ANNUAL REPORT

2020-21

Central Muga Eri Research & Training Institute

Central Silk Board, Ministry of Textiles, Government of India

Lahdoigarh, Jorhat-785 700, Assam, INDIA

वार्षिक प्रतिवेदन
ANNUAL REPORT
2020-2021

केन्द्रीय मूगा एरी अनुसंधान व प्रशिक्षण संस्थान
Central Muga Eri Research and Training Institute
केन्द्रीयरेशमबोर्डCentral Silk Board

वस्त्र मंत्रालय, भारत सरकार Ministry of Textiles, Govt. of India

लाहदोईगढ़, जोरहाट-785700,

असम Lahdoigarh, Jorhat-785700, Assam

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Our Vision

To emerge as an international research institute of excellence for Muga, Eri and Oak Tasar culture to ensure higher productivity and growth in sericulture

Our Mission

To achieve excellence in application oriented research for transforming the Muga, Eri and Oak Tasar industry from the subsistence level of production to a vibrant commercial base

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प्रस्तावना

संस्थान की वर्ष २०२०-२१ की वार्षिक रिपोर्ट का प्रकाशन करते हुए मुझे बहुत खुशी हो रही है। यह रिपोर्ट केन्द्रीय मूगा एरी अनुसंधान एवं प्रशिक्षण संस्थान ,लाहदोईगढ, जोरहाट की गतिविधियों और उपलब्धियों का पूरे साल का सारांश है। हमारा संस्थान दो दशकों से रेशम किसानों/लाभार्थियों की सेवा करने और पूर्वोत्तर भारत में वन्या रेशम मूगा , एरी और ओक तसर विकास के इतिहास का एक हिस्सा रहा है। कुल वन्या रेशम उत्पादन को बढ़ाने में, किसानों और अन्य लाभार्थियों की मदद करने में हमें बहुत अधिक संतुष्टि मिलती है। हमने कई तकनीकों का विकास और उनका सफलतापूर्वक व्यवसायीकरण भी किया है।मैं इस अवसर पर सभी वैज्ञानिकों और संस्थान के अन्य सहायक कर्मचारियों के सहयोग को याद करती हूँ, और उन सभी लाभार्थियों/किसानों को भी जो नई तकनीकों को अपनाते हैं और जो मूगा, एरी और ओक तसर रेशम उत्पादन को बढ़ाने मे मदद करते हैं।यद्यपि वन्यारेशम के क्षेत्र में अनुसंधान और विकास में एक महत्वपूर्ण प्रगति हुई है, लेकिन ज्वलंत मुद्दों को संबोधित करने के लिए अभी एक लंबा रास्ता तय करना है लेकिन बदलती जलवायु और बढ़ते प्रदूषण के कारण अनुसंधान और रेशम उत्पादन कार्य को और अधिक चुनौतीपूर्ण बनाती है। इन सभी को ध्यान मे रखते हुए, संस्थान ने अधिक उपज देने वाले मूगा, एरी और ओक तसर रेशम कीटों की वेराइटी को विकसित करना, उन्नत किस्मों के मेजबान/खाद्य पौधोंको विकसित करना, रेशम कीट पालन पर जलवायु परिवर्तन के प्रभाव का अध्ययन करना तथा वन्या रेशम कीटों के रोगों को बेहतर प्रबंधन इत्यादि के लिए नए परियोजनाओं की शुरुआत की गयी है।

रेशमकीट प्रभाग ने अनुसंधान और विकास में एक महत्वपूर्ण प्रगति की है। फ़्लचरी रोग प्रबंधन के लिए एक रासायनिक सूत्रीकरण विकसित किया गया है जिससे कोकून/कोसा उत्पादन में काफी सुधार हुआ है। मूगा पारिस्थितिकी तंत्र मे पेब्रिन संक्रमण का क्रॉस संक्रामकता का अध्ययन किया और पाया गया कि कुछ कीट पेब्रिन स्पोरेस के वाहक हैं जो मूगा रेशम कीट को भी संक्रमित कर सकते हैं।मूगा संरक्षण के लिए निर्धारित इन-सीटू स्थान पर मूगा रेशम को संरक्षण करने के लिए प्रयास किए जा रहे हैं। रोगों के पूर्वानुमान और पूर्वाभास को एहतियाती उपाय करने के लिए किसानों को नियमित रूप से संदेश भेजे जा रहे हैं।

मेजबान/खाद्य पौध प्रभाग द्वारा लगातार वन्या रेशम कीटों के खाद्य पौधो की गुणवत्ता और मात्रा को बढ़ाने के दिशा में काम किया जा रहा है। एरी रेशम कीट के लिए पूरे साल अंडी पत्तों की उपलब्धता के लिए परियोजना की शुरुआत की गयी है। तीन कृषि जलवायु क्षेत्रों मे मूगा रेशम खाद्य पौधा सोम का विभिन्न मौसम मे फाइटोकेमिकल विविधता और पत्तियोंकी गुणवत्ता का अध्यन्न किया गया जा रहा है। पूर्वोत्तर भारत के विभिन्न क्षेत्रों की मिट्टी की गुणवत्ता का आकलन करने के लिए मृदा परीक्षण भी जारी है।

जैव प्रौद्योगिकी प्रभाग द्वारा विभिन्न परियोजनाओं पर काम किया जा रहा है जो अंततः पूर्वोत्तर भारत में वन्या रेशम को बेहतर बनाने में मदद करता है। नागालैंड से एकत्रित जंगली रेशम कीटों के डीएनए अनुक्रम का बारकोडिंग पूरा हो गया है। मूगा रेशम कीट के पेट मे उपस्थित माइक्रोबायोटा पर आहार प्रभाव के अध्ययन की शुरूआत की गयी है। मूगा रोग प्रारंभिक चेतावनी प्रणाली को सिल्क्स पोर्टल के साथ लिंक करने से दस दिन पहले फ़्लचरी रोग की प्रारंभिक चेतावनी के

लिएप्रणाली विकसित किया गया है।एरी रेशमकीट अंडों को लंबे समय तक संरक्षण करने लिए एक पद्धति को मानकीकृत किया गया है।

इस वर्ष प्रशिक्षण प्रभाग ने मूगा और एरी रेशम की नई तकनीकों और पद्धतियों पर किसानों, अधिकारियों, छात्रों और गैर-सरकारी संगठनों के सदस्यों के लिए प्रशिक्षण कार्यक्रमों को सफलतापूर्वक पूरा कर के लक्ष्य को हासिल किया है। विस्तार प्रभाग ने बड़ी संख्या में किसानों को कवर करते हुए कुल 103 विस्तार संचार कार्यक्रम इस साल पूरे किए हैं। रेशम मोडल गांव कार्यक्रम के तहत नई कीट पालन तकनीकी और प्रौद्योगिकियों का प्रदर्शन किया गया है।

केन्द्रीय मूगा एरी अनुसंधान एवं प्रशिक्षण संस्थान और इसकी नेस्टेड इकाइयों ने अपने-अपने लक्ष्यों की प्राप्ति के लिए सरहनीय कार्य कर रही हैं। आर.एस.आर.एस., इम्फाल ने ओक तसर रेशम के कीड़ों से संबंधित अनुसंधान और विस्तार गतिविधियों में सबसे आगे रहा है। आर.एस.आर.एस., बोको निचले असम के रेशम किसानों के साथ-साथ पश्चिम बंगाल के किसानों की जरूरतों और उनकी मदद करने के लिए तत्पर रहता है। आर.ई.सी. ने मूगा और एरी कोकून उत्पादन बढ़ाने में किसानों की मदद करते हुए इस वर्ष के लिए अपने लक्ष्य हासिल किए हैं।

मैं अनुसंधान सलाहकार समिति (Research Advisory Committee) के अध्यक्ष और सभी सम्मानित सदस्यों को उनकी बहुमूल्य जानकारी और सहयोग के लिए तथा नई परियोजनाओं के शुरूआत के साथ-साथ अनुमोदित परियोजनाओं के सुचारू संचालन के लिए आभार और धन्यवाद देती हूँ। केन्द्रीय मूगा एरी अनुसंधान एवं प्रशिक्षण संस्थान के विकास के लिए सहायता प्रदान करने के लिए केंद्रीय रेशम बोर्ड, बैंगलोर के सक्षम प्राधिकारी का भी धन्यवाद करती हूँ।मैं विकास और विस्तार संचार कार्यक्रमों को सभी पूर्वोत्तर भारतीय राज्यों के रेशम विभागों द्वारा सफलतापूर्वक लागू करने के लिए दिये गए समर्थन को ईमानदारी से स्वीकार करती हूँ और उनकी सराहना भी करती हूँ। सहयोगी संस्थानों और अनुसंधान फंडिंग एजेंसियों द्वारा विस्तारित समर्थन की बहुत बहुत सराहना करती हूँ।

पूर्वोत्तर भारत एक अनूठी जगह है क्योंकि यह क्षेत्र रेशम का गढ़ है जहाँ चार प्रकार के रेशम मुगा, एरी, तसर और शहतूत को महत्तव दिया जाता है और इनका पालन भी किया जाता है। केन्द्रीय मूगा एरी अनुसंधान एवं प्रशिक्षण संस्थान के साथ ओक तसर रेशम के अनुसंधान और विकास को भी शामिल करने के साथ, हमारी जिम्मेदारी और भी बढ़ गई है।

केन्द्रीय मूगा एरी अनुसंधान एवं प्रशिक्षण संस्थान के दो दशकों के अस्तित्व के बाद, यह पारंपरिक मूगा और एरी रेशम संस्कृति के संरक्षण की आवश्यकता के लिए चौमुखी चौराहे पर खड़ा है, साथ ही साथ और नई तकनीकों को जो पूर्वोत्तर भारत के रेशम किसानों लिए उपयुक्त हो के विकास की जिम्मेदारी को भी साथ लिए हुए है।हम इसे हासिल करने की दिशा में प्रयास कर रहे हैं।

कोविड-19 महामारी की शुरुआत, पूर्ण लॉकडाउन और कर्मियों की आवाजाही के प्रतिबंध के साथ यह वर्ष समाप्त हुआ। मैं एक बड़ी उम्मीद के साथ यह आशा करती हूँ कि इस महामारी से रेशम किसानों का जीवन तथा सम्पूर्ण रेशम अर्थव्यवस्था प्रभावित न हो।

के एम वि कुमारि

(डॉ. के. एम. विजया कुमारी)

निदेशक

FOREWORD

It gives me immense pleasure to bring you the Annual Report for the year 2020-21, which summarizes the activities and achievements of the Central Muga Eri Research and Training Institute (CMER&TI) during the year. We have just past three decades of existence of the institute, serving the stakeholders and being a part of the history of Vanya sericulture growth in Northeast India. There is a deep sense of satisfaction in helping farmers and other stakeholders in enhancing the total Vanya silk production. Several technologies have been developed and successfully commercialized. I take this opportunity to remember the hard work of scientists and cooperation of other supporting staff of the institute, and also the stakeholders who adopted the new techniques. All this have helped in increasing the raw silk production in muga, eri and oak tasar sector. Though a significant progress has been made in research and development in the area of Vanya sericulture, there is a long way to go to address the burning issues. The changing climate makes the task much more challenging. With these points in mind the institute has initiated new projects such as breeding high yielding varieties of muga and eri silkworms, developing better host plants of vanya silkworms, studying the effect of climate change on rearing performance, understanding the diseases of vanya silkworms for better management, etc.

The silkworm division has made a significant progress in research and development. A chemical formulation has been developed to control flacherie disease in Muga silkworm during summer crops. Cross infectivity of pebrine in muga ecosystem has been studied and found that some pests carry Nosema spores that can infect muga also. Efforts are being made for *in situ* conservation of muga germplasm. Disease forecasting and forewarning is being carried and regular messages are being sent to farmers to take precautionary measures.

The host plant division is working towards increasing the availability of both quantity and quality leaves to Vanya silkworms. Castor improvement program has been initiated to make the host plants available to eri farmers throughout the year. Phytochemical diversity of som plants from three agro-climatic zones revealed region and season specific differences in quality of leaves. Nutrientcorrection has been recommended fordifferent season in different agroclimatic zones as well as all the possible district of muga growing northeastern states therough extension communication programs (ECPs). The long-term district-wise weather data has been collected and processed for all the district of Assam. The petroleum affected muga culture soil and plants have been documented and the mitigation measure has been identified.

The biotechnology division is working on various projects that eventually help in improving the Vanya sericulture in Northeast India. DNA sequence based barcoding of wild silkworms collected from Nagaland has been completed. A new study on dietary impact on gut microbiota of muga silkworms has been initiated. Muga Diseases Early Warning System (MDEWS) linking with SILKS portal has been developed for early warning of flacherie

disease 10 days in advance. Eri silkworm egg preservation schedule has been standardized for prolonging the egg incubation time.

The training division has been successful in achieving the target for the year in training the stakeholders including farmers, officials, students and NGO members in new technologies in muga and eri culture. The extension division (SEEM) has conducted maximum possible Extension Communication Programmes with wide coverage of farmers. Under SMV programme new rearing technologies have been demonstrated.

The nested units of CMER&TI have been working towards the achievement of their respective targets. RSRS, Imphal has been in forefront on research and extension activities pertaining to oak tasar silkworms. RSRS, Boko, has been catering to the needs of seri-farmers of lower Assam as well as of West Bengal. RECs have achieved the targets for the year, helping farmers in increasing the cocoon production.

I take this opportunity to thank the Chairman and members of Research Advisory Committee for their valuable inputs and support in initiation of new projects as well as smooth running of approved projects. I also thank the Competent Authority of Central Silk Board, Bangalore for providing support for development of the CMER&TI. I sincerely acknowledge and appreciate the support extended by the Department of Sericulture of all Northeast Indian states in implementing developmental and extension communication programmes. The support extended by the collaborating institutes and research funding agencies is highly appreciated.

Northeast India is a unique place as far as sericulture is considered, as it is home to all four kinds of sericulture, namely muga, eri, tasar and mulberry. CMER&TI is fortunate to work on three of these silks. With the recent inclusion of research and development of oak tasar silkworms into CMER&TI mandate, the responsibility has increased further. After two decades of existence, the CMER&TI is at crossroads with the requirement of the preserving traditional muga and eri culture, and also with the responsibility of development of newer technologies that are suitable for seri-farmers of the Northeast India. We are striving towards achieving this.

The year was highly affected by COVID-19 pandemic and near complete lockdown restricting the movement of personnel. I would like end this foreword with a high hope that the pandemic will not significantly affect the lives of seri-farmers and also the overall seri-economy of Northeast India.

(Dr. K.M. Vijaya Kumari)
Director

CMER&TI, LAHDOIGARH AT A GLANCE

Established by Central Silk Board (CSB), Ministry of Textiles, Govt. of India in 1999, Central Muga Eri Research & Training Institute (CMER&TI) has been the premier R&D centre catering to the needs of vanya sericulture industry in Northeast India. Situated in Northeast India, a proud producer of all types of vanya silks, CMER&TI focuses mainly on R&D activities in muga, eri and oak tasar culture. The institute is strengthening the infrastructural facilities in recent years for conducting research in the frontier areas. The main objectives of the institute are to evolve new technologies for increasing the productivity of muga, eri and oak tasar silkworms and thereby transforming these cultures from the state of traditional culture to a profit making and sustainable enterprises.

The institute is located at Lahdoigarh, 16 km east of Jorhat, Assam, well connected with road. It has extension units in the North Eastern States, West Bengal and Uttar Pradesh. Scientists are working in close coordination towards the development of farmer friendly technologies, their application in field, evaluation and fine tuning of the technologies and its dissemination. Research and Developmental activities of this institute are carried out undersixdivisions.There is a Project Monitoring Cell (PMC) in the institute for planning and monitoring of the institutional R&D activities. The administrative activities are carried out by ten sections *viz*., Establishment, Accounts & Bill, Stores and Purchase, Library, Vehicle, Construction, Labour, Computer, Hindi and Receipt & Dispatch.

To facilitate effective transfer of technologies developed by the institute and their validation in the fields, two Regional sericulture Research Stations (RSRS) viz., RSRS Boko, Assam, and RSRS Imphal, Manipur alongwith three Research Extension Centres (REC) have been established. The regional stations are located in major sericulture zones to carry out region and season specific research and to facilitate test verification and effective dissemination of laboratory findings to the field. The research station situation at Boko is dedicated to Muga related research while the research station at Imphal is dedicated to Oak tasar. The regional stations, along with the RECs under their control, are working towards identification of technologies suitable to regional needs and their diffusion to field. RECs for muga are located at Coochbehar (West Bengal) and Lakhimpur (Assam). Field labolarory T. Khullen under the control of RSRS Imphal is sharing the responsibility of transferring the technologies to the beneficiaries involved Oak tasar sericulture.

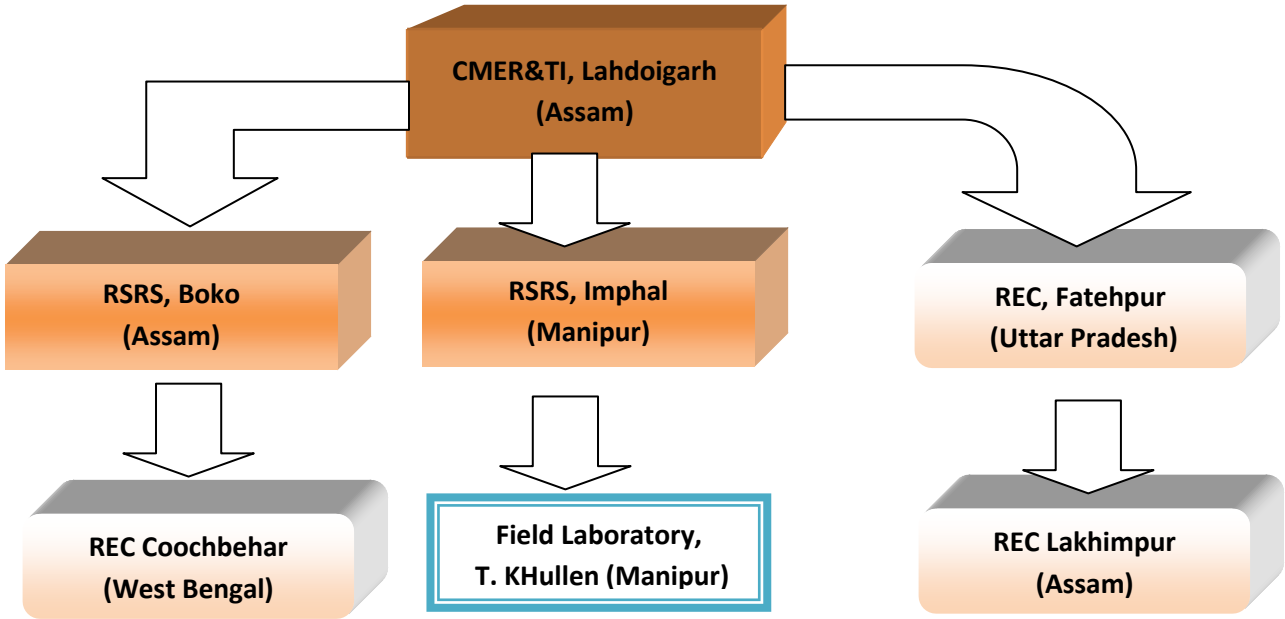
MANDATE OF THE INSTITUTE

- To act as an apex Research Institute for providing R&D support for muga, eri and oak tasar sericulture.
- To conduct basic, strategic and applied research to increase production and productivity of silkworms and their host plants.
- Improvement of food plants and silkworm eco-races and hybrids.
- To conduct socio-economic research for assessing sustainability of newly developed technologies.
- To percolate the research findings to the end users through extension and training mechanism.

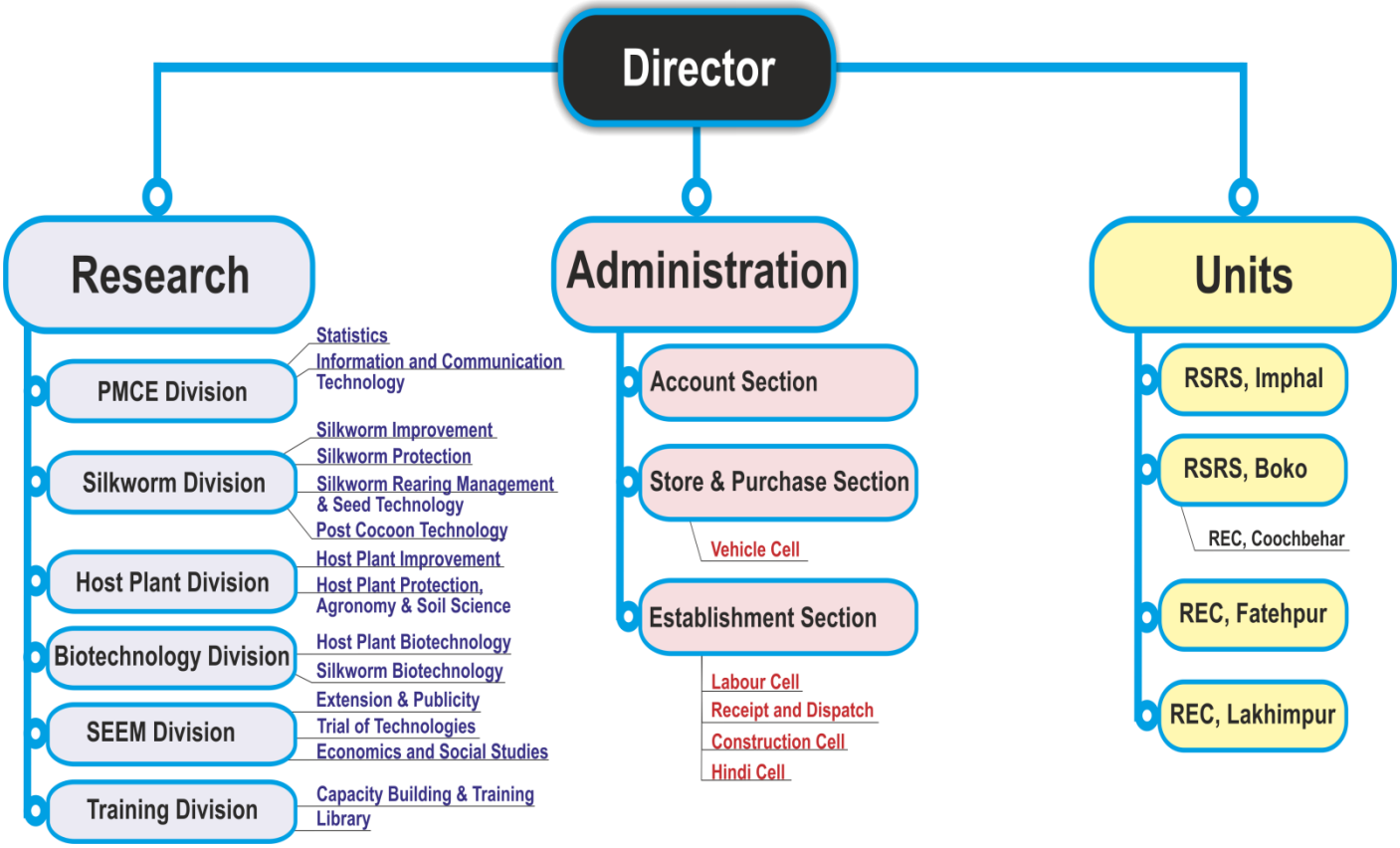
HUMAN RESOURCES

Director	01
Scientists	23
Technical staff	45
Administrative Staff	24
Supporting Staff	31
Total Staff	**124**

EXTENSION NETWORK



ORGANIZATIONAL SETUP



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DELEGATED AND NON-DELEGATED UNITS OF CMER&TI

Delegated Units

- Central Muga Eri Research & Training Institute, Lahdoigarh, Assam (Main Institute)
- Regional Sericulture Research Station, Boko, Kamrup, Assam
- Regional Sericulture Research Station, Imphal, Manipur

Non-Delegated Units

- Research Extension Centre, Coochbehar, West Bengal
- Research Extension Centre, Lakhimpur, Assam
- Research Extension Centre, Fatehpur, Uttar Pradesh

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Member Convener
Director, CMER&TI, Lahdoigarh, Jorhat - 785700, Assam

Research Advisory Committee held on 09th Jan 2021.

