# वार्षिक प्रतिवेदन ANNUAL REPORT 2021 - 22





केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान Central Sericulutral Research & Training Institute केंद्रीय रेशम बॉर्ड Central Silk Board, वस्त्र मंत्रालय Ministry of Textiles भारत सरकार Govt. of India, बहरमपुर Berhampore742101 पश्चिम बंगाल West Bengal



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#### प्रस्तावना

अन्य कृषि क्षेत्रों की तरह रेशम कृषि के क्षेत्र में भी इस वर्ष वैश्विक कोरोना महामारी की दूसरी लहर का प्रभाव देखने को मिला।रेशमकीट पालनकर्ताओं को विभिन्न समस्याओं जैसे इनपुट की अनुपलब्धता, कोसा की कीमतों में बेतहासा गिरावट, कोसा परिवहन तथा बाजार में कोसा खरीदारों या रीलरों की भारी कमी आदि समस्याओं का सामना करना पड़ा। मांग-आपूर्ति श्रृंखला में असंतुलन के कारण रेशम मूल्य श्रृंखला से संबंधित सभी गतिविधियां अत्याधिक प्रभावित हुई। महामारी के दौरान कई कृषकों ने अस्थायी तौर पर रेशम कृषि से पलायन कर अन्य कृषि क्षेत्र से जुइ गए। लेकिन, जैसे ही परिस्थितियों में सुधार हुआ वैसे ही धीरे-धीरे रेशम-



गतिविधियों में भी सुधार दर्ज की गई। बहरमपुर द्वारा पूर्वी तथा उत्तर-पूर्वी क्षेत्रों के रेशम कृषकों के लाभार्थ आवश्यकता आधारित प्रौद्योगिकियों के विकास के जरिए आर एंड डी, विस्तार तथा सीबीटी के अंतर्गत काफी उपलब्धियां हासिल की गई। कृषकों के लिए अग्रहयनी की फसल फलदायी साबित हुई क्योंकि इस दौरान उन्हें कोसा का बेहतर मूल्य प्राप्त हुआ। कोसा की कीमतों में वृद्धि उनके लिए वरदान साबित हुआ जिसके फलस्वरुप फाल्गुनी फसल के दौरान कृषकों द्वार बड़ी संख्या में रोमुच मांग की गई।

वर्ष के दौरान, केरेउअवप्रसं द्वारा शहतूत में सुधार; शहतूत पर्ण उपज एवं गुणवत्ता में सुधार के लिए 785 पीसीएच का चयन किया गया। पश्चिम बंगाल के लिए नए फसल सारणी की पहचान की गई। C-2038 प्रजाति को पूर्वी तथा उत्तर-पूर्वी भारत के 8 राज्यों में 290 कृषकों (38 एकड़) के मध्य लोकप्रिय बनाया गया। सी-9 द्वारा लाल एवं लेटराइट मृदा के अधीन सी-2038 (10.28 टन/हे/वर्ष) तथा एस-1 (7.71 टन/हे/वर्ष) की तुलना में 10% अधिक पर्ण उपज (11.36 टन/हे/वर्ष) दर्ज की गई। तीन (03) नए जीनोटाइप C-131, B-30 एवं E-13 द्वारा C-2038 की तुलना में 10% अधिक पर्ण उपज दर्ज की गई। सी-2038 प्रजाति हेतु शहतूत कृषि के लिए 130% आरडीएफ के साथ 2'×2' के अंतराल की अनुशंसा की जाती है। शहतूत पर्ण के वार्धक्यता को विलंबित करने हेतु बीएपी (20 पीपीएम), एसएनपी (30 पीपीएम), बीएपी + आईएए (10 पीपीएम + 2 पीपीएम) एवं बीएपी + एए (10 पीपीएम + 25 पीपीएम) के 4 हार्मोनल फॉर्मूलेशन वाले पौधें प्रभावी पाए गए। PMLD आसिता प्रतिरोधी जीनोटाइप CBP-1 द्वारा AICEM IV के अंतर्गत उच्चतम मौसमी पर्ण उपज दर्ज की गई। नीम केक के साथ जैव-कीटनाशक स्पिनोसैड 45 एससी के अनुप्रयोग द्वार शहतूत पीइक का प्रकोप कम दर्ज किया गया। शहतूत मूल विगलन रोग के प्रबंधन के लिए रोटफिक्स [कवकनाशी - कार्बेन्डाजिम (12%) + मैनकोजेब (63%) @ 0.20%)]का अनुप्रयोग किया जाए। बीसीए - क्राइसोपरला ज़ास्त्रोवी सिलेमी को प्रक्षेत्र परिस्थितियों में श्रिप्स के प्रकोप को 71.31% कम करने में प्रभावी पाया गया।

वर्ष के दौरान रेशमकीट में सुधार; उन्नत बहुप्रजता के साथ उन्नत चिहिनत व प्लेन निस्तरी, बीएमएनपीवी के प्रति उच्च सहिष्णुता, उच्च तापमान एवं आर्द्रता के प्रति सहनशीलता, बेहतर कोसा विशेषताओं तथा फिलामेंट लंबाई। 12Y x BFC1 के लगभग 2.29 लाख रोमुच का परीक्षण कर उनके आकड़े दर्ज किए गए। N x SK6.SK7 की तुलना में कोसा उपज तथा कवच सामग्री में क्रमशः 12.49% एवं 10.22% का सुधार दर्ज किया गया। प्रदर्शन के आधार पर दो ताप सहिष्णु डीएच (WB 1.3 × WB 7.5 और KA19.WB5 × WB 1.3) यह दर्शाता है कि कि WB 1.3 × WB 7.5 में 82% प्यूपेशन के साथ अधि ताप सहिष्णु एवं 13.04 किग्रा / 10000 लार्वा कोसा उपज, बेहतर धाग़ाकरण मापदंडों जैसे धाग़ाकरण की क्षमता (71%), फिलामेंट लंबाई (694 मीटर) एवं रेशम रिकवरी (68%) उपलब्ध है। पाइरेक्सिया एवं एसएसआर आधारित मार्कर सहायक चयन के जरिए उच्च तापमान तथा उच्च आर्द्रता को सहन करने के लिए पांच द्विप्रज नस्लों जैसे SK7HH, B.Con4HH, N5HH, HTH10HH एवं WB1HH की पहचान की गई।

द्विप्रज [बीबीआई-0338 (डीडी-1; डंबेल) तथा बीबीआई-0301 (वाईएस-7; ओवल)] कोसा लक्षणों के संदर्भ में नियंत्रण पर बेहतर जीनोटाइप के रूप में चिहिनत किया गया है। शहतूत पर्ण प्रोटीन द्वारा बैक्टीरिया के फ्लेचरी के विकास को अवरुद्ध कर दिया जिससे सूक्ष्मजीव बेसिलस थुरिंगिनेसिस एवं स्टैफिलोकोकस एसपी @ 150-300µg इन विट्रो में 24-48 घंटे के उपचार के बाद एएमपी की पहचान की गई। पर्यावरण एवं कृषकों के हितैषी कीटपालन गृह रोगाणुनाशन 'निर्मूल<sup>™</sup> तथा संस्तर रोगाणुनाशन 'सेरी-विन' तैयार किया गया और निरमूल को ट्रेड मार्क के लिए पंजीकृत किया गया है।

