	Gain (%)
CSRTI-BHB	Agrhayani 2020	M6DPC × SK6.7	43	55.29	50.0	10.58
REC-Mothabari		N x SK6.7	50	36.5	32.2	13.35
RSRS-Koraput	Oct – Nov 2020	FC1 x FC2	12	25.9	29.5	-12.20
RSRS-Jorhat	Autumn 2020	DH-BHP; 12Y x BFC	10	48.4	32.0	51.2
REC-Mangaldoi		SK hybrids	30	45.2	42.2	7.13
REC-Agartala		TT21xTT56	5	44.5	42.0	5.97
REC-Dimapur		DH-BHP; 12YxBFC	15	50.4	41.0	23.02
REC-Aizawl		DH-BHP; SK hybrid	10	49.6	47.8	3.70
REC-Shillong		SK hybrids	10	47.01	44.2	6.36
REC-Sille		M6DPCxSK6.7; BHP-DH	3	51.3	50	2.67
Tota/Avg.				44.8	40.3	11.03

Demonstration of Bio-control Agent

Anil Pappachan (From Oct 20), Radha.M.B. (till Sept 20), Manjunatha GR, Shafi Afroz and V. Lakshmanan

A total of 43,629 *Chrysoperla zastrowi sillemi* eggs were mass produced on 302.4 cc of *Corcyra cephalonica* eggs. 23,900 *Chrysoperla* eggs were released among 78 farmers field in Murshidabad, Nadia & Birbhum Districts for the management of thrips. Remaining eggs were released at different institute plots as well as used for mass multiplication. Biocontrol agent was released at Kalyanpur (15), Purapara (18), Senpara (24) and Kanupur (21) villages coinciding with thrips incidence at the field. On average release of biocontrol agent resulted in 67.4 % reduction of thrips over untreated control.

Efficacy of *Chrysoperla zastrowi sillemi* against thrips under field conditions

Location	BCA		Control		Reduction over control (%)
	Pre-release	Post-release	Pre-release	15 days after release	
Kanupur	8.4	5.0	8.5	13.8	63.3
Kalyanpur	4.4	3.2	5.0	10.3	69.0
Purapara	6.6	3.5	7.0	12.3	71.6
Senpara	5.1	3.6	4.4	10.6	65.8
Avg.	6.1	3.8	6.2	11.8	67.4

Evaluation of BHP Double Hybrid, (BHP3.2) x (BHP8.9)

V. Lakshmanan and Incharges of RSRs/RECs of CSRTI-Berhampore

A total of 11,440 dfls of BHP DH along with 2500 dfls of SK6.SK7 and 950 dfls of BCon1.Bcon4, the popular bivoltine combinations were evaluated in E & NE India region. The analyzed data indicates that BHP-DH is superior over the popular FCs, exhibiting 19-23% higher cocoon yield per 100 dfls, 7-8% higher cocoon weight, 12-20 % higher shell wt and 5-11% higher shell percentage.

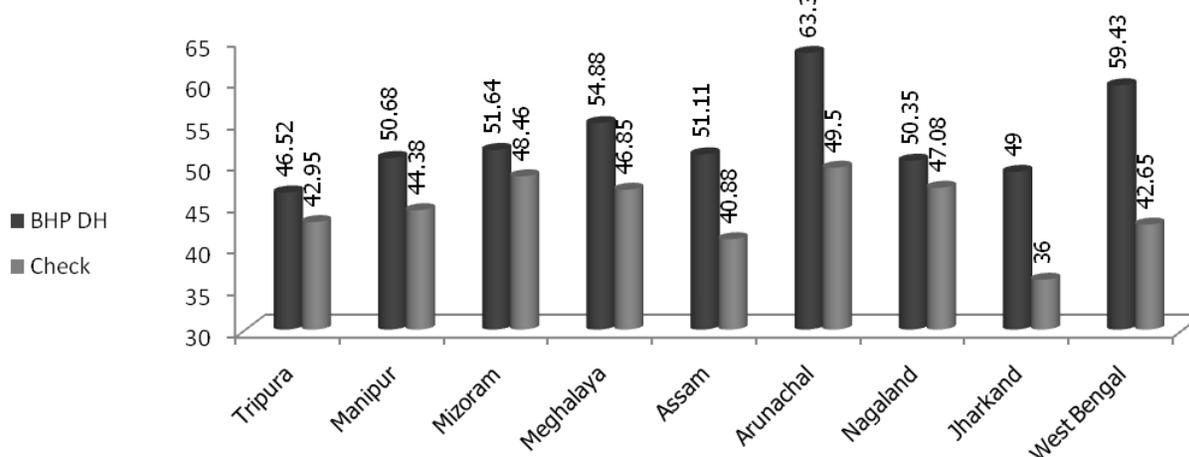
Evaluation of BHP-DH with farmers @ E & NE – Overall performance (2020-21)

Hybrid	Dfls	Crops	Yield/100 Dfls (kg)		SCW (g)	SSW (g)	Shell (%)
			Yield Range	Average Yield			
BHP DH	11440	184	24-88	54.37 (17.73)	1.624 (10.62)	0.306 (13.26)	18.82 (6.17)
SK6.7-C1	2500	40	10-60	44.35 (25.20)	1.506 (11.72)	0.254 (14.43)	16.89 (6.38)
BCon1.4-C2	950	18	20-57	45.34 (20.31)	1.515 (10.95)	0.272 (12.43)	17.92 (4.68)
IOC (%) over C1				22.59	7.83	20.47	11.42
IOC (%) over C2				19.91	7.19	12.50	5.02

Figures in parenthesis indicates CV%; > Avg:48%; >Control-1:84%; >Control-2:81%

Frequency distribution of cocoon yield per 100 dfls reveals that in case of new bivoltine hybrid, about 48% of crops yielded more than the average cocoon production (> 52.11Kgs); about 84% of crops yielded > 44.35 kgs of SK6.SK7, and about 81% of crops yielded > 45.34 Kgs of BCon1.Bcon4. About 40% of cocoon crops of new bivoltine double hybrid were recorded in the range of 50-60 kgs per 100 dfls, about 10% crops in the range of 61-70Kgs and about 7% crops in the range of 71-88 Kgs per 100 dfls indicating its good productivity potential.

State-wise Cocoon Yield (kg/100dfls)



Among the states, Arunachal Pradesh has recorded a highest cocoon yield (63.33 Kgs), while West Bengal has registered, the second best (59.43 Kgs). Highest yield improvement of 39.34% was registered with West Bengal farmers in new BHP bivoltine double hybrid and the least yield of improvement of 6.94% with farmers of Nagaland over check.





Popularization C-2038 Mulberry Variety @ Bihar



GRC@ West Bengal



Shelf / Shoot Feeding @ West Bengal



Plastic Mountages @ West Bengal



Popularization of ICB @ Eastern India



Suvarna Prototype

NORTH EAST REGION TEXTILE PROMOTION SCHEME (NERTPS)

V. Sivaprasad, Dipesh Pandit, Manjunatha G.R. and Incharges of NE untis of CSRTI-BHP

NERTPS, an umbrella scheme of Ministry of Textiles, Govt. of India have approved 38 sericulture projects in the North Eastern States in potential districts under categories i.e., Integrated Sericulture Development Project (ISDP), Intensive Bivoltine Sericulture Development Project (IBSDP), Eri Spun Silk Mills and Aspirational Districts (2015-2021). NERTPS focuses on providing special thrust for consolidation and expansion of mulberry, eri and muga sericulture with the basic objectives of uplifting of the overall socio-economic status sustainably. The project envisages holistic development of seri-industry in all spheres from plantation to fabric production with value addition at every stage. The project is proposed to bring ~38170 acres of plantation under mulberry, eri and muga sectors; contribute additional production of 2650 MT raw silk and generate employment for three lakh persons in NE India. CSRTI-Berhampore is involved in coordination of technical support and monitotring activities in mulberry sector.