मुख्य उपलब्धियों का विवरण (२०२०-२१)

अनुसंधान और विकास में प्रमुख उपलब्धियां

२०२०-२१ के दौरान, २१ अनुसंधान परियोजनाएं की गईं, जिनमें से ३ परियोजनाएं डी.बी.टी. वित्त पोषित हैं, ३ परियोजनाएं डी.एस.टी. वित्त पोषित हैं , १ परियोजना एन.ई.आर.टी.पी.एस. वित्त पोषित है और शेष सी.एस.बी. वित्त पोषित हैं। तीन परियोजनाओं को पूरा किया गया , ३ नई शुरू की गईं और शेष ११ परियोजनाएं पिछले वर्ष से जारी रखी जा रही हैं। सभी शोध परियोजनाएं अलग-अलग वर्गीकरण के तहत हैं , जैसे पर्यावरणीय चुनौतियां और ग्लोबल वार्मिंग , कठिन परिश्रम में कमी और महिलाओं के अनुकूल प्रौद्योगिकियां , इनपुट लागत में कमी , पर्यावरण के अनुकूल और जैविक खेती इत्यादि। शोध कार्यों का एक संक्षिप्त हाइलाइट नीचे प्रस्तुत किया गया है:

खाद्य **पादप सुधार, उत्पादन और संरक्षण**

- अरंडी जीन पूल को उत्तर पूर्व और देश के अन्य हिस्सों से २२ अरंडी एसेसंस संग्रहों से समृद्ध किया गया था ताकि बारहमासी पौध बनाया जा सके। बेहतर विशेषताओं के साथ एक बारहमासी अरंडी किस्म विकसित करने के उद्देश्य से चयनित संभावित बारहमासी एसेसंस और खेती की गई एसेसंस को १२ विभिन्न क्रॉस संयोजनों किया गया था।
- सोम पौधे में पादप-रासायनिक विविधता मूल्यांकन के द्वारा इसकी खेती पर विभिन्न पर्यावरणीय और अकारक परिस्थितियों के प्रभाव पर अध्ययन किया गया है। अधिक गुणवत्ता वाली सोम पौधे की पत्तियों के उत्पादन के लिए उपयुक्त मिट्टी में सुधार करने का अध्ययन किया गया है।
- असम में उत्पादित होने वाले मूगा रेशम पर पेट्रोलियम उद्योग के प्रभावों का अध्ययन अध्ययन किया गया है। बायोचार से पेट्रोलियम द्वारा प्रदूषित मृदा मे पेट्रोलियम प्रदूषण भार को कम करने तथा संशोधन कर मूगा खाद्य पौधा सोम को उगाने तथा उस पर मूगा रेशम कीट पालन करने की पद्धति को स्थापित किया गया है।
- मणिपुर में वान्या रेशम उत्पादन क्षेत्र की शीर्ष मिट्टी की पोषण स्थिति का आकलन किया गया और सूक्ष्म और मैक्रो पोषक तत्वों की उपलब्धता को दर्शाने के लिए स्थानिक वितरण मानचित्र तैयार किए गए। गुणवत्ता वाले मूगा और एरी कोकून की कटाई के लिए पोषक तत्वों की कमी वाली मिट्टी को समृद्ध करने के लिए सुधारात्मक उपायों का सुझाव दिया गया था।
- पूर्वोत्तर भारत में जलवायु अनुकूल मूगा संस्कृति को सुनिश्चित करने के लिए उपयुक्त शमन उपायों को तैयार करने के लिए मूगा पर बढ़े हुए CO_2 और तापमान के प्रभाव का आकलन करने के लिए एक अध्ययन शुरू किया गया था।
- एरी रेशमकीट के तीन प्रमुख खाद्य पौधों जैसे की अरंडी , केसेरू और टैपिओका का मूल्यांकन मणिपुर की विभिन्न कृषि-जलवायु परिस्थितियों में एरी रेशमकीट पालन के लिए किया गया था। अरंडी को पसंदीदा खाद्य पौधे के रूप में पाया गया।
- इस वर्ष के दौरान विभिन्न कार्यक्रमों और योजनाओं के तहत विभिन्न हितधारकों को मूगा और एरी मेजबान पौधों के १६७५८ पौधो की आपूर्ति की गई। इससे किसानों ने अपने खेतों में लगभग ३३ एकड़ में बेहतर मेजबान पौधों के रोपण कर मेजबान पौधों क्षेत्र को बढ़ाने में मदद की है।

रेशमकीट सुधार, उत्पादन और संरक्षण

- जीवित पौधों से सीधे एक्स्ट्रेक्टर उपकरण का उपयोग करके होस्ट प्लांट लीफ से वाष्पशील तत्व को निकाला गया और जीसी-एमएस सन्यंत्र के माध्यम से रासायनिको की पहचान की गई। गैस क्रोमैटोग्राफी से जुड़े इलेक्ट्रो-एंटीनो डिटेक्शन (जीसी-ईएडी) प्रयोग में चयनित मेजबान संयंत्र वाष्पशील तत्व के प्रति एरी और मूगा रेशम कीट की प्रतिक्रियाएं देखी गईं। मूगा रेशम तितलि पर *पी. बॉम्बिसीना* लीफ एक्सट्रेक्ट का अनुप्रयोग करने से तितलि द्वारा अंडे की अवधारण को कम करके वास्तविक अंडे की संख्या को बढ़ाता है। इसी प्रकार, एरी (*एस. रिकिनी*) रेशम कीट के डिंबोत्सर्जन के दौरान *रिकिनस कम्युनिस* लीफ एक्सट्रेक्ट के प्रयोग से वास्तविक अंडे की संख्या में वृद्धि होती है।
- पूर्वोत्तर भारत के विभिन्न मूगा संभावित क्षेत्रों से स्वस्थ मूगा रेशमकीट एकत्र किए गए और कुल २६० रोगाणुओं को अलग किया गया। उनमें से १६० बैक्टीरियल आइसोलेट्स की सेलुलोलिटिक गतिविधि के लिए जांच की गई और अंत में २८ सेल्युलेस डिग्रेडिंग बैक्टीरिया को आगे के प्रयोग के लिए प्राप्त किया गया।
- मूगा रेशमकीट सुधार कार्यक्रम के तहत , ५०० मीटर से अधिक रेशम धागा (फिलामेंट) की लंबाई , कॉम्पैक्ट कोकून और २५० से उपर वाले अंडे की संख्या जैसी उन्नत विशेषताओं वाली एक आशाजनक मूगा रेशमकीट को चुना गया था और इसका स्थिरीकरण का अनुसंधान प्रगति पर है।
- पहली बार एक एंडोपैरासिटॉइड ततैया , *ज़ैंथोम्पिप्ला पेडेटर* की पहचान की गई , जो कि मूगा रेशमकीट के साथ-साथ अटाकस एटलस जैसे अन्य सैटर्निडी रेशमकीटों को परजीवी बनाने वाले मूगा पारिस्थितिकी तंत्र में मौजूद है।
- मूगा रेशमकीट को संक्रमित करने वाले माइक्रोस्पोरिडिया को अलग किया गया , शुद्ध किया गया और अंकुरण की परख की गई।
- मणिपुर के विभिन्न जिलों में जंगली एरी (एस कैनिंगी) का सर्वेक्षण और संग्रह किया गया। २२० *एस. कैनिंगी* कोकून एकत्र किए गए , एफ१ सेल्फ़्ड बीज तैयार किया गया और एफ१ पीढ़ी का पालन सफलतापूर्वक पूरा किया गया। अंतर और अंतर-विशिष्ट संकरण कार्यक्रम में उपयोग के लिए समयुग्मकता प्राप्त करने के लिए प्रत्येक पीढ़ी में निरंतर चयन के साथ एफ४ पीढ़ी तक ०४ पारिस्थितिकी और सी२ नस्ल को सेल्फ़्ड द्वारा प्राप्त किया गया था।
- आर्थिक रूप से व्यवहार्य नवीन अंडे देने वाले उपकरणों को कम जगह में अधिक एरी डीएफएल का उत्पादन करने के लिए डिज़ाइन किया गया था। नए उपकरणों से प्रत्येक दिन मानकीकृत अंडा संग्रह तकनीक ने अंडे सेने के तुल्यकालन में मदद की है, जो बाद के एरी पालन में और अधिक लाभ देता है।
- अरंडी की किस्म एनबीआर-१ को एरी चौकी पालन के लिए सबसे उपयुक्त के रूप में पहचाना गया। अन्य एरी चौकी पालन तकनीक जैसे कि नोवेल ब्रशिंग तकनीक , नोवेल बेड डिसइंफेक्टेंट विधि , नंबर का अनुकूलन प्रति ट्रे में पाले जाने वाले कीड़ों की संख्या , प्रति डीएफएल के लिए आवश्यक पत्ती की मात्रा , निर्मोचन के दौरान और बाद में प्रति डीएफएल के लिए आवश्यक चूने की मात्रा डिसइंफेक्टेंट के लिये और आदर्श तापमान और आर्द्रता का मानकीकरण किया गया।
- मणिपुर की विभिन्न कृषि-जलवायु परिस्थितियों के तहत चार मौसमों में सी२ नस्ल के साथ तीन एरी रेशमकीट की पारिस्थितिकी-प्रजातियों, बोरद्वार, तिताबार और मणिपुर स्थानीय नस्ल का मूल्यांकन किया गया। बोरद्वार को ८३.५७% ईआरआर के साथ बेहतर नस्ल के रूप में पाया गया जो सी२ नस्ल के ८३% के बराबर है। छह प्रजातियों में सबसे अधिक ईआरआर पीले सामान्य (९१.३३%) और जीबी सामान्य (९१.२७%) का पाया गया।

- ओक टसर के ४५१०० डीएफएल के लक्ष्य के मुकाबले ४५७०० डीएफएल का उत्पादन किया गया जिसकि १०१.३३% उपलब्धि रही तथा वसंत फसल २०२१के दौरान आगे गुणन के लिए गोद लिए गए बीज पालकों को राज्य सरकार के द्वारा आपूर्ति की गई।
- *पी. राया* और *एच. पुएरा* द्वारा संक्रमित *क्यू. सेराटा* के आर्थिक क्षति स्तर और आर्थिक सीमा स्तर का निर्धारण किया। जैव-कीटनाशक के रूप में जैव-नीम का ओक के पौधों के कीटों के नियंत्रण के लिए उपयोग कर *पी. राया* में क्रमशः ८३.४०% और *एच. पुएरा* में ७६.०८% की कमी संक्रमण की पुस्टि की गई। जिसके खोज से किसानों द्वारा कीड़ों के नियंत्रण के लिए खतरनाक रासायनिक कीटनाशकों के उपयोग में कमी भी आएगी।
- उजी मक्खी के नियंत्रण के लिए एकीकृत कीट प्रबंधन रणनीति के तहत वयस्क उजी मक्खी के नियंत्रण के लिए सरल, कम लागत और उपयोगकर्ता के अनुकूल पी.ई.टी. बोतल ट्रैप विकसित किया।

प्रौद्योगिकी हस्तांतरण

- संस्थान द्वारा तीन वन्या रेशम कृषि मेलों , ०१ कार्यशाला, ०२ प्रदर्शनियों, ०३ क्षेत्र दिवसों , १६ जागरूकता कार्यक्रमों और १६ प्रौद्योगिकी प्रदर्शन कार्यक्रमों का आयोजन किया गया। वर्ष के दौरान इन कार्यक्रमों के माध्यम से लगभग ३१३१ व्यक्तियों को जागरूक किया गया।
- कुल १७०१ किसानों , अधिकारियों, छात्रों और गैर सरकारी संगठनों के सदस्यों को छह अलग-अलग प्रशिक्षण कार्यक्रमो जैसे किसान कौशल प्रशिक्षण , प्रौद्योगिकी अभिविन्यास कार्यक्रम , पोस्ट कोकून क्षेत्र के तहत प्रशिक्षण , रेशम उत्पादन संसाधन केंद्र के तहत प्रशिक्षण और गैर-सीबीटी वित्त पोषित प्रशिक्षण के तहत प्रशिक्षित/अप-कुशल किया गया। "समर्थ" योजना के तहत ४६७ लाभार्थी किसानों को कपड़ा क्षेत्रों में भी प्रशिक्षित किया गया।
- प्रौद्योगिकी कार्यक्रम (ओएफटी) के कृषि परीक्षण के तहत १४ किसानों के खेत में ज्याद मूगा कोकून उपज के लिए आईटीके और आधुनिक तकनीक के एकीकृत अभ्यास को प्रयास किया गया था। मौजूदा अनुशंसित अभ्यास की तुलना में औसत कोकून उपज में २२ .८% की वृद्धि हुई और जरुआ फसल (दिसंबर-जनवरी २०२१) के दौरान मौजूदा अनुशंसित अभ्यास की तुलना में कोकून की उपज और ईआरआर दोनों ही अत्यधिक महत्वपूर्ण थे।
- स्टेशन मे परीक्षणों के तहत मूगा रेशमकीट में बैक्टीरियल फ्लेचरी रोग को नियंत्रित करने के लिए सूत्रीकरण की प्रभावकारिता की पुष्टि की गई थी। गर्मी की फसल के दौरान कोसा उत्पादन में १०-१२% की उल्लेखनीय वृद्धि दर्ज की गई।
- ऊपरी असम क्षेत्र मे टीओटी कार्यक्रम के तहत ८ .४४ एकड़ के लिये केसेरू की उच्च प्रजाति एचएफ-००५ और एचएफ-००८ के ३७५० पौधे २६ एरी किसानों को दिए गए।
- असम के जोरहाट जिले में ४ .५ एकड़ भूमि में ब्लॉक वृक्षारोपण करने के लिए ७ एरी रेशम पालन करने वाली महिलाओ को २००० बोरपत पौधे वितरित किए गए। इस आशाजनक बारहमासी एरी होस्ट प्लांट की दो किसान नर्सरी ऊपरी और निचले असम में सफलतापूर्वक स्थापित की गईं।

संस्थान के प्रकाशन

- वर्ष २०२०-२१ के दौरान, सीएमईआर एंड टीआई ने राष्ट्रीय और अंतर्राष्ट्रीय सहकर्मीओ के समीक्षा पत्रिकाओं में ३६ शोध पत्र , ०१ सम्मेलन / कार्यशाला पत्र , ०७ तकनीकी पत्रक / बुलेटिन , ०१ हिंदी समाचार पत्र और ०४ पुस्तकें / पुस्तक अध्यायो को प्रकाशित किए गए।

HIGHLIGHTS OF ACHIEVEMENTS (2020-21)

Major achievements in R&D

During 2020-21, 21 research projects were carried out, of which 3 projects are DBT funded, 3 projects are DST funded, 1 project is NERTPS funded and remaining are CSB funded. Three projects were concluded, 3 were newly initiated and remaining 11 projects are being continued from previous year. All the research projects are under different categorization viz., Environmental challenges and global warming, Drudgery reduction and women friendly technologies, Input cost reduction, Eco-friendly & organic farming etc. A brief highlight of the research works is presented below:

Host Plant Improvement, Production and Protection

- Castor gene pool was enriched with 22 collections made from North East and other parts of the country to bring in variability with focus on perennial character. Selected potential perennial accessions and cultivated accessions were crossed in 12 different cross combinations with an aim to develop a perennial castor variety with improved characteristics.
- The phyto-chemical diversity assessment study in Som has thrown light on the impact of varied environmental and edaphic conditions on its cultivation. The study has also aided in identifying the suitable soil corrections for quality leaf production.
- The study on the effects of petroleum industry on muga culture in Assam has thrown light on the real impact of anthropogenic activity of petroleum industry on muga growing areas. The biochar based soil amendment has been found as one of the most suitable mitigation strategies to minimize the petroleum pollution load in muga growing areas.
- Nutritional status of vanya sericulture top soils in Manipur was assessed and spatial distribution maps were prepared to depict the availability of micro and macro nutrients. Ameliorative measures were suggested to enrich the nutrient deficient soils for harvesting quality Muga and Eri cocoons.
- A study was initiated to assess the impact of elevated CO_2 and temperature on muga culture for devising suitable mitigation measures to ensure climate resilient muga culture in NE.
- Three major food plants of eri silkworm, viz., Castor, Kesseru and Tapioca were evaluated for eri silkworm rearing under different agro-climatic conditions of Manipur. Castor was found as preferred food plant.
- During the year 16,758 seedlings of Muga and Eri host plants were supplied to different stakeholders under various programmes/ schemes. This has supported to augment plantation of superior host plant accessions at farmers' fields about 33 acres.

Silkworm Improvement, Production and Protection

- The host plant leaf volatiles were extracted by using extractor equipment directly from the living plants and chemical cues were identified through GC-MS. Responses of Eri and Muga silk moth towards selected host plant volatiles was observed in Gas Chromatography linked Electro-Antenno detection (GC-EAD) experiment. Application of *P. bombycina* leaf extract on Muga silk moth enhances realized fecundity by

reducing egg retention. Similarly, application of *Ricinus communis* leaf extract during oviposition of Eri (*S. ricini*) silk moth increases realized fecundity.

- The healthy muga silkworms from various muga potential areas of North-east India were collected and total 260 microbes were isolated. Out of them 160 bacterial isolates were screened for cellulolytic activity and finally 28 cellulase degrading bacteria were obtained for further experiment.
- Under muga silkworm improvement programme, one promising muga silkworm line with improved characteristics such as above 500 m filament length, compact cocoons and fecundity above 250 was shortlisted and its stabilization is in progress.
- Identified for the first time an endoparasitoid wasp, *Xanthompimpla pedator*, which exists in muga ecosystem parasitizing muga silkworm along with other saturniid silkworms like *Attacus atlas*.
- Microsporidia infecting Muga silkworm was isolated, purified and germination assays were conducted.
- Survey and collection of wild eri *(S. canningi*) was carried out in different districts of Manipur. 220 numbers of *S. canningi* cocoons were collected, F1 selfed seed was prepared and F1 generation rearing was successfully completed. 04 ecoraces and C2 breed were selfed upto F4 generation with constant selection in each generation to attain homozygosity for utilization in inter and intra-specific hybridization programme.
- Economically viable novel egg laying devices were designed to produce more Eri DFLs in less space. Standardized each day egg collection technique from the new devices has helped in synchronization of hatching, which further benefits in subsequent rearing performance.
- Castor variety NBR-1 was identified as most suitable for Eri chawki rearing. Other eri chawki rearing techniques such as novel brushing technique, novel bed disinfectant method, optimization of no. of worms to be reared per tray, leaf quantity required per DFL, lime quantity required per DFL during and after moulting and ideal temperature and humidity were standardized.
- Three promising eri silkworm eco-races, viz., Borduar, Titabar & Manipur local along with C2 breed were evaluated in four seasons under different agro-climatic conditions of Manipur. Borduar was found as better race with 83.57% ERR which is at par with C2 breed (83%). Among six strains, the highest ERR was found in Yellow plain (91.33%) and GB plain (91.27%).
- 45,700 dfls of Oak Tasar were produced against the target of 45,100 with 101.33% achievement and supplied to state government and adopted seed rearers for further multiplication during spring crop 2021.
- Determined the economic injury level and economic threshold level of *P. raya* and *H. puera* infesting *Q. serrata*. Identified bio-neem as the most effective bio-pesticide for control of oak plant pests with a reduction percentage of 83.40% in *P. raya* and 76.08% in *H. puera*, respectively. This finding will reduce the use of hazardous chemical insecticides for control of insect pests by farmers.
- Developed simple, low cost and user friendly PET bottle trap for control of adult uzi fly. Also developed an integrated pest management strategy for control of uzi fly.

Extension, Capacity Building & Training

- Three Vanya Resham Krishi melas, 01 workshop, 02 exhibitions, 03 Field Days, 16 Awareness Programmes and 16 Technology Demonstration Programmes were organized by the Institute. About 3131 persons were

sensitized through these programmes during the year.
A total of 1701 nos. of farmers, officials, students and NGO members were trained/up-skilled under six different training components like Farmers Skill Training, Technology Orientation Programme, Training under Post cocoon Sector, Training under Sericulture Resource Centre and Non-CBT funded trainings. 467 beneficiary farmers were also trained in Textile Sectors under "SAMARTH" scheme.

- Integrated practice of ITK and modern technology for higher muga cocoon yield was validated at 14 farmer's field under on farm trials of technology programme (OFT). Average cocoon yield increased by 22.8% over the existing recommended practice and both the cocoon yield and ERR was highly significant over the existing recommended practice during Jarua crop (Dec-Jan 2021).
- Efficacy of formulation for controlling bacterial flacherie disease in Muga silkworm was confirmed under on station trials. Significant enhancement was recorded in cocoon production (10-12%) during summer crop.
- 3750 seedlings of Kesseru accessions (HF-005 and HF-008) were supplied to 26 Eri farmers for popularization of these superior accessions in Upper Assam area with a total area plantation of 8.44 acres under TOT programme.
- 2000 Borpat seedlings were distributed among 7 women Eri culture farmers for raising block plantations in 4.5 acres of land in Jorhat district of Assam. Two kissan nurseries of this promising perennial eri host plant were successfully established in upper and lower Assam.

Publications of institute

- During 2020-21, CMER&TI, Lahdoigarh published 36 research papers in National and international peer reviewed journals, 01 conference/workshop paper, 7 technical leaflets/bulletin, 01 Hindi Newsletter and 04 books/book chapters.

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LIST OF R&D PROJECTS

CONCLUDED PROJECTS

Sl. No	Code	Title	Duration	Principal Investigator	Co-Investigator
1	PPA 5879	Assessment of phytochemical diversity in Som (Persea bombycina Kost), the primary host plant of *Antheraea assamensis*Helfer from Northeast India.	Sept., 2016 to Feb 2021	Dr. P Sangannavar and Dr. Amit Kumar (From Jul 2019)	Dr. R. Das Dr. D. K. Gogoi
2	ARP 5889	Studies on the cross transmission of pebrine spores from lepidopteran caterpillars to Muga silkworm (*Antheraea assamensis* Helfer) and its control measures.	June, 2017 to May, 2020	Dr. Kh. Subadas Singh	Dr. M. Chutia
3	PPF 5893	Impact assessment of petroleum crude oil on muga silkworm and their host plants in Assam.	Oct., 2017 to Jan., 2021	Dr. D. K. Jigyasu	Dr. Kh. Subadas Singh Dr. K.Neog
4	AIB 5894	*In-situ* conservation of muga and other wild silk moths in Natural Habitat (In collaboration with R.O., CSB, Guwahati and DoS of Assam, BTC, Meghalaya, Arunachal Pradesh).	April, 2016 to March, 2021	Dr. G. Subramanyam	Dr. Kh. Subadas Singh
5	ARE 4726	Bio-ecology, economic injury level and management of insect pest infesting oak ecosystem.	June, 2017 to May, 2020	Dr. S. Subharani Devi	Dr. Y. Debaraj Dr. RSur Chaudhuri
6	ARP-5887	Isolation and characterization of lytic bacteriophages infecting bacterial pathogens of Muga silkworm *Antheraea assamensis* Helfer (DST funded project)	Apr, 2017- Mar, 2021	Dr. M.Chutia	G.Subrahmanyam
7	APR 5892	Formulation of Semi-synthetic diet for rearing of Muga silkworm, *Antheraea assamensis* Helfer.	Aug, 2017- July, 2020	Dr. James T Keisa	Dr. Subadas Singh, Dr. Arun Kumar
8	APR-5890	Biodiversity Assessment of Wild silk moths and Rearing Potentialities of Muga (*Antheraea assamensis* Helfer) and Eri (*Samia ricini* Donovan) for sustainable development in Nagaland	Feb.,2017- June 2020	Dr. Rajal Debnath (Since June 2019)	Dr. D K Gogoi
9	ARE:4726	Bio-ecology, economic injury level and management of insect pest infesting oak ecosystem	June, 2017- May, 2020	Dr.S. Subharani Devi	Dr.Y.Debaraj
10	ARP:3606	Development of a diagnostic tool for early detection of baculovirus causing Tiger band disease in *A. proylei*.	Feb. 2017- Aug, 2020	Dr.. S. S.Devi, Dr. K.M.Ponnuvel	Dr.Y.Debaraj

ONGOING PROJECTS

Sl.No.	Code	Title	Duration	Principal Investigator	Co-Investigators
1.	APS05001EF	Development of technology for enhancing egg laying in Vanya Silk moths by application of host plant volatiles. (collaboration with SSTL, Kodathi)	Mar., 2018 to Sept., 2021	Dr. DK Gogoi	-
2.	MOE 05003 EF	Socio-economic uplifting of farmers through adoption of improved technologies and skill development in Eri culture.	Nov., 2018 to Oct., 2021	Dr. H Barman	Sri. SAS Rehman
3.	MOE05004EF	Adoption of improved sustainable technologies of Muga culture for elevation of cocoon production in the tribal belt of Assam.	Aug 2019 to Jul 2022	Dr. Vijay N	Dr. D. K. Gogoi Dr. D. Mech Dr. SAS Rahaman Dr K. Sathyanarayana
4.	PIB-05005SI	Genetic enhancement of Castor (*Ricinus communis* L.) germplasm as a source material fo development of productive perennial varieties	Oct 2019 to Sep 2022	Dr. Aftab A Shabnam	Dr. Amit Kumar Dr. V.K. Naik Dr. L Somen Singh
5.	AIB05006SI	Breeding of muga-silkworms for improved silk quality and disease tolerance	Oct 2019 to Sep 2022	Dr. Arun Kumar K P	Dr. Mahesh D. S Dr. Manjunath R. N
6.	APR05007SI	Standardization of chawki rearing practices for Eri silkworm, *Samiaricini* (Donovan)	Oct 2019 to Sep 2022	Dr. Mahesh D. S	Dr. Arun Kumar K P Dr. Subadas Singh
7.	APR:05008SI	Standardization of Rearing and Grainage Technologies of *Antheraea frithi* Moore	Oct, 2019 -Sept, 2022	L. Somen Singh	Dr. S. Subharani Devi
8.	AIB: 05009SI	Isolation of thermo-tolerant line(s) of Oak tasar silkworm *Antheraea proylei* J.	Oct, 2019 -Sept, 2022	Dr. Y. Debaraj	Dr. S.Subharani Devi, Dr. Arun Kumar
9.	APR: 5010SI	Evaluation of Eri Silkworm Races suitable for different agro-climatic conditions of Manipur.	Oct, 2019 -Sept, 2022	Dr. Y. Debaraj	L. Somen Singh
10.	AIT 05011EF	Molecular investigation into the lignocellulolytic system of a few Wild silkmoth in North-East India	Sept,2019-Aug,2022	Dr. Rajal Debnath	Dr. DK Gogoi Dr. Arun Kumar KP

11	AIB-05012-SI	Inter and intra-specific hybridization for improvement of eri silkworm, *Samia ricini* Donovan	Mar, 2020-Feb, 2024	Dr. Reeta Luikham	Dr. Aftab A Shabnam
12	AIP-05013SI	Impact of elevated CO_2 and temperature on muga silkworm and its primary host plant	Mar 2020 to Feb 2023	Dr. Amit Kumar	Dr. Aftab A Shabnam Dr. G. Subrahmanyam
13	BPP 05014CN	Standardization of Processing and Production of a Consumable Beverage from Mulberry Leaves and Blending with Green Tea (CSB Funded) Collaboration with CSR&TI, Mysore TTRA, TOCKLAI & AAU, JORHAT	Mar.,2020 to June, 2021	Dr. K. Sathyanarayana	Dr. M Chutia, Dr. P SangannavarDr. P Kumerasen
14	ARP05015SI	Development of chemical based control measures for management of pebrine disease in Muga silkworm, *Antheraea asamensis* Helfer	Jan.,2021 to Dec.,2023	Dr. G. Subrahmanyam-	Dr. Arun Kumar KP
15	AIT05016MI	Integrating genomic and transcriptomics resources for functional insight into the biology of Muga Silkmoth *Antheraea assamensis*	Jan.,2021 To Dec.,2023	Dr. Arun Kumar K.P.	Dr. Rajal Debnath
16	CFC 5017 MI	Exploration and adoption of novel muga cocoon cooking technology for increasing its reelability and raw silk quality Collaboration with CSTRI, Bangalore	Mar.,2021 To Feb.,2023	Dr. Manjunath R.N.	Dr. D.K.Gogoi Dr. Rajiv K.Munshi
17	APR 05018	Effect of various host plants separately and in combination on Rearing and grainage performance of Muga silkworm, *Antheraea assamensis* Helfer Collaboration With MSSO, Guwahati	Mar.,2021 to Feb.,2024	Dr. Kh. Subadas Singh -CI	SAS Rahman Dr. D K Jigyasu M.Deka Dr. Vikram Kumar
18	MFM5019MI	Development of honeycomb mountages and harvesting technology for muga Cocoon production with improved	Mar.,2021 to Feb.,2023	Manjunath RN -	Dr. Mahesh D.S Dr. Urmimala Hazarika

		uniformity and raw silk recovery COLLABORATION WITH MSSO, GUWAHATI			
Projects as Co-I in other institutes					
1	CYF 07010MI	Grading of Muga silk yarn- Development of methods and procedure	June, 2019- May, 2021	Prakash Bhat -	Ravi Kumar Dr. Manjunath R N
2	CYF 7014MI	Development of 3D woven silk fabrics and their applications	July, 2020- June, 2022	H.S.Hambulingappa-	Nil Dr. Manjunath R.N
3	BPS 01013CN	Utilization and diversification of silkworm pupae products for human & animal consumption and composting.	Sept.,2020 to Aug, 2022	Mahesh D.S.	Dr. James Kiesa

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ACHIEVEMENTS IN R&D PROJECTS

SILKWORM DIVISION

CONCLUDED PROJECTS

Project Code: AIB5894

Project Title: *In-situ* conservation of muga silkworm, *Antheraea assamensis*, Helfer (Lepidoptera: Saturniidae) and other wild silk moth

Project Period : April 2016 to March 2021
Funding Agency : NERTPS, Ministry of Textiles
Total Budget : 41.00 lakhs
Scientists involved : Dr. Rajesh Kumar, PI (April 2016 to May 2018)
Dr. P. Sangannavar, PI (June 2018 to June 2019)
Dr. G. Subrahmanyam, PI (July 2019 onwards)
Dr. KH. Subdas Singh, CI (June 2018 onwards)
Dr. B.N. Choudhury, CI (September 2020 onwards)

Objectives

1. Development of in-situ conservation site for muga silkworm and other wild silk moths species.
2. Utilization of muga silkworm germplasm for breeding and seed production

Summary of the findings/achievements

- Under this project, total 04 site viz. Upper Doigrung, Golaghat (Assam), Kuklung RF, (BTC, Assam), East Jaintia hills(Meghalaya), Pasighat, east Siang (Arunachal Pradesh) were established in coordination of the respective state DOS and Forest departments.
- In situ conservation area is found to be rich in natural Muga host plants *Litseae monopetala, Persea bombycina, Litisea saliciifolia, L. citreta* etc. at both peripheral, buffer and core areas
- Weather station has been installed in each site to record the important metereological parameters such as temperature, relative humidity and rainfall.
- Awareness programmes among tribal and local peoples were organized for implementation and conservation of muga and other wild silk moth.
- Silkworm larvae, cocoons and DFLs were periodically released at conservation site to buildup the muga population.However continuous release of DFLs or cocoons are required for optimized muga population at conservation site.