वर्ष के दौरान, हितधारकों के लिए विभिन्न सीबीटी एवं एसयू कार्यक्रम आयोजित किए गए। साथ ही, वर्ष 2021-22 के दौरान 28 पीजीडीएस छात्रों ने पाठ्यक्रम संपन्न किया तथा 16 छात्र ऑफ़लाइन मोड के जरिए अध्य्यन कर रहे हैं। आईएसटी एवं एफएसटी कार्यक्रमों के माध्यम से क्रमशः 21 प्रशिक्षुओं तथा 150 कृषकों को प्रशिक्षित किया गया। चार टॉप एवं दो हैंड्स-ऑन-प्रशिक्षण आयोजित कर क्रमशः 211 एवं 40 कृषकों को प्रशिक्षित किया गया। ईसीपी के माध्यम से उपलब्ध नवीनतम तकनीकों पर तथा 130 ईसीपी के माध्यम से कृषकों में जागरूकता उत्पन्न करने के लिए किए गए। अत्याधिक प्रयासों द्वारा 5938 हितधारकों को प्रशिक्षित किया गया। 6 एसआरसी ने सक्रिय रूप से काम किया तथा 60 आयोजनों के माध्यम से वर्ष के दौरान 1200 कृषक प्रशिक्षित किए गए। मुर्शिदाबाद जिले के मल्लिकपुर एवं बंकीपुर [प.बं.] में दो रेशम -व्यवसायों सीआरसी की स्थापना पर नाबार्ड वित्त पोषित परियोजना सफलतापूर्वक आरंभ हुई। डीएसटी-जेएसपीएस, डीबीटी-बीआईआरएसी, डीबीटी-एनई एवं एसईआरबी के साथ कुछेक सहयोगी शोध कार्य प्रस्तावित किए गए हैं। पूर्वी तथा उत्तर-पूर्वी क्षेत्र के लिए शहतूत क्षेत्र में इस संस्थान द्वारा विकसित प्रौद्योगिकियों के मूल्यांकन व लोकप्रिय बनाने तथा पश्चिम बंगाल के पहाड़ी क्षेत्र में एक उपयुक्त आईएफएस मॉडल स्थापित करने हेतु दो मेगा परियोजनाएं 5+4 घटक को सम्मिल्लित कर आंरभ किया गया।

> [डॉ. किशोर कुमार, सी. एम.] निदेशक

#### FOREWORD



Like other agriculture sectors, this year also sericulture in the region witnessed the aftermath effects of Covid pandemic second wave. The silkworm rearers faced problems like non-availability of the inputs, crash in the cocoon prices, cocoon transportation and fewer cocoon purchasers or reelers in the market, etc. Due to imbalance in the demand-supply chain, all the activities involved in the silk value chain got affected. Many of the farmers temporarily gave up sericulture and shifted to the other cultivations due to the constraints faced by them amidst the pandemic situation. But, later when the situation improved with lesser infections and normalcy was

restored, seri-activities also gradually recovered. BHP made considerable achievements under R&D, Extension and CBT by the way of developing need-based technologies for the benefit of the sericultural farmers of E & NE regions. Developed Fortune was on the side of farmers during Aghrayani crop, as they got higher cocoon prices. The rise in the price has come as a boon, and instrumental in shooting up farmer's confidence to place indent for large no. of dfls to graineurs during the Falguni crop.

During the year, CSRTI, in mulberry improvement; 785 PCH selected for improvement of leaf yield and quality in mulberry. Identified new crop schedules for West Bengal. C-2038 popularized among 290 farmers (38 acres) in 8 states of E & NE India. C-9 recorded 10% higher leaf yield (11.36 t/ha/y) over C-2038 (10.28 t/ha/y) and S-1 (7.71 t/ha/y) under red and laterite soil. Three (03) new genotypes C-131, B-30 & E-13 recorded more than 10% higher leaf yield over C-2038. For C-2038 mulberry cultivation 2'×2' spacing with 130% RDF recommended. For delay in mulberry leaf scenescense, 4 hormonal formulations of BAP (20 ppm), SNP (30 ppm), BAP+IAA (10 ppm + 2 ppm) & BAP+AA (10 ppm + 25 ppm) found effective in potted plants. PMLD mildew resistant genotype CBP-1 recorded highest pooled seasonal leaf yield in AICEM IV. Bio-pesticide Spinosad 45 SC with Neem cake application recorded less mulberry pest infestation. Rotfix [fungicides - Carbendazim (12%) + Mancozeb (63%) @ 0.20%)] for management of mulberry root rot disease. BCA - *Chrysoperla zastrowi sillemi* found effective in reduction of thrips population by 71.31 % under field conditions.

During the year, in Silkworm improvement; Improved Marked and Plain Nistari with enhanced fecundity, higher tolerance to BmNPV, tolerance to high temperature & humidity, improved cocoon characteristics and filament length. About 2.29 lakh dfls of 12Y x BFC1 were tested & recorded its performance, observed an improvement of 12.49% and 10.22% in terms of cocoon yield and shell content, respectively over N x SK6.SK7. Among two thermo-tolerant DH (WB 1.3 × WB 7.5 and KA19.WB5 × WB 1.3) based on performance showed that WB1.3 × WB7.5 had higher thermo tolerance with 82% pupation and cocoon yield of 13.04 kg/10000 larvae, superior reeling parameters like reelability (71%), filament length (694 m) and silk recovery (68%). Five bivoltine breeds viz., SK7HH,

B.Con4HH, N5HH, HTH10HH and WB1HH are identified for tolerance to high temperature and high humidity through *Pyrexia* and SSR based marker assisted selection. Bv. [BBI-0338 (DD-1; Dumbbell) and BBI-0301 (YS-7; Oval)] have been identified as better genotypes over control in terms of cocoon traits. Identified AMP from the mulberry leaves protein suppressed the growth of bacterial flacherie causing microorganisms *Bacillus thuringiensis* and *Staphylococcus* sp. @ of 150-300µg after 24-48h of treatment *in vitro.* An eco-friendly and farmer- friendly room disinfectant **'Nirmool**<sup>TM'</sup> and a bed disinfectant **'Seri-Win'** have been formulated and **Nirmool** has been registered for Trade Mark (TM).

During the year, various CBT & SU programmes were conducted for the stakeholders and 28 PGDS students completed the course & during 2021-22: 16 students are continuing the course in the offline mode. Through IST and FST programmes sensitized 21 trainees & 150 farmers, respectively. Four TOP and two Hands-on-training conducted and sensitized 211 farmers & 40 farmers, respectively. More & more efforts made for creating awareness of farmers on the latest technologies available through ECPs and through 130 ECPs sensitized 5938 stakeholders. 6 SRCs worked actively and through 60 events 1200 farmers were imparted training during the year. A NABARD funded project on establishment of two Seri-businesses CRC's commissioned successfully at Mallickpur and Bankipur in Murshidabad Dist. (WB). Few collaborative research works have been proposed with DST-JSPS, DBT-BIRAC, DBT-NE & SERB. To pupularize & evaluating the developed technologies evolved by this institute in the mulberry sector for E & NE region, two mega projects have been initiated comprising 5+4 components and is on process to establish a suitable IFS model in the hilly region of WB.

[Dr. Kishor Kumar, C. M.] Director

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

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान (केरेउअवप्रसं) की स्थापना पूर्वी तथा उत्तर-पूर्वी भारत में (पूर्वः पश्चिम बंगाल, ओडिशा, बिहार, झारखंड, छत्तीसगढ़; उत्तर-पूर्व: अरुणाचलप्रदेश, असम, मणिपुर, मेघालय, मिजोरम, नागालैंड, सिक्किम एवं त्रिपुरा) रेशम उद्योग को अनुसंधान, विकासात्मक, तकनीकी, प्रौद्योगिकी, विस्तार सहायता प्रदान करने हेतु बहरमपुर में किया गया था। केरेउअवप्रसं, बहरमपुर का 79<sup>वॉ</sup> वर्ष जारी है तथा इस क्रम में, संस्थान द्वारा क्षेत्र हेतु उपयुक्त शहतूत उपजातियों का विकास, रेशमकीट नस्लों / संकरों, शहतूत कृषि के लिए पैकेज का अनुप्रयोग, रेशम कीटपालन व नवाचार/उत्पादों/प्रक्रियाओं के विकास में अपना महत्वपूर्ण योगदान किया गया है।

#### विजन

पूर्वी तथा उत्तर-पूर्वी राज्यों को रेशम कृषि के क्षेत्र में उत्कृष्ट केंद्र बनना मिशन

- प्रमुख (थ्रस्ट) क्षेत्रों में अन्संधान व विकास परियोजनाओं को आरंभ करना
- 🔹 अधि-उपज शहतूत उपजातियों को लोकप्रिय बनाना
- 🔹 क्षेत्र और मौसम विशिष्ट रेशमकीट संकरों को लोकप्रिय बनाना
- 🔹 उन्नत शहतूत पैकेज को लोकप्रिय बनाना
- प्रौद्योगिकी हस्तांतरण कार्यक्रम का क्रियान्वयन
- 🔹 लाभकारी रोजगार के अधिक से अधिक अवसर पैदा करना