ISDP: Eighteen ISDP projects are being implemented in Assam (including BTC), Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura to support 29,910 acres plantation of Mulberry, Eri & Muga predominantly. These projects are being implemented through respective DoSs including establishment of Silk Printing & Processing unit for Tripura, Soil to Silk for BTC (Assam), Post Cocoon Technology for Nagaland & creation of seed infrastructure to produce and ensure uninterrupted supply of quality seed (NSSO-CSB).

IBSDP: Ten projects are being implemented to produce for import substitute bivoltine silk covering 4900 acres of mulberry plantation benefitting around 10607 women beneficiaries in all the NE states, except Manipur.

Aspirational Districts: Five sericulture projects are being implemented in Assam, BTC, Mizoram, Meghalaya and Nagaland to develop silk industry in one/two blocks of the identified aspirational districts. These projects aims cover 3360 acres of plantation benefitting around 4185 beneficiaries.

Arunachal Pradesh: Presently 4,580 hectares of land is covered under silkworm food plantation by involving around 8220 families and producing 37 MT Raw Silk in 116 villages and give the subsidiary income to about 2500 families. Project region was in East Siang (Pasighat, Mebo, Ruksin, Sille & Aalong). New mulberry plantation established during the project period 500 acres and 20 Kisan nurseries in 20 acres of land. 1000 pucca rearing houses and 250 vericompost pits were constucted. 1100 stakeholders covered under CBT during the period.

Manipur: Presently ~5464 families are engaged in mulberry sericulture. Traditional weaving is a major cottage based industry (14,064 silk loom) and demand of indigenous silk products are increasing, the present gap between demand & supply of raw silk in Manipur is about 850 MT. ISDP is being implemented in four valley districts (Imphal east, Imphal west, Thoubal & Bishnupur) and four hill districts (Churachandpur, Chandel, Ukhrul & Tamenglong) of Manipur with an object to promote mulberry sericulture activities under the umbrella of NERTPS. Well established plantation (2500 to 5000 nos) of mixed varieties (predominated by S-1635 & S-1) with 3ft x 4ft / 3ft x 3ft spacing and intercropping of vegetables & pulses. Mounting hall & basic rearing appliances were supported. Capacity of rearing / batch ranges from 50 dfls to 150 dfls with 3 to 4 rearing per year. In IMFW a good number of beneficiaries started 5 rearing /year and converted their cocoon to silk using indigenous reeling system 'Khere'.

Nagaland: 10 SHG (20 beneficiaries each) had been constituted and 10 Mahila Resham Karmis (MRK) were selected for 10 SHGs by the SPV in consultation with SHGs for assistance to the women beneficiaries at the village level. Ten programs for Women Education organized to have knowledge on preliminary reading and writing, women right, child care, hygiene and sanitation by inviting local resource person. Eight (8) Group Discussions were organized at the cluster level for creating general awareness about the role of women and potential of pre-cocoon activities in generating productive employment in rural areas. One month residential training programme on "*Improved Bivoltine Sericultural Technologies*" was organized with 40 very progressive women sericulturists, in CSRTI-BHP (West Bengal) and CSRTI- Mysuru (Karnataka). The expertise and experience of these forty farmers were utilized for providing training on Bivoltine rearing to other 218 farmers. These women beneficiaries were trained under the component by following the standard training module on improved mulberry cultivation practices and rearing technologies. Exposure visits to 100 progressive women sericulturists were undertaken. Fifteen (15) Kissan Nurseries were established with high yielding mulberry varieties (S-1635, BC₂59, TR-10). Accordingly, 450 acres of land at Acuhaiga village of Changpang Block of wokha-District of Nagaland was identified for raising community type of plantation for encouraging group activities and 320 acres of mulberry plantation of high yielding variety has been developed with the help of the beneficiaries. 3 Vermicompost shed of combined or community type were Constructed. The first two Vermicompost shed have 20 (twenty) units each and the third shed have 10 (ten) units respectively, totaling to 50 (fifty) units. Each unit is having composting area of 150 ft³ and in total 7500 ft composting area. NADEP method of composting was adopted where from each NADEP tank approximately 2.5 tons of compost can be prepared within 90-120 days. Accordingly a large size rearing house was constructed measuring 10000 Sq.ft per rearing house(10 rearing houses) with rearing capacity of 2,000 DFLs /rearing house at a total cost of Rs 438.75 Lakhs(Both for rearing house and mounting hall). The construction of rearing house and mounting hall were inspected by a chartered engineer and certified.

Meghalaya: Raw Silk Production scenario in Meghalaya has been changed and the production of the State Raw silk increased to 1213.06 MTs (Mulberry 55.60 MT) during 2020-21 of which 66.01 MT is the production under NERTPS (for Mulberry, Muga and Eri). Prior, farmers could hardly produce 30-35 kg of cocoon per 100 dfls. Cocoon so produced were converted to raw silk through various traditional means. However, the mind set of mulberry farmers has been dramatically changed with the intervention of Central Silk Board under its different units and implementation of NERTPS. The individual Sericulture farmers have been assisted right from raising of Kissan nursery, raising of systematic plantation, scientific rearing house, using disinfecting materials etc besides providing training on latest package of practices and ToTs developed by the Research Institute of Central Silk Board, which was the boost for the farmers to intake more dfls per crop rearing resulting in more cocoon/raw silk production in the State. Under Post Cocoon Sector, setting up of Cocoon Storage Centres, electrical Hot-Air Drier for drying of cocoons scientifically, support for multi-end reeling unit and twisting plant were some of the components under the project to upgrade the sector for qualitative and quantitative products.

Mizoram: ISDP and IBSDP under NERTPS covered 600 beneficiaries under Lunglei District and 1000 women beneficiaries at Champhai District respectively. After fully implementing NERTPS Project, the total production of cocoons produced by the farmers increases by three to four folds and the entire quantity of cocoons so produced in the project area are then converted into reeled yarn. Such silk yarns so produced in Mizoram have been sold outside the state. It is revealed that Sericulture Industry in Mizoram may be one of the best suitable industry having enough scope for marketing as well as an industry that could fetch foreign exchange. Hence, introduction of silkworm rearing among the Mizo people especially in rural areas is necessary for the upliftment of rural economy in the state to generate gainful direct and indirect

employment opportunity. Sericulture could play a key role in the economic development of the state by giving and generating many jobs and in agro-processing or provides livelihood with a regular income to as many from the unprivileged group and is as environment-friendly.

Tripura: ISDP covered 800 acres mulberry plantation with 1150 farmers, developed one reeling Unit (10 basins capacity) along with other machineries, upgraded the existing State Grainage Unit, and established of one Center of Excellence for capacity building. IBSDP @ Dhalai covered 760 farmers by establishing 380 acres mulberry plantation, developed one Reeling unit (10 basins capacity) along with other machineries. IBSDP @ Sepahijala released additional installment for plantation development, construction of rearing house, Kisan nursery and training for field functionaries and beneficiaries. Implementation is on progress.