Figure 1: Buildup of muga silkworm population at *in situ* conservation site Upper Doigrung, Golaghat. Muga silkworm larvae and cocoons were observed during the field visits on 8-05-2020 and 10-06-2020 respectively.

Project Code: ARP-5889

Project Title: Studies on the cross transmission of pebrine spores from lepidopteran caterpillars to muga silkworm (*Antheraea assamensis* Helfer) and its control measures

Project Period : June 2017 to May 2020
Funding Agency : CSB, Bangalore
Total Budget : Rs. 15.55 lakhs
Scientists involved : Dr. Kh. Subadas Singh, PI
Dr. M. Chutia, CI

Objectives

1. Isolation of pebrine spores from infected Muga silkworms and other lepidopteran insects from different Muga silkworm rearing sites.
2. Seasonal prevalence and cross infection of pebrine spores from lepidopteran caterpillars to Muga silkworm.
3. Morphological and molecular characterization of isolated pebrine spores.Final report of the project

Summary of the findings/achievements

- Insects belonging to Saturniidae, Nymphalidae, Papilionidae and Noctuidae are frequently detected with pebrine spores.
- 24 species were detected with pebrine spores including saturniid insects.
- Among the saturniids, *Cricula trifenestrata* is abundantly found in Muga ecosystem; feeding same host plant of muga silkworm especially *Persea bombycina.*
- *C. trifenestrata* were tested for pebrine spores,
- *Attacus atlas* is also tested in available in soalu based muga ecosystem. There were no pebrine spore was detected.
- Cross infectivity test between *Cricula* to Muga silkworm and Muga to *Cricula*, confirms cross transmission of pebrine spores.
- Morphometric studies using Scanning electron microscopy (SEM) also confirms the cross transmission, however, in case of otherno similarity was detected in pebrine sproes.
- Molecular characterizations of different spores are under process.

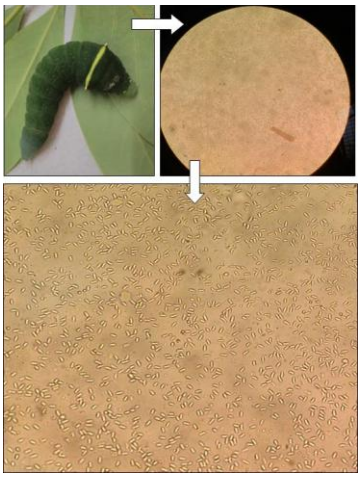


Figure 1: Pebrine spores isolated from wild lepidopteran *Graphium sarpedon* caterpillars

Project Code: APR-5892

Project Title: Formulation of Semi-synthetic diet for rearing of Muga silkworm, *Antheraea assamensis* Helfer

Project Period : April 2017 to July 2020
Funding Agency : CSB, Bangalore
Total Budget : Rs. 16.46 lakhs
Scientists involved : Dr. T. James Keisa, PI
Dr. Subadas Singh, CI
Dr. Arun Kumar K. P, CI

Objectives

1. Formulation and standardization of Semi-synthetic diet for rearing of Muga silkworm, *Antheraea assamensis* Helfer.

Summary of the findings/achievements

- Semi-synthetic diets were prepared with Som and Soalu leaf powder, Aga-agar, nutrient chemicals, Vitamins and salt mixtures, etc.
- Eleven different Semi-synthetic diets were formulated, out of which two suitable diets were selected for rearing of Muga chawki worms (Fig).
- Rearing of first instar on Semi-synthetic diets showed larval survival percentage is at par with control rearing.
- Rearing of 2nd instar on Semi-synthetic diets is also showed less larval survival percentage when compared to control rearing except commercial crop.
- After second moult out the worms were transferred to outdoor, the worms, the worms does not fed immediately on host plant leaves, as the worms are very soft and fragile, slow in hardening and worms became weak.
- Worms have weak gripping power when rear outdoor on host plant as a result they were easily fallen down on the ground.
- Effective rate of rearing percentage on Semi-synthetic diets showed 3 - 16% and control is 14-45% during different seasons.

Figure 1: Second instar muga larvae feeding on semi-synthetic diet.

Project Code: ARP 5887

Project Title: Isolation and characterization of lytic bacteriophages infecting bacterial pathogens of Muga silkworm *Antheraea assamensis* Helfer

Project Period : Mar 2018 to Feb 2021
Funding Agency : DST, New Delhi
Total Budget : Rs. 35.28 lakhs
Scientists involved : Dr. M. Chutia, Scientist-D & PI
Dr. G. Subrahmanyam, Scientist-C & CI
Dr. R. Das, Scientist-C & CI (Till Feb 2020)

Objectives

1. Isolation and characterization of bacteriophages against muga silkworm bacterial pathogens.
2. Study of the phage biology and genome organization.
3. Evaluation of the potential phages cocktail against muga silkworm pathogens.

Summary of the findings/achievements

- The disease was recorded throughout the year in the rearing fields and the infection percentage varied from season to season.
- Temperature variations were not significantly different in the rearing sites, but varied season wise and more prevalent during summer months (June-August) when temperature rises up to 30-35°C.
- The Petrovski's method was followed for the isolation and purification of bacteriophages.
- On the basis of growth of bacteriophages on *P.aeruginosa (4A), B. subtilis (HM1), L. sphaericus (W),*and *E. casseliflavus* (4B) phages were named as BHM1, BW2, B4A and B4B, respectively.
- The infectivity of Phage decreased gradually upon increasing the temperature when exposed for 1 h to temperatures ranging from 30 to 60 °C, dropped significantly at 70 °C, and was completely lost at ≥80°C.
- About 9 different isolates (three each) of four bacterial pathogens i.e. P.aeruginosa (2), B. subtilis (3), L. sphaericus (2), and E. casseliflavus (2) previously isolated were used to evaluate the host range against the four phages. All these bacterial strains were susceptible against the specific phages. Further studies are required on host range increasing the number of the bacterial strains against the phages.
- Theobserved phages were icosahedral heads and contractile tails with small rod. As such, the phages belonged to the order Caudovirales and the Myoviridae family.
- The isolate phages were mass cultured for preparation of phage cocktail signgle phage and as cocktail (4 phages) for in vivo application.
- About 70-85% of larvae could survive after treatment of the formulation. However, if the formulation is applied in the field with no challenged pathogen, this can protect the larvae from the bacterial infection.

Figure 1: *Invivo* trails of the phage cocktail

Pilot Study Code:PS 001 APS

Pilot Study Title: Loose egg production in Ericulture

Project Period: June, 2020 to November, 2020.
Funding Agency: CMER&TI, Jorhat
Scientists involved: Dr. Mahesh D. S., PI

Objectives:

1. Oviposition performance of erisilkmoth on different egg laying devices for loose egg production.
2. Study of economics of loose egg production technologies in Ericulture.

Summary of the findings/achievements:

- Various loose egg production devices viz., Nylon nets, egg sheets, various dimension boxes, hanging cloths, cellules on sheets, kharika are tested and screened on pilot scale based on their economically viablility, labour intensivity, time saving capacity, DFL production efficiency, handy nature and amenable for disinfection compared to kharika.
- Reduction or avoidance of non synchronized hatching was achieved by using each day egg harvesting technique in different treatments and the same was compared with kharika based egg device.
- In view of the promising initial leads obtained in the pilot study, we have envisaged to further work onthis technology for large scale commercial egg production technology in Ericulture with the following leads,

a. The newly designed egg laying devices help produce number of DFLs in less space.
b. Each day egg collection from the new devices helps in synchronization of hatching during brushing which further benefits in subsequent rearing performance of rearing *Viz.*, uniformity in moulting, proper feeding, uniform larval size, less missing larvae, very less spinning duration, reduced cocoon harvesting time and increased cocoon yield.
c. The new device is economically viable as it is less labour intensive, less time consuming and easy for handling and disinfection.

Table 1: Ovipositional performance of erisilkmoths on the different egg laying devices

Treatments	First day laid (gms/25 DFLs)	Second day laid (gms/25 DFLs)	Third day laid (gms/25 DFLs)	Total Realized fecundity (gms/25 DFLs)
T_1 (WOS)	6.91	3.33	2.46	12.70
T_2 (WOP)	6.97	3.44	2.17	12.58
T_3 (WS)	6.58	3.32	2.71	12.62
T_4 (WP)	7.54	3.10	2.05	12.69
T_5 (Muslin)	4.98	3.93	3.78	12.69
T_6– (Kharika with each day egg harvesting)	6.12	3.86	2.66	12.65
CD	0.24	0.19	0.27	-
CV	1.83	2.67	5.06	-
SE.m	0.06	0.05	0.07	-
S/NS	S	S	S	-
T_7-Kharika with final day egg harvesting (Control)	NH	NH	NH	12.61*

NH- Not Harvested; * Harvested after completion of egg laying

Table 2: Hatching percentage of first day laid eggs harvested from different devices compared with eggs harvested from kharika

Treatments	Hatching %			Unhatched %
	1st day	2nd day	3rd day	
T_1 (WOS)	93.25	5.00	0.00	1.75
T_2 (WOP)	92.50	5.50	0.00	2.00
T_3 (WS)	94.00	3.25	0.00	2.75
T_4 (WP)	94.00	4.75	0.00	1.25
T_5 (Muslin)	90.50	6.50	0.00	3.00
T_6– (Kharika with each day egg harvesting)	92.00	5.00	0.00	3.00
T_7-Kharika with final day egg harvesting (Control)	**49.75**	**31.00**	**15.50**	**3.75**
CD	4.04	3.90	2.00	2.73
CV	2.33	22.32	45.16	54.51
SE.m	1.00	0.97	0.5	0.68
S/NS	**S**	**S**	**S**	**NS**

Project Code: PS CFC 01

Project Title: Exploration of a novel chemical assisted muga cocoon cooking method for improving its reelability and raw silk recovery

Project Duration : June – August 2020

Funding Agency : CSB Bangalore

Scientists Involved : Dr. Manjunath R.N

Objectives:

1. To explore/optimize a novel chemical assisted cooking method for improving reelability and raw silk recovery of muga cocoons

Summary of the findings/achievements

- The problems concerning frequent breakages and poor raw silk recovery% of the muga cocoons were established and the ways of possibilities to overcome were studied. A new cocoon cooking formulation that can facilitate efficient and uniform cooking of muga cocoons was developed and tested for its efficacy on reeling performance.
- Intense trials were carried out in comparison with conventional soda based cooking chemical and the comparative results were documented. The trial results indicated that the newly developed formulation significantly contributed to the reelability of muga cocoons by reducing breakages (upto 35-40%) during the reeling process and improving the raw silk recovery (by 6-10%). Based on the obtained results, an optimized procedural protocol suitable for ideal reeling process was developed.
- The formulation was found suitable for cooking both Muga and Eri cocoons and the cooking solution can be reused effectively for 2-3 times thereby supporting the conservation of materials involved.

ONGOING R&D PROJECTS

Project Code: AIB05006SI

Project Title: Breeding of muga-silkworms for improved silk quality and disease tolerance

Project Period : Oct 2019 to Sep 2022
Funding Agency : CSB, Bangalore
Total Budget : Rs. 18.32 lakhs
Scientists involved : Dr. Arun Kumar K.P, PI
Dr. Mahesh D. S, CI
Dr. Manjunath R. N, CI

Objectives

1. Selection of better parents by field collection of muga silkmoth samples.
2. Classical breeding studies to select better lines for muga silkmoths.
3. Mass production for limited trials.

Summary of the findings/achievements

- The genetic material was collected from surveys in farmers' fields as well as wild locations (Assam, Arunachal Pradesh and Manipur) by examining the compactness and weight of the cocoons, then through cold reeling to select the cocoons with long filament lengths.
- Finally, the moths that had high fecundity were selected for further rearing of DFLs. Five generations of rearing have been conducted with selection in each rearing and grainage. Also, the larvae have been reared in unfavorable conditions (pre-seed and seed crop in Jorhat) through summer and winter to select for robust genetic material.
- Refined cold reeling procedure was adopted to select better genetic stock based on filament length (>500m filament).
- The selected DFLs were used for 'cellular rearing' and group rearing also.Crosses have been set up from the selected genetic stock. The selected line tentatively named BP1 is now being stabilized.
- Wild muga silkworms are also being reared for developing muga line that hibernate during winter season.
- *Breeding characteristics achieved so far:*
  a) Highest cocoon weight achieved 9.50gms (Benchmark – 5.5g)
  b) Highest filament length achieved 938.25m (Benchmark – 350m)
  c) Highest fecundity achieved 307 (Benchmark – 150)
  d) Highest no. of cocoons obtained per DFL is 122 (Benchmark – 55)

Figure 1: Cocoons from the shortlisted line BP1

Table 1: A representative table showing the data obtained by the 'Cold Reeling' procedure

Sl no.	Sample no.	Sex	Weight of cocoon (in gm)	Weight of pupa (in gm)	Filament length (in cm)	Weight of filament (in gm)	No. of breaks	Shell ratio (%)	Denier	Mortality
1	8.8	Female	5.72	5.28	923.62	0.409	0	7.69	3.99	L
2	11.6	Female	5.70	5.29	924.75	0.408	0	7.19	3.97	L
3	8.11	Female	5.86	5.50	934.87	0.410	0	6.14	3.95	L
4	8.13	Female	5.65	5.22	938.25	0.411	0	7.61	3.94	L
5	8.16	Male	4.30	4.03	794.25	0.379	1	6.28	4.29	L
6	11.20	Male	4.36	4.01	796.50	0.380	1	8.03	4.29	L
7	8.20	Male	4.22	3.87	761.62	0.371	0	8.29	4.38	L
8	3.47	Male	4.20	3.93	757.12	0.372	1	6.43	4.42	L

Project Code: AIB05007SI

Project Title: Standardization of chawki rearing practices for Eri silkworm, *Samiaricini* (Donovan)

Project Period : Oct 2019 to Sep 2022
Funding Agency : CSB, Bangalore
Total Budget : Rs. 18.15 lakhs
Scientists involved : Dr. Mahesh D. S, PI
Dr. Arun Kumar K.P, CI
Dr. Kh Subadas Singh, CI

Objectives

1. Establishment and management of eri host plant garden for eri chawki rearing.
2. Design and fabrication of Eri silkworm chawki reaing equipment.
3. Development of new rearing method and ideal environment for eri chawki rearing.

Summary of the findings/achievements

- NBR-1 has been found to be most suitable for castor varietythan Kalpi-6, DCH-519, ICH-66 & DCS-9 at GCC, Chenijan.
- Number of trays, frames, stands and other rearing equipments for required and for brushing 100 dfls is standardized.
- Ground planning for micro chawki rearing centre has been completed.
- Selected different ecoraces*Viz.*, Borduar, kokhrajar, mixed ecoraces including C2 breed and reared for standardization of different chawki rearing techniques.
- Selected farmers from different regions and erichawki worms were distributed and recorded rearing data from each farmer and same has been compared with conventional rearing to study the impact of erichawki rearing.

- Frequent rearing has been conducted by using different ecoraces. Biochemical contents of the different varieties of castor are recorded. Health status erichawki worms are being conducted before the supply of worms to the farmers.

Special attainments/ innovations from the project:

a. A new brushing technique for newly hatched worms.
b. A new bed cleaning method with the standardized size of nets.
c. Standardized optimum number of chawki worms per tray.
d. Standardized quantity of feed (Castor) required for chawki worms per DFL.
e. Standardized lime quantity required per DFL.
f. Standardized ideal temperature and humidity required for erichawki worms.
g. Comapred therearing performance of erichawki worms after distribution and conventional rearing in the farmers' field. The farmers are very happy about the techniques used to get a uniform batch and also they have been got a very good income from chawki reared batch compared conventional rearing practiced by them.

Figure 1: Established chawki castor garden

Fig. 2: Uniformity in eri chawki worms at 2nd moult

Table 1: Plant growth parameters of different castor varieties at 30, 60 and 90 days after sowing

Castor varieties	30 DAYS		60 DAYS		90 DAYS		Chawki leaves (gm/plant) after 90 days	Chawki leaves (kg/ha) after 90 days
	Plant height (CM)	No. of leaves / plant	Plant height (CM)	No. of leaves / plant	Plant height (CM)	No. of leaves/ plant		
NBR-1	31.25	8.3	82.95	20.75	129.15	43.2	105.35	1053.5
Kalpi-6	34.55	7.15	83.60	18.65	132.25	41.1	87.45	874.5
DCH-519	30.00	6.85	78.20	17.25	101.25	31.65	71.99	712.30
DCS-9	29.95	6.15	73.45	15.65	97.95	27.3	65.93	667.80
ICH-66	28.65	6.40	72.65	16.75	99.40	28.55	62.25	638.85
CD	1.45	0.74	4.04	2.23	3.74	1.92	5.62	-
CV	0.61	1.37	0.67	1.63	0.43	0.73	0.93	-
SE.m	**0.47***	**0.24***	**1.31***	**0.73***	**1.21***	**0.62***	**1.82***	**-**

Project Code: AIB-05012-SI

Project Title: Inter and intra-specific hybridization for improvement of Eri silkworm, *Samia ricini* Donovan

Project Period : March, 2020 to February, 2024
Funding Agency : CSB, Bangalore
Total Budget : Rs. 23.15 Lakhs
Scientists involved : Dr. Reeta Luikham, PI
Dr. Aftab Ahmad Shabnam, CI

Objectives

1. To develop improved cross breeds/hybrids of Eri silkworm with higher fecundity and silk yield for commercial exploitation

Summary of the findings/achievements

- Four Eri ecoraces viz., Borduar, Genung, Titabar, Kokrajhar and C2 breed were collected from the Germplasm bank of CMER&TI, Lahdoigarh. The rearing of the parental stocks were carried out. The seed cocoons of each ecoraces and C2 breed were preserved and maintained separately for self seed.
- An average fecundity ranges from 356±4.766 to 376±4.077 nos. with hatching 90.33±1.473% to 92.37±1.597% of F1 to F4 was found.
- The mature larval weight average ranges from 7.431±0.090gmsto 8.127±0.124 gms and effective rate of rearing of silkworm ranges from 84.19±0.526% to 87.88±0.265% was observed (Table 2).
- The selection of pureline parental stock for utilization in actual breeding programme was completed.
- The average cocoon weight ranges from 2.96±0.062gms to 3.71±0.60gms, average shell weight ranges from 0.40±0.11gm to 0.55±0.11gm with average shell ratio 13.40±0.174% to 14.87±0.405% (Table 3).
- Wild eri silkworm, S*amia canningi* were collected from Thoubal, Tenougpal, Bishenpur, Imphal East and Imphal West in Manipur.
- Cocoon assessments showed cocoon weight an average of 2.405±0.144gm, Shell weight 0.304±0.016 gm and Shell ratio 12.873±0.485%.
- The seed cocoons were preserved under cage for emergence; during the period 71% erratic moth emergence was recorded. Only four coupling moths were obtained for F_1 selfed seed showing an average fecundity of 202±24.907 nos., hatching 92.578±1.732%. Rearing performance was assessed for F_1 generation showing an average of matured larval weight 6.42 gm and 87.072% effective rate of rearing. Selfed F1 generation of *S. canningi* collected from Manipur was successfully completed and harvested cocoon assessments showed an average cocoon weight of 2.805±0.121gm, Shell weight 0.337±0.023gm and Shell ratio 12.014±0.75%. The seed cocoons were preserved in cage for emergence to prepare selfed F2 seed.

Table 1: Fecundity, hatching and morphologies of eggs of F_1 to F_4 selfed seeds (Mean±S.E).

Treatment	(Mean±S.E)				
	Fecundity (Nos.)	Eggs (mm)		Hatched Eggs (Nos.)	Hatching (%)
		Length	Breadth		
C2 breed	376±4.077	1.621±0.35	1.324±0.017	347±4.06	92.37±1.597
Borduar	368±2.489	1.581±0.025	1.285±0.018	335±5.755	91.25±1.057
Titabar	363±4.554	1.528±0.017	1.278±0.016	331±5.344	92.33±1.473
Genung	356±4.766	1.555±0.030	1.264±0.01	319±8.67	90.75±1.688
Kokrajhar	366±4.193	1.549±0.018	1.267±0.02	331±7.324	91.75±1.584

Table 2: Rearing performance of Eri ecoraces and C2 breed of F_1 to F_4 generations (Mean±S.E)

Treatment	(Mean±S.E)						
	Larval Weight (gms)	Body (mm)		Head capsule (mm)		Larval duration (Days)	ERR (%)
		Length	Breadth	Length	Breadth		
C2 breed	8.127±0.12	70.20±0.64	12.70±0.22	4.54±0.14	4.71±0.14	22-24	87.88±0.27
Borduar	7.818±0.15	70.73± 0.79	12.35±0.16	4.36±0.03	4.52±0.03	22-24	85.48±0.25
Titabar	7.431±0.09	70.06± 0.37	12.22±0.17	4.37±0.05	4.50±0.05	22-24	84.79±0.30
Genung	7.509±0.08	66.12± 0.92	11.56±0.17	4.14±0.02	4.30±0.02	22-24	84.19±0.53
Kokrajhar	7.497±0.17	64.26± 0.72	11.52±0.14	4.17±0.03	4.34±0.03	22-24	85.78±0.19

Table 3: Cocoon characters of each ecoraces and C2 breed of selfed F_1 to F_4(Mean±S.E).

Treatment	(Mean±S.E)					
	Cocoon Weight (gms)	Cocoon (mm)		Shell weight (gm)	Pupa weight (gm)	Shell ratio (%)
		Length	Breadth			
C2 breed	3.71±0.60	55.32±1.19	24.177±0.90	0.55±0.11	3.16±0.05	14.87±0.41
Borduar	2.96±0.06	53.42±0.80	24.29±0.61	0.40±0.11	2.58±0.06	13.49±0.21
Titabar	3.12±0.04	50.33±0.82	21.573±0.60	0.42±0.01	2.74±0.05	13.47±0.21
Genung	3.19±0.06	50.85±0.91	23.03±0.55	0.43±0.01	2.92±0.06	13.405±0.17
Kokrajhar	3.15±0.11	53.21±0.96	21.75±0.71	0.42±0.01	2.69±0.15	13.93±0.24

Project Code: APR 05018 MI

Project Title: Effect of various host plants separately and in combination on Rearing and grainage performance of Muga silkworm, *Antheraea assamensis* Helfer

Project Period : March, 2021-Feb, 2024
Funding Agency : CSB, Bangalore
Total Budget : Rs. 15.42 Lakhs
Scientists involved : Dr. Kh. Subadas Singh (PI),
Dr. DK Jigyasu (CI),
Shri S. A. S. Rahman (CI),
Shri Vikram Kumar (CI)

Objectives

1. To study the effect of various host plants separately and in combination on rearing performance of muga silkworm.
2. To study the effect of various host plants separately and in combination on grainage performance of muga silkworm.