#### उद्देश्य

- भारतीय रेशम के उत्पादन, उत्पादकता एवं गुणवत्ता को समृद्ध करने हेतु वैज्ञानिक, तकनीकी व आर्थिक अनुसंधान का संचालन करना
- 🔹 परपोषी पौधों, रेशम कीटपालन, कोसोत्तर प्रौद्योगिकी तथा इसके प्रचार-प्रसार के लिए पैकेज का विकास
- उत्पाद एवं प्रौद्योगिकी व उद्योग इंटरफेस का व्यावसायीकरण
- इनपुट लागत व कठिन परिश्रम को कम करने का प्रयास
- 🔹 श्द्ध आय एवं उत्पादकता बढ़ाने हेत् उप-उत्पाद का उपयोग
- आयात प्रतिस्थापन तथा विदेशी मुद्रा के अर्जन हेत् अंतरराष्ट्रीय स्तर के रेशम का उत्पादन बढ़ाना
- 🔹 मानव संसाधन विकास
- प्रजनकों के स्टॉक का रख-रखाव
- रोग एवं पीड़क की निगरानी तथा पूर्वानुमान व पूर्व-चेतावनी
- 🔹 आईसीटी उपकरणों के माध्यम से ज्ञान, अनुसंधान एवं विकास नवाचारों व शहतूत पैकेज का प्रचार-प्रसार
- प्रतिष्ठित राष्ट्रीय और अंतर्राष्ट्रीय अनुसंधान एवं विकास संस्थानों के साथ सहयोगात्मक अनुसंधान कार्यक्रम / परियोजनाओं का संचालन
- जारी अनुसंधान संबद्ध गतिविधियों एवं वैज्ञानिक व तकनीकी सेवाओं का समर्थन करने के लिए संस्थागत ढांचे को मजबूत करना
- बेहतर तालमेल के लिए अंतर-संस्थागत सहयोग
- 🔹 रेशम कृषि प्रौद्योगिकियों की तकनीकी-आर्थिक व्यवहार्यता
- 🔹 तकनीकी व परामर्श सेवाएं प्रदान करना

63 एकड़ के जीवंत परिसर में फल-फूल रहा यह संस्थान अनुसंधान एवं विकास के प्रमुख विषयों(शहतूत संवर्धन, रेशम संवर्धन, कोसोत्तर, विस्तार व क्षमता निर्माण)समेत सस्य विज्ञान व मृदा रसायन, प्रजनन व आनुवांशिकी (परपोषी पौध व कीट), फसल संरक्षण, कीटपालन प्रौद्योगिकी एवं जैव-प्रौद्योगिकी के साथ परियोजना मॉनिटरिंग समन्वय व मूल्यांकन (पीएमसीई) कक्ष के अलावे प्रशासनिक इकाइयों से प्राप्त सक्रिय सहयोग से उत्कृष्टता की परिकल्पना कर रही है। संस्थान विभिन्न संस्थानों / संगठनों द्वारा प्रायोजित अनुसंधान एवं विकास परियोजनाएं भी संचालित करती है। साथ ही, केरेउअवप्रसं, बहरमपुर द्वारा हितधारकों के लाभार्थ प्रौद्योगिकी से जुड़े पैम्फलेट/पुस्तिकाओं का प्रकाशन विविध भाषाओं में नियमित रुप से किया जाता है। वैज्ञानिकगण राष्ट्रीय और अंतर्राष्ट्रीय पत्रिकाओं, वैज्ञानिक सेमिनार/संगोष्ठियों में शोध-लेख प्रस्तूत करते हैं। हितधारकों में विकसित प्रौद्योगिकियों के प्रचार-प्रसार एवं



उनसे नियमित तौर पर प्रतिक्रिया प्राप्त करने के लिए संस्थान के पास पूर्व एवं पूर्वोत्तर के क्रमशः पांच व आठ राज्यों में 3 क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र (क्षेरेउअके) एवं 9 अन्संधान विस्तार केंद्र (अविके) का विस्तार नेटवर्क है। ये अधीनस्थ इकाइयां संबंधित राज्यों में रेशम कृषि विभाग के साथ घनिष्ठ समन्वय स्थापित कर हितधारकों को तकनीकी प्रदान करती हैं। केरेउअवप्रसं, सहायता बहरमपुर संबंधित सरकार तथा गैर - सरकारी एजेंसियों सभी के साथ समन्वय कर विकासात्मक कार्यक्रमों (क्लस्टर विकास, संस्थान-ग्राम लिंकेज, आदर्श रेशम ग्राम, सेरी-मॉडल गांव आदि) का क्रियान्वयन करती है। कल्याणी विश्वविद्यालय, कल्याणी के तत्वावधान में, केरेउअवप्रसं, बहरमपुर में शहतूत रेशम कृषि में संपूर्ण भारत के छात्रों हेत् रेशम कृषि में 15 महीने का पोस्ट-ग्रेजुएट डिप्लोमा (PGDS) पाठ्यक्रम का संचालन किया जाता है। संस्थान में कृषकों, रीलरों, केरेबो व गैर-केरेबो अधिकारियों, छात्रों आदि के लिए विभिन्न विषयों में कई प्रशिक्षण

कार्यक्रम आयोजित किए जाते हैं। केरेउअवप्रसं, बहरमपुर द्वारा स्नातकोत्तर [M.Sc.] के छात्रों हेतु भुगतान आधार पर शोध प्रबंध की सुविधा प्रदान करने का भी कार्य किया जाता है। प्रशिक्षण प्रभाग में आधुनिक कक्षाएं, पुस्तकालय व छात्रावास की सुविधाएं भी उपलब्ध हैं।

#### ABOUT CSRTI-BERHAMPORE

Central Sericultural Research & Training institute (CSRTI) was established at Berhampore for rendering research, training and extension support to the silk industry in Eastern and North Eastern India (East: West Bengal, Odisha, Bihar, Jharkhand, Chhattisgarh; North-East: Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura). CSRTI-Berhampore is now in its 79<sup>th</sup> year and contributed a lot and still contributing to the development of mulberry varieties, silkworm breeds / hybrids, package of practices for mulberry cultivation, silkworm rearing and innovations / products / processes suitable to the region.

#### VISION

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

#### MISSION

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

#### **OBJECTIVES**

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

The Institute established in 63-acre campus and envisages its excellence in major R&D disciplines like moriculture, sericulture, post-cocoon, extension & capacity building including Farm Management & Agronomy, Crop Protection, Rearing Technology and Biotechnology with active support from Project Monitoring Coordination & Evaluation (PMCE) cell. The institute undertakes R&D projects of its own as well as sponsored by various institutions/ organizations. It regularly publishes technology pamphlets/ booklets for the benefit of stakeholders in various languages. The scientists contribute research articles in national and international journals, scientific seminars/symposia.

For dissemination of developed technologies to the stakeholders and obtain regular feedback, the Institute has an extension network of 3 RSRSs and 9 RECs covering 5 Eastern and 8 North-Eastern states. These nested units provide technological support to the stakeholders in the respective states in close coordination with DoS. CSRTI-BHP implements all the developmental programmes (Bivoltine Cluster Promotion Programme, Seri Resource Centres, Model Chawki Rearing Centres etc.) in co-ordination with government and nongovernment agencies.

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

equipped classrooms, library and hostel facilities.