Assam: IBSDP mulberry project area covered Baksa (Tamulpur & Goreswar), Udalguri (Udalguri) & Chirang regions, 444 acres new S1635 mulberry variety (1000 farmers @ 0.5 acres per farmer) in two Blocks viz. Kalaigaon and Sipajhar of Darrang district of Assam and in three Blocks viz. Tamulpur, Borobazar and Rowta of Baksa, Chirang and Udalguri districts of BTC.



राजभाषा अनुभाग की उपलब्धियाँ (वर्ष 2020- 21)

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर (प.बं.) में वर्ष 2020-21 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 व्यौरा निम्नवत है:

- ✓ **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 रूप से द्विभाषी में जारी किए गए।
- ✓ **हिन्दी पत्राचार:** वर्ष के दौरान 'क', क्षेत्र में स्थित केन्द्र / राज्य सरकार को क्रमशः 85.85%, तथा 'ग' क्षेत्र में स्थित केन्द्रीय सरकार के कार्यालयों को 67.39% पत्र हिन्दी में भेजे गए। इस प्रकार पत्राचार के मद में निर्धारित लक्ष्य से अधिक पत्राचार किया गया।
- ✓ **हिन्दी प्रशिक्षण:** आलोच्य अवधि के दौरान अधिकारियों/कर्मचारियों को हिन्दी शिक्षण के योजना के अधीन प्रशिक्षण कार्य जारी है। अब तक संस्थान के कुल 98.31% अधिकारी/कर्मचारी इस योजना के अर्न्तगत प्रशिक्षित हो चुके हैं।
- ✓ **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 2020-21 के अर्न्तगत राजभाषा कार्यान्वयन समिति की चार बैठकों का नियमित आयोजन क्रमशः दिनांक 19.06.2020, 14.09.2020, 16.12.2020 एवं 22.03.2021 को किया गया तथा बैठक में लिए गए निर्णयों पर अनुवर्ती कार्रवाई की गई।
- ✓ **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 21.09.2020, 17.12.2020 एवं 23.03.2021 को हिन्दी कार्यशाला आयोजित कर संस्थान के कुल 25 पदधारीगण राजभाषा हिन्दी में प्रशिक्षित किए गए तथा आगे भी यह क्रम जारी है।
- ✓ **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 03 अधीनस्थ केन्द्रों में भी हिन्दी कार्यशालाओं का आयोजन किया गया।
- ✓ **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 अर्न्तगत निर्धारितशब्द संख्या हिन्दी में लिखने पर अनुपाततः नगद प्रोत्साहन राशि (महत्तम रु

5000.00) प्रदान की जाती है। हिन्दी दिवस/पखवाड़ा ,2020 के अवसर पर वर्ष 2019-20 के दौरान मूल रूप से हिन्दी में कामकाज करने हेतु कुल 14 पदधारियों को पुरस्कृत किया गया।

- ✓ **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 रूप से हिंदी में लिखित पुस्तकें आवश्यकतानुसार प्रकाशित की जाती है। वर्तमान वर्ष के अंतर्गत संस्थान की वार्षिक वैज्ञानिक एवं प्रशासनिक रिपोर्ट वर्ष 2019-20 का सारांश हिंदी में प्रकाशित करने के अतिरिक्त आलोच्य अवधि के दौरान प्रौद्योगिकी डिस्क्रेटर [हिंदी, अंग्रेजी व बंगला] व निमूल-रेशम कृषि हेतु पर्यावरण व उपयोगकर्ता के अनुकूल एक सामान्य रोगाणुनाशी नामक पैम्फलेट [हिंदी, अंग्रेजी व बंगला] प्रकाशित की गई।
- ✓ **नगर राजभाषा कार्यान्वयन समिति का गठन एवं उसकी बैठकों का आयोजन:** वर्ष 1997-98 के शुरुआत 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 कार्यालयों 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।
- ✓ **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।
- ✓ **हिन्दी प्रतियोगिता का आयोजन:** वर्ष 2020-21 के दौरान दिनांक 01.09.20 से 14.09.20 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 क्रमशः शब्दावली 01/09/2020, निबन्ध 02/09/2020, सुलेख व श्रुतिलेख 04/09/2020 तथा हिंदी टिप्पण व आलेखन प्रतियोगिता 05/09/20 का आयोजन किया गया। प्रत्येक प्रतियोगिता के सर्वश्रेष्ठ प्रतिभागियों को प्रथम, द्वितीय, तृतीय एवं सांत्वना पुरस्कार से पुरस्कृत किए गए।
- ✓ **कंप्यूटर पर हिन्दी में कार्य:** राजभाषा अधिनियम-1963 की धारा 3(3) का अनुपालन, फार्म/प्रपत्र का द्विभाषीकरण, संबद्ध/अधीनस्थ केन्द्रों की तिमाही रिपोर्ट का समेकीकरण एवं अनुभागीय प्रगति रिपोर्ट के तुलनात्मक विवरण आदि के संकलन एवं पत्रिका के प्रकाशन/संपादन का कार्य तथा नगर राजभाषा कार्यान्वयन समिति की गतिविधियों संबंधी कार्य को कंप्यूटर पर सुचारू रूप से किया जा रहा है। राजभाषा कार्यान्वयन के विभिन्न पहलुओं में कंप्यूटर के प्रयोग की शुरुआत 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 सहूलियत एवं गति आई है।

STAFF PROFILE (2020-21) as on March 2021				
Designation	MI	RSRS	REC	Total
Director	1			1
Scientists				
Scientist-D	7	1	7	15
Scientist-C	9	1	1	11
Scientist-B	7	2		9
Technical				
Junior Engineer	2			2
Sr. Technical Asst.	48	16	19	83
Technical Asst.				
Sr. Field Asst.			1	1
Field Asst.	2	3	9	14
Technician	6	1		7
Asst. Technician	4	2		6
Multi Tasking Staff	7	17	11	35
Skilled Farm Worker	38	49	9	96
Skilled Farm Worker(TS)	31	9	32	72
Accounts & Administration				
Deputy Director	1			1
Assistant Director	2			2
Superintendent	1	2		3
Asst. Supdt.	10	3	1	14
Stenographer-Grade-I		1		1
Jr. Translator (Hindi)	1			1
Staff Car Driver Grade-I	1	2	1	4
UDC	3	3		6
Stenographer-Grade-II	1			1
Staff Car Driver Grade-II		1		1
Cook	1			1
Total	183	113	91	387

बजट / Budget 2020-21	
शीर्ष /Head	राशि/ Amount (रु. लाख में/ Rs. in lakhs)
प्लान-वेतन/ Plan-Salary	3150.83
प्लान-सामान्य / Plan-Gen	328.79
प्लान-कैपिटल / Plan-Cap	6.31
उत्तर-पूर्वी- सामान्य / NE-Gen	59.00
उत्तर-पूर्वी - कैपिटल / NE-Cap	9.12
कुल /Total	3554.06