Summary of the findings/achievements:

- As project is newly started, only preliminary research work had been done.
- Muga silkworm rearing had been conducted on four different food plants viz., Som (*Persea bombycina*), Soalu (*Litsea monopetala*), Dighloti (*Litsea salicifolia*) and Mejankori (*Litsea cubeba*) both in solo and comibination.

- During rearing period, moulting rate, larval weight and larval longevity had been recorded along with weather data. During combination of host plant, feeding behaviour of silkworm had been recorded. After then, cocoons obtained from silkworm rearing on different host plants had been subjected to further studies on grainage parameters. Cocoon weight, shell weight, shell ration had been studied. Muga DFLs produced were ready for next rearing in different crop season.

Figure 1: Rearing of muga silkworm on different food plants both solo and combination

Project Code: BPS01013CN

Project title: Utilization and diversification of silkworm pupae products for human & animal consumption and composting.

Project Period : September, 2020 to August, 2022.
Funding Agency : Central Silk Board, Bengaluru
Collaborative Institutes : CSRTI, CSTRI, CTRTI, CFTRI & CIFRI
Scientists involved : Dr. Mahesh D. S., Co-PI
Dr. James Keisa, CI

Objectives:

1. To evaluate nutrients and bioactive compounds in silkworm pupae of Eri and Muga.
2. To characterize proteome of Eri and Muga silkworm pupae.

Summary of the findings/achievements:

- Completed the estimation of major nutrient composition of both eri and muga pupae *Viz.*, crude proteins, carbohydrates, total lipids, crude fibres, ash, reducing sugars and phenols.
- Completed the profiling of biochemical compounds *Viz.*, amino acids, phenolic acids and flavonoids of both eri and muga pupa.
- Standardized the drying procedure for both eri and muga pupae.
- Fresh eri pupae are collected for various experiments and supplied to collaborators based on their indent.

Table 1: Composition of major nutrients in Eri and Muga pupae

Nutrients (%)	Eri pupae (%)	Muga pupae (%)
Crude proteins	57.61±3.31	45.16±2.89
Carbohydrates	11.92±2.64	15.36±3.20
Total lipids	17.68±1.92	25.52±1.63
Crude fibers	1.81±0.36	1.59±0.31
Ash	5.38±0.72	6.36±0.55
Reducing sugars	1.70±0.40	1.22±0.48
Phenols	1.66±0.31	1.21±0.40

Project Code : CFC 05017 MI

Project Title: Exploration and adoption of novel solvent based muga cocoon cooking technology for increasing its reelability and raw silk quality

Project Duration : March 2021 – Feb 2023
Proposed Funding Agency : CSB Bangalore
Scientists Involved : Dr. Manjunath R. N, PI
Dr. Dip Kumar Gogoi, CI
Dr. Rajiv Munshi, CI

Objectives:

1. To study the efficacy of enzymatic and non-enzymatic (chemical) approaches in muga cocoon cooking/softening.
2. To develop a new solvent based cocoon cooking technique to improve the reelability & raw silk quality in muga cocoons dried under different techniques
3. To carry out large scale Multi-location trials at CSB and DoS reeling units for validating the efficacy of the newly developed cooking method.
4. To create awareness among the reeling beneficiaries to adopt/popularize the new solvent based muga cocoon cooking technique for efficient reeling and quality raw silk production.

Summary of the findings/achievements:

- Microbial samples were isolated from the soil samples and dumping sites and Gram's staining test was carried for the isolated microbes.
- Comparative analysis of different cooking techniques viz soda, silkplus, NaOH and new formulation, on muga cocoons are being carried out.
- There boil loss percentage and single cocoon reeling characteristics are being studied and documented

Project Code: MFM 05019 MI

Project Title: Development of Honeycomb Mountages and Harvesting Technology for Muga Cocoon Production with Improved Uniformity and Raw Silk Recovery.

Project Duration : March 2021 – Feb 2023
Proposed Funding Agency : CSB Bangalore
Scientists Involved : Dr. Manjunath R. N. (PI)
Dr. Mahesh D.S. (CI)
Dr. Urmimala Hazarika,(CI)

Objectives:

1. Fabrication of honeycomb mountages and suitable harvesting technology for uniform Muga cocoon production.
2. Impact assessment of honeycomb mountages on cocoon production, cocoon characteristics and reeling performances.
3. To conduct on-station feasibility trials of the mountages at CSB/DoS units for prototype test verification.

Summary of the findings/achievements:

- Morphological study of Muga Silkworm was carried out and then worm dimensions were recorded for construction of Honeycomb Mountages.
- Fabrication of honeycomb mountages was trialed with hard-sheet material by taking two samples with the edge measurement of 1.5cm and 2 cm.
- Muga Silkworms were weighted and then transferred into honeycomb mountages for spinning. After Spinning, cocoons were further harvested and their parameters like weight, dimensions, Filament length, Filament weight, Denier and Silk Recovery Percentage were evaluated and recorded.

HOST PLANT DIVISION

CONCLUDED PROJECTS

Project Code: PPF-5893

Project Title: Impact assessment of petroleum crude oil activities on Muga Silkworm (*Antheraea assamensis* Helfer) and its host plants in Assam

Project Period : Aug 2017 to July 2020
Funding Agency : CSB Bangalore
Total Budget : Rs. 22.89 lakhs
Scientists involved : Dr. D. K. Jigyasu, PI
Dr. Subadas Singh, CI
Dr. Amit Kumar, CI (w.e.f. July, 2019)
Dr. Kartik Neog, CI (Upto June, 2019)

Objectives

1. Determination of crude oil contamination in Muga Silkworm rearing and its mitigation measure

Summary of the findings/achievements

- It was ascertained the crude oil and foreign substances released from petroleum oil industry in the shape of aerosols continuously enter into the muga ecosystem and reach to plant system or deposit on leaf surface which hamper the physiological activities of plants, ultimately affect plant health and reduces its nutritional value.
- Ultimately, environmental pollution and low nutritional value of host plants affects muga silkworm in respect to its feeding efficiency, health of silkworm and diseases incidences.
- Average effective rate of rearing at polluted site was reduced by 15.21% as compared with control and average cocoon yield production per dfl also reduced significantly (40.74%) at contaminated site. Reduction in silk ratio (SR %) of both male (30.8%) and female (30.5%) were recorded at contaminated site as compared to control site. Significant reduction in male cocoon weight was 27.6% and female cocoon weight is 21.9% at contaminated site (Table 1).
- The physiological, biochemical and anatomical features of the host plant (som) were also negatively impacted by petroleum pollutants. Significant reductions in Free Amino Acid (39.17%), Carbohydrate (36.89%), Chlorophyll (7.71%), Carotenoid (16.32%), Protein (10.61%), Lipid (9.94%) and Ash (11.18%) in leaves of Som plant were observed at contaminated site, Ponka. Significant reductions in phytochemcial content of Free Amino Acid (23.37%), Carbohydrate (52.90%), Chlorophyll (9.80%), RWC (79.04%), Protein (12.36%), Lipid (9.41%) and Ash (0.47%) in leaves of Som plant were observed at contaminated site, Gelakey as compared with control. Ascorbic acid content was found increased by 57.26% and 88.85% in Ponka and Gelakey, respectively as compared with control indicating stress level of the plants (Table 2).
- Soil parameters were also found being negatively impacted by petroleum contamination. The sulphur availability index suggests the very low availability of sulphur in contaminated soil. Mitigation measures were worked out to reduce the impact of petroleum contamination on muga culture (Fig 1 & 2).
- The identified mitigation measures of barrier plantation coupled with application of biochar has the potential to significantly reduce the impact of petroleum contamination on muga silkworm and its host plant (Fig. 3 & 4).

Table 1: Muga silkworm crop wise rearing data of (a) hatching %, cocoon/yield and ERR% of 2018, (b) male and female cocoon characteristics of 2018, (c) hatching %, cocoon/yield and ERR% of 2019 and (d) male and female cocoon characteristics of 2019 of contaminated samples and compared with control samples.

a Crop	2018	Hatching %	Cocoon yield/DFl	ERR %
Chotua (Feb–Mar)	Contaminated	54.00	28.35	36.24
	Control	68.47	41.00	38.63
Jethua (Apr–May)	Contaminated	55.00	36.25	44.40
	Control	72.14	65.00	53.98
Aherua (Jun–Jul)	Contaminated	23.65	35.26	31.02
	Control	75.29	69.00	41.17
Bhodia (Aug–Sep)	Contaminated	25.36	22.35	30.00
	Control	68.36	45.00	42.69
Kotia (Oct– Nov)	Contaminated	65.65	42.50	38.36
	Control	74.78	65.00	49.65
Jarua (Dec–Jan)	Contaminated	48.75	30.25	35.08
	Control	70.88	66.00	54.78

b Crop	2018	Cocoon wt (gm) ♀	Shell wt (gm) ♀	Cocoon wt (gm) ♂	Shell wt (gm) ♂	SR % (♀)	SR % (♂)
Chotua (Feb–Mar)	Contaminated	4.65±0.14	0.29±0.03	3.65±0.37	0.35±0.04	6.15±0.49	9.56±1.44
	Control	6.57±0.19	0.57±0.01	4.84±0.44	0.47±0.02	13.39±1.1	10.79±1.0
Jethua (Apr–May)	Contaminated	5.29±0.17	0.32±0.04	3.15±0.10	0.22±0.03	5.97±0.69	6.98±0.98
	Control	6.55±0.18	0.59±0.03	4.54±0.14	0.5±0.03	9.01±0.22	11.01±0.71
Aherua (Jun–Jul)	Contaminated	4.63±0.16	0.24±0.02	3.62±0.24	0.33±0.02	5.19±0.63	9.12±0.56
	Control	7.25±0.34	0.58±0.03	4.65±0.14	0.51±0.03	8.75±0.06	10.00±0.24
Bhodia (Aug–Sep)	Contaminated	4.86±0.15	0.33±0.05	2.72±0.20	0.17±0.02	6.71±0.94	6.27±1.02
	Control	6.52±0.01	0.57±0.01	4.75±0.11	0.46±0.02	8.66±0.17	9.93±0.15
Kotia (Oct–Nov)	Contaminated	5.60±0.43	0.48±0.03	3.68±0.11	0.22±0.02	8.49±0.17	6.09±0.44
	Control	6.56±0.20	0.57±0.03	4.54±0.09	0.47±0.03	8.63±0.026	10.27±0.56
Jarua (Dec–Jan)	Contaminated	4.78±0.17	0.38±0.01	1.93±0.03	0.07±0.07	7.87±0.42	3.63±0.79
	Control	5.82±0.13	0.48±0.01	3.80±0.15	0.37±0.01	8.17±0.09	9.76±0.39

c Crop	2019	Hatching %	Cocoon yield/ DFl	ERR %
Chotua (Feb–Mar)	Contaminated	55.45	26.85	38.16
	Control	70.76	44.60	44.68
Jethua (Apr–May)	Contaminated	61.75	38.25	50.00
	Control	71.97	60.00	51.52
Aherua (Jun–Jul)	Contaminated	58.25	27.00	47.25
	Control	59.25	47.67	46.10
Bhodia (Aug–Sep)	Contaminated	36.85	crop not completed	
	Control	58.57	37.67	43.97
Kotia (Oct– Nov)	Contaminated	62.50	crop not completed	
	Control	68.45	56.17	51.22
Jarua (Dec–Jan)	Contaminated	58.45	30.15	37.78
	Control	71.19	45.75	38.47

d	Crop	2019	Cocoon wt (gm) ♀	Shell wt (gm) ♀	Cocoon wt (gm) ♂	Shell wt (gm) ♂	SR % (♀)	SR % (♂)
Chotua (Feb–Mar)		Contaminated	4.87±0.27	0.32±0.03	3.72±0.49	0.35±0.04	6.64±0.68	9.43±1.39
		Control	6.57±0.19	0.57±0.01	4.84±0.44	0.47±0.02	13.39±1.1	10.79±1.0
Jethua (Apr–May)		Contaminated	5.57±0.21	0.37±0.02	3.40±0.28	0.23±0.02	6.65±0.46	6.86±0.77
		Control	6.55±0.18	0.59±0.03	4.54±0.14	0.5±0.03	9.01±0.22	11.01±0.71
Aherua (Jun–Jul)		Contaminated	4.73±0.21	0.25±0.02	3.58±0.24	0.34±0.02	5.21±0.52	9.62±0.62
		Control	7.25±0.34	0.58±0.03	4.65±0.14	0.51±0.03	8.75±0.06	10.00±0.24
Bhodia (Aug–Sep)		Contaminated						
		Control	6.52±0.01	0.57±0.01	4.75±0.11	0.46±0.02	8.66±0.17	9.93±0.15
Kotia (Oct–Nov)		Contaminated						
		Control	6.56±0.20	0.57±0.03	4.54±0.09	0.47±0.03	8.63±0.02	10.27±0.56
Jarua (Dec–Jan)		Contaminated	4.72±0.17	0.36±0.02	2.01±0.06	0.07±0.02	7.62±0.40	3.44±0.84
		Control	5.82±0.13	0.48±0.01	3.80±0.15	0.37±0.01	8.17±0.09	9.76±0.39

Table 2: Pooled results of biochemical constituents of primary host plant leaf Som at control and contaminated site.

Sl	Parameters	Control (n=35)				Contaminated (n=35) Ponka				Contaminated (n=35) Sivasagar			
		Min	Max	Mean	CV %	Min	Max	Mean	CV %	Min	Max	Mean	CV %
1	pH	5.10	6.40	5.68±0.28	4.38	5.10	6.24	5.64±0.34	5.99	4.53	6.93	6.25±0.54	8.59
2	Chl a (mg/g)	1.15	1.97	1.45±0.18	9.15	0.56	1.72	1.31±0.29	21.86	0.87	2.69	1.80±0.49	27.25
3	Chl b (mg/g)	0.51	1.52	0.91±0.27	17.42	0.45	1.70	0.87±0.27	30.77	0.09	1.43	1.00±0.31	31.39
4	Total Chl (mg/g)	1.67	3.32	2.35±0.41	12.35	1.17	2.85	2.17±0.45	20.87	1.23	2.97	2.12±0.48	22.41
5	Carotenoid (mg/g)	0.01	0.05	0.02±0.01	12.45	0.01	0.03	0.02±0.01	26.27	0.01	0.05	0.03±0.01	37.78
6	Ascorbic Acid (mg/g)	1.35	26.7	9.95±6.71	25.08	13.33	35.14	23.29±5.93	25.44	86.34	93.26	89.25±1.60	1.79
7	RWC (%)	52.65	93.3	75.87±12.60	13.51	47.34	90.94	73.35±14.68	20.01	11.35	32.89	15.90±4.12	25.91
8	Protein (mg/g)	11.21	21.5	15.27±2.55	11.85	10.62	18.70	13.65±1.94	14.20	11.21	14.82	13.38±1.03	7.73
9	Carbohydrate (mg/g)	15.49	38.5	23.17±4.87	12.62	8.44	22.23	14.62±3.48	23.79	0.74	19.16	10.91±5.02	45.99
10	Phenol (mg/g)	0.14	4.41	2.69±1.02	23.22	0.80	6.14	3.42±1.55	45.23	1.29	4.41	2.94±0.88	30.02
11	Amino acid (µg/g)	2.47	77.8	19.51±18.65	23.98	1.22	37.78	11.87±9.09	76.59	10.56	21.11	14.95±3.12	20.84
12	Lipid (mg/g)	5.38	9.8	6.40±1.01	10.37	2.98	7.05	5.76±0.90	15.64	3.23	9.77	5.80±1.12	19.35
13	Ash Content (%)	4.36	5.9	4.74±0.36	6.10	3.25	6.12	4.21±0.86	20.43	3.85	5.96	4.71±0.38	7.97

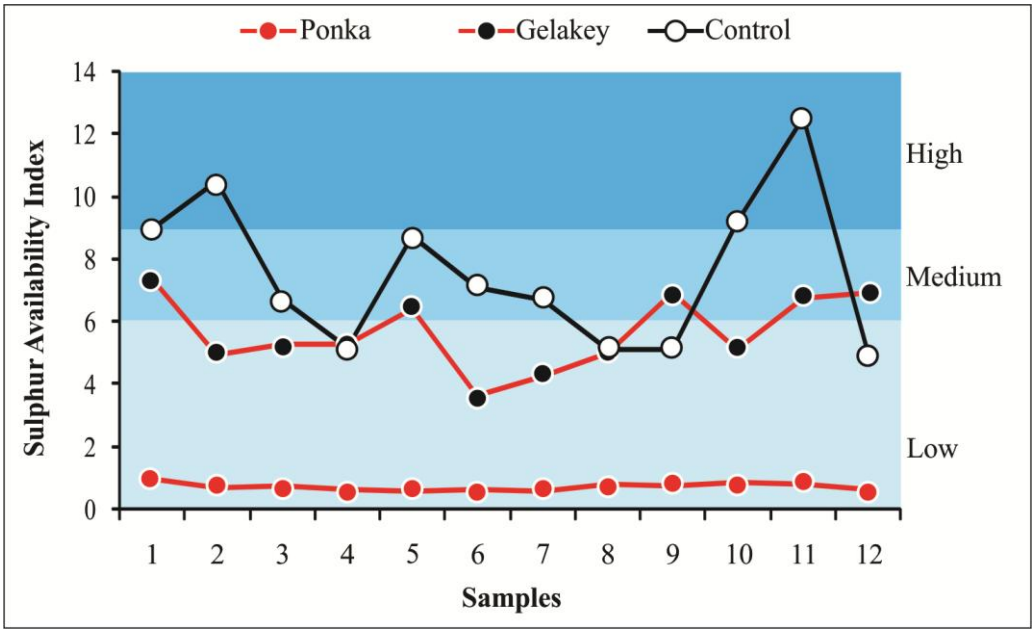


Fig. 1: Sulphur availability index in soil of control, contaminated site (Ponka) and contaminated site (Gelakey).

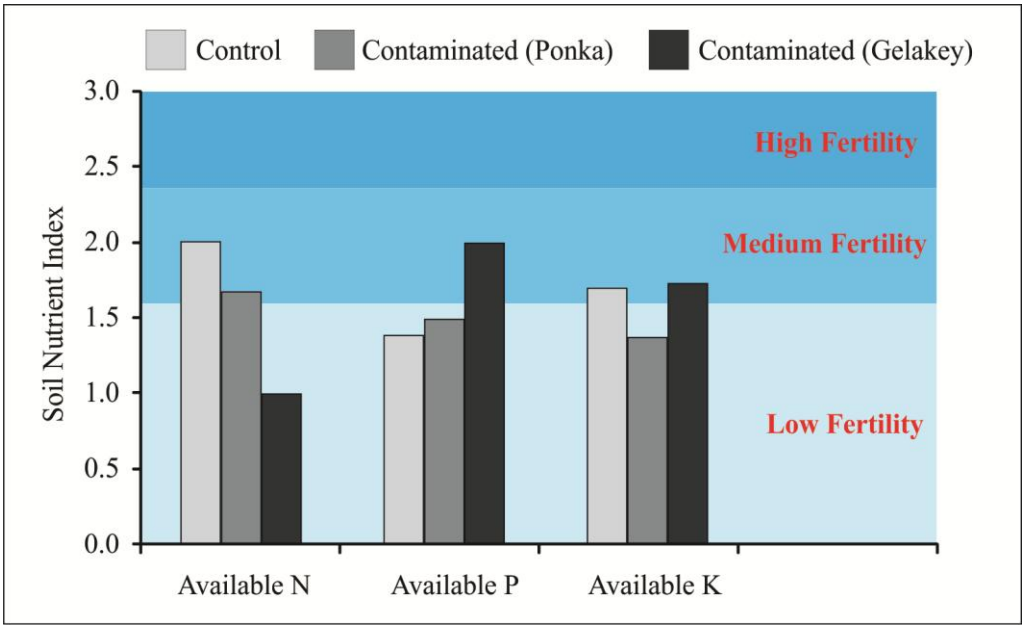
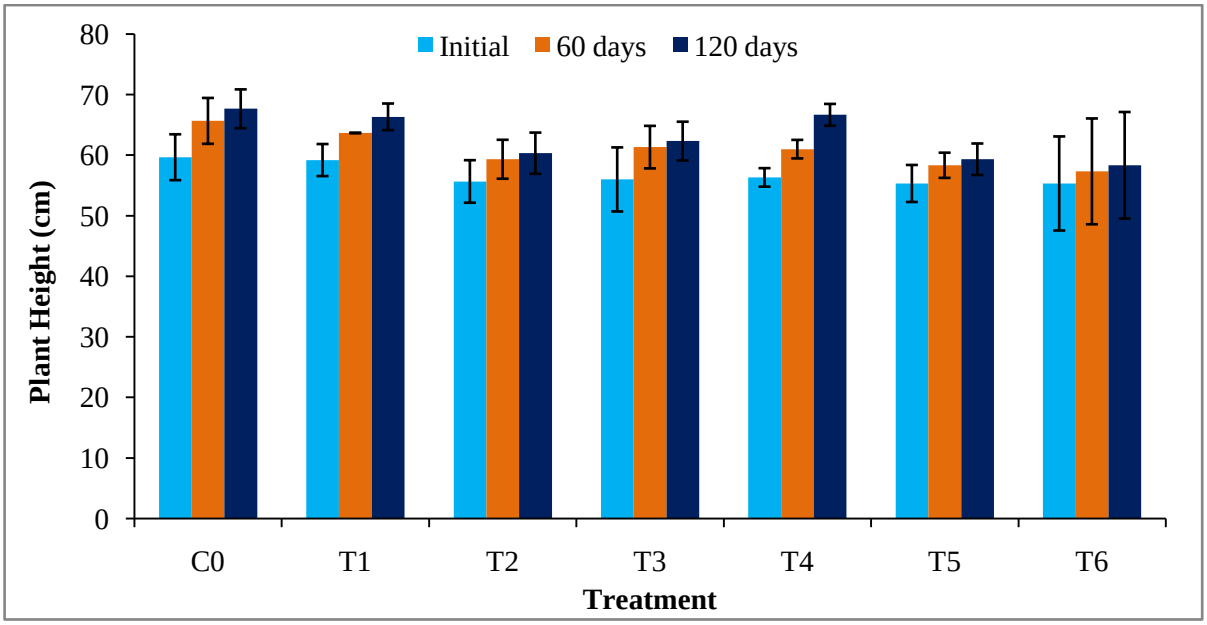


Fig. 2: Variation of Soil nutrient fertility of control, contaminated (Ponka) and contaminated (Gelakey) soils.



[Treatment C0: Control Soil with recommended package & practice; T1: Contaminated soil with KNO_3; T2: Contaminated soil with Muga waste water (effluent); T3: Contaminated soil with bacterial consortium; T4: Contaminated soil with Biochar; T5: Contaminated soil with Muga litter; T6: Contaminated soil with recommended package & practice]

Fig. 3: Bar diagram showing the treatments and effects on Som plants height (cm).

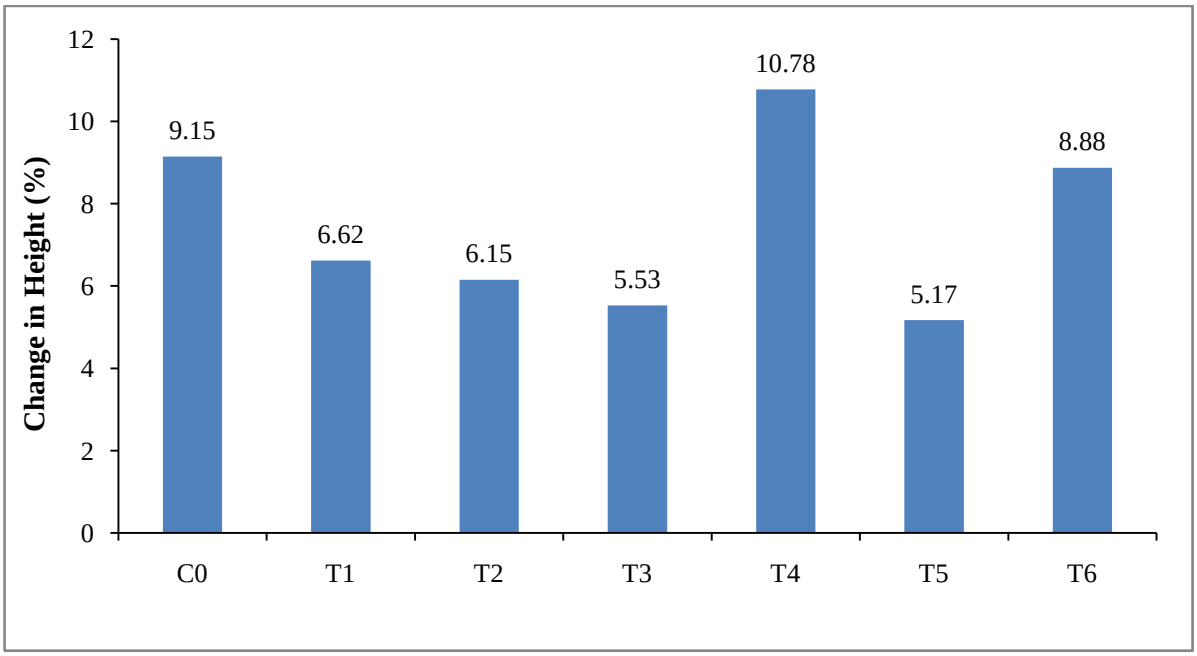


Fig. 4: Bar diagram showing the treatments and percent changes in Som plants height (cm).

Project Code: PPA-5879

Project Title: Assessment of phytochemical diversity in Som (*Persea bombycina* Kost), the primary host plant of *Antheraea assamensis* Helfer from Northeast India

Project Period : Sep 2016 to Feb 2021
Funding Agency : CSB Bangalore
Total Budget : Rs. 15.20 lakhs
Scientists involved : Dr. Prashant S, PI (upto July, 2019)
Dr. Amit Kumar, PI (w.e.f. August, 2019)
Dr. D. K. Gogoi, CI

Objectives

1. Assessment of phyto-chemical constitutes of Som during different rearing seasons under agro-climatic zones of northeast region
2. To develop a comprehensive nutrient management package for muga host plant.