### अन्संधनात्मक एवं विकासात्मक उपलब्धियां

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर अपने तीन अधीनस्थ क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्रों [क्षेरेउअके] तथा नौ अनुसंधान विस्तार केन्द्रों [अविके] के साथ पूर्वी तथा उत्तर-पूर्वी राज्यों में रेशम उद्योग के विकास में उल्लेखनीय योगदान करते आ रहा है। शहतूत एवं रेशमकीट प्रजनन, फसल उत्पादन व संरक्षण, प्रौद्योगिकी के हस्तांतरण, विस्तार तथा प्रशिक्षण कार्य-कलापों में अनुसंधान व विकास गतिविधियों को आरंभ करने के परिणामस्वरुप पश्चिम बंगाल, ओडिशा, छत्तीसगढ़, झारखंड, बिहार, असम, नागालैंड, सिक्किम, मणिपुर, त्रिपुरा, मेघालय, अरुणाचल प्रदेश एवं मिजोरम राज्य के कृषकों के लिए उपयुक्त प्रौद्योगिकी विकसित की गई। मुख्य संस्थान एवं इसके अधीनस्थ केन्द्रों की वर्ष 2021-22 की प्रमुख उपलब्धियाँ निम्नानुसार हैः-

#### शहतूत फसल स्धार तथा संरक्षण

- शहतूत पर्ण उपज एवं गुणवत्ता में सुधार हेतु संस्थापित पॉलीक्लोनल बीज बागान से 785 पॉलीक्रॉस हाइब्रिड (पीसीएच) विकसित किए गए।
- सिंचित अवस्था में पश्चिम बंगाल के अधीन मौजूदा कृषक सारणी की तुलना में अधि पर्ण (10-25%) तथा कोसा उत्पादकता (12-14%) के लिए नए शहतूत रेशम फसल की पहचान की गई।
- शहतूत की एक नई प्रजाति सी-2038 पूर्वी तथा पूर्वोत्तर भारत के 8 राज्यों में 290 कृषकों (38 एकड़) के मध्य लोकप्रिय बनाया गया। वर्तमान समय में उपलब्ध प्रजाति एस-1635 की तुलना में इस प्रजाति में सिंचित अवस्था में 34% एवं वर्षाश्रित अवस्था में 19% उपज सुधार दर्ज किया गया। ठीक इसी प्रकार मौजूदा प्रजाति एस-1635 की तुलना में सिंचित एवं वर्षाश्रित अवस्था में क्रमशः 11% तथा 12% का कोसा सुधार भी दर्ज किया गया।
- सी-9 द्वारा लाल एवं लेटराइट मृदा के अधीन सी-2038 (10.28 टन/हे/वर्ष) तथा एस-1 (7.71 टन/हे/वर्ष) की तुलना में 10% अधिक पर्ण उपज (11.36 टन/हे/वर्ष) दर्ज की गई। उत्तर-पूर्वी क्षेत्र में वर्षाश्रित अवस्था के अधीन सी-9 में 26.35 टन/हेक्टेयर/वर्ष की उच्चतम पर्ण उपज क्षमता दर्ज की गई जो कि सी -2038 (23.65 टन/हे/वर्ष) की तुलना में 12% अधिक पर्ण उपज को दर्शाता है।
- तीन (03) नए जीनोटाइप C-131, B-30 एवं E-13 द्वारा सिंचित अवस्था के अधीन बेहतर पर्ण गुणवत्ता तथा कम पीड़क प्रकोप के साथ C-2038 की तुलना में 10% से अधिक अधिक पर्ण उपज दर्ज की गई।
- अनुशंसित खुराक/नियंत्रण (47.99 टन/हेक्टेयर) की तुलना में सी-2038 शहतूत कृषि के लिए 130% आरडीएफ के साथ 2'×2' के तहत सी-2038 की खेती में 20% अधिक पर्ण उपज (57.88 टन/हे.) एवं पोषक गुणवत्ता दर्ज की गई।
- एस-1635 तथा सी–2038 नियंत्रण की अपेक्षा पर्ण उपज में सुधार [34%] तथा गुणवता शहतूत पर्ण के वार्धक्यता को विलंबित करने हेतु बीएपी (20 पीपीएम), एसएनपी (30 पीपीएम), बीएपी + आईएए (10 पीपीएम + 2 पीपीएम) एवं बीएपी + एए (10 पीपीएम + 25 पीपीएम) के 4 हार्मोनल फॉर्मूलेशन

वाले पौधें प्रभावी पाए गए। यह अध्ययन शहतूत पर्णों की लंबी उम्र को बेहतर बनाने में एसएनपी, बीएपी, बीएपी + आईएए और बीएपी+एए की संभावित भूमिका को इंगित करता है जिसका भविष्य में प्रक्षेत्र स्तर पर मूल्यांकन किया जा सकता है।

- AICEM IV के अंतर्गत चूर्णिल आसिता प्रतिरोधी जीनोटाइप CBP-1 (सिंचित: 6.57 टन/हे. असिंचित 5.81 टन/हे.) सिंचित अवस्था में अधिक पर्ण उपज दर्ज की गई जो की राष्ट्रीय चेक, सी-2038 (सिंचित: 6.61 टन/हे. असिंचित 5.16 टन/हे.) के समान पाई गई है और असिंचित अवस्था में 12% ज्यादा पाई गई है ।
- नियंत्रण (43.8%) की अपेक्षा जैव-कीटनाशक स्पिनोसैड 45SC और नीम कि खली के अनुप्रयोग से कम शहतूत पीड़क संक्रमण (15 दिनों में 11.4%) दर्ज किया गया और यह स्पिनोसैड एक गैर-खतरनाक व गैर-लक्षित कीटनाशक है जिसका उपयोग 30 दिनों की सुरक्षा अवधि के साथ किया जा सकता है ।
- शहतूत मूल विगलन रोग के प्रबंधन के लिए एक पर्यावरण हितैषी कवकनाशी रोटफिक्स, द्वारा अकेले अनुशंसित कवकनाशी (कार्बेनडाज़िम 50% WP @ 0.20%) की तुलना में प्रक्षेत्र अवस्था में 91.5% (रेंज 60-100) उत्तरजीविता व संक्रमित पौधों की रिकवरी कर सकता है।
- जैविक नियंत्रण एजेंट क्राइसोपरला ज़ास्त्रोवी सिलेमी को लोकप्रिय बनाना, जो शहतूत कीट के प्रबंधन के लिए एक सामान्य प्रीडेटर है जो प्रक्षेत्र अवस्था में थ्रिप्स की आबादी को 71.3% तक कम करने में प्रभावी पाया गया।

#### रेशमकीट फसल स्धार व संरक्षण

- क्ष 2020-22 के दौरान पश्चिम बंगाल तथा अन्य पूर्वोत्तर राज्यों के किसानों के साथ 12Y x BFC1 के कुल 2.29 लाख डीएफएल का परीक्षण किया गया। 12Y x BFC1 का समग्र प्रदर्शन N x SK6.SK7 की तुलना में कोसा उपज तथा कवच सामग्री के मामले में क्रमशः 12.49% और 10.22% का सुधार दर्ज किया गया।
- 16 मौसम में की गई ओएसटी के प्रदर्शन के आधार पर दो थर्मो-टॉलरेंट डबल हाइब्रिड (WB 1.3 × WB 7.5 एवं KA19.WB5 × WB 1.3) से ज्ञात हुआ कि WB 1.3 × WB 7.5 में 82% प्यूपेशन के साथ अधि ताप सहिष्णु एवं 13.04 किग्रा / 10000 लार्वा कोसा उपज, बेहतर धागाकरण मापदंडों जैसे धागाकरण की क्षमता (71%),फिलामेंट लंबाई (694 मीटर) और रेशम रिकवरी (68%)उपलब्ध है।
- उन्नत चिहिनत व प्लेन निस्तरी रेशमकीट में सुधार से उन्नत बहुप्रजता के साथ बीएमएनपीवी के प्रति उच्च सहिष्णुता, उच्च तापमान एवं आर्द्रता के प्रति सहनशीलता, बेहतर कोसा विशेषताओं तथा फिलामेंट लंबाई देखी है।
- पैरेकसिया और SSR मार्कर द्वारा पाँच नस्लों (SK7HH, B.Con4HH, N5HH, HTH10HH एवं WB1HH) में उच्च तापमान एवं आर्द्रता के प्रति सहनशीलता की पहचान की गई । क्वानटीटेटीव

विश्लेषण द्वारा उच्च तापमान एवं उच्च आर्द्रता स्थितियों के तहत मस्तिष्क के ऊतकों में पाइरेक्सिया के अप-विनियमन तथा जीन-पर्यावरण संवाद को दर्शाया गया।