R & D PERSONNEL

<p>Director Dr. V. Sivaprasad</p> <p>CSRTI-BERHAMPORE</p> <p>Scientist-Ds Dr. Dipesh Pandit Mr. Gopal Chandra Das Dr. Lakshmanan Velusamy Dr. Soumen Chattopadhyay Dr. Tapati Dutta (Biswas) Dr. Sukhabrata Sarkar</p> <p>Mr. Debashish Chakravarty [upto Oct-2020] Dr. Anil Kr. Verma [upto Dec-2020] Mr. Gautam Mitra [upto Dec-2020] Dr. Pradeep A.R. [From Feb-2021]</p> <p>Scientist-Cs Dr. Chadranth N Dr. Mahesh R Dr. Manjunatha G. R Dr. Pooja Makwana Dr. Shafi Afroz Dr. Suresh K Dr. Vijay V Dr. Anil Pappachan Dr. Rahul K</p> <p>Scientist-Bs Dr. Aparna Koppurapu Dr. Deepika Kumar Umesh Dr. Mihir Rabha Dr. Parameshwaranaiik, J Dr. Raviraj, V.S Dr. Thangjam Ranjita Devi Mr. Yallappa Harijan Ms. Radha, M. B [upto Sept 2020]</p>	<p>RSRS-KALIMPONG Mr Zakir Hossain, Scientist-D Dr. S. Harish Babu, Scientist-B</p> <p>RSRS-KORAPUT Mr. Khasru Alam, Scientist-B</p> <p>RSRS-JORHAT Mr. P. Kumaresan, Scientist-C</p> <p>REC-MOTHABARI Dr. Satadal Chakrabarty, Scientist-D</p> <p>REC-BHANDRA Dr. G. S. Singh, Scientist-D</p> <p>REC-MAMRING (RONGPO) Techical Assistant</p> <p>REC-DIMAPUR Dr. Karthik Neog, Scientist-D</p> <p>REC-MONGALDAI Mr. B. K. Basumatary, Scientist-D</p> <p>REC-SHILLONG Dr. Collin Z. Renthlei, Scientist-D</p> <p>REC-AIZWAL Dr. L. Pachuau, Scientist-D</p> <p>REC-SILLE Mr. Lohit Sonowal, Scientist-C</p> <p>REC-AGARTALA Dr. Narayan Biswas, Scientist-D</p> <p>ADMINISTRATIVE PERSONNEL Mr. Mirza Ibrahim Baig (DD-A&A; upto April 2020) Mr. Prasad P.K (DD-Computer) Mr. Abdul Latif Qureshi (AD-A&A) Mr. Ram Briksh Choudhary (AD-OL) Mr. Sanatan Tiadi (AD-A&A; upto April 2020) Mr. Sasanka Sekhar Das (AD-A&A; from Jan 2021-Feb 2021)</p>
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RESEARCH ADVISORY COMMITTEE (RAC)

CHAIRMAN

Dr. Chirantan Chattopadhyay
Chairman, Former Vice Chancellor, UBKV, Coochbehar, West Bengal

MEMBERS

Dr. Somnath Bhattacharya Professor, Dept. of Genetics & Plant Breeding, Bidhan Chanadnra Krishi Viswavidyalaya (BCKV), Mohanpur -741 252, Nadia, West Bengal	Prof. R. Varatharajan Department of Zoology (Entomology), Centre of Advanced Study in Life Sciences, Manipur University, Canchipur, Imphal - 795 003, Manipur
Dr. Debabrata Basu Professor & Head, Department of Agricultural Extension, Bidhan Chanadnra Krishi Viswavidyalaya (BCKV), Mohanpur -741 252, Nadia, West Bengal	Dr. S. Nirmal Kumar Director (Rtd)-CSB #1169, II Main, II Cross, SRIRAMPURA, IIStage Mysore -570 023, Karnataka
Commissioner, Textiles & Sericulture Govt. of West Bengal, New Secretariat Building, 6th Floor, Block-A, 1 Kiran Sharkar Ray Road, Kolkata - 700 001, West Bengal	Director of Sericulture Govt. of Manipur, Project Management Complex, Sangaipat, Imphal East, Imphal - 795 004, Manipur
Joint Secretary & Director Deptt. of Handlooms Handicrafts & Sericulture, Govt. of Tripura, Indra Nagar, PO- Kunjaban, Agartala - 799 006, Tripura	Shri. Bikash Chandra Roy Ramesharpur, Debogram, Nalhati, Birbhum -731220, West Bengal
Md. Salauddin Momin S/o Md. Najimuddin Momin, Marupur, Shershahi, Malda-7 3220 1, West Bengal	Director, National Silkworm Seed Organization (NSSO), Central Silk Board, CSB Complex, BTM Layout, Madiwala, Bengaluru - 560 068, Karnataka
Director (Technical) Central Silk Board Madiwala, BTM Layout, Bangalore - 560 068, Karnataka	Scientist-D & Head, Research Coordination Section, Central Silk Board, CSB Complex, BTM Layout, Madiwala, Bengaluru - 560 068 Karnataka

MEMBER CONVENOR

Director, CSRTI-Berhampore

AWARDS & REWARDS

Dr. K. Neog, Scientist-D

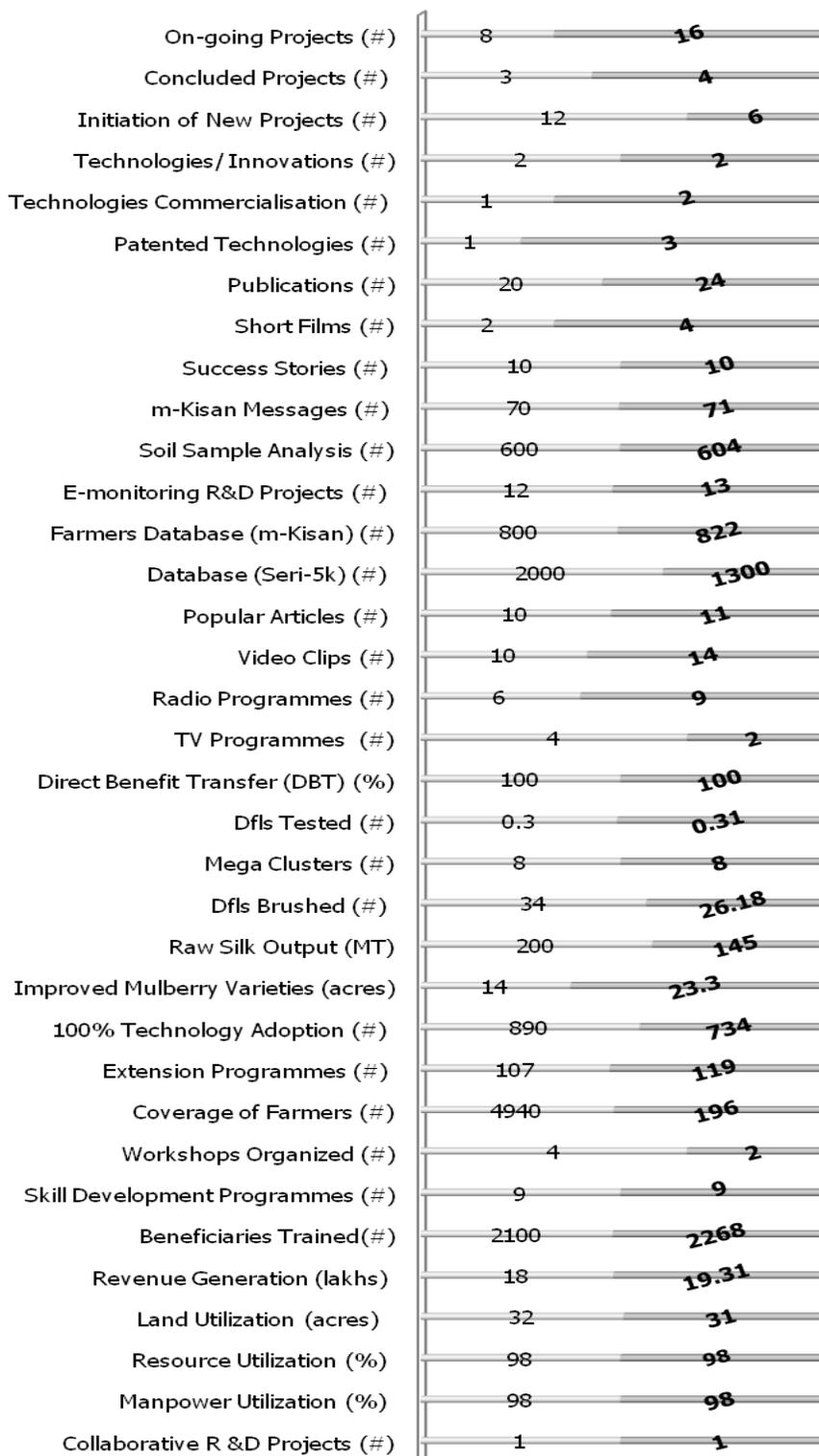
Outstanding Scientist Award (Engineering, Science and Medicine Conference on 6-7 March 2021, Goa-India, organized by VDGGOOD Professional Association)