Summary of the findings/achievements

- The similar morphotype ware selected to analyze the seasonal and regional phyto-chemical diversity Som to avoide the chance of genetic based variability.
- The seasonal variation in the growth parameters, medium properties as well as the biochemical characteristics envisage that significant variation exists in the same population type in different regions.
- The magnitude of the variance suggest that the variation is due to the change in meteorological condition, regional effects as well as the edaphic influences as the pool data correlation suggest that nitrogen is highly responsible for the protein and free amino acid content.
- The independent variation among the three-leaf stage, it was observed that the tender and semi-mature leaves were least affected than the mature leaves. This might be due to the remobilization of nitrogen as nitrogen is the mobile element.
- The regression analysis shows the overall impact of the organic contents with the total carbohydrate effects. This might be due to the decreased availability of nutrient under low organic carbon conditions.
- The PCA suggest that the variation in the Tura location was more profound in the Kotia and Jarua season than the Aherua and Bhodia seasons. Similarly, at Goalpara location the highest varied seasons were observed during Bhodia and Kotia and in case of Dhakuakhana Bhodia and Aherua seasons were observed with higher variation in all the studied parameters. However, Aherua and Bhodia seasonal variation of Tura is having the close proximity with Jarua season of Goalpara and Dhakuakhana in-terms of leaf phyto-chemical diversity which may be due to the climatic as well as the seasonal variance in edaphic characters. Jarua seasons of the Dhakuakhana and Goalpara also shares the variance boundary of all the locations that suggest the least varied under different conditions (Fig. 1).
- Based on the phyto-chemical and soil physico-chemical characteristics of the all the studied location a ready-reckoner for soil nutrient correction was prepared for nitrogen, potassium and phosphorous nutrients (Table 1).
- The ready-reckoner for the other districts of of north eatern states was also prepared utilizing the relation of the studied location (Table 2).

Table 1: N, P and K variability and correction required among the regional and seasonal scale.

Locations	Nutrient correction (kg/ha)			Nutrient correction (g/Plant); RFD=195:351:75		
	N	P	K	N	P	K
Aherua						
TURA			86.46			77.82
GOALPARA			99.71			89.75
DHKAKUKHANA	37.5	45.31	63.71	33.75	40.79	57.34
Bhodia						
TURA			69.24			62.32
GOALPARA	22	62.5	93.12	19.80	56.26	83.82
DHKAKUKHANA	13	32.81	69.18	11.70	29.53	62.27
Kotia						
TURA			57.84			52.06
GOALPARA	35	81.25	82.98	31.50	73.13	74.69
DHKAKUKHANA	9.5	21.87	24.94	8.55	19.69	22.45
Jarua						
TURA		0.78	47.06			42.36
GOALPARA		75.78	84.98			76.49
DHKAKUKHANA	9.5	31.25	62.31	8.55	28.13	56.08

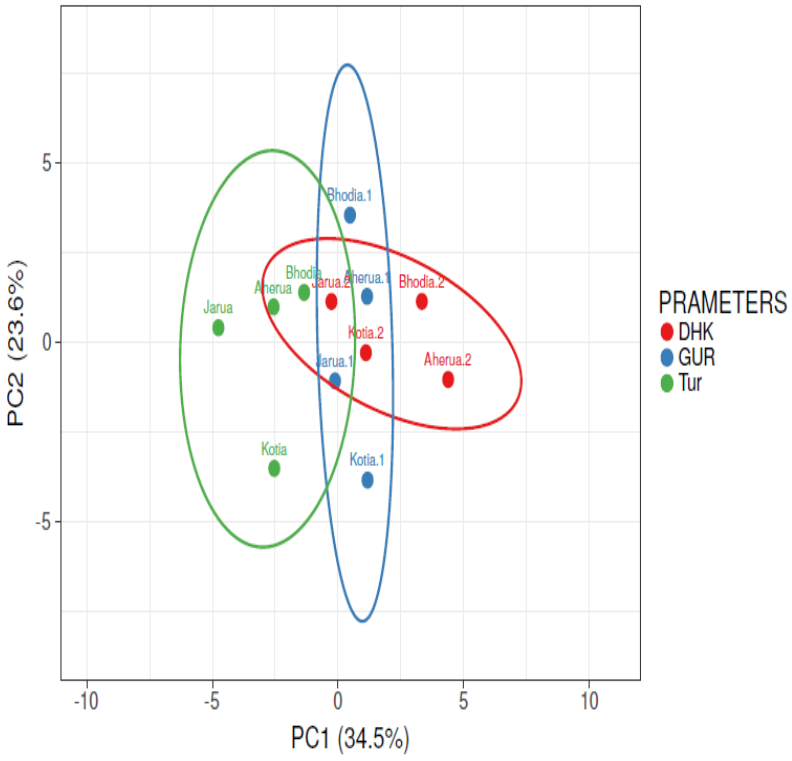


Figure 1: Unit variance scaling is applied to leaf characteristics; SVD with imputation is used to calculate principal components. X and Y axis show PC1 and PC2 that explain 34.5% and 23.6% of the total variance, respectively. Prediction ellipses are such that with probability 0.95, observations of different parameters of leaf characteristics from the same locations of the agro-climatic regions fall inside the ellipse. Numbers of

the studied seasons are 4 and studied locations are 3. Thus total N = 12 data points are considered to analyze the PCA. Total 58.1% data represents in this PCA. (Tur = Tura; GUR = Goalpara; DHK =Dhakuakhana)

Table 2: Nutrients corrections (NPK) for different district of the northeastern state of India in the soil of the Som plantation

Locations		Nutrient correction (kg/ha)			Nutrient correction (g/Plant); RFD=195:351:75		
State	**District**	**N**	**P**	**K**	**N**	**P**	**K**
Assam	**Lakhimpur**			1.8			1.62
	Baksa			129.24			116.33
	Baksa BTAD	43.75		131.53	39.38		118.39
	Bongaingaon	87.5		129.87	78.76		116.89
	Charaideo			111.24			100.13
	Kokrajhar			95.39			85.86
	Chirang			129.41			116.48
	Dhemaji			83.99			75.60
	Dibrugarh			125.29			112.77
	Goalpara			110.44			99.41
	Kamrup			116.15			104.55
Meghalaya	**Ri Bhoi**			116.61			104.96
	West Garo Hills			121.76			109.59
Arunachal Pradesh	**Borguli**		62.5	61.05		56.26	54.95
	Dabang Valley Roing	212		25.83	191.27		23.25
	East Siang Pasighat			69.01			62.12
	Lingka		40.63			36.57	
	Namsai			102.36			92.13
	Oyam		31.25	3.09		28.13	2.78
	Roing			106.28			95.66
	Serum		52.3	53.08		47.11	47.78
Nagaland	**Dimapur**			81.97			73.78
	Mokokchung			100.61			90.56
	Wokha						
Mizoram	**Aizawl**			76.96			69.27
	Kolasib			49.84			44.86
	Serchhip			132.22			119.01

ONGOING R&D PROJECTS

Project Code: PIB-05005SI

Project Title: Genetic enhancement of Castor (*Ricinus communis* L.) germplasm as a source material for development of productive perennial varieties

Project Period : Oct. 2019 to Sep. 2022
Funding Agency : CSB Bangalore
Total Budget : Rs. 13.30 lakhs
Scientists involved : Dr. Aftab A Shabnam, PI
Dr. Amit Kumar, CI
Dr. Dharmendra Kumar Jigyasu, CI
Dr. L. Somen Singh, CI

Objectives

1. Genetic enhancement of castor germplasm.
2. Development of pre-bred intermediate castor with perennial characteristics.

Summary of the findings/achievements:

- Gene pool was enriched with 22 castor accessions [14 perennial and 03 annual castor accessions collected from NER, 03 annual castor varieties (DCS-9, ICH-66 and DCH-519) collected from IIOR, Hyderabad, Kalpi-6 collected from UP and YTP-1 Collected from TNAU] (Table-1).
- All the 22 accessions were characterized for seed morpho-metric traits and 06 accessions were also characterized for morphological, metric and biochemical traits. Plantation of different newly collected accessions is presently under establishment and bioassay study was initiated.
- Morpho-metric data of 06 castor accessions was statistically analyzed. Variability in the traits was observed to be ranging from 7.096 to 47.346 with highest variability observed in total shoot length (m) (Table 2&3). Significant differences were observed between the accessions in Leaf area, Lobe length, Lobe breadth, Petiole length, Petiole diameter, Length of primary receme, No. of shoots/plant, Total shoot length, Seed yield and Leaf petiole ratio. Significant differences were also observed in seed morpho-metric traits with highest variability in 100 seed weight (38.50%).
- **1st crossing lot:** 12 different reciprocal/cross combinations were executed. Preliminary selection was carried out in F_1 generation, selfed & F_2 seeds harvested. Selfed F_1 seeds of potential perennial accessions were also sown for mass selection. 05 perennial plants were selected from mass selection lot and these plants are presently in the 2nd year of establishment.
- **2nd crossing lot:** Pollens of potential perennial donor parents NBR-perennial-Imphal and Single Bloom Red-perennial-Shillong were collected and dusted on NBR-1 (2nd crossing lot). Seed setting was successfully achieved in these wide crosses. YTP-1 was crossed with NBR-1. Total 17 cross combinations including reciprocal crosses were carried out in 2nd crossing lot and F_1 seeds were harvested.
- F_1 generation of 1st crossing lot, mass selection lot and plantation of germplasm accessions is maintained as per recommended package of practices.

Table 1: Castor accessions collected/acquired till March 2021

Acc. No.	Type/Source	Acc. No.	Type/Source
01	NBG-P. Leimakhong, Kangpokpi (Manipur)	**12**	NBR-A. Tilikhian, Jorhat (Assam)
02	NBR-P. L.Phaikot, Kangpokpi (Manipur)	**13**	NBR-P. Murmuria Gaon, Jorhat (Assam)
03	NBR-P. Pukhao Wakhong, Imphal (E) (Manipur)	**14**	NBR-A. CMER&TI Quarter Campus, Jorhat (Assam)
04	NBR-P. Upper Doigrung, Golaghat (Assam)	**15**	Kalpi-6. (Perennial) REC Fatehpur (Uttar Pradesh)
05	NBR-P. Upper Golaghat (Assam)	**16**	DCS-9. Indian Institute of Oil Seed Research, Hyderabad (Telangana)
06	NBR-P. Ghotovi, Nuiland, Dimapur (Nagaland)	**17**	ICH-66. Indian Institute of Oil Seed Research, Hyderabad (Telangana)
07	NBR-P. Mokokchung (Nagaland)	**18**	DCH-519. Indian Institute of Oil Seed Research, Hyderabad (Telangana)
08	NBG-P. Jakhama village (Nagaland)	**19**	NBR-1 (Annual). Germplasm Conservation Centre, Chenijan, Jorhat (Assam)
09	NBG-P. Borholla, Titabar, Jorhat (Assam)	**20**	NBR-P. Kumbi, (Manipur)
10	NBR-A. Dulia Gaon, East Jorhat (Assam)	**21**	YTP-1 (Perennial), TCRS, Tamil Nadu Agriculture University, Yethapur Salem, (TN)
11	NBG-P. Lahdoigarh, Jorhat (Assam)	**22**	NBR-P. RSRS Campus, Imphal (Manipur)

Note: NBR-A = Non Blooming Red-Annual, NBR-P = Non Blooming Red-Perennial
NBG-A = Non Blooming Green-Annual, NBG-P = Non Blooming Green-Perennial

Table 2: Variability in metric traits of 06 castor accessions

#	Character	Min.	Max.	Mean	Variance	S.E	CV%
1	**Plant height (m)**	1.28	2.9	1.99	0.103	0.076	16.174
2	**Internodal distance (cm)**	9.09	20	13.37	10.061	0.748	23.719
3	**Leaf area (sq.cm)**	483.25	875.49	675.67	15920.88	29.74	18.675
4	**Lobe length (cm)**	14	35	22.78	39.007	1.472	27.419
5	**Lobe breadth (cm)**	7	20	12.28	14.212	0.889	30.705
6	**Petiole diameter (mm)**	5.13	24.43	14.2	35.688	1.408	**42.073**
7	**Insertion of primary raceme (m)**	0.46	1.62	1.11	0.095	0.073	27.718
8	**Stem diameter (mm)**	18.51	35.44	28.6	19.344	1.037	15.376
9	**Length of primary raceme (cm)**	22	48	30.94	41.35	1.516	20.78
10	**No. of shoot per plant (No)**	4	14	7.61	6.958	0.622	34.656
11	**Total shoot length per plant (m)**	4.1	19.6	8.38	15.727	0.935	**47.346**
12	**100 leaf weight (g)**	1508.2	2504.2	1883.86	60379.83	57.917	13.044
13	**No. of lobe (No./leaf)**	9	11	9.67	0.471	0.162	7.096
14	**Seed yield (g/plant)**	15.83	58.62	32.23	226.062	3.544	**46.645**
15	**Leaf yield (kg/plant)**	0.61	1.626	0.99	0.084	0.068	**29.404**
16	**Leaf petiole ratio**	2.07	3.85	2.85	0.365	0.142	21.227
17	**Leaf shoot ratio**	0.323	0.619	0.46	0.007	0.019	17.836

Table 3: Variability in Morphological traits of 06 castor accessions

S. no	Characters	Frequency Distribution
1	**Habit**	Erect (83%), Spreading (17%)
2	**Growth Nature**	Erect (100%)
3	**Stem colour**	Green (17%), Red (33%), Mahogany (33%), Pinkish red (17%)
4	**Lobe shape**	Incised (100%)
5	**Branching Nature**	Divergent (50%), Convergent (50%)
6	**Bloom**	Non-bloom (100%)
7	**Leaf Shape**	Peltate (100%)
8	**Leaf colour**	Light green (17%), Medium green (33%), Dark green (50%)
9	**Leaf apex**	Mucronate (50%), Acuminate (50%)
10	**Leaf glossiness**	Slightly glossy (33%), Non glossy (67%)
11	**Leaf Margin**	Serrate (100%)
12	**Leaf Surface**	Smooth (33%), Slightly rough (67%)
13	**Mature shoot colour**	Red (83%), Green (17%)
14	**Pigmentation of primary veins**	Greenish (67%), Reddish (33%)
15	**Wax on adaxial blade surface**	Absent (100%)
16	**Coloration of adaxial blade surface**	Medium green (33%), Dark green (67%)
17	**Staminate flowers on the Raceme**	Present (100%)
18	**Location of staminate flowers**	Predominantly on the lower part of the Raceme (83%), Interspersed with the pistillate flowers (17%)
19	**Stigma coloration**	Yellowish (17%), Reddish (83%)
20	**Density of Raceme**	Intermediate (67%), Sparse (33%)
21	**Raceme shape**	Conical (33%), Cylindrical (67%)
22	**Fruit wax**	Absent (100%)
23	**Fruit coloration**	Dark green (50%), Medium green (50%)
24	**Fruit Dehiscence**	Non dehiscent (100%)
25	**Presence of secondary coloration on seed**	Present (100%)
26	**Presence of Prickles on the fruits**	Present (100%)
27	**Density of the Prickles on the fruits**	High (50%), Medium (50%)
28	**Coloration of the fruit prickles**	Medium green (83%), Pinkish green (17%)
29	**Sex Expression**	Monoecious (100%)
30	**Phyllotaxy**	Distichous (17%),Pentastichous (33%), Tristichous (50%)
31	**Leaf texture**	Membranous (50%), Coriacious (50%)

Table 4: Variability in seed metric traits of 22 castor accessions

S. No.	Character	N	Min.	Max.	Mean	Variance	S.E	CV%
1	**Seed Length (mm)**	660	7.47	16.920	10.764	2.929	0.067	15.900
2	**Seed Breadth (mm)**	660	4.60	10.720	6.950	1.549	0.048	17.911
3	**Elongation Index**	660	1.283	1.939	1.558	0.012	0.004	6.948
4	**Caruncle Length (mm)**	110	0.930	3.400	2.006	0.243	0.047	24.562
5	**Caruncle Breadth (mm)**	110	0.290	2.000	1.000	0.119	0.033	34.471
6	**100 seed weight (g)**	66	11.07	61.723	27.646	113.31	1.291	38.505

Project Code: AIP-05013SI

Project Title: Impact of elevated CO_2 and temperature on muga silkworm and its primary host plant

Project Period : Mar 2020 to Feb 2023
Funding Agency : CSB Bangalore
Total Budget : Rs. 44.72 lakhs
Scientists involved : Dr.Amit Kumar, PI
Dr. Aftab A Shabnam, CI
Dr. G. Subrahmanyam, CI

Objectives

1. To assess the influence of elevated CO_2 and temperature on growth and yield attributes of primary host plant (Som).
2. To assess the impact of elevated CO_2 and temperature on muga seed crop production, cocoon characteristics and fecundity.
3. To design strategies for adoption in muga silkworm rearing under the changing environmental scenario in Assam.

Summary of the findings/achievements:

- Som plot selected for the experiment was maintained as per recommended package of practices.
- Initial analysis of biochemical parameters of leaf and soil has been completed.
- The long-term (1981-2018) metereological data of the different districts of Assam has been collected and processed for different muga rearing seasons.
- The inferences of the data have been documented in a book entitled "Seri-climatic Manual of Muga Growing Districts of Assam". This book is under final stage of the editing.

Soil Samples analyzed during 2020 -21

#	State	Target (No.)	Achievement (No.)
1	Assam	20	04
2	BTC, Assam	20	0
3	Manipur	20	0
4	Arunachal Pradesh/WB	20	20
	Total	**80**	**24**

BIOTECHNOLOGY DIVISION

ONGOING R&D PROJECS

Project Code: APS05001EF

Project Title: Development of technology for enhancing egg laying in Vanya Silk moths by application of host plant volatiles.

Project Period : June 2018 to May 2021
Funding Agency : DBT, New Delhi
Total Budget : Rs. 71.34 lakhs
Scientists involved : Dr. D.K. Gogoi, PI (w.e.f. July 2019)

Objectives

1. To survey & establish population diversity of Muga & Eri silk moth across India
2. To establish potent food plants (=oviposition hosts) for Muga & Eri silk moth for egg production.

Summary of the findings/achievements

- **Impact of host plant twigs (kharikas) on the realized fecundity and egg retention:** The average results of three crops season revealed that Muga moth which ovipositioned on Soalu kharikas has got more fecundity (121.5) as compared to Control (100.8) followed by Som (114.3) and Digloti (113.3). Similarly the retained eggs were found least in Digloti (57.4) followed by Soalu (98) and Som (99.5) in comparison to control (111.8).
- **Impact of host plant leaves on the realized fecundity and egg retention:** The results revealed that (Fig. 2) Muga moth ovipositioned on Soalu leaf has maximum fecundity (179.6), followed by Som (175.61) and Control (147.18). Negative impact was found when mother moth was treated with Mejankari leaf and recorded lowest fecundity (119.2). As compared to control (66.71), lowest retained eggs were found in Soalu (36.26) followed by Dighloti (64.26) and Mejankari (65.3)
- The results revealed that Eri moth which ovipositioned on Castor leaf has more fecundity (311.3) as compared to Control (273) followed by Kesseru (297.55), Borpat (291.8). Least numbers of retained eggs were recorded in Castor (38.4), followed by Kesseru (40.95) in comparison to control (54.95).
- **Impact of host plant leaf extract on the realized fecundity and egg retention:** The results revealed that Muga moth which ovipositioned on Som plant extract has more fecundity (157) as compared to Control (99), followed by Soalu (145.5). In case of retained eggs, Som has the lowest (31.25) followed by Soalu (44.17), Mejankari (67.12) and Digloti (70.17).
- The results revealed that Eri moth ovipositioned on Castor extract treated kharikas has more fecundity (357) as compared to Control (301) followed by Kesseru (352.5) and Borpat (350.5). Retention of egg was found least in Castor (39.6) followed by Kesseru (57.24) and Borpat (59.52), whereas in control, it was found 87.9. (Fig. 5)
- Four synthetic volatile treatments (T1, T2, T3 & T4) developed by IIHR, Bangalore were trialed on Eri silk moth. The results revealed that Eri moth which ovipositioned on T4 treated kharikas has more fecundity (245) as compared to Control (115), followed by T3 (147), T2 (116) and T1 (109). Egg retention was lowest in T4 (45), followed by T3 (73), T1 (75) and T2 (112), whereas in control it was recorded 143.
- **Survey, Collection and study of population diversity of Muga and Eri silk moth:** Sampling was carried out throughout NE India to collect Muga/Eri silk moth populations. The moth samples of different ecoraces/strains/breeds for both Muga (Jorhat, Boko, Kamalabari, Kuklung, Lepetkata,

Nagaland, CMR-1, CMR-2) and Eri silkworms (Yellow plain, Yellow spotted, GB spotted, GB plain) were collected from different localities and genomic DNA was isolated by standard methodology. Cytochrome oxidase1 gene was amplified by using Lep-F and Lep-R primers to study population diversity.

- The genomic DNA of the collected samples were isolated and MICO-1 gene was amplified in PCR using Lep F and Lep R primer for both Muga and Eri silk moth.(Fig:7, Fig:8, Fig;9, Fig:10)
- Cocoons and moths of different race/morphotype/eco-race of Muga & Eri silkworms were collected from potential locations and their morphometric characters were studied.

Project Code: AIT05016MI

Project Title: - Integrating genomic and transcriptomics resources for functional insight into the biology of muga silkmoth *Antheraeaassamensis*

Project Period : Jan 2021- Dec 2023
Funding Agency : CSB, Bangalore
Total Budget : 69.67 lakh
Scientists involved : Dr. Arun Kumar K.P PI
Dr. Rajal Debnath CI

Objectives

1. Development of web accessible database 'Mugabase' to host the muga sequence data, initially within CSB and later for public access.
2. Refining of assembly and annotation of the whole genome and transcriptome sequence data
3. Refining of assembly and annotation of the whole genome and transcriptome sequence data

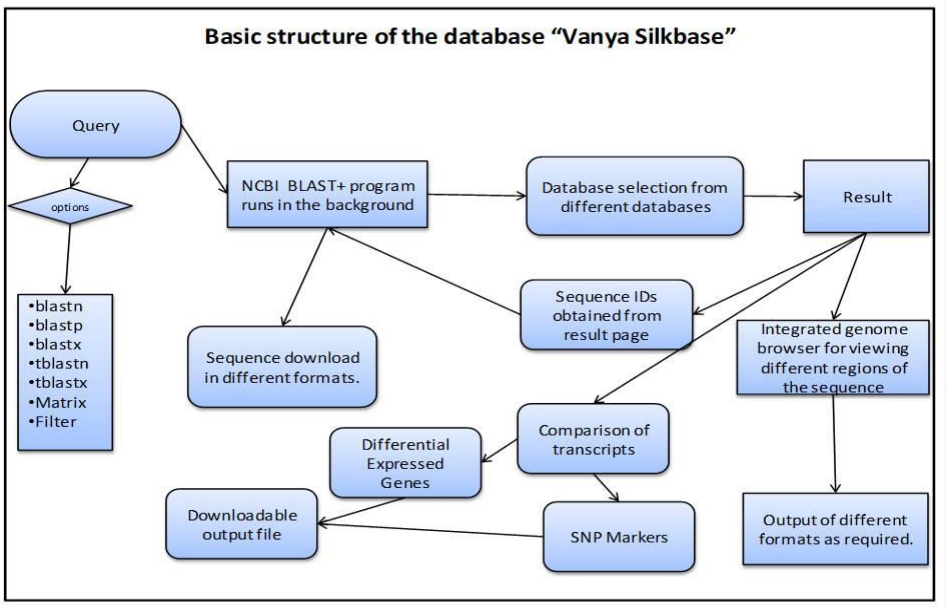
Summary of the achievements:

- A standalone BLAST database of wild silkmoth genome has been created for searching whole genome sequences of wild silkmoths available on NCBI website and also those that are available at the institute (Table 1).
- *Analysis of wild silkworm sericins:* To pull out the homologs of sericin in saturniidsilkmoths, a BLAST search was performed using coding sequence of the Bombyx protein Sericin 1, 2 and 3 against the standalone BLAST database and several hits were obtained. For this a BLAST database of 6 silkmoth genomes, five saturniidsilkmoth species viz- *A.assamensis, A.mylitta, A. pernyi, S.ricini, A.yamamai*and one bombycidsilkmothviz- *B. mandarina*was prepared. Upon the BLAST of protein Sericin 1, Sericin 2, Sericin 3 with the nucleotide database of 6 silkmoth genomes, it was found that Sericin 1 and Sericin 2 had homologs in all 6 Silkmoths, but Sericin 3 has no homolog in 5 Saturniidaesilkmoths but only in Bombycidaesilkmoth.

Table 1: List of wild silkmoths whose draft genome sequences are available

Species Name	Genome Size	Number of Contigs
Antheraeaassamensis	500 MB	2456
Antheraeamylitta	698 MB	16774
Antheraeapernyi	786 MB	72727
Samiaricini	450 MB	155
Antheraeayamamai	661 MB	7723

- Basic Structure of the web-based BLAST database i.e. "Vanya Silkbase'is prepared.
- Vanya Silkbase, a web-based interface will be a platform to provide storage of sequenced data and access to annotated information on genomes of wild silkmoths.
- Vanya Silkbase enables users to conduct BLAST on the website and view the BLAST output result in an interactive way.For this, the user is asked to provide the query sequence file or manually enter the sequences and then he has option to select different BLAST algorithms according to his need. The user also has the option to selectdifferent BLAST databases already provided on Vanya Silkbase. Once the user selects all the required parameters for the BLAST and proceeds, after sometimes the BLAST output is shown on the screen.



- Vanya Silkbase also allows the user to view the sequence alignment on Integrated Genome Browser embedded on the website. After this the user will be able to download the aligned sequence in his desired format. The user also can download the contigs which were hit during the BLAST. Vanya Silkbase also allows the user to compare the transcripts and analyse the differential expressed genes and SNP markers, after this the user is also able to download the output file of the analysis according to his desired format.