- सर्वोपरि प्रदर्शन के आधार पर अजैविक तनाव के प्रति सहिष्णुता के लिए बाइवोल्टाइन रेशमकीट आनुवंशिक संसाधनों के मूल्यांकन के तहत, बीबीआई-0338 (डीडी-1; डंबेल) एवं बीबीआई-0301 (वाईएस-7;ओवल) बाइवोल्टाइन नस्लों को नियंत्रण पर बेहतर जीनोटाइप के रूप में चिहिनत किया गया।
- एंटी-माइक्रोबियल पेप्टाइड्स (एएमपी) प्रोटीन द्वारा बैक्टीरिया के फ्लेचरी के विकास को अवरुद्ध कर दिया जिससे सूक्ष्मजीव बेसिलस थुरिंगिनेसिस एवं स्टैफिलोकोकस एसपी @ 150-300µg इन विट्रो में 24-48 घंटे के उपचार के बाद एएमपी की पहचान की गई।
- संश्लेषित विशिष्ट पेप्टाइड द्वारा रोग दमन क्षमता एवं रेशमकीट गुणवत्ता मानकों का सत्यापन।
- पर्यावरण अनुकूल एवं किसान-हितैषी गृह कीटाणुनाशक 'निर्मूल' एवं बेड-कीटाणुनाशक 'सेरी-विन' गैर-क्लोरीनयुक्त, गैर-औपचारिक व गैर-विषैले रसायनों से तैयार किया जाता है। इन कीटाणुनाशकों के प्रयोग से रेशमकीट को संक्रमित करने वाले विभिन्न सूक्ष्मजीव, कवक तथा माइक्रोस्पोरिडियन परजीवी नष्ट हो जाते हैं। बेड डिसइंफेक्टेंट SERIWIN को ट्रेडमार्क के लिए पंजीकृत किया गया है।
- केरेउअवप्रसं-वहरमपुर में विकसित कुल 20 द्विप्रज नस्लों एवं 6 वहुप्रज नस्लों की बीएमबीडीवी प्रतिरोध मार्कर के लिए जांच की गई। 20 द्विप्रज नस्लों में से 10 द्विप्रज नस्लों (SK6, SK7, SK6xSK7, B.Con 1, B.Con 4, NFC8, NFCR, BHP8, BHP9 और BHP FC2) को BmBDV प्रतिरोध मार्कर के लिए सकारात्मक पाया गया। 6 वहुप्रज नस्लों में से केवल 12Y BmBDV प्रतिरोधी मार्कर के लिए सकारात्मक पाया गया।

#### दक्षता निर्माण व प्रशिक्षण

- पीजीडीएस (वर्ष 2020-21 के दौरान: 28 छात्रों ने पाठ्यक्रम पूरा किया एवं वर्ष 2021-22 के दौरान: 16 छात्र ऑफ़लाइन मोड के द्वारा पाठ्यक्रम जारी रखे हैं।
- दो गहन रेशम उत्पादन प्रशिक्षण आयोजित कर 21 प्रशिक्षणार्थियों को प्रशिक्षण दिया गया।
- 6 एफएसटी कार्यक्रम आयोजित कर 150 किसानों को प्रशिक्षित किया गया।
- चार प्रौद्योगिकी उन्म्खीकरण कार्यक्रम आयोजित कर 211 किसानों को प्रशिक्षित किया गया।
- गैर-सीबीटी निधि से तेरह (13) प्रशिक्षण कार्यक्रम आयोजित कर 434 किसानों को प्रशिक्षित किया गया।
- 2 व्यावहारिक प्रशिक्षण आयोजित कर 40 किसानों को किसानों को प्रशिक्षित किया गया।
- 6 रेशम उत्पादन संसाधन केन्द्रों (एसआरसी) में 60 कार्यक्रम आयोजित कर 1200 किसानों को प्रशिक्षित किया गया।
- दिनांक 11.03.2022 से 20.03.2022 के दौरान आलो, पश्चिम सियांग जिला, अरुणाचल प्रदेश में दस दिवसीय व्यावहारिक प्रशिक्षण कार्यक्रम आयोजित किया गया।

#	कार्यक्रम	कार्यक्रमों की संख्या	प्रशिक्षित किए गए हितधारकों की सं.
		कुल	कुल
1	रेशम कृषि मेला-सह- प्रदर्शनी	1	200
2	कृषक प्रक्षेत्र दिवस	20	1215
3	जागरुकता कार्यक्रम	65	3507
4	प्रौद्योगिकी प्रदर्शन	44	1016
	कुल=	130	5938

#### विस्तार संचार कार्यक्रम

25 मार्च, 2022 को कोरोना से जुड़े सभी नियमों का अनुपालन करते हुए काकोटीबाड़ी गांव, माजुली में क्षेरेउअके जोरहाट द्वारा एकमात्र रेशम कृषि मेला का आयोजन किया गया। समारोह में शहतूत, एरी एवं मुगा के कुल 200 रेशम उत्पादन किसानों ने सक्रिय रूप से भाग लिया।

#### प्रौद्योगिकी हस्तांतरण

- शहतूत की नई किस्मों को लोकप्रिय बनाना (C-2038, Tr-23/BC259 & C-2028): 5.74 एकड़ में
  C-2038 एवं C-2028 के शहतूत उद्यान की स्थापना ।
- अधि उपज देने वाली एवं बैक्टीरियल लीफ स्पॉट प्रतिरोधी किस्मों सी -2070 का मूल्यांकन: सी -2070 में दोनों अवस्थाओं में सी -2038 (आईआर: 5.84 और आरएफ: 2.37 टन / हेक्टेयर) की तुलना में अधिक उपज (आईआर: 6.21 और आरएफ: 2.07 टन / हेक्टेयर) दर्ज की गई।
- अधि उपज एवं कम तापमान तनाव सहिष्णु सी-2060 तथा सी-2065 का मूल्यांकन; 2 परीक्षण जीनोटाइप एवं जांच के सैपलिंग का गुणन व रख-रखाव। संस्थापना चरण के अधीन वृक्षारोपण।
- शहतूत के लिए कम लागत वाली ड्रिप फर्टिगेशन: पूर्वी एवं उत्तर-पूर्वी राज्यों के सिंचित तथा वर्षाश्रित क्षेत्रों में ड्रिप टेप एवं ड्रम-किट फर्टिगेशन सिस्टम आधारित शहतूत की कृषि द्वारा पारंपरिक प्रणाली / नियंत्रण की अपेक्षा क्रमशः 36% एवं 34% अधिक पर्ण उपज दर्ज की गई।
- जैव नियंत्रण एजेंटों का प्रदर्शन; फाल्गुनी फसल में जैव नियंत्रण एजेंट (फरवरी -22) निर्मुक्त किया गया ।
- समान कताई के लिए संपूर्णा को लोकप्रिय बनाना; निर्मोचन अवधि को 48 घंटे से 24 घंटे कर समान परिपक्वता दर्ज की गई
- चौकी पालन को लोकप्रिय बनाना; 11300 रोमुच का कुर्चन; औसत कोसा उपज 44.48 किग्रा (चॉकी); 41.87 किग्रा. (प्रत्यक्ष); लाभ-6.32%। नाबार्ड सहायता प्राप्त परियोजना के अंतर्गत प्रदर्शन के लिए म्शिंदाबाद जिले (डब्ल्यूबी) में 2 वाणिज्यिक चॉकी पालन केंद्र स्थापित किए गए।

कॉलैप्सिबल प्लास्टिक माउंटेज एवं प्ररोह अशन फीडिंग (शेल्फ पालन) को लोकप्रिय बनाना; 17050 रोमुच कीटपालित किए गए; औसत कोसा उपज 44.75 किग्रा (लाभार्थी); 40.86 किग्रा (गैर-लाभार्थी); लाभ-9.36%।