Dr. Pooja Makwana, Scientist-C

Best Paper Presentation Award (Effect of thermal stress on antioxidant responses in *Bombyx mori*) in online conference VICAFAST-2020 organized by Chemical Science

RFD Highlights (2020-2021)

■ Target ■ Achievement



**केरेउअवप्रसं-बहरमपुर की/ CSRTI-BERHAMPORE'S
आभार-विदाई / GRATEFUL FAREWELL**

पदधारी /Employee	पदनाम /Designation	सेवानिवृत्त/ Retirement
मो. मिर्जा इब्राहिम बेग / Md. Mirza Ibrahim Beig	उप निदेशक (ए एंड ए) / Deputy Director(A&A)	30.04.2020
श्री सनातन तिआदि / Shri Sanatan Tiadi	सहायक निदेशक (ए एंड ए) / Assistant Director(A&A)	30.04.2020
श्रीमती शंपा रॉयचौधरी / Smt. Shampa Roychowdhury	सहायक तकनीशियन / Technical Assistant	30.05.2020 (Expired)
श्री काली किंकर रॉय / Shri Kali Kinkar Roy	सहायक तकनीशियन / Assistant Technician	31.05.2020
श्री दिलीप गांगुली / Shri Dilip Ganguly	सहायक तकनीशियन / Assistant Technician	31.05.2020
श्री विष्णुपाद कुंडू / Shri Bishnupada Kundu	चालक / Driver	31.07.2020 (VR)
श्री देवाशीष आचार्य / Shri Debasish Acharya	वरिष्ठ तकनीकी सहायक / Sr. Tech. Assistant	31.08.2020
श्री अशोक तरु प्रामाणिक / Shri Ashok Taru Pramanik	वरिष्ठ तकनीकी सहायक / Sr. Tech. Assistant	31.08.2020
श्री देवशीष चक्रवर्ती / Shri Debasish Chakravorty	वैज्ञानिक-डी / Scientist-D	01.10.2020 (VR)
श्री बुद्धदेव धर / Shri Buddhadev Dhar	वरिष्ठ तकनीकी सहायक/ Sr. Tech. Assistant	02.11.2020 (VR)
श्री प्रमोद कु. सिन्हा / Shri Pramod Kr. Sinha	सहायक अधीक्षक (प्रशासन) / Asst. Suptd.(Admn.)	06.11.2020 (VR)
श्री गौतम मित्र / Shri Gautam Mitra	वैज्ञानिक-डी / Scientist-D	30.11.2020
डॉ. अनिल कुमार भर्मा / Dr. Anil Kr. Verma	वैज्ञानिक-डी / Scientist-D	31.12.2020
श्री संदीप कु. मुदी / Shri Sandip Kr. Mudi	वरिष्ठ तकनीकी सहायक/ Sr. Tech. Assistant	01.01.2021 (VR)
श्री भोलानाथ पॉल / Shri Bholanath Paul	वरिष्ठ तकनीकी सहायक/ Sr. Tech. Assistant	31.01.2021
श्री रमेश चौ. गोगोई / Shri Ramesh Ch. Gogoi	एम.टी.एस / MTS	31.01.21
श्री शशांक शेखर दास / Shri Sasanka Sekhar Das	सहायक निदेशक (स्टोर) / Assistant Director (Store)	28.02.2021
श्री अरुन खतानियर / Shri Arun Khataniar	एम.टी.एस / MTS	28.02.2021
श्रीमति अन्नपूर्णा मण्डल / Smt Annapurna Mandal	वरिष्ठ तकनीकी सहायक/ Sr. Tech. Assistant	02.02.2021 (VR)
श्री स्नेहांगशु घोषाल / Shri Snehangshu Ghosal	वरिष्ठ तकनीकी सहायक/ Sr. Tech. Assistant	28.02.2021
श्रीमती डाली पॉल / Smt. Dali Paul	अधीक्षक (प्रशासन) / Superintendent(Admn)	18.03.2021 (VR)