Project Code: AIT05011EF

Project Title: Molecular investigation into the lignocellulolytic system of a few wild silkmoth in North-East India

Project Period : Sep 2019 to Sep 2022
Funding Agency : DBT, New Delhi
Total Budget : 46.0 lakhs
Scientists involved : Dr.Rajal Debnath, PI
Dr. D.K. Gogoi, CI
Dr. Arun Kumar K P, CI

Objectives

1. Impact of host plant range on the microbial community in *Antheraea assamensis* Helfer and *Samia ricini* Donovan

2. Lignocellulose degradation by the gut microbes associated with *Antheraea assamensis* Helfer and *Samia ricini* Donovan
3. Molecular characterization of the lignocellulolytic biomass degrading enzyme
4. Developing microbial pathogen resistance through induction of immunity in silkworm via manipulation of gut microbiome

Summary of the findings/achievements

- Each developmental stages of the silkworm (Instar I–V and adult moth) were field collected and a portion of the intestinal gut extractant was utilized to isolate, purify and catalogue microbial strains for downstream application (Fig. 1). The whole gut metagenome (19 samples) was also sent for NGS amplicon sequencing, the results have been obtained and will be submitted to NCBI SRA database. A total of 7001402 nos of raw reads amounting to ~610 Mb data was generated from the 19 samples.
- 16S Ribosomal RNA Gene Amplicons(V3-V4) for the Illumina sequencing was done using Platinum® Taq DNA Polymerase High Fidelity with the below primer set. 16S Forward Primer = 5'TCG TCG GCA GCG TCA GAT GTG TAT AAG AGA CAG CCT ACG GGN GGC WGC AG-3' and 16S Reverse Primer = 5'GTC TCG TGG GCT CGG AGA TGT GTA TAA GAG ACA GGA CTA CHV GGG TAT CTA ATC C-3'. The gene-specific sequences used in this protocol target the 16S V3 and V4 region. They are selected from the Klindworth et al. (2013) as the most promising bacterial primer pair. Illumina adapter overhang nucleotide sequences are added to this gene-specific sequences. The full length primer sequences, that were used in the protocol targeting this region are: Forward Primer with overhang = 5'TCG TCG GCA GCG TCA GAT GTG TAT AAG AGA CAG CCT ACG GGN GGC WGC AG-3' and Reverse Primer with overhang= 5'GTC TCG TGG GCT CGG AGA TGT GTA TAA GAG ACA GGA CTA CHV GGG TAT CTA ATC C-3'
- These 1363 ASV sequences were then taxonomically classified. QIIME2 sklearn based Naïve-Bayes classifier was used to assign taxonomic categories to all the ASVs at a confidence threshold of > 0.70. A barplot of relative abundances were generated to obtain taxonomy classification of each sample.
- Preliminary analysis suggested Top ASVs with more than relative abundance (20%) at the taxonomic level: Family in Muga silkworm belonged to the family of Beijerinckiaceae, Lachnospiraceae, Sphingomonadaceae, Erwiniaceae. In eri silkworm Rhizobiaceae, Pseudomonadaceae, Sphingomonadaceae, Beijernickiaceae, Rhodobacteraceae, Flavobacteriaceae comprised the Top ASVs with more than 5% relative abundance.At the genus level these microbes belonged to Methylobacterium-Methylorubrum, Tyzzerella, Sphingomonas genera and in Eri these belonged to Ochrobactrum, Pseudomonas, Aureimonas, Sphingomonas, Methylobacterium-Methylorubrum Furhter analysis of the microbiome of non-mulberry silkmothmuga and eri are being carried out.

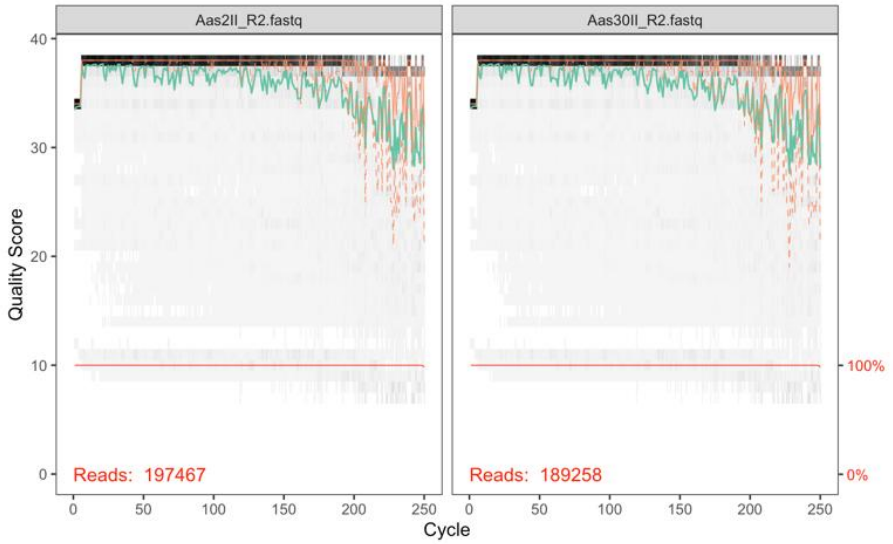


Figure 1: Quality plots of raw sequence data before pre-processing.

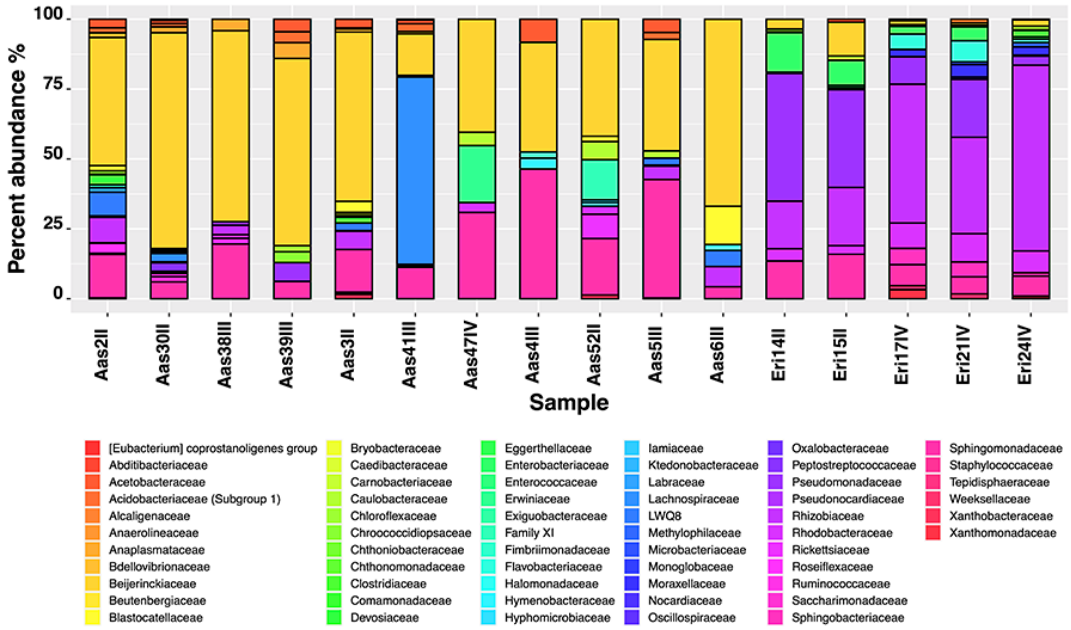


Figure 2: Relative abundance barplot of gut microbiome of eri and muga at family level

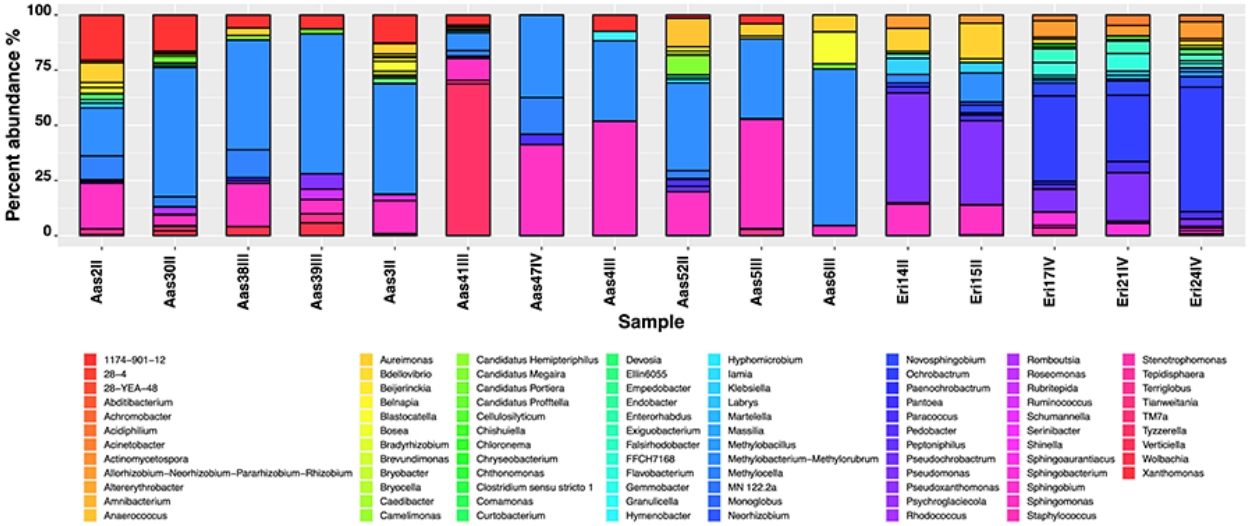


Figure 3: Relative abundance barplot of gut microbiome of eri and muga at genus level

SEEM DIVISION

ONGOING PROJECT

Project Code: MOE05004-EF

Project Title: Adoption of improved sustainabletechnologies of Muga culture for elevation of cocoonproduction in the tribal belt of Assam.

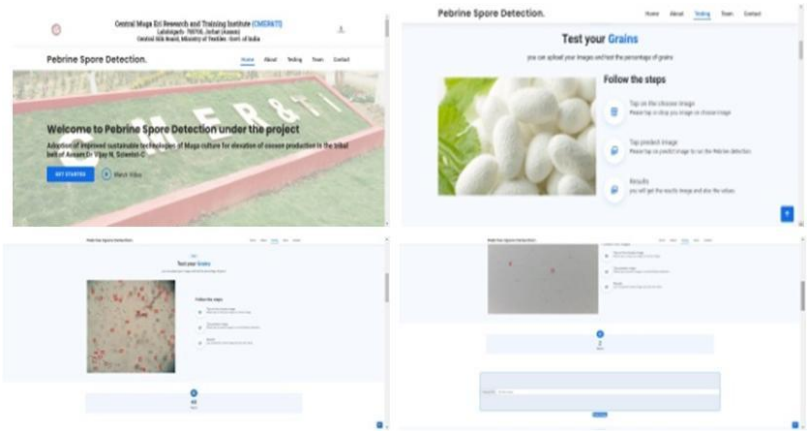
Project Period : Aug 2019 to Jul 2022
Funding Agency : DST, New Delhi
Total Budget : Rs. 25.51 lakhs
Scientists involved : Dr. Vijay N, PI
Dr. D. K. Gogoi, CI
Dr. D. Mech, CI
Dr. SAS Rahaman, CI
Dr K. Sathyanarayana, CI

Objectives

1. To promote adoption of improved Muga rearing technologies among tribal rearers through sustainable NGO-rearer linkages facilitated by CMER&TI, Lahdoigarh.
2. To improve the socio-economic status of tribal population by enhancing cocoon production through improved muga culture

Summary of the findings/achievements

- A total of **9** programs were conducted *i.e.*, six Awareness Programs, two Group discussion, a Field day. **575** farmers were sensitized about the use of improved technologies of muga culture.
- **A Three (03)** field training programs have been conducted at study area. Muga silkworm rearing management and Disinfection practices, Systematic plantation of Muga Host plant and Management, Selection of stage wise food for Muga silkworm, Diseases and Pest of Muga silkworm and Management
- Farmers were provided with the inputs like fertilizers , nylon net, DFL, Lahdoi, sodium hypo chloride , improved bamboo mountage etc
- Hands on training on Foot sprayer, use of Lahdoi and disinfectants demonstrations were provided to the farmers
- In Mid survey, information related crop performance, Knowledge and Adoption level of improved technologies of Muga culture after the ECP programs are collected.(Annexure I)
- For efficient management of pebrine disease in muga culture, A Graphical user interface (GUI) based software launched to detect Pebrine spores under microscope using adapter mounted mobile phone combined with artificial intelligence and machine learning tools.



EXTENSION AND TRAINING ACTIVITIES IN CMER&TI LAHDOIGARH

VANYA RESHAM KRISHIMEL

- Central Muga Eri Research & Training Institute (CMER&TI), Lahdoigarh organized a one day Muga Vanya Resham Krishi Mela at Public Auditorium, Gogamukh, Dhemaji district (Assam) on 19th January, 2021 as per Plan of Action for the year 2020-21. Total of 320 sericulture farmers from different localities of Dhemaji and Lakhimpur districts of Assam participated in the programme.
- The exhibition stall was inaugural by Dr. Ranoj Pegu, Hon'ble MLA, Dhemaji LAC along with Shri Sunil Pegu, Hon'ble Chairman, MAC Dhemaji; Shri Paramananda Chayengia, Hon'ble Chief Executive Councilor Missing Autonomous Council; Shri Dilip Rabha, Assistant Director Sericulture, Dhemaji and Dr. Jalaja S. Kumar, Director, CMER&TI, Lahdoigarh, Jorhat.
- Dr. Dip Kumar Gogoi, Sc-D briefed various technologies developed by this institute since beginning.
- Shri Dilip Rabha, Assistant Director Sericulture, Dhemaji described about the various sericulture schemes being implemented by Govt. of Assam throughout the Dhemaji district.
- Four progressive farmers i.e.. Sri Dwipen Gogoi, Sri Vikash Dutta, Smt Prativa Basumatary and Smt Tilakanti Gogoi were awarded for their outstanding contribution in Muga, Eri and Post Cocoon activities, respectively.


Figure: Vanya Reshom Krisimela at Goagamukh, Demaji, Assam on 19.01.2021

Workshop on"Technological Interventions in Eri Culture"

- Central Muga Eri Research & Training Institute (CMER&TI), Lahdoigarh organized a Workshop on "Technological Interventions in Eri Culture" at Panjayat Hall, Chungtia, Mokokchung, Nagaland state on 11th March, 2021.Total of 102 nos of Eri culture farmers from different localities of Mokokchung districts of Nagaland participated in the programme.
- Dr. T. James Keisa, Scientist-D, CMER&TI, explained about Eri silkworm rearing technology including the management of disease and pest management in audio visual system.

Extension Communication Programmes conducted during 2020-21

#	Programmes	No. of events		No. of stakeholders	
		Target	**Achmt.**	**Target**	**Achmt.**
4.1	Krishi Mela/ Reelers Mela cum exhibition	3	3	800	770
4.2	Farmers Field day	4	4	200	301
4.3	Awareness programme	16	16	800	1394
4.4	Technology demonstration / Enlightenment programmes	16	16	320	464
4.5	Workshop/ Seminars & Conferences	1	1	100	102
	Total	**39**	**21**	**2120**	**1310**

BRIEF NOTES ON ACTIVITIES OF NESTED UNITS

RSRS, BOKO

HIGHLIGHTS OF ACTIVITIES/ACHIEVEMENTS

- Sexual multiplication of S3 & S6 morphotypes of Som, their maintenance and supply to stakeholders as and when needed.
- A total of 20200 (against the target of 20000) seedlings were raised and supplied to local farmers, DOS Meghalaya, MSSO Guwahati, DOS Assam and NGOs & private farmers. During the period two new plots of Dighloti and Kesseru (one each) were developed at RSRS, Boko farm.
- Under extension and technology awareness programme 731 farmers were covered through Krishimela, Field Day, Technology Orientation Programme and Awareness Programme.
- Under training programme for farmer's skill development, 12 batches of 5-days training programme were conducted and covered 210 Nos. of farmers by RSRS, Boko.
- Under grainage activity, 950 DFLs were prepared all the dfls were utilized for own rearing.
- Under commercial Muga crop rearing 950 g DFLs were reared to produce 15407 nos. of cocoons against target of 150000 Nos of cocoons.
- The centre generated a total revenue of Rs. 43,300/- against the target of Rs. 600000/-.

ONGOING PROJECT

Project Code: MOE05003EF

Project Title: Socio-economic uplifting of farmers through adoption of improved technologies and skill development in Eri culture

Project Period : Nov 2018 to Oct 2021
Funding Agency : DST, New Delhi
Total Budget : Rs. 21.57 lakhs
Scientists involved : Dr. Barman H, PI
Dr. S. A. S. Rahman CI

Objectives

1. To adopt improved technologies (both pre and post cocoon sectors) at farmers' level.
2. To improve the economies of scale through group approach.
3. Diversification of Eri-culture towards income and employment generation.

Summary of the findings/achievements

- 41kgs. castor seed of RB-2 variety were supplied to 200 beneficiaries. Each of 200 beneficiaries developed Castor garden 3 times.Castor leaf production increased. As a result DFls rearing capacity increased from initial 5-10 to 20-30 nos.
- 2000 Nos. kesseru saplings were supplied for gap filling in total of 200 nos. perennial Kesseru garden developed by 200 nos.120 nos. beneficiaries raised their own Tapioca garden.Secondary food plant leaf production increases ensuring Eri culture activities throughout year.Increases number of crops and DFLs reared per annum.
- 2000 kgs ginger and 2000 kgscolocasia intercropped in 2st year. Average Ginger production per beneficiary is 63.105kg and colocasia is 155.525 kg.Average income per beneficiary from Ginger is Rs.6,310.50 and from Colocasiait is Rs.6,227.80.

- All beneficiaries undertook rearing (culturing) of Eri Silkworm C-2 breed regularly.In 2nd year 6,855 nos. DFLs of C-2 breed was supplied and reared by 110 nos. beneficiaries in 5 nos. crop.Total 12, 34,000 nos. cocoon produced @ 11,218 nos. per beneficiary by 110 nos. beneficiaries from these supplied C2 breed DFLs.
- For production of seed cocoons, 7 nos. beneficiaries reared 5 nos. seed crops for grainage activities of the project. Another 20 nos. beneficiaries from village Falafang and Satekona reared seed crop producing 38,000 nos. seed cocoons that were sold in a cocoon market organised at Falafang under this project.
- 7 beneficiaries, carried grainage activities to produce DFLs required for rearing activities of all beneficiaries.They produced6,855 nos. Eri C-2 breed DFLs.

Figure 1: Eri Cocoon shell coloring technique innovated and extended to beneficiaries

EXTENSION ACTIVITIES OF THE CENTER

VANYA RESHAM KRISHI MELA AT BOKO, KAMRUP, ASSAM

A Vanya Resham Krishi Mela was organized by the Regional Sericulture Research Station, Boko, Kamrup, Assam in collaboration with Directorate of Sericulture, BTR, Kokrajhar at Office Campus of ADS, Udalguriat, Assam on 29th January 2021. The Inaugural Session of Krishimela was Chaired by Dr. Jogesh Deuri, Director of Sericulture, BTR, Kokrajhar. Sri Gobinda Basumatary, Deputy Chief Executive Member, BTR, Kokrajhar was honoured as Chief Guest and Dr. Jalaja S. Kumar, Director, CMER&TI, Lahdoigarh as Guest of Honour. Sri Harkanta Hazarika, Joint Director, Department of Sericulture, Assam was present as Special Guest in the occasion. Among others, Sri B. K. Basumatari, Scientist-D, REC, Mangaldoi and all the Assistant Directors and Superintendent of Sericulture, BTR, Assam participated in the Vanya Resham Krishi Mela. More than 250 Muga and Eri rearers, graineures, reelers and weavers from Udalguri District, BTR, Assam and Scientists of RSRS, Boko participated in this Krishi Mela.

To commemorate the occasion, the newly constructed COCOON BANK at Office campus of ADS, Udalguri was inaugurated by Sri Gobinda Basumatari Deputy Chief Executive Member, BTR, Kokrajhar. An exhibition was organized on the occasion, where all the Technologies of eri and muga culture were showcased through technology posters, models, final products etc. Live eri silkworm rearing and eri yarn spinning were demonstrated. Moreover, practical demonstration of newly developed technologies of Muga and Eri culture was also done to the farmers. The exhibition was inaugurated by Sri Gobinda Basumatari Deputy Chief Executive Member, BTR, Kokrajhar and was visited by large number of Muga and Eri farmers, reelers and weavers, officials of the Department of Sericulture and Scientists from Central Silk Board.

Sri S A S Rahman, Scientist-D & Head, RSRS, Boko appealed the farmers to come forward and adopt different recent technologies developed by Central Muga Eri Research and Training Institute, Lahdoigarh and Regional Sericultural Research Station, Boko to increase production and productivity of vanya silk cocoons and to earn more foreign exchange by exporting various silk products.

Speaking on the occasion, Sri Gobinda Basumatary, Chief Guest of Vanya Resham Krishi Mela encouraged the farmers to improve the quality of Muga and Eri silk yarn to earn more for their family livelihood. He specially stressed the farmers to work on pupa processing so that they can earn more by exporting the processed pupa to the East Asian counties as the food habit of East Asian Countries are same with Assamese Tribes. He also emphasised on value addition and diversification of silk fabrics to increase the farmer's income. Dr. Jalaja S Kumar, Director, CMER&TI, Lahdoigarh graced the occasion as Guest of Honour. She gave a detailed account of Research Projects conducted by CME&TI, Lahdoigarh. She mentioned that CME&TI, Lahdoigarh has developed Technologies of Host Plant Development & Management, Silkworm Development & Rearing Management in both Eri and Muga Sector which are available as Package of Practices in CMERTI website. She expressed that to make muga and ericulture more profitable, farmers should stress on diversification and value addition to produce branded products.

Sri B N Choudhury, Scientist-D, RSRS, Boko elaborated about different Developmental Schemes under NERTPS. He appealed the farmers to take the maximum benefit from the different schemes.

Sri H K Hazarika, Joint Director of Sericulture, Assam encouraged the farmers to take the sericulture on commercial scale. He appealed the farmers to adopt scientific approach to increase the productivity of sericulture.

Dr. Jogesh Deuri, Director of Sericulture, BTR, Kokrajhar detailed about different sericultural schemes and activities of BTR. He elaborated that Directorate of Sericulture, BTR has established Silk Park at Kokrajhar where different activities of soil to silk has been showcased. He also informed that modern eri spun mill has been established at Kokrjhar which will boost the sericulture industry of BTR. He expressed his satisfaction that hard work of sericulture workers and farmers of BTR made it possible to get distinct brand of BODOLAND SILK in the country.

Technical Session during the Muga Krishi Mela

A technical session chaired by S A S Rahman, Scientist-D & Head, RSRS, Boko was held in the afternoon on the occasion of Vanya Resham krishi Mela wherein the farmers and scientists present interacted on various problems being faced by the farmers. A number of farmers spoke about various muga and eri culture related constraints being faced by them and also expressed their observations on crop performance. The queries put by farmers regarding muga and eri rearing, grainage and maintenance of food plants were answered by Sri B N Choudhury, Scientist-D, RSRS, Boko, Sri B K Basumatary, Scientist-D, REC, Mangaldoi, Dr. M Deka, Scientist-C, RSRS, Boko.

ORGANIZATION OF FIELDAY AND AWRENESS PROGRAMME

Date: 20/12/20; Venue: Bathouguri;
Number of participants: 101

Date: 24/12/20; Venue: Punia;
Number of participants:75

Date: 15/02/21; Venue: Dairang;
Number of participants: 102

Date: 06/03/21, Venue: Amranga;
Number of participants:150

TECHNOLOGY DEMONSTRATION PROGRAMME

Date: 19/12/20; Venue: Bathouguri;
Number of participants:93

Date: 24/12/20; Venue: Punia;
Number of participants: 62

Plan for Land Use and Resource Conservation

Particulars	**Target (Nos.)**	**Achievement (Nos.)**
Raising of quality Som/Soalu planting material	20000	20200
Supply of Som/Soalu planting materials	20000	270
Muga Dfls rearing		
Commercial	2500	950
Seed	700	1500
Muga Cocoons production		
Commercial	1500000	15407
Seed	28000	7277
Muga Dfls production (Nos.) Rs. 8.00/- Per g	7000	950
Muga Dfls supply (g.)	7000	950
Vermicompost Production (kg)	20000	22000

Extension Communication Programme:

Particulars	**Target (nos)**	**Achievement (Nos.)**
Krishi Mela	1	1 (250)
Field Day	2	2 (201)
Technology Orientation/Demonstration programme	4	4 (60)
Awareness programme	2	2 (252)
Technology demonstration	2	2 (171)

Training

Particulars	**Target (Nos.)**	**Achievement (Nos.)**
Farmers Skill Training Programme	8	8 (180)
Training under Post Cocoon Sector	2	2 (30)

Land area under plantation, Area of building and roads, vacant and unutilized land area

Nursery	Plantation area	National Bamboo Mission	Low land	Roads	Office Building and Laboratory	Staff Quarters	Total	Vacant	Status of land
2.50	24.50	2.00	1.50	6.50	7.00	6.00	50	Nil	Own land

Training Programmes conducted (indicating the title, target groups, number of persons trained and impact (training and extension section/ scientist concerned)

Batch No.	Date	Venue	Topic	Farmers covered	Scientists involved
1.	15-17/10/20	Vill- Falafang Goalpara.	Muga & Eri Host Plant Management and Rearing Technology	15	Dr.Reena Choudhury, Sc-D (Retd.)
2.	19-21/10/20	Vill- Bamunigaon Kamrup	Muga & Eri Host Plant Management and Rearing Technology	15	Dr.A.K.Gogoi, Sc-D (Retd.)
3.	03-05/12/20	J.N.College, Boko	Muga & Eri Host Plant Management and Rearing Technology	15	Sri Brojen Choudhury, Sc-D (Retd.)
4.	07-09/12/20	J.N.College, Boko	Muga & Eri Host Plant Management and Rearing Technology	15	Dr.B.K.Singh, Director, CMERTI, (Retd.)
5.	17-19/02/21	Lengupara Goalpara	Muga & Eri Host Plant Management and Rearing Technology	30	Dr.B.B.Simha Sri J.C.D.Phukan, Sc-D (Retd.)
6.	22-24/02/21	Bikali College, Dhupdhara, Goalpara	Technology orie4ntation programme on Muga Culture	30	Dr.B.B.Simha Sri J.C.D.Phukan, Sc-D (Retd.)
7.	25-27/02/21	Lengupara Goalpara	Post Cocoon Technology	30	Sri Prabeen Kalita, Master Reeler
8.	15-17/03/21	Amranga Barihat, Kamrup	Muga & Eri Host Plant Management and Rearing Technology		Dr.B.B.Singha, Sc-D (Retd.)
9.	20-23/03/21	Amranga Barihat, Kamrup	Muga & Eri Host Plant Management and Rearing Technology Muga & Eri Host Plant Management and Rearing Technology	30	Dr.B.B.Simha, Sc-D (Retd.)