#### सहयोग

- नाबार्ड द्वारा वित्त पोषित परियोजना (MOE 02011EF)।
- SBRL-बैंगलोर परियोजना (PRP 08002 MI और AIT08005MI)।
- उत्तर बंगाल विश्वविद्यालय, सिलीग्ड़ी, पश्चिम बंगाल (AIC02004CN)।
- DST-JSPS जापान (AIT02012CI)के साथ।
- सीएसटीआरआई-बेंगल्र (एआईबी 02009एमआई) के साथ।
- टीटीआरआई, जोरहाट एवं एएयू, जोरहाट (बीपीपी 05014 सीएन) के साथ।
- CSGRC होस्र कर्नाटक (AIE06002MI) के साथ।
- सीएसआरटीआई-मैसूर (AIB01009MI) के साथ।
- जैव प्रौद्योगिकी विभाग, नई दिल्ली (MOT02016EF) के साथ।
- केवीके, कलिम्पोंग, प.बं. (MTL02017CN) के साथ।

#### पूर्वी और उत्तर-पूर्वी भारत में क्लस्टर संवर्धन कार्यक्रम (सीपीपी)

आठ मेगा क्लस्टर (पश्चिम बंगाल में मालदा एवं मुर्शिदाबाद; मणिपुर-मैदान तथा मणिपुर-पहाड़ी; असम-निचला व असम-ऊपरी; मिजोरम में आइजोल; पश्चिम त्रिपुरा) द्वारा 956.63 टन कोसा तथा 110.34 टन (53.30%) कच्चे रेशम उत्पादन (बीवी: 55.72 टन और आईसीबी: 54.64 टन) का उत्पादन दर्ज किया है।

#### स्वच्छता पखवाड़ा

स्वच्छता पखवाड़ा कार्यक्रम के तहत 01.03.2022 से 15.03.2022 के दौरान कई गतिविधियों जैसे पखवाड़े के दौरान स्वच्छता अभियान, पोस्टर प्रतियोगिता, पुरानी फाइलों को हटाना, पर्यावरण जागरूकता अभियान, "व्यक्तिगत स्वच्छता", 'रोड शो', "अपशिष्ट से स्वास्थ्य" पर एक संगोष्ठी का आयोजन किया गया। इस संस्थान के सभी कर्मचारियों द्वारा कार्यालय परिसर में स्वच्छता का पालन करने का संकल्प लिया गया।

#### प्रकाशन:

शोध पत्र -23 (अंतर्राष्ट्रीय -16 एवं राष्ट्रीय -7);

लोकप्रिय लेख -6;

सफलता की कहानियां- 2;

सम्मेलनों/सेमिनारों/संगोष्ठियों आदि में प्रस्तुत पत्र- 10;

प्स्तिका -6;

वैज्ञानिकों द्वारा ऑनलाइन अन्संधान/प्रशिक्षण कार्यक्रम में भाग लिया- 9;

पैम्फलेट/बुकलेट - 8

#### **R & D ACHIEVEMENTS AND MAJOR EVENTS**

Central Sericultural Research & Training Institute, Berhampore along with three Regional Sericultural Research Stations (RSRSs) and nine Research Extension Centres (RECs) are rendering significant services for the development of sericulture industry in E & NE states. R & D activities undertaken in mulberry & silkworm breeding, crop production & protection, transfer of technology, extension and CBT activities have resulted in developing improved technologies suitable for the farmers in the 13 states *viz.* West Bengal, Odisha, Chhattisgarh, Jharkhand, Bihar, Assam, Nagaland, Sikkim, Manipur, Tripura, Meghalaya, Arunachal Pradesh and Mizoram. The salient achievements of the institute and its nested units for the year 2021-22 are as follows:

#### **MULBERRY CROP IMPROVEMENT PRODUCTION & PROTECTION**

- Developed 785 Polycross Hybrids (PCH) from established Polyclonal Seed Orchard for improvement of leaf yield and quality in mulberry.
- Identified new mulberry sericulture crop schedules for higher leaf (10-25%) and cocoon productivity (12-14%) over existing farmers schedule under irrigated west Bengal.
- C-2038, a new mulberry variety was popularized among 290 farmers (38 acres) in 8 states of E & NE India. It recorded yield improvement of 34% in irrigated and 19% in rainfed over existing variety S-1635. Similarly cocoon improvement of 11% and 12% was observed under irrigated and rainfed condition respectively over existing variety S-1635.
- C-9 recorded 10% higher leaf yield (11.36 t/ha/y) over C-2038 (10.28 t/ha/y) and S-1 (7.71 t/ha/y) under red and laterite soil. Highest leaf yield potential of 26.35 t/ha/y was recorded in C-9 under rainfed NE region which is 12% higher leaf yield over C-2038 (23.65 t/ha/y).
- Three (03) new genotypes C-131, B-30 & E-13 recorded more than 10% higher leaf yield over C-2038 along with better leaf quality & lower pest severity under irrigated condition.
- C-2038 cultivation under 2'×2' spacing with 130% RDF recorded 20% higher leaf yield (57.88 t/ ha) and nutritive quality compared to recommended dose/control (47.99 t/ha).
- Four (04) hormonal formulations of BAP (20 ppm), SNP (30 ppm), BAP+IAA (10 ppm + 2 ppm) & BAP+AA (10 ppm + 25 ppm) on pot plantation of S-1635 & C-2038 for three crop seasons (Sept., 2021, Nov., 2021 & Feb., 2022) revealed that all four treatments able to reduce senescence rate (49%) and improve leaf yield (34%) & quality over control. This study indicates potential role of SNP, BAP, BAP+IAA and BAP+AA in improving mulberry leaf longevity which could be further evaluated under field conditions.
- Powdery mildew resistant genotype CBP-1 recorded highest pooled seasonal leaf yield (Irrigated: 6.57 t/ha; Rainfed: 5.81 t/ha) which is at par with the national check C-2038 (Irrigated: 6.61 t/ha; Rainfed: 5.16 t/ha) in irrigated and 12% higher in rainfed conditions under AICEM IV.
- Barrier of bio-pesticide Spinosad 45SC with Neem cake application recorded less mulberry pest infestation (11.4% in 15 days) as compared to control (43.8%). It is a non-hazardous & nontargeted pesticide which can be used in sericulture with a 30 days safety period.
- An ecofriendly fungicide *Rotfix*, for management of mulberry root rot disease, revealed 91.5% (range 60-100) survival and recovery of infected plants under field condition over stand-alone recommended fungicide (Carbendazim 50% WP @ 0.20%).

Popularization of Biological Control Agent *Chrysoperla zastrowi sillemi* a generalist predator for management of mulberry pest was found to be effective in reduction of thrips population by 71.31 % under field conditions.

#### SILKWORM CROP IMPROVEMENT, PRODUCTION & PROTECTION

- A total of 2.29 lakh dfls of 12Y x BFC1 were tested with the farmers of West Bengal and other NE states during 2020-22. The overall performance of 12Y x BFC1 shows an improvement of 12.49% and 10.22% in terms of cocoon yield and shell content, respectively over N x SK6.SK7.
- Among two thermo-tolerant double hybrids (WB 1.3 × WB 7.5 and KA19.WB5 × WB 1.3), based on performance at OST of 16 seasons showed that WB 1.3 × WB 7.5 had higher thermo tolerance with 82% pupation and cocoon yield of 13.04 kg per 10000 larvae. The hybrid is also superior in reeling parameters studied like reelability (71%), filament length (694 m) and silk recovery (68%).
- Improvement of Marked and Plain lines of Nistari with enhanced fecundity, higher tolerance to BmNPV, tolerance to high temperature & humidity, improved cocoon characteristics and filament length.
- Five bivoltine breeds viz., SK7HH, B.Con4HH, N5HH, HTH10HH and WB1HH are identified for tolerance to high temperature and high humidity through *Pyrexia* and SSR based marker assisted selection. Quantitative gene expression analysis revealed up-regulation of *pyrexia* in brain tissue after rearing under simulated high temperature and high humidity conditions showed geneenvironment interaction.
- Under evaluation of bivoltine silkworm genetic resources for tolerance to abiotic stress, based on overall performances, BBI-0338 (DD-1; Dumbbell) and BBI-0301 (YS-7; Oval) bivoltine breeds were identified as better genotypes over control in terms of cocoon traits.
- Identified anti-microbial peptides (AMP) from the mulberry leaves protein suppressed the growth of bacterial flacherie causing microorganisms *Bacillus thuringiensis* and *Staphylococcus* sp. @ of 150-300µg after 24-48h of treatment *in vitro*.
- Validation of disease suppression ability and silkworm quality parameters by the synthesized specific peptide.
- An eco-friendly & farmer-friendly room disinfectant 'Nirmool' and a bed disinfectant 'Seri-Win' are formulated from non-chlorinated, non-formalin and non-toxic chemicals. Application of these disinfectants disintegrate different microbial, fungal and microsporidian parasites that infects silkworms. The room disinfectant Nirmool has been registered for trade mark.
- A total 20 Bivoltine breeds and 6 multivoltine breeds developed at CSRTI-Berhampore were screened for BmBDV resistance marker. Out of 20 bivoltine breeds, 10 bivoltine breeds (SK6, SK7, SK6xSK7, B.Con 1, B.Con 4, NFC8, NFCR, BHP8, BHP9 and BHP FC2) were found positive for the BmBDV resistance marker. Out of 6 multivoltine breeds only 12Y was found positive for BmBDV resistant marker.