PUBLICATIONS

Research Papers

- Alam K, Manjunatha GR, Mishra S K and Sivaprasad V. 2020. Impact of hydrogel with drip irrigation on mulberry production in Odisha. *Sericologia*, 60 (1&2):1-5.
- Alam K, Mishra SK and Sivaprasad V. 2020. Studies on evaluation and identification of suitable bivoltine hybrids (*Bombyx mori* L.) for better productivity in Odisha. *Journal of Pharmacogonosy and Phytochemistry*. 9(4):990-994.
- Bhattacharjya D, Alam K, Bhumali A and Soumen Saha. 2020. Status, potentials, constraints and strategies for development of sericulture farming system in West Bengal state of India (review) *Bulg. J. Agric. Scie.*, 26(4):709-718.
- Chakrabarty S, Manna B and Saha AK. 2021. *Nosema asamensis*: A pathogen causing pebrine disease of muga silkworm and recent strategy adopted for sustainable development of muga culture in North Eastern India. *Journal of Exp. Zoology*, 24:7-13. <https://connectjournals.com/03895.2021.24.7>
- Chandrakanth N, Moorthy SM and Sivaprasad V. 2021. Molecular diversity between two indigenous silkworm races of *Bombyxmori* L. *Munis Entomology & Zoology*, 16(2): 798-806.
- Chinnappa B, Kiran Kumar R Patil, Manjunatha GR and H S Soumya. 2020. Economic Utilisation of Areca Leaf Sheaths for Rural Livelihood. *Indian Journal of Agricultural Economics*, 75(1), 90-110.
- M Kumar, LM Bhar, A Majumder and Manjunatha GR. 2020. Robust Block Designs for Comparing Test Treatment versus control with Correlated Observations. *Journal of the Indian Society of Agricultural Statistics*, 74 (2), 159-164
- Mahesh R, Pappachan A, Chakravarty, D., and Sivaprasad V. 2020. Improved mulberry productivity and resource efficiency through low-cost drip fertigation. *Archives of Agronomy and Soil Science*, 1-5 (<https://doi.org/10.1080/03650340.2020.1852552>)
- Makwana P, Rahul K, Chattopadhyay S and Sivaprasad V. 2021. Effect of thermal stress on antioxidant responses in *Bombyxmori*. *Chemical Science Review and Letters*, (ISSN 2278-6783). 10(38):288-294.
- Manjunatha GR, Patil KKR, Afroz S, Pandit D, Sivaprasad V. 2020. Profitability of Mulberry cocoon production in West Bengal. *Indian Journal of Economics and Development*, 8(3): 22-29.
- Neog K, Dutta P, Das R and Sivaprasad V. 2021. Effects of commonly used plant protection formulations on rearing and cocoon production of muga silkworm *Antheraea assamensis* (Helfer). *Munis Entomology & Zoology*, 16 (1): 331-350.
- Pappachan A, Rahul K, Irene L and Sivaprasad V. (2020). Molecular identification of fungi associated with mulberry root rot disease in eastern and north-eastern India, *Journal of Crop and Weed*, 16(1):180-185.
- Parameswaranaik J, Sarsiim Teron, Manjunatha GR, Radha M B and Sivaprasad V. 2020. Entrepreneurial Behaviour of Ericulture Farmers in Assam (BTC) North-East India. *Journal of Global Communication*, 13 (2):117-122.
- Patil KKR, Chinnappa B, Manjunatha GR. 2020. Comparative economics of mechanical and manual dehusking of Arecanut. *Indian Journal of Economics and Development*, 8(3):1-9.
- Prabhuling S H, Makwana P, Pradeep ANR, Vijayan K and Mishra RK. 2021. Release of mediator enzyme β -hexosaminidase and modulated gene expression accompany hemocyte degranulation in response to parasitism in the silkworm *Bombyxmori*. *Biochemical Genetics*. Doi: <https://doi.org/10.1007/s10528-021-10046-x>.
- Rahul K, Behera GK, Pappachan A, Rabha M and Sivaprasad V. 2021. *Bacillus flexus* isolated from *Harmonia axyridis* (Pallas) causing bacteriosis in *Bombyx mori* L. *Proceedings of International Conference on Advances in Science and Technology*, 219-224.
- Saha S, Alam K, Adhikari S and Ghosh P. 2020. Efficiency and reliability of random DNA markers (RDMs) for evaluation of genetic variability and relationship in ocimum accessions. *Plant Gene* 23. PP.1-17.
- Shafi A, Singh R, Nain M S, Mishra J R, Kumar P, Khan S A and Iquebal M A. 2020. SWOT-Analytic Hierarchy Process (AHP) of Agriclincs and Agribusiness Center (ACABC) scheme; *Indian Journal of Agricultural Sciences*, 91(6):96-100.

- Singh, Amardev, Himntraj MT and Alam K. 2020. Acceleration of natural mounting process in the silkworm (*Bombyx mori* L.) By applying dust formulation of dried eucalyptus leaves. **Journal of Pharmacognosy and Phytochemistry**. Sp 9(4):146-149.
- Sivaprasad V and Manjunatha GR. 2020. ROBEVA-Bm: A Robust Multivariate Evaluation Method for Selecting Silkworm Genetic Resources. **Sericologia**, 60 (3&4):75-95.
- Sivaprasad V, Satish L, Mallikarjuna G, Chandrakanth N, Mary Josepha A V and Moorthy S M. 2021. A field-friendly loop-mediated isothermal amplification (FF-LAMP) method for rapid detection of Nosemabombycis in silkworm, *Bombyxmori*. **Invertebrate Survival Journal**, 18, 66-74. (Impact factor 0.70)
- Suresh K, Yallappa H, Pappachan A, Laskar M, Manjunatha G R, Chakravarthy D and Sivaprasad V. 2021. Selection of mulberry genotypes for rainfed conditions through principal component analysis. **Int. J. Curr. Microbiol.App.Sci.**, 10(01): 2762-2778.
- Vijay V, Mahesh R, Sayantan Manna, Arunima Banerjee, Anil Pappachan, Manjunatha GR, Soumen Chattopadhyay and Sivaprasad V. 2021. Soil nutrient status of mulberry (*Morus* species) growing fields in West Bengal, India. **International Journal of Current Research**, 13(6):18058-18066.

Papers Presented in Conferences/Seminars/Symposia etc. (Online)

International online conference on recent trends in agriculture, biosciences, computer applications, environment & humanities (18-19 Aug 2020 @ Poonch, Jammu & Kashmir)

Alam, K., Singh, A. and Saha, S. 2020. Diversity in cocoon and associated parameters in two different Tasar (*Antheraea mylitta* D.) ecoraces of simlipal Biosphere Reserve, Odisha

International e-Conference on the Effect of COVID-19 Pandemic on Agriculture and Allied Sectors, Society for Science and Nature (SFSN), Lucknow, Rajkiya Engineering College Ambedkar Nager U.P., Oura Prakashan & Books Distributors Pvt. Ltd. (23-24th Aug 2020)

Kartik Neog¹ and V. Sivaprasad. 2020. Impact of Covid-19 on the Sericulture Production in Nagaland.

Manjunatha GR, Kiran Kumar R Patil, Kumaresan P, Parmeswaranaik J, Dipesh Pandit, Sivaprasad V and Chinnappa B. 2020. An Impact Analysis of COVID-19 on Profitability of Sericulture in Karnataka

International Conference on Advances in Food and Agricultural Science and Technology (VICAFast 2020) organised by Chemical Science Review and Letters on 31st October 2020.

Makwana P., Rahul, K., Chattopadhyay, S. and Sivaprasad, V. 2020.. Effect of thermal stress on antioxidant responses in *Bombyx mori*

In AMI-2021 Conference on Microbial World: Recent Development in Health, Agriculture & Environmental Sciences held on 3rd - 5th Feb 2021

Kopparapu, A. and Sivaprasad V. 2021. Simplification of Soil Microbiological techniques to promote technology translation in Agriculture & Allied Sectors.

Abstracts:

International E-Conference on Genetics & Plant Breeding Research in Post Covid-19 era

Yallappa H, Deepika KU, Padmini B, Suresh K., D. Chakravarty and V. Sivaprasad. 2020. Comparative performance of physiological and biochemical traits of different mulberry varieties. p. 104

International E-Conference on Advances and future outlook in biotechnology and crop improvement for sustainable productivity

Suresh K, Yallappa H, Deepika U K, Manjunath G R and Sivaprasad V. 2020. Principle component analysis and selection index for identification of superior mulberry genotypes under rainfed condition. Abs. p. 154.

International E-Conference on "Advances and future outlook in biotechnology and crop improvement for sustainable productivity"

Ramesha, A., Dubey, H., Vijayan, K., Ponnuvel, K.M., Mishra, R.K. and Suresh, K. 2020. Genome wide characterization of MLO genes involved in powdery mildew disease susceptibility in mulberry. p.230.