Farm activities

Total acre of plantation: 24.5 acre plantation of Som and Soalu with 2.5 acre nursery
Available host plant: 10044 plants and 20000 Seedlings/saplings.

RSRS, IMPHAL

HIGHLIGHTS OF ACTIVITIES/ACHIEVEMENTS

- Executing five research projects funded by CSB and progress achieved are as per milestone. Three collaborative mulberry based projects are also being carried out in the station.
- Produced 45,700 dfls with 101.33 % achievement and supplied to State govt. and ASRs for further multiplication during spring crop 2021.
- In the silkworm GPB, three species of Oak tasar silkworm *A. proylei, A. pernyi,,A. frithi* and 9 evolved breeds, three eco-races of eri and muga silkworm are being maintained. In host plant GPB, all the primary food plants of oak Tasar, eri, muga & mulberry are being maintained.
- Three ToT programmes on Oak Tasar culture were conducted and achieved improvement in productivity against control.
- Conducted 9 (nine) nos. training programme on Farmers skill training and Post Cocoon technology in ericulture and oak Tasar culture.
- Conducted Second Semester Examination (Session 2019-20) for Post Graduate Diploma in Sericulture (Vanya Silk) under CTR&TI, Ranchi as assigned from 16.10.2021 to 21.10.2021. Eleven (11) students appeared in the examination.
- Published 1 no. of research paper in scientific journals (International) .
- Published four bilingual booklets entitled "Sodium hypochlorite disinfection: An effective disinfection for silkworm eggs to protect against tiger band disease"; "Package and practices for muga rearing"; Oak tasar silkworm rearing technology" and "Management of major insect pests infesting *Quercus serrata*".
- A total of 5000 kg of vermicompost were prepared during the year and applied in the field of RSRS, Imphal.
- A **Sericulture Krishi Mela** was organised on 11.02.2021 at RSRS, Imphal campus to popularize the latest technologies of four different types of sericulture among farmers and attended by 200 stakeholders.
- Under ECP: Conducted 2 (two) nos. technology demonstration, 2 (two) nos. awareness programme,1 (one) no. field day and sensitized 340 stakeholders during the year 2020-21.
- **DCB realization:** In the year 2020-21 a sum of Rs. 3,85,813/- was received towards sale of oak tasar dfl, eri dfl, muga dfl and sale proceed of pierced cocoons.
- Conducted Hindi workshop on quarterly basis and Hindi Pakhwada (fortnight) from 16th to 30th September, 2020.
- Conducted various cleanliness drives under Swachh Bharat Abhiyan on 2nd October, 2020.

CONCLUDED PROJECTS

Project Code: **(ARE: 4726)**
Title of the Project: **Bio-ecology, Economic injury level and Management of insect pest infesting oak Ecosystem**

Project Period	: June 2017- May 2020.
Funding Agency	: Central Silk Board, Bangalore
Total Budget	: 17.31 lakhs
Scientists involved	: Dr.S. Subharani Devi (PI) Dr.Y.Debaraj (CI)

Objectives:

1. To study the population dynamics of Uzi fly, *Blepharipa sugan* infesting oak tasar silkworm, the semilooper, *Hyblaea puera* and hairy caterpillar, *Phalera raya* infesting oak plant.
2. Studies on the biology of Uzi fly, *Blepharipa* sugan, *Hyblaea puera* and *Phalera raya*.
3. To determine the ETL of major insect pests infesting oak plant and its preferred host.

4. Integrated management practices for control of *Blepharipa sugan*.
5. To evaluate the efficacy of biopesticides for control of *Hyblaea puera* and *Phalera raya*.

Summary of the findings/achievements

- Studied the population dynamics of uzi fly infesting the silkworm, *A. proylei*, the hairy caterpillar and semilooper infesting the host plant, *Q. serrata*. The information generated in the study gives an indication about the importance of the different weather parameters in successful implementation of the pest management strategies against insect pests for increasing production efficiency.
- Studied the biology of uzi fly, semilooper and hairy caterpillar and the total developmental period was 36-43 days, 27-38 days and 65-72 days respectively. Revealed six larval instars in *P. raya* and five larval instars in *H. puera* through Dyars law.
- Determined the economic injury level and economic threshold level of *P. raya* and *H. puera. infesting Q. serrata*. The results gave an idea that control measures should be initiated when the larval population reaches one larva per plant in *P. raya* and four larva per plant in *H. puera* infesting oak plant, in order to prevent the population of both the pest from reaching economic injury level. These findings will help the farmers in timely application of the control measures.
- Developed user friendly and cost effective PET bottle uzi trap for control of adult uzi flies. Increased the seed cocoon recovery to the extent of 13 % to 16 % as against control. Management of uzi fly through chemical method by spraying 3 % bleaching powder solution exhibited reduced infestation of 22.49 % against 42.83 % in control.
- Bioneem is the most effective biopesticide for control of *P. raya* and *H. puera* with a reduction percentage of 83.40 % and 76.08 % in *P. raya* and *H. puera* respectively. This finding will reduce the use of hazardous chemical insecticides for control of insect pests by farmers.

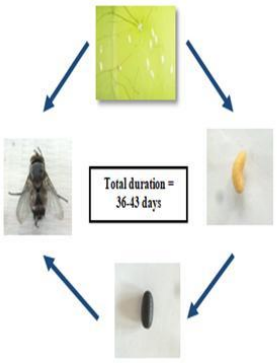


Plate 1. Life cycle of *Blepharipa sugan*

Plate 2. Life cycle of *Phalera raya* Moore infesting *A. proylei*

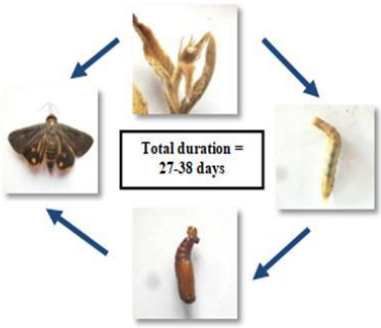


Plate 3. Life stages of *Hyblaea puera*

Plate 4. Uzi flies trapped in PET bottle

Project Code: ARP (3606):
Title of the project: Development of a diagnostic tool for early detection of baculovirus causing Tiger band disease in *Antheraea proylei*".

Project Period : Feb 2017- Aug 2020
Funding Agency : Department of Biotechnology
Total Budget : 17.14 lakhs
Scientists involved : Dr. S. Subharani Devi (PI),
Dr. K.M.Ponnuvel (PI)
Dr.Y.Debaraj (CI)

Objectives:

1. To characterize the baculovirus pathogen causing tiger band disease in oak tasar silkworm, *Antheraea proylei*.
2. To study the pathogenesis, source and mode of transmission of the viral pathogen.
3. Validation of developed diagnostic tools in Oak tasar grainages and egg production centers

Summary of the findings/achievements

- The complete viral genome sequencing was performed (Accession: GI: 1371952746), depicting that the *Antheraea proylei* nucleopolyhedrovirus (AnprNPV) is the causal agent of this disease.
- The virus particles were detected in almost all the developmental stages of silkworm.
- The identified p94 gene is specific to viral pathogen and was targeted for developing a sensitive PCR technique, capable of early detection of the viral pathogen in various tissues and affected silkworm development stages. Further, the vertical transmission of the virus revealed and established as the most desirable mode of disease transmission.
- The current study was highly beneficial in revealing egg surfaces to be the potential source of contamination.
- As an immediate consequence to this, an egg surface disinfection technique was developed which was further tested and at various seed production centres providing a greater degree of assurance by showing increased cocoon yields against the previously developed conventional disinfection methods. The outcomes from this study definitely have given ways to ponder over future research to further understand and improve the oak tasar culture.

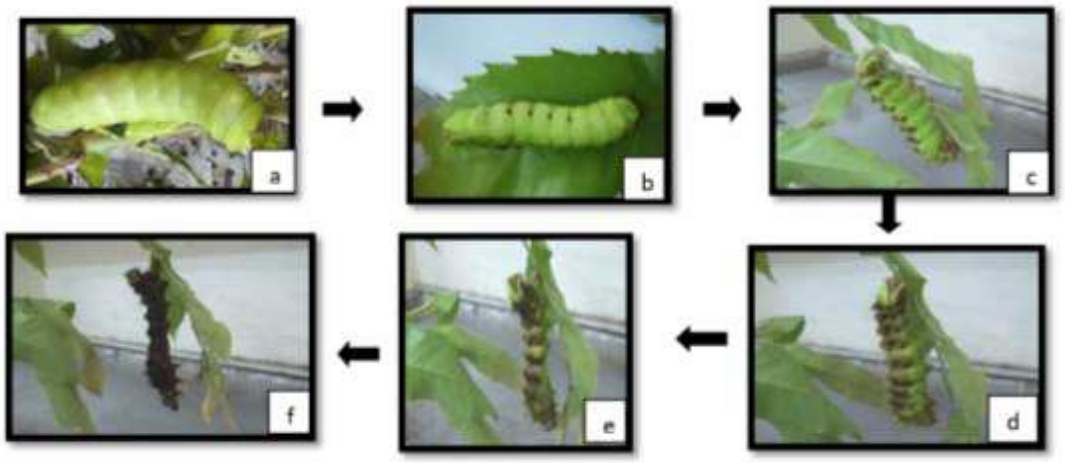
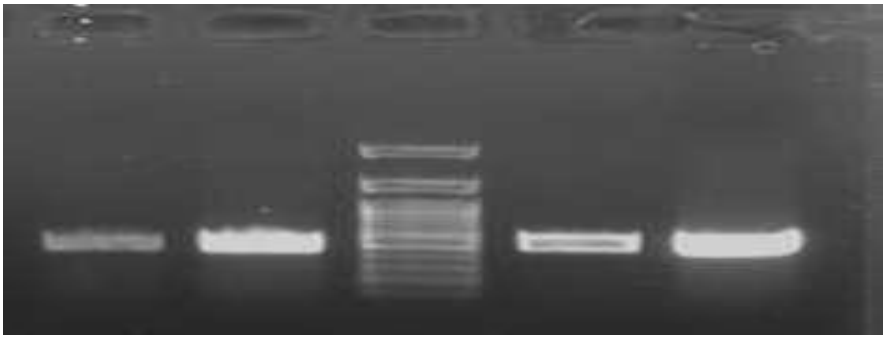


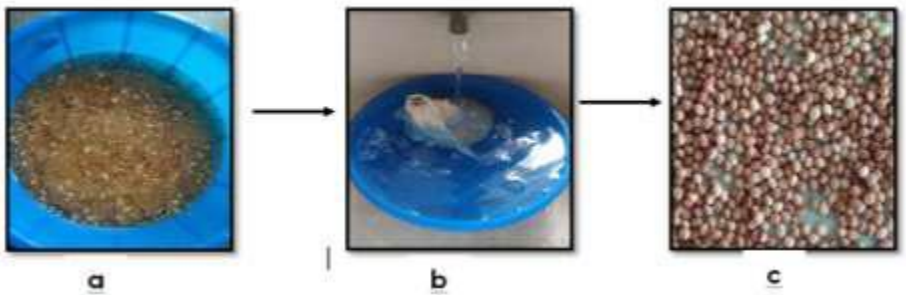
Figure 1: Stages of infection of *Antheraea proylei* larva by *Anpr*NPV (a). Healthy larva (b). Initially black spots appear on dorsal body segments; (c-d).The black spots spread all over the body segments (e-f) the whole body become black and larva died.

105-106K M 65-66K



Lane 1 & 2: amplified genomic DNA with 105-106 K primer; Lane 3: Marker; Lane 4 & 5: Genomic DNA amplified with 65-66 K primer

Figure 2: Detection of AnprNPV in the haemolymph of *Antheraea proylei* larvae through PCR



a. Eggs soaked for 30 minutes in 0.2 % NaOCl
b. Eggs washed thoroughly under running tap water for 1 hour
c. Eggs laid for drying in the shade

Figure 3: Egg washing steps using 0.2 % Sodium hypochlorite

ONGOING PROJECTS

Project Code: APR 05008SI.

Project Title: Standardization of Rearing and Grainage technology of *Antheraeafrithi* Moore.

Project Period	: October, 2019 - September, 2022
Funding Agency	: Central Silk Board, Bangalore
Total Budget allocation	: Rs.12.85
Scientists involved	: Dr. L. Somen Singh (PI) Dr. S. Subharani (CI)

Objective:

1. To standardize the rearing and grainage technologies to suit for commercial adoption.

Summary of the findings/achievements:

- During the period under report five different cocoon preservation devices for observing moth emergence/coupling and four egg laying devices such as Nylon bag (15 x 20 cm), Bamboo monia, Bamboo basket & Khorika were prepared.
- During 1st crop (April-May, 2020), Chawki rearing was conducted in indoor condition by using *L. dealbata* twigs and the result indicates about 20 % mortality.
- Rearing of *Antheraea frithi* was conducted in outdoor condition on three different food plants such as *Lithocarpus dealbata, Quercus serrata and Q. grifhithi* and it was observed that the worms reared on *L. dealbata* leaves recorded the highest cocoon yield of 42±1.0 cocoons per dfl followed by worms reared on *Q. serrata* with an average cocoon yield of 15±1.53 coons per dfl.

- During 2nd crop, of *Antheraea frithi* seed cocoons were consigned to photoperiodic treatment by providing 16 hrs light (5am to 5pm natural sunlight and 5pm to 9pm artificial light) and 180 LUX (following the procedure of *A. proylei*).
- Emergence of moth started after 27 days of photoperiodic treatment. 52.94 % of moths were emerged out within 19 days, out of which 44.44 % & 55.55 %were female and male respectively.
- The emerged male and female moths were mixed together and put in different devices for coupling after 4.0 pm. 50 % of natural coupling was recorded when the moths were release inside the nylon net of 15' x 15' x 9' (L x B x H) followed by 42 % inside the wire mesh cage of 6' x 6' x 6.5'.
- Decoupled moths were kept individually for egg laying in different devices such as nylon bag (15 x 20 cm), bamboo monia, bamboo basket & khorika. The female moth's allowed to lay eggs upto 3rddays. The average fecundity ranges from 195±2.89 to 220±2.5 eggs. The highest average fecundity of 220±2.5 recorded when the moths allowed to lay eggs inside monia followed by nylon bag of 216±1.15 eggs. When the moths were allowed for 12 hrs of coupling and recorded 73 – 75 % hatching.
- During second crop, *A. frithi* were reared both in indoor and outdoor condition by feeding *Lithocarpus dealbata* leaves.
- In indoor, the worms are reared on *L. dealbata* leaves by inserting the *L. dealbata* twigs inside the water bottle with the normal room temperature (Min.24 ^{0}C; Max.29 ^{0}C) and R.H. 77%.
- For outdoor, after 2nd moult, the worms were released on *L. dealbata* leaves by covering the trees with nylon net. The average Temperature and RH % during the rearing period was recorded as Min. Temp.21 ^{0}C; Max. Temp.32 ^{0}C and RH74 % respectively.
- The result showed that the cocoon yield per dfl of 18±1.15 was recorded in indoor condition whereas it was recorded as 39±1.52 cocoons per dfl in outdoor condition.

Figure 1: Standardization of optimum coupling duration and suitable egg laying device

Figure 2: Chawki rearing and adult rearing on different food plants

Project Code: AIB 05009SI.

Project Title: Isolation of thermotolerant line (s) of oak tasar silkworm *Antheraea proylei* J.

Project Period : October, 2019- September, 2022
Funding Agency : Central Silk Board, Bangalore
Total Budget allocation : Rs.16.90 (Rs.21.90 in revised)
Scientists involved : Dr.Y.Debaraj (PI),
Dr. S. Subharani (CI)
Dr. R. Debnath (CI)

Objective:

1. To isolate thermo-tolerant line of oak tasar silkworm, *Antheraea proylei*
2. Characterization of Heat shock protein gene in thermo-tolerant line.

Summary of the findings/achievements :

- **Silkworm grainage, rearing and maintenance of generation:** During spring crop grainage, 2020 prepared the eggs of *Antheraea proylei* and incubated under optimum temperature 26±1 ^{0}C and 80±5 % relative humidity until hatching. The larvae were cellularly reared on oak leaves under nylon net upto spinning following standard rearing procedures.
- **Induction of heat stress:** The fifth instar 3rd day silkworm larvae were subjected to high temperature thermal stress at different temperature regimes (32, 35, 38 ^{0}C) in varying durations (1, 2, 4, 6, 8 hr). The larvae reared at 26 ^{0}C were treated as control. After induction of thermal stress, the larvae were reared until cocooning under nylon net in natural fluctuated outdoor conditions. The harvested cocoons were analyzed and preserved for continuing the generation.
- The average larval duration is 37.5 days in the treated lot as against 40 days in control.
- An improvement in the ERR (72 %) was observed in the heat treated larval population as compared to the control (60 %). However increasing the heat shock to 38^{0}C severely affected survivability and it may be considered as a lethal temperature for *A. proylei*.
- Selected seed cocoons from the treated and control lot were assessed. Induction of heat shock in the 3rd day fifth stage silkworm larvae exhibited significant relative influence on the characteristics of cocoons, shell weight and silk ratio as against control.
- The seed cocoons are preserved in the grainage for continuing the generation during spring crop 2021.
- Further protein profiling and detection of heat shock protein will be carried out from the fifth instar larvae after induction of thermal stress during spring crop rearing 2021.

Fig 1: Induction of heat stress in vth instar larvae inside BOD

Fig 2: Outdoor rearing after induction of heat stress

Project Title: APR 05010SI. Evaluation of eri silkworm races suitable for different agro-climatic conditions of Manipur

Project Period : October, 2019 - September, 2022
Funding Agency : Central Silk Board, Bangalore
Total Budget allocation : Rs. 11.80 lakhs
Scientists involved : Dr.Y.Debaraj (PI)
Dr. L. Somen Singh (CI)

Objective:

1. To identify the best performing eri silkworm race in different agro-climatic conditions of Manipur.

Summary of the findings/achievements:

- Three major food plants of eri silkworm, *viz*., castor, kesseru and tapioca have been maintained.
- Three promising eri silkworm eco-races, *viz*., Borduar, Titabar & Manipur local along with C-2 breed and Six strains *viz*., Yellow plain, Yellow spotted, Yellow zebra, Greenish blue plain, Greenish blue spotted and Greenish blue zebra have been maintained.
- Two localities have been selected for the experiment, i.e., low altitude (Imphal-786 m) and high altitude (T. khullen-1200 m) as suggested. Four crop rearings (Spring, Summer, Autumn & Late Autumn) of eco-races and strain have been completed in low altitude area.
- Data revealed that Borduar was found better among three eco-races with 83.57 % ERR. The performance of C-2 breed (83 % ERR) is at par with that of Borduar. Autumn crop was found better than other seasons.
- Among the strains, the highest ERR was found in Yellow plain (91.33 %) and GB plain (91.27 %).
- Comparative rearing of Borduar eco-race on three food plants revealed that castor showed most preferred food with 90.9 % ERR followed by Tapioca (77.75 % ERR).

Table: Rearing performance of eri silkworm eco-races (in low altitude)

Eco-race/ breed	Fecun-dity	H%	Larval wt. (g)	Larval period day	ERR (%)	Cocoon wt. (g)	Shell wt. (g)	Shell ratio (%)
C2	394	94.06	10.18	19.00	80.00	3.53	0.52	14.73
Borduar	396	96.12	10.50	19.00	81.50	3.42	0.50	14.62
Titabar	391	92.35	9.45	19.00	78.25	3.35	0.47	14.03
Manipur local	372	90.50	9.03	18.50	75.50	3.28	0.44	13.41

Table: Rearing performance of eri silkworm strains (in low altitude)

Eri silkworm Strain	**Fecun-dity (Nos.)**	**H%**	**Larval wt.(g)**	**Larval period (days)**	**ERR (%)**	**Cocoon wt. (g)**	**Shell wt. (g)**	**Shell ratio (%)**
Yellow plain	382	96.21	9.70	18.50	80.50	3.53	0.52	14.73
Yellow potted	336	96.43	9.83	18.50	66.00	3.58	0.51	14.25
Yellow zebra	394	95.64	9.82	18.00	72.50	3.67	0.55	14.98
Greenish blue plain	380	95.79	9.43	18.00	78.50	3.62	0.54	14.92
Greenish blue spotted	374	95.86	9.46	18.50	61.50	3.61	0.51	14.13
Greenish blue zebra	391	96.25	10.09	18.50	74.00	3.93	0.52	13.23

Project title: AICEM Phase-IV (All India Coordinated Experimental Trial for Mulberry).
Scientists involved: Dr.Y.Debaraj

Objective:

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

Summary of the findings/achievements:

- Five mulberry varieties, *viz*., C-1360, AGB-8, PPR-1, C-2038 and S-1635 will be tested at Imphal test centre as assigned. Plantation was raised from saplings supplied from CSR&TI, Berhampore. Plantation of five varieties already completed with six replications in RBD layout. Plants are being maintained as per programme schedule with required cultural practices along with gap filling. Nursery propagation studies just initiated.

Project title **:** PIE02002SI:
Project Title **: Evaluation of performance of mulberry genotype C9 under red and laterite soils.**
Scientists involved **:** Dr. L. Somen Singh

Objective:

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

Summary of the findings/achievements:

- Data on leaf yield, growth parameters viz. length of longest shoot , number of primary branches per plant, total shoot length, leaves per meter shoot, leaf fall percent, leaf moisture content (%) and leaf moisture retention capacity (%) were recorded during July, 2020, October, 2020 and March 2021 as per activities of the project. Amongst the genotypes, highest leaf yield per plot was recorded in "C9" with 33.50 kg followed by "C2038" with 30.13 kg during October, 2020.

ACTIVITIES OF THE CENTER

Sericulture Krishi Mela cum Exibition held at RSRS, Imphal on 11.02.2021

"**Sericulture Krishi Mela cum Exhibition"** was organized on 11th February 2021 at RSRS, Imphal. At the outset, Dr. Y. Debaraj, Scientist-D & Head explained the need of organizing the Sericulture Krishi Mela which is to popularize and create awareness of the technologies developed by the station amongst the farmers and to identify the problems faced by farmers in practising sericulture. The programme was graced by Shri Ch. Harendra Kumar Singh, Deputy Director (H/Q), Department of Sericulture, Govt. of Manipur as Chief Guest, Shri Th. Surjaboro Singh, Chairman, Manipur State Sericulture Co-operative Federation, Ltd. (SERIFED) as Guest of Honour and Dr. Jalaja, S. Kumar, Director, Central Muga Eri Research and Training Institute, Lahdoigarh, Jorhat as president. All the dignitaries appreciated the active participation of farmers and advised the farmers to take up sericulture with sincerity to achieve good production for income generation and sustainable livelihood.

An exhibition with 14 stalls showcasing yarn samples, silk fabrics, cocoons, wild silk moths, reeling machines, different sericulture products was also set up which evoked much interest among

farmers and invitees. Three booklets were released on the occasion. One farmer each from oak tasar, mulberry, muga sector were awarded best farmer prize based on the rearing performance during 2020. The programme was actively participated by about 200 participants including rearers, SHG, NGO, reelers, weavers, entrepreneurs and officials from Central and State sericulture Departments.

Field Day programme held at District Sericulture Office, Imphal West, Lamphelpaton 12.11.2020

A field day programme was organized on 12.11.2020 at District Sericulture Office, Imphal West, Lamphelpat to create awareness amongst the farmers about the improved sericulture technologies particularly in mulberry and eri culture and 100 farmers participated in the event along with staff of DOS and CSB attended the event.

Awareness programme held at Irong Khongneiram, Thoubal District on 28.11.2020

An awareness programme was organized on 28.11.2020 at**Irong Khongneiram, Thoubal District** to create awareness amongst the farmers about the improved sericulture technologies particularly in mulberry and eri culture and 100 farmers participated in the event along with staff of DOS and CSB attended the event.

Awareness programme held at Wangkhem Village, Imphal East on 23.12.2020


An awareness programme was organized on 23.12.2020 **at Wangkhem Village, Imphal East,** to create awareness amongst the farmers about the improved sericulture technologies particularly in oak tasar and eri culture and 100 farmers participated in the event along with staff of DOS and CSB attended the event.

Technology Demonstration held at State Oak Tasar Grainage, Phayang, Kangpokpi District on 23.12.2020

A technology demonstration programme was organized on 23.12.2020 at State oak tasar grainage, Kangpokpi district**,** to demonstrate the sodium hypochlorite egg disinfection technique developed by RSRS, Imphal during the ongoing spring crop grainage. Twenty officials of DOS and CSB participated in the programme.

Technology Demonstration held at State Sericulture Farm, Chingarel, Imphal East on 02.03.2021

A technology demonstration programme was organized on 02.03.2021 at State Sericulture Farm, Chingarel, Imphal East**,** to demonstrate the sodium hypochlorite egg disinfection technique developed by RSRS, Imphal during the ongoing oak tasar spring crop grainage under DOS, Imphal. Twenty officials of DOS and CSB participated in the programme.