#### **CAPACITY BUILDING & TRAINING PROGRAMMES**

- PGDS (2020-21: 28 students and 2021-22: 16 students).
- ✤ Conducted Two Intensive Sericulture Training and sensitized 21 trainees.
- ✤ Conducted 6 Farmers' Skill Training programmes and sensitized 150 farmers.
- ✤ Conducted four Technology Orientation Programme and sensitized 211 farmers.
- ✤ Conducted 13 Training with non-CBT fund and 434 farmers were sensitized.
- ✤ Conducted 2 Hands-on-training and 40 farmers were sensitized.
- ✤ Conducted 60 programmes at 6 Sericulture Resource Centres; Trained 1200 farmers.
- Ten days Hands-on-Training Programme conducted during 11.03.2022 to 20.03.2022 at Aalo, West Siang dist. (Arunachal Pradesh).

#### **EXTENSION COMMUNICATION PROGRAMMES**

#	Programmes	No. of events	Stakeholders sensitized (No.)
1	RKM cum exhibition	1	200
2	Farmers Field day	20	1215
3	AW programme	65	3507
4	Technology demonstration	44	1016
	Total=	130	5938

Maintaining all the COVID-19 protocol sole RKM organized by RSRS Jorhat at Kakotibari village, Majuli on 25<sup>th</sup> March, 2022. A total 200 sericulture farmers of Mulberry, Eri and Muga were actively participated in the function.

#### TRANSFER OF TECHNOLOGY

- Popularization of new mulberry varieties (C-2038, Tr-23/BC259 & C-2028): Established mulberry garden of C-2038 & C-2028 in 5.74 acres
- Evaluation of high yielding & bacterial leaf spot resistant varieties C-2070: C-2070 recorded higher yield (IR: 6.21 & RF: 2.07 t/Ha) compared to C-2038 (IR: 5.84 & RF: 2.37 t/Ha) which was at par in both condition.
- Evaluation of High yielding and Low temperature stress tolerant C-2060 and C-2065; Multiplied and maintained saplings of 2 test genotypes and checks. Plantation under establishment stage
- Low cost drip fertigation for mulberry: Drip tape & Drum-kit fertigation system based mulberry cultivation recorded 36% & 34% higher leaf yield over conventional system/control at irrigated and rainfed areas of E & NE states respectively.
- Demonstration of Bio-control agents; Bio-control agent released in Falguni (Feb-22).
- Popularization of Sampoorna for uniform spinning; Observed uniform maturity with reduced mounting period from 48 hrs to 24 hrs.

- Popularization of chawki rearing; 11300 dfls brushed; Avg Cocoon Yield 44.48 kg (Chawki); 41.87 kgs. (Direct); Gain-6.32%. Established 2 commercial Chawki Rearing Centres in Murshidabad district (WB) for demonstration under NABARD assisted project.
- Popularization of Collapsible Plastic Mountages & shoot feeding (shelf rearing); 17050 dfls reared; Avg. Cocoon Yield 44.75 kg (beneficiary); 40.86 kg (Non-beneficiary); Gain-9.36%.

#### COLLABORATION

- With NABARD funded project (MOE 02011EF).
- ✤ With SBRL-Bangalore project (PRP 08002 MI & AIT08005MI).
- With North Bengal University, Siliguri, West Bengal (AICO2004CN)
- ✤ With DST-JSPS Japan (AIT02012CI).
- ✤ With CSTRI-Bengaluru (AIB 02009MI).
- With TTRI, Jorhat and AAU, Jorhat (BPP 05014 CN).
- With CSGRC Hosur Karnataka (AIE06002MI).
- ✤ With CSRTI-Mysuru (AIB01009MI).
- With Department of Biotechnology, New Delhi (MOT02016EF).
- ✤ With KVK, Kalimpong, WB (MTL02017CN).

#### **CLUSTER PROMOTION PROGRAMME (CPP) IN EASTEN & NORTH-EASTERN INDIA**

Eight Mega clusters (Malda and Murshidabad in West Bengal; Manipur-Plain and Manipur-Hill; Assam-Lower and Assam-Upper; Aizawl in Mizoram; West Tripura) have produced 956.63 tons of cocoons and recorded 110.34 tons (53.30%) of raw silk production (BV: 55.72 tons & ICB: 54.64 tons).

#### SWACHHATA PAKHWADA

Under the Swacchata Pakhwada programme during 01.03.2022 to 15.03.2022, several activities viz. cleanliness drive, poster competition, weeding out of old files, environmental awareness campaign, a talk on "Personal Hygiene", 'Road show', a seminar on "Waste to Health" were undertaken during the fortnight. All the employees of this institute took pledge to observe cleanliness in office premise.

#### **PUBLICATIONS:**

- Research papers-23 (International -16 & National-7);
- Popular Articles -6;
- Success Stories- 2;
- Papers Presented in Conferences/Seminars/Symposia, etc.- 10;
- Book Chapters-6;
- Scientists attended Online Research / Training Programme- 9;
- Pamphlets / Booklets 8.

#### **MULBERRY BREEDING & GENETICS**

#### **Concluded Research Project**

## *PIB 3627: Development of superior mulberry (Morus spp.) genotypes through Polyclonal Seed Orchard.* [June, 2018 to May, 2021]

Yallappa Harijan (PI, from Oct., 2020), D. Chakravarty (PI, up to Sept., 2020), Suresh, K., Deepika K.U (from March, 2019), Yallappa Harijan (from March, 2019 to Sept., 2020).

#### **Objectives:**

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

Improved mulberry varieties play an important role in enhancing silk productivity and profitability of sericulture. Development of mulberry varieties through conventional hybridization breeding method is mainly dependent on generation of hybrid seeds from several crosses. Cross hybridisation is a time consuming and tedious process because it involves emasculation, bagging and pollination, needs more labor and resources. Further, only few parents are utilized and little hybrid population is derived. In mass or OPH selection, pollen source of hybrid is unknown and several OPH varieties thus developed may have some undesired traits. In contrary, the polycross mating allows natural pollination among several selected parents in isolation to create greater amount of genetic variability and consequently generates large number of segregating population with least manpower and resources.

Twenty nine parents (16 female & 13 male parents) were selected from institute gene bank and based on the available pedigree, flowering traits, ploidy level, *per se* performance diversity and combining ability studies. The seed orchard was established at CSRTI-BHP (5'x5'; males centred-within the famale genotypes; clonal plantation) for genereartion of polycross hybrids. After natural open pollinated in winter, mature polycross hybrid (PCH) fruits were harvested (March, 2020 to April, 2021). PCH seeds from 16 female parents were extracted by water soaking method and processed following standard procedures. The seedling nursery was established from the harvested hybrid seeds. The desirable seedlings of 16 hybrid populations were established in experimental plot (PRT). These hybrids populations will be subjected to standard evaluation and selection for isolating superior genotpes for leaf yield and quality. Besides, information on seed viability, germination & fruit traits of 16 PCH of established seed orchard was generated.