Popular Articles:

सुभ्रा चंद, शफी अफरोज, विपद कर्मकार, दिब्रयेन्दु सरकार व कणिका त्रिवेदी. 2020. खुले कीट पालन गृह के लाभ, **Indian Silk**. 11(2): 44-46

Afroz S. and Singh, R. 2021. Cultivation of Superfood – Spirulina (Blue Green Algae): An Agribusiness Outlook; **Food & Scientific Report (FSR)**. ISSN-2582-5437

Mahesh R, Debashis C and Sivaprasad V. 2020. Drip Fertigation in Mulberry Sericulture, **Resham Bharti**, CSB, June Issue: 26-27.

Parmeswaranaik J and Manjunatha GR. 2021. A Persons' Dream, Hope & Succession Sericulture in Arunachal Pradesh. **Agriculture Observer**, 2 (2): 69-70.

Saha, A.K., Biswas, T.D., Chakarbarty, S., Das,D., Das, S., and Kumar, N. S. 2020. Open rearing method–New boulevard for sustainable sericulture in West Bengal, **Indian Silk**, 11(3): 6-9

Online Research Programme /Training Programme attended:

Online Basic Course in Mass Spectrometry-based Proteomics (3-4 Aug 2020 by C-CAMP, Bangalore)
Dr. Pooja Makwana, Scientist-C, CSRTI-Berhampore (WB).

Research Methodology on Social Science (10 days w.e.f.01.09.2020 by ICAR & AAU-Anand via CAAST platform)
Dr. Manjunatha GR, Scientist-C, CSRTI-BHP (WB)

Efficient Tools for Effective Research Communication and Publication (12-14 June by WFPC-USA)

Leadership & Team Building (17th June 2020 by NPC, New Delhi)

Stress Free Success by Enhancing Personal Productivity (18th June 2020 by NPC, New Delhi)

IMMUNO - Nutrition, Wellness Management & Livelihood Change (3-5 July 2020 by AICRP on Women in Agriculture, Assam Agricultural University, Jorhat In association with ICAR- CIWA, Bhubaneswar)

Response of the Start Up Community to COVID-19 (6 July 2020 by Dept of Biotech, GOI)

Emotional Intelligence at Workplace for Scientists/ Technologists (21-25 Sept 2020 by DST-New Delh)

1st Eri Silk Village of Umden-Diwon (12th Feb 2021 by Department of Textiles, Nagaland)

Extension Management Approaches for promotion of Sericulture Industry (24-26 March 2021 by MANAGE)

Dr. K. Neog, Scientist-D, REC-Dimapur

Extension Management Approaches for Promotion of Sericulture Industry (15-18 Dec 2020 NIAEM-Hyd)

Dr. C.Z Renthelie, Sci-D, REC-Shillong

Dr. L. Pachao, Sci-D, REC-Aizwal

Dr. P Kumareson, Sc-C, RSRS-Jorhat

Development of Resource Person (25th Feb 2021 by District Sericulture Officer, West Jaintia Hills and 8th March 2021 by District Sericulture Officer, Ri-Bhoi)

Dr. C.Z. Renthelli, Scientist-D, REC-Shillong.

Mr. P. Kumareshan, Scientist-C, RSRS, Jorhat, Assam

Manuals/Books/Book Chapters

Manjunatha GR, Kiran Kumar R Patil, Kumaresan P, Parmeswaranaik J, Dipesh Pandit, Sivaprasad V and Chinnappa B. 2020. Impact Analysis of COVID-19 on Profitability of Sericulture in Karnataka, *Effect of COVID-19 pandemic on Agriculture & Allied Sciences* (ISBN: 978-81-935728-8-7). Oura Prakhshan & Book Pvt. Ltd. Pp.174-181.

Rahul K, Manjunatha GR and V Sivaprasad. 2021. Pebrine monitoring methods in sericulture, **Methods in Microbiology** (ISBN: 978-0-12-821145-8), Elsevier. Vol.49, Pp.79-95

Chandrakanth N, Makwana P, Satish L, Mihir R & Sivaprasad V. 2021. Molecular approaches for detection of pebrine disease in sericulture. **Methods in Microbiology** (ISBN: 978-0-12-821145-8), **Elsevier**. Vol.49, Pp.47-77.

Sivaprasad V, Rahul K and Pooja M. 2021. Immunodiagnosis of silkworm diseases, **Methods in Microbiology** (ISBN: 978-0-12-821145-8), **Elsevier**. Vol.49, Pp.27-46.

CSRTI-Berhampore Magazine/Books

News & Views - Half Yearly R&D News Bulletin [English/Hindi; Vol.14 (1&2); 2020-21

East & North East Mulberry Sericulture Technology Descriptor CSRTI-Berhampore Publisher.pp.60 (English/Hindi/Bengali)

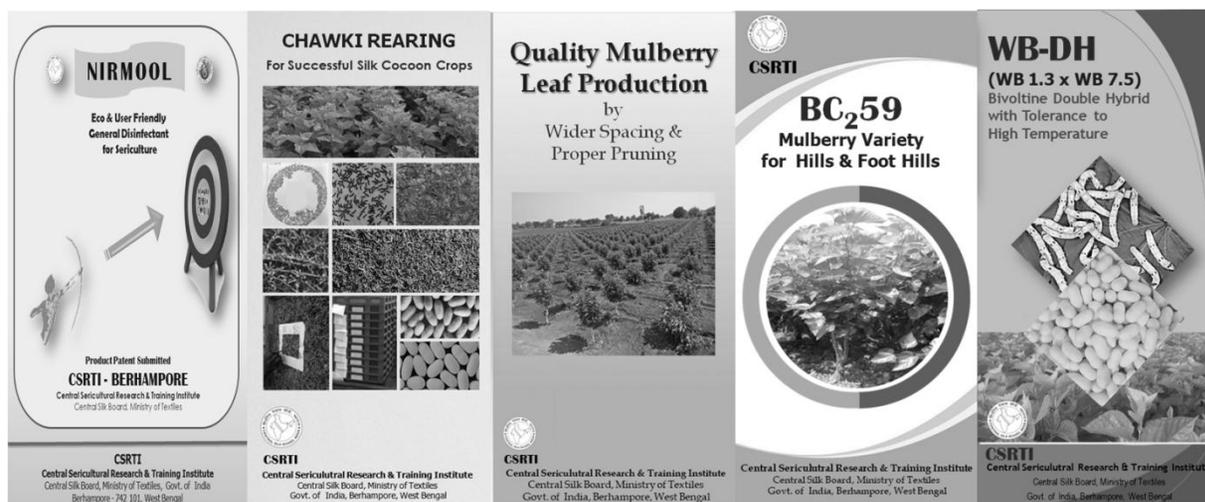
Sericulture Success Stories Eastern & North Eastern States CSRTI-Berhampore Publisher.pp.56.