Miscellaneous activities

- Bivoltine Cluster Promotion Programme: 1.55 lakhs dfls were reared under Churachandpur cluster and harvested 73.3 MT of cocoons. At Ukhrul, 1.58 lakhs dfls were reared and harvested 76.6 MT of cocoons.
- Evaluation of bivoltine double hybrid, BHP-DH (under tot-OFT): 400 dfls of BHP-DH along with 100 dfls for control were brushed during autumn crop, 2020 covring 7 farmers and harvested an average cocoon yield of 51.57 kg/100dfls against the control 42.55 kg/100dfls. Another 300 dfls of BHP-DH and 100 dfls of B.Con 1x B.Coon4 (control) were also reared during spring crop and harvested an average of 48.9 kg/100dfls against control 46.20 kg/100dfls.
- Validation of disinfectant "Nirmool" (under TOT-OST): Application of the disinfectant "Nirmool" was conducted during autumn crop, 2020 and recorded 8800 and 13.9 kg ERR by number and weight respectively.

RESEARCH EXTENSION CENTRE

FATEHPUR (U.P.)

As per mandate and target allotted by the main Institute CMER&TI, Lahdoigarh (Assam) the following Technical activities have been performed by the Centre during the Year (2020-21) under report in Association with District DOS, U.P. for the cause of growth of Ericulture in Non-Traditional State U.P. with special reference to District Fatehpur, Kanpur Nagar, Kanpur Dehat, Unnao, Hamirpur, Chitrakoot, Jalon and Banda through Extension activities, Technology Awareness Meet, Field Day, Group Discussion, Training, Demonstration, Supervision and Monitoring of Rearing under Transfer of Technology etc.

1. Extension Activities

(a) Publicity:

(1) Technology Awareness Meet: Target 04, achievement 04 (100%)

- ***1st Programme***have been organized by The Centre (@ of 10000.00 per programme) at Village – Gajja Ka Dera, Dist.- Fatehpur (U.P.) on 04.12.2020 . The 82 Eri farmers participated in the programme (Table No. – 01) Eri Research Extension Centre, Central Silk Board , Fatehpur (U.P.) was organized Technology Awareness Meet Programme on 04.12.2020 in Village- Gajja Ka Dera, Amauli Block of Fatehpur District. The Programme was attended 82 Eri Farmer of 04 Villages. 1st Screening and hygienic provision for Thermal screening, washing and sanitization of hand of Farmers and distributed mask to farmers. Then Shri Suraj Pal, Scientist-D, EREC, Fatehpur explained new technologies developed by CMER&TI, Lahadoigarh (Assam) and He also explained how to disinfect rearing house before rearing and after rearing and how to increaseincome from Sericulture. Shri S.P.Nigam, ASDO, Sericulture DevelopmentDepartment Fatehpur (U.P.) explained scheme of DoS (Sericulture) and how to control Bacterial and virosis disease. Shri Ramjiwan, F.A. EREC, Fatehpur explained castor plantation management and how to produce quality leaves for the batter result.Shri Ramvishal,Pradhan- Ramdinvapur, appealed to

farmersto increase castor plantation in Ramdinvapur village. After that supervised rearing activities in Ramdinvapur village was conducted**.**

- ***2nd Programme***has been organized at Village– Ramdinvapur, Dist. Fatehpur (U.P.) on 08.01.2021 and 83 Eri farmers attended the programme (Details in Annexure –I). Eri Research Extension Centre, Central Silk Board, Fatehpur(U.P.) was organized Technology Awareness Meet Programme on 08.01.2021 in Village- Ramdinvapur, Khajuha Block of Fatehpur District. The Programme was attended 83 Eri Farmer of 04 Villages. 1st Screening and hygienic provision for Thermal screening, washing and sanitization of hand of Farmers and distributed mask to farmers. Then Shri Suraj Pal, Scientist-D, EREC, Fatehpur explained new technologies developed by CMER&TI, Lahadoigarh (Assam) and He also explained how to disinfect rearing house before rearing and after rearing and how to increase income from Sericulture.Shri S.P.Nigam, ASDO, Sericulture Development Department Fatehpur (U.P.) explained scheme of DoS (Sericulture) and how to control Bacterial and virosis disease. Shri Ramjiwan, F.A. EREC, Fatehpur explained castor plantation management and how to produce quality leaves for the batter result. Shri Ramvishal, Pradhan- Ramdinvapur, appealed to farmers to increase castor plantation in Ramdinvapur village. After that supervised rearing activities in Ramdinvapur village.

- ***3rd Programme*** has been organized at Village – Khadra, Dist. Fatehpur (U.P.) on 13.03.2021 and 83 Eri farmers attended the programme. Eri Research Extension Centre, Central Silk Board, Govt. of India, Fatehpur (U.P.) was organized Technology Awareness Meet Programme on 13.03.2021 in Village- Khadara, Devmai Block of Fatehpur District on 13.03.2021. The Programme was attended 100 Eri Farmers of 05 Villages. 1st Shri Suraj Pal, Scientist-D, EREC, Fatehpur (U.P.) explained new Technologies developed by CMER&TI, Lahadoigarh (Assam) and He also explained How to Disinfect Rearing House before rearing and and after Rearing. Sri S.P. Nigam, ASDO, Sericulture Development Department, Fatehpur explained scheme of DoS, (Sericulture). Sri Pankaj Gupta, ASDO, Sericulture Development Department, Fatehpur (U.P.) explained castor plant management and How to produce Quality Leaves for the better result.

- ***4th Programme***hasbeen organized at Village – Katiliha, Dist. Fatehpur (U.P.) on 15.03.2021 and 82 Eri farmers attended the programme (Details in Table No. 01): Eri Research Extension Centre, Central Silk Board,Fatehpur (U.P.) was organized Technology Awareness Meet Programme on 15.03.2021 in Village- Katiliha, Khajua Block of Fatehpur District. The Programme was attended 82 Eri Farmer of 04 Villages. 1st Screening and hygienic provision for Thermal screening, washing and sanitization of hand of Farmers and distributed mask to farmers. Then Shri Suraj Pal, Scientist-D, EREC, Fatehpur explained new technologies developed by CMER&TI, Lahadoigarh (Assam) and He also explained how to disinfect rearing house before rearing and after rearing and how to increase income from Sericulture . Shri Vivek Kumar, Anudeshak, Department Fatehpur (U.P.) explained scheme of DoS (Sericulture) and how to control Bacterial and virosis disease. Shri Ramjiwan, F.A. EREC, Fatehpur explained castor plantation management and how to produce quality leaves for the batter result. Shri Chanderpal, Pradhan- Katiliha, appealed to farmers to increase castor plantation in Khadra village. After that supervised rearing activities in Katiliha village was conducted.

1. Technology Demonstraion Programme: Target 04, achievement 04(100%)

- **1st Technology Demonstration Programme** organized by the Centre at Village-Khadra, Fatehpur (U.P.) on 13.03.2021 and total no's of 31 Eri farmers covered.
- **2nd Technology Demonstration Programme** organized by the Centre at Village-Katiliha, Fatehpur (U.P.) on 15.03.2021 and total no's of 30 Eri farmers covered.
- **3rdTechnology Demonstration Programme** organized by the Centre at Village-Gajaipur, Fatehpur (U.P.) on 16.03.2021 and total no's of 31Eri farmers covered.
- **4thTechnology Demonstration Programme** organized by the Centre at Village-Chhituva Dera, Fatehpur (U.P.) on 16.03.2021 and total no's of 32 Eri farmers covered.

2. **Organization of Farmers Training:**

- **DoSLevel:** Target 50, Achievement 75 (150%) As per instruction of CMER&TI, Lahadoigarh (AssaM) during the year 2020-21 Shri Suraj Pal, Scientist-D, EREC, Fatehpur imparted quality Training to Eri Farmer at Mirzapur (U.P.) in March,2021 and covered 30 Eri farmers and 50 Farmers trained in fatehpur (U.P.) in December ,2020 and January, 2021.

- **Departmental Level (Farmer Skill Training Programme):** Target 45 (03 Batch), Achievement 45 (03 Batch):

  a) ***1st Batch*** have been organized by The Centre at Office Campus (Residential) w.e.f. 12.10.2020 To14.10.2020 and trained 15 farmers as per course of Ericulture like - What is Sericulture? It'sHistory? Races of Silkworm and their distribution. Host Plant of Eri Silkworm, pest and disease of Eri Food Plant and it is control, Eri Silkworm rearing Technology (Chawki and Late age Rearing), Silkworm grainage Technology, selection, transportation, preservation of Eri Seed cocoons, Microscopic examination of moth and identification of pb and other diseases, What is dis-infection method of in Grainage and Rearing House, profit of farmers from Ericulture.

  b) ***2nd Batch***have been organized by The Centre at Office Campus (Residential) w.e.f. 16.10.2020 To 18.10.2020 and trained 15 farmers as per course of Ericulture.

  c) ***3rd Batch*** have been organized by The Centre at Office Campus (Residential) w.e.f. 20.10.2020 To22.10.2020 and trained 15 farmers as per course of Ericulture.

9. Other Technical Activities:

(1) Report to be submitted on survey and surveillance of disease / pest occurrence in castor plantation and Eri Silkworm.

(a) **Plant side: Target 02, Achievement 02**: Two report prepared on the Data collected from the farmers before commencing two commercial crop rearing of the year Oct-Nov 2020 and Feb-March 2021 on occurrence of Castor disease/ pest in the area were sent to The Director CMER&TI , Lahdoigarh (Assam).

(b) **Silkworm Side: Target 02, achievement 02:** Two report prepared on the data collected from the Farmers during the Two commercial crop rearing of the year Oct-Nov 2020 and Feb-March 2021 on the occurrence of Silkworm disease have been submitted to The Director , CMER&TI, Lahdoigarh (Assam).

(c) JCPC Meeting: The Centre has been organized 01 JCPC meeting in different Villages of Kanpur Dehat-Distt. Of U.P. with association of DOS Kanpur Dehat (U.P.). A total No of 250 Eri Farmers covered during the year 2019-20 all the farmers were covered and assistant technically by the Centre during two commercial crop i.e. Oct-Nov 2020 and Feb-March 2021 , Village members reported their problems conducting Eri rearing in all the said Eri villages Farmers do not have sufficient quantity of rearing Trays and rearing stands . They asked for supply of rearing kit at the earliest. All the meeting minutes sent to The Director CMER&TI, Lahdoigarh (Assam), Director Resham Lucknow, Scientist-D &Head, MSSO, Guwahati (Assam), Assistant Director (Seri) Kanpur Dehat and all members of JCPC with in 7 Days.

RESEARCH EXTENSION CENTRE, LAKHIMPUR

TECHNOLOGIES UNDER MULTI-LOCATIONAL TRIAL

From the concluded research project entitled **'APR-5882-Validation of Indigenous Technical Knowledge (ITK) associated in muga culture'**, two technology packages were developed. Accordingly, ToT was conducted for both the technology package and feedback is highlighted as below.

1. **Integrated Practice of ITK and Modern Technology for Higher Muga cocoon yield:** TOT conducted as OFT at farmers field has shown to enhance average cocoon yield by 8.3% during the Kotia commercial crop (Oct-Nov) and 22.8% during Jarua crop (Dec-Jan) over the existing recommended practice. Both the cocoon yield and ERR under OFT was highly significant.

2. **Integrated Practice of ITK and Modern Technology for Muga Silkworm Seed production:** TOT conducted as OST during June, August, October and November at CSB as well as DoS units has shown that average fecundity under integrated practice of ITK and modern technology is significantly enhanced by 10.9% over existing recommended practice

Training Programmes conducted - Training programme for 62 Farmers under Farmer Skill Training and 30 college students under Technology Orientation Programme was conducted during the year under report.

Workshops, Seminars, Farmers' Day, etc., Organized:

As per target, 4 Technology Awareness Meet 4 Technology Field demonstration programmes were conducted to sensitize all together 447 farmers at different muga and eri potential pockets in Assam.

Technology Awareness Meet

REC, Lakhimpur had organized four Technology Awareness Meet on Integrated Technology Package of Muga culture during the year 2020-21. Total 330 farmers along with DoS staffs were sensitized in different potential areas of Muga Culture in Lakhimpur district, Assam. In all the programme, improved technologies of muga culture viz.,muga host plant raising and maintenance, silkworm seed production, early and late stage silkworm rearing, pest and disease management, improved cocoon spinning devices, post rearing management of field, etc were demonstrated through multimedia projector and explained the benefit of improved technologies to the participants.

Fruitful interaction with the farmers on various problems were also held in the programme and provided necessary suggestions to the farmers for overcoming the problems.

Some Views of Awareness meet organized by REC, Lakhimpur during 2020-21



Technology Demonstration

As per Action Plan, REC, Lakhimpur had organized 4 technology field demonstration programme on integrated technology package of muga culture were organized at different muga growing pockets in Lakhimpur and Dhemaji district during the year 2020-21. Total 117 muga farmers were actively participated in the demonstration programme. In each programme, techniques of pruning/pollarding of host plants, application of inputs to the host plants, disinfection of rearing field before brushing of silkworm, etc were demonstrated at the field practically. The whole demonstration programme was farmers' participatory mode. Some views of the programme are furnished below.




Special activities on Women Empowerment, Development of SC/ST or people below poverty line

In implement the 'Eri Silk Development Project for Women Empowerment in Chungtia of Mokokchung' in Nagaland under NERTPS, total 350 ST women have been covered as beneficiaries during 2020-21. Performing duty as Nodal Officer of the project, all necessary coordination has been extended to the Project Executing Agency i.e., Chungtia Village Council providing the required technological and managerial supports for implementing the project smoothly as per schedule.

Sericulture Resource Centres (SRCs)

As Nodal Officer, coordinated to SRC owner in Dhakuakha, Lakhimpur for conducting farmers training to 100 muga farmers as per assigned target. Besides, training classes in the training programme of the SRC was imparted as invited resources

1. **<u>For Farm activities</u>**

Total Plantation area **:** 3.0 acre

Available Host Plants **:**750 nos

Land Use Programme of REC, Lakhimpur for the year 2020-21

#	Programme	Target		Achievement	
		Phy (No.)	Fin (Rs.)	Phy (No.)	Fin (Rs.)
1	Raising of Som Seedling (nos)	5000	0.25	5000	0.004
2	Supply of Som Seedling (nos)	5000	--	650	-
3	Muga Commercial crops dfls brushing(g)	200	0.02	200	0.02
4	Muga Commercial cocoon production (nos)	12000	--	12360	-
5	Muga Seed Crop dfls brushing(g)	200	0.02	200	0.02
6	Muga Seed Cocoon production (nos)	8000	--	9195	-
7	Muga dfl production (g)	1200		1227	-
8	Muga dfl supply (g)	1200	-	1227	-
9	Revenue generation (Rs. In lakh)		-		0.38

TRANSFER OF TECHNOLOGY PROGRAMS

1. On Farm Trials (for demonstration of Technologies at farmers' level)

#	Name of the Technology	No. of locations	No. of stakeholders
1	Popularization of Kesseru eri host plant HF005 & HF008	02	26
2	Popularization of Borpat	02	09
3	Evaluation of new eri cocoon opener	-	100
4	Beneficial gut microflora	02	10
5	INM for castor host plant	02	10
6	Popularization of eri egg incubation device	02	50
7	Integrated practice of ITK and improved technology for higher muga cocoon yield	02	10

2. On Station Trials (for validation of technology at CSB institutes/ RSRSs/ DoS units etc.)

#	Name of the Technology	CSB institutes	RSRSs	DOS Units
1	Formulation for controlling bacterial flacherie disease in Muga silkworm	01	03	02
2	Validation of microbial formulation for reclamation of oil contaminated soils	-	-	03
3	Validation of LED light trap for control of Muga insect pests	1	5	4
4	Validation of use of Sodium Hypochlorite for seed treatment against tiger band disease of Oak tasar silkworm	-	2	5
5	Validation of use of PET bottles for uzi trap in Oak tasar silkworm including Muga	2	3	5
6	Establishment and Popularization of new breed C27 among farmers (300 dfls per unit)	2	3	5

Capacity Building and Training Institute-wise for financial year of 2020-21

#	Title of the training programme	Target		Achievement	
		No. of programme	No. of stakeholders	No. of programme	No. of stakeholders
3.2	Farmers Skill Training	16	400	11	422
3.3	Exposure visit for technology awareness				
3.4	Technology Orientation Programme	08	200	08	209
3.5	Sericulture Resource Centres (SRCs)	45	900	33	860
3.6	**Training under Post Cocoon Sector****	06	100	06	127
3.12	**Non-CBT:** Training programme funded by agencies other than CSB*	05	200	03	83
3.13	**Training under SAMARTH *****	40	800	15	441
	Total	**63**	**2600**	**76**	**2142**

PUBLICATIONS OF THE INSTITUTE (2020-21)

Research/Review Articles

1. Arunkumar KP (2020) Behavioral Genomics: a way to study insect behavior in the post-genomics era. *Indian Entomologist* 1: 6-14.

2. Arunkumar KP, Kalita S, Mahesh DS and Vijay n (2021) *Xanthopimpla predator* endoparasitoid: a minor pest on *Antheraea assamensis* in muga ecosystem, *Indian Silk*, 11(59-5):24-25.

3. Devi B., **M. Chutia**, N. Bhattacharyya (2021) Food plants diversity, distribution and nutritional aspects of the endemic golden silk producing silkworm, *Antheraea assamensis* (Helfer) – a review. *Entomologia Experimentalis et Applicata.*169:237–248.

4. Debbarma J, Saikia B, Singha DL, Maharana J, Velmurugan N, Dekaboruah H, **Arunkumar KP** and Chikkaputtaiah C (2021) XSP10 and SlSAMT, Fusarium wilt disease responsive genes of tomato (Solanum lycopersicum L.) express tissue specifically and interact with each other at cytoplasm in vivo. *Physiol Mol Biol Plants*.

5. Vishaka G. V., T. K. Narayanaswamy, D. N. Vidyashree, R. Muthuraju and D. S. Mahesh. (2020),Investigations on utilization prospects of silkworm (*Bombyxmori*L.) pupal residue bio soft descent (SPRBD) as nutrient source for tomato crop, *J. Exp. Zool. India*, 23(2): 1165-1170.

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7. Kumar A, Yadav AN, Mondal R, Kour D, Subrahmanyam G, Shabnam AA, Khan SA, Yadav KK, Sharma GK, Cabral-Pinto M, et al. (2021), Myco-remediation: A mechanistic understanding of contaminants alleviation from natural environment and future prospect. *Chemosphere*, 284: 131325. *Chemosphere*: 131325. (***IF=7.9; NAAS=13.9***)

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9. Kumar, A., Medhi, K., Fagodiya, R. K., Subrahmanyam, G., Mondal, R., Raja, P. & Pathak, H. (2020). Molecular & ecological perspectives of nitrous oxide producing microbial communities in agro-ecosystems. *Reviews in Environmental Science and Bio/Technology*, 1-34.

10. Kumar, A., Subrahmanyam, G., Mondal, R., Cabral-Pinto, M. M. S., Shabnam, A. A., Jigyasu, D. K.,.& Yu, Z. G. (2021). Bio-remediation approaches for alleviation of cadmium contamination in natural resources. *Chemosphere*, *268*, 128855.

11. Liu J, Chen Z, Xiao Y, Asano T, Li S, Peng L, Chen E, Zhang J, Li W, Zhang Y, Tong X, Kadono-Okuda K, Zhao P, He N, Arunkumar KP, Gopinathan KP, Qingyou Xia, Willis J, Goldsmith MR, Mita M (2021) Lepidopteran wing scales contain abundant cross-linked film-forming histidine-rich cuticular proteins. *Communications Biology* 4: 1-10 (***NAAS: 12.27, Impact factor – 6.27***)

12. Madhu, H.R., A.D. Ranganatha, G. Nagesha., and Mahesh, D.S. (2020), Knowledge difficulty index and attitude level of farmers about soil health card in Mandya district of Karnataka, *Ind.*

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15. Mahesh, D. S. and Arunkumar, K. P. (2020), Status of ericulture in Northeast India, *Insect Environment*, 22:68-69.

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21. Reeta Luikham, T. James Keisa, L. Bidyapati Devi and A.K. Sinha (2020) *Antheraea frithi* Moore: A potential silkmoth of Manipur. Indian Silk (Sep-Oct), vol.11 (Old 59) No.3: 28-31.

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Books/ Book Chapter

1. G. Subrahmanyam, A. Kumar, R. Luikham, JS Kumar. (2020). Global Scenario of Soil Microbiome Research: Current Trends and Future Prospects, Chapter 18, In: Soil Microbiomes for Sustainable Agriculture-Functional Annotation", Springer Nature book.

2. Hota S; Sharma, Gulshan Kumar; Subrahmanyam, Gangavarapu; Kumar, Amit; Shabnam, Aftab A.; Baruah, Padmini; Kaur, Tanvir; Yadav, Ajar Nath (2021) Fungal Communities for Bioremediation of Contaminated Soil for Sustainable Environments. In: Yadav A.N. (eds) Recent Trends in Mycological Research. Fungal Biology. Springer, Cham.

3. Manjunath RN, Kumar A and Arunkumar KP (2020) Utilization of sericulture waste by employing possible approaches. In: Contaminants in agriculture: Sources, impacts and management pp 385-398.

Booklets/ leaflets/ News items

1. Rahman, S.A.S., Choudhury, B.N. and Deka.M.,(2021), Muga xilpor Bikaxot Baigyanik Poddhoti Xomuh, An assamese booklet published by RSRS, Boko, Assam.
2. Somen, L., Subharani, S., Debaraj, Y. (2021) Package and practices for muga rearing pp. 12.
3. Subharani, S., Somen, L., Priyadarshini, O., Debaraj, Y., Jalaja, S. Kumar (2021) Management of major insect pests infesting *Quercus serrata* pp. 8.
4. Subharani, S., Debaraj, Y., Somen, L., Priyadarshini, O. and Singh, N.I. (2020) Integrated Pest Management of Uzi fly: A serious pest of oak tasar silkworm. pp. 10.
5. Subharani, S., Ponnuvel, K.M., Singh, N.I. and Mishra, R.K. Sodium hypochlorite disinfection: An effective disinfection for silkworm eggs to protect against tiger band disease pp11.
6. Subharani, S., Somen, L. and Debaraj, Y. (2021) Oak tasar silkworm rearing technology pp10.
7. Subharani, S., Somen, L., Priyadarshini, O. and Debaraj, Y. (2021) Management of insect pests infesting *Quercus serrata*pp8.

AWARD/ACHIEVEMENTS

- Dr. Mahananda Chutia, Scientist-D received Young Scientist Award, Botanical Society of Assam .
- Dr. Subadas Singh, Scientist-C received Dr. SN Chowdhury Award – CMER&TI, Central Silk Board
- Dr. Mahesh DS, Scientist-B received Young scientist award in International Web-Conference on New Trends in Agriculture, Environmental & Biological Sciences for Inclusive development
- Dr. Manjunath RN, Scientist-B received Research Excellence Award-2020 by Institute of Scholars, Bangalore
- Dr. Arun Kumar, Scientist-C served as Member Expert Committee, RCGM (DBT) & Member Scientific Advisory Board, International Congress of Entomology.
- Dr. T. James Keisa, Scientist-D served as Member Board of undergraduate studies, Manipur University
- Dr. G. Subrahmanyam, Scientist-C served as editorial board member of Frontiers in Microbiology
- Dr. M. Chutia & Dr. R. Debnath, served as editorial board member of Heliyon - Cell Press
- Dr. M. Chutia, Scientist-D served as editorial board member of SN Applied Sciences, Springer
- Dr. Arun Kumar, Scientist-C served as editorial board member of International Journal of Wild Silkmoth and Silk
- Dr. Amit Kumar, Scientist-C served as editorial board member of Assoc. Editor, Land; Frontier in Environment Science
- Dr. G. Subrahmanyam, Scientist-C served as Editor, Methods in Silkworm Microbiology, Elsevier & Member IBSC, AAU, Jorhat
- Dr.S.N.Choudhury Memorial Annual Award "Certificate of Excellence" conferred to

❖ Sri Ghanakanta Bharali, STA

❖ Sri Prabil Changma, MTS

❖ Sri Prabin Kal;ita, SFW

GRANTS-IN-AID for the year 2020-21

Head	GIA RECEIVED	EXPENDITURE INCURRED
Plan Salary	142144244.00	142144244.00
NE- SC Salary	5425000.00	5425000.00
NE- ST Salary	16226598.00	16226598.00
Plan (NESalary)	32554158.00	32554158.00
Plan (General)	0.00	0.00
Plan (NE General)	17350000.00	17350000.00
Plan Capital	3500000.00	1050000.00
Plan (NE Capital)	2558000.00	2558000.00
Total	**219758000.00**	**217308000.00**

EXTERNAL FUND BALANCES FOR THE YEAR 2020-21

	DBT FUND	DST FUND
Opening Balance as on 01.04.2019-2020	3312975.00	1582982.00
Amount Received during the year	0.00	1400000.00
Expenditure during the year	650233.00	1027168.00
Surrendered during the year	107000.00	272638.00

Progress at a glance for the year 2020 -21

Research Projects as PI			**Research Projects as CI**			**On Station Trials**		**On Farm Trials**			**Capacity Building & Training**		**Extension Communication programmes (ECPs)**							**Information, Education and Communication during**	**Soil Samples analyzed**	**No. of patents filed/granted and technologies to be commercialised**	**Revenue generated (Rs. in Lakhs)**
Projects of earlier year continued through	Projects concluded during the year	New Projects initiated	Projects of earlier year continued through	Projects concluded during the year	New Projects initiated	No. of technologies validated	No. of trials covered	No. of technologies demonstrated	No. of locations covered	No. of stakeholders covered	No. of Programs Conducted	No. of stakeholders trained	Krishi Mela / Farmers meet	Farmers Field day	Awareness programme	Technology demonstration / Enlightenment programmes	Workshop / Seminars & Conferences	Field Visits	Other activities				
11	**9**	**5**	**2**	**1**	**1**	**6**	**46**	**7**	**12**	**165**	**105**	**2142**	**3**	**3**	**16**	**16**	**1**	**10**	**0***	**53**	**24**	**0**	**37.39**