Sequences pulished in NCBI

Accession number	Identified organism	Source	Scientists involved
MW774362	<i>Fusarium solani</i>	Mulberry root (Pipulkhola, West Bengal)	Anil Pappachan, Raviraj,V.S., Sahdeb,R., Rahul,K. and Sivaprasad, V
MW774361	<i>Fusarium solani</i>	Mulberry root (Kanupur, West Bengal)	
MW774359	<i>Fusarium solani</i>	Mulberry root (Balashpur, West Bengal)	
MW774360	<i>Lasiodiplodia theobromae</i>	Mulberry root (Balashpur, West Bengal)	

PAMPHLETS

- Nirmool Eco & User Friendly General Disinfectant for Sericulture
- Chawki Rearing For Successful Silk Cocoon Crops
- BC259 Mulberry Variety for Hills & Foot Hills
- Quality Mulberry Leaf Production by Wider Spacing & Proper Pruning
- WB-DH (WB 1.3 x WB 7.5) Bivoltine Double Hybrid with Tolerance to High Temperature



METEOROLOGICAL DATA

CSRTI-BERHAMPORE						RSRS-JORHAT					RSRS-KALIMPONG				
Months	Temp(°C)		RH (%)		Rainfall (mm)	Temp(°C)		RH (%)		Rainfall (mm)	Temp(°C)		RH (%)		Rainfall (mm)
	Max	Min	Max	Min		Max	Min	Max	Min		Max	Min	Max	Min	
Apr-20	36	23	76	63	136	28	17	87	52	238	29	13	99	29	
May-20	36	24	81	71	205	31	21	96	52	295	29	16	98	47	
Jun-20	36	26	79	71	86	32	22	94	66	347	31	18	100	50	
Jul-20	35	27	87	77	212	32	20	94	62	622	32	21	100	58	
Aug-20	35	26	82	76	174	37	23	99	64	316	35	20	100	50	
Sep-20	34	27	86	80	43	36	20	97	69	314	34	19	100	38	
Oct-20	34	25	86	79	22	36	22	97	71	188	32	15	100	19	
Nov-20	29	15	91	80	0	29	18	92	40	34	29	10	97	21	
Dec-20	26	11	84	76	0	28	16	84	36	3	27	9	99	26	
Jan-21	23	10	82	58	0	21	17	91	72	20	25	8	100	26	
Feb-21	29	14	75	65	0	23	17	91	78	3	28	8	99	19	
Mar-21	36	18	67	51	0	27	17	92	62	74	29	11	100	10	
Total/Avg	32	20	81	71	878	30	19	93	60	2455	30	14	99	33	
RSRS-KORAPUT						REC-MOTHABARI					REC-DIMAPUR				
Apr-20	33	20	91	24	70	41	20	91	53	24	32	23	92	63	0
May-20	36	21	92	31	230	41	23	86	56	139	36	26	93	44	35
Jun-20	31	21	99	54	171	40	19	89	56	211	36	30	93	75	57
Jul-20	30	21	95	70	116	43	21	93	58	98	36	30	100	78	81
Aug-20	30	21	100	71	369	37	20	88	62	56	36	32	100	80	38
Sep-20	29	21	100	70	181	38	21	93	61	216	35	31	100	79	63
Oct-20	28	17	98	47	154	35	21	92	68	54	32	26	93	70	84
Nov-20	27	13	93	42	6	35	21	92	63	20	30	22	85	50	0
Dec-20	24	10	95	25	6	24	12	91	67	0	29	17	82	48	0
Jan-21	26	12	91	22	18	32	10	89	61	0	26	16	91	53	0
Feb-21	30	11	90	11	12	28	13	88	53	0	22	16	91	45	0
Mar-21	34	16	91	19	14	33	15	93	57	0	23	20	83	72	7
Total/Avg	30	17	94	40	1348	36	18	90	60	817	31	24	92	63	365
REC-AIZWAL						REC-MANGALDOI					REC-SHILLONG				
Apr-20	27	8	80	72	96	36	16	91	55	204	24	8	97	48	80
May-20	29	18	65	52	108	36	20	92	58	532	24	12	98	41	371
Jun-20	28	20	80	68	290	37	22	92	65	494	26	13	100	63	898
Jul-20	28	21	87	78	218	37	25	92	62	293	30	18	100	73	1138
Aug-20	28	3	87	79	256	38	24	85	61	169	27	18	98	62	478
Sep-20	29	21	83	74	157	37	23	92	63	208	26	18	97	64	140
Oct-20	29	20	81	74	238	35	22	92	65	118	28	16	97	69	385
Nov-20	30	21	84	74	385	29	14	91	64	0	26	9	98	67	80
Dec-20	27	16	75	66	33	27	10	89	62	0	24	5	96	76	1
Jan-21	25	11	82	73	3	25	09	89	60	14	23	5	92	69	0
Feb-21	27	11	77	67	1	30	10	89	50	0	19	4	98	21	0
Mar-21	31	15	63	51	61	27	15	90	52	0	22	7	86	30	3
Total/Avg	28	15	79	69	1846	33	17	90	60	2033	25	11	96	57	3575
REC-SILLE															
Apr-20	21	20	92	57	21										
May-20	28	23	98	69	28										
Jun-20	29	24	96	78	29										
Jul-20	29	26	99	85	29										
Aug-20	32	27	96	78	32										
Sep-20	30	26	99	83	30										
Oct-20	31	20	93	75	31										
Nov-20	25	20	95	71	25										
Dec-20	21	15	96	68	21										
Jan-21	21	13	92	68	21										
Feb-21	23	16	95	52	23										
Mar-21	26	20	98	63	26										
Total/Avg	26.3	20.83	95.7	70.58	26.33										

Mulberry Agerage (ha) in East & North East India						
States	2016-17	2017-18	2018-19	2019-20	2020-21(P)	Growth Rate
Arunachal Pradesh	100	140	300	278	218	1.18
Assam & BTC	7898	8594	2783	2539	2653	-0.66
Bihar	421	557	598	577	530	0.26
Chhattisgarh	322	261	261	242	244	-0.24
Jharkhand	372	472	502	606	545	0.47
Manipur	7548	3590	3300	3300	3291	-0.56
Meghalaya	3209	3209	3209	3289	3300	0.03
Mizoram	4009	4094	4094	1698	1658	-0.59
Nagaland	290	290	394	694	570	0.97
Odisha	686	464	537	537	465	-0.32
Sikkim	198	185	185	300	179	-0.10
Tripura	2450	2184	1935	2064	1944	-0.21
West Bengal	15990	16480	15400	15721	15853	-0.01
India	216810	223927	235001	239676	237578	0.10
E & NE Share (%)	20%	18%	14%	13%	13%	

Mulberry Raw Silk Production (MT) in East & North East India						
States	2016-17	2017-18	2018-19	2019-20	2020-21(P)	Growth Rate
Arunachal Pradesh	2	2.3	3	3	1	-0.30
Assam & BTC	52	59	69	69	16	-0.69
Bihar	23	17	8	2	2	-0.90
Chhattisgarh	8	8.3	9	8	8	-0.06
Jharkhand	1	3	3	3	1	0.01
Manipur	161	92.5	137	150	111	-0.31
Meghalaya	28	39	49	54	56	0.98
Mizoram	65	75	83	93	37	-0.42
Nagaland	8	12	13	12	6	-0.25
Odisha	3	3	3	2	1	-0.79
Sikkim	6	0.001	0.4	1	0.08	-0.99
Tripura	75	87	230	94	112	0.50
West Bengal	2524	2570	2365	2428	850	-0.66
India (Mulberry Silk)	21273	22066	25345	25384	23896	0.12
E & NE Share	14%	13%	12%	11%	5%	
India (Raw Silk)	30348	31906	35468	36152	33739	0.11
Mulberry Silk Share	70%	69%	71%	70%	71%	