Among 16 polycrosses, Berhampore-A recorded highest fruit weight followed by Kajli OP & CSRS-1. The polycross C-2045, C-2036 & Phillipines observed to have higher test weight and while number of seeds in fruit was maximum in Berhampore-A followed by C-2036 & S-30. Highest seed set percentage noticed among the polycrosses C-2045, Sujanpur-5 & C-2036. Higher seed viability was noticed among 16 polycrosses on a day of extraction. The seed viability under desiccator-based preservation was recorded at 30 and 60 days after extraction along with germination.

#	Parents	Accession No	Species/ Parentage	Origin
Female	e parents			
1	Kosen	EC493823	M. latifolia	Japan
2	China White	EC493799	M.alba	China
3	C-2038	-	CF <sub>1</sub> (10) × C-763	India (WB)
4	C-2045	-	MHP $\times$ CF <sub>1</sub> (13)	India (WB)
5	C-2036	-	MHP $\times$ CF <sub>1</sub> (23)	India (WB)
6	C-2060	-	$KOP \times V1$	India (WB)
7	S-30	IC 313692	M.indica	India (Mys)
8	Kajli OP	OPH of Kajli	M. indica	India (WB)
9	Phillipines	EC493768	M. latifolia	Phillipines
10	CSRS-1	IC 313815	M. indica	India (WB)
11	Berhampore-A	IC 313818	M.indica	India (WB)
12	Sujanpur-5	IC 313682	M.alba	India (Punjab)
13	M. Black	IC 313720	M.indica	India (WB)
14	Bogura-4	EC493975	M.indica	Bangladesh
15	T-13	IC313875	M. indica	India (WB)
16	Kajli	IC313711	M. indica	India (WB)
Male pa	arents			
17	MS-1	IC313699	M.alba	India (Mys)
18	MS-7	IC313963	M.alba	India (Mys)
19	Mandalaya	EC493953	M.alba	Burma
20	Sultanpur-5	IC313734	M.indica	India (UP)
21	Bisanpur-10	IC313831	M. indica	India (WB)
22	White Badan	IC314009	M. alba	India (J&K)
23	Almora	IC313680	M.indica	India (UP)
24	Molai	EC493760	M.indica	Burma
25	Monali	IC313819	M.alba	Burma
26	Jodhapur	IC313792	M.indica	India(Rajasthan)
27	M.multicaulis	EC493763	M. multicaulis	France
28	C-776	IC 313917	M. nigra x M. multicaulis	India
29	CT-44	-	M.indica HP x CF <sub>1</sub> 12	India

#### Parents utilized to establish Polyclonal Seed Orchard

Seed germination percentage was widely varied (70-99%) among the polycrosses studied and maximum seed germination was noticed in C-2038 (99%) & China white (70%) minimum on the day of extraction. After 60 days, germination varied between 6% (Sujanpur-5) to 71% (Berhampore-A) revealed greater decrease in germination with increase in storage period.

Highest reduction in germination was observed in Sujanpur-5 (92.5%) followed by Bogura-4 (90.40) & China white (87.1%) at 60 days. However, at 30 days after seed extraction reduction percentage was ranged from 12.4% to 41.8% indicating, that mulberry seeds can be stored in desicators for two to three weeks only after harvest.

The seedlings nursery was raised (5670 No's) and characterized for visual observations of leaf and growth parameters after 8 months of establishment. The seedlings with desired characteristics such as unlobed large greenish colour thick leaves with smooth texture, acute posture & glossy appearance without any disease & pest incidence on vigour erect stem were shortlisted for further assessment. Around 785 no's seedlings were identified among 16 polycross seedling population. The maximum numbers of desirable seedlings were obtained in polycross C-2038 followed by C-2036 & C-2045. The identified desirable seedlings of 16 polycross population were transplanted to experimental field at a row spacing of  $90 \times 90$  cm for further assessment.

			<u> </u>		
Polycross	Achenes/	Fruit Wt.	Seeds / fruits	Test Wt.	Seed set
name	fruit (No.)	(g)	(No.)	(g)	(%)
Kosen	47.60	0.83	35.80	1.39	75.21
China White	57.60	1.26	40.30	1.25	69.97
C-2038	40.00	1.43	25.00	1.76	62.50
C-2045	43.50	1.52	40.00	2.20	91.95
C-2036	54.00	1.78	44.25	1.98	81.94
C-2060	48.60	1.67	29.00	1.79	59.67
S-30	57.00	1.39	43.20	1.38	75.79
Kajli OP	56.00	2.18	41.00	1.32	73.21
Phillipines	35.60	0.79	28.00	1.87	78.65
CSRS-1	68.40	1.98	39.80	1.56	58.19
Berhampore-A	62.20	2.27	47.00	1.43	75.56
Sujanpur-5	47.80	0.94	42.40	1.42	88.70
Matigera Black	46.20	0.74	37.50	1.55	81.17
Bogura-4	48.60	0.78	34.00	1.83	69.96
T-13	40.30	0.63	31.25	1.36	77.54
Kajli	46.20	0.88	32.20	1.46	69.70
CD at 5%	4.63	0.29	3.42	0.15	5.02

#### Fruit and seed traits among the polycross hybrids

The seedlings population will be established and assessed for morphological traits and leaf yield.



#### Desirable polycross seedlings selected among PCH population

Polycross	Total PCHs	Selected PCHs	Progeny name
C-2038	2880	160	PCH-1 to PCH-160
C-2036	836	119	PCH-161 to PCH-279
C-2045	458	93	PCH-280 to PCH-372
Kajli	437	84	PCH-373 to PCH-456
Berhampore-A	165	47	PCH-455 to PCH-503
KOP	137	22	PCH-504 to PCH-525
C-2060	90	35	PCH-526 to PCH-560
T- 13	112	33	PCH-561 to PCH-593
Matigera Black	106	31	PCH-594 to PCH-624
Kosen	133	28	PCH-625 to PCH-652
Philipines	66	25	PCH-653 to PCH-677
S-30	33	15	PCH-678 to PCH-692
CSRS- 1	63	25	PCH-693 to PCH-717
Bogura- 4	74	28	PCH-718 to PCH-745
Sujanpur-5	55	27	PCH-746 to PCH-772
China White	25	13	PCH-773 to PCH-785
Total	5670	785	

**Inference:** Mulberry polyclonal seed orchard was established with twenty nine selected parents & developed 785 desirable polycross hybrids.

Future work plan: Assesment of Polycross hybrids population's morphological traits and leaf yield to identify superior genotyped and maintainnece of established seed for further utilization orchard of variability for improvement of mulberry.

#### **Concluded Pilot Study**

### Development of Mulberry crop schedule for optimal silk productivity in West Bengal. [December, 2020 to November, 2021]

Suresh, K. (PI) and Deepika, K.U.

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

Mulberry can be grown under various climatic conditions ranging from temperate to tropical. The ideal temperature & relative humidity for mulberry (24- 28<sup>o</sup> C, 65-80% RH & 9-13 Hrs day length) and silkworm (24-28<sup>o</sup> C & 70-80% RH) are essential for maximum productivity. Climate change is recognized to have significant impact on sericulture production and have shifted the distribution of temperature variability across the globe. These remarkable shifts have resulted in more frequent abiotic stresses during the mulberry-growing season in subtropical regions. The weather conditions prevailing during the mulberry crop stage determines the leaf quality and yield. The need for adaptation connected to optimizing the timing of critical growth stages to minimize stresses and enhance resource utilization. The adjusting of mulberry pruning and silkworm rearing times proved to be an important management technique for improving mulberry leaf and cocoon yield along with quality.

The productivity of mulberry and silkworm is being affected by many climate change variables including temperature, relative humidity, day length, rainfall, changes in pruning and harvesting dates, silkworm brushing and cocoon harvesting times. Analysis of past 10 year weather data of West Bengal found that the minimum and maximum temperature has increased significantly. Based on weather data new mulberry sericulture crop schedules was prepared to provide favourable situation for adequate mulberry and silkworm growth as it ensure realization of productivity potential of the crop. The new mulberry pruning and silkworm rearing dates along with existing dates during five different seasons are given below. The existing 15 year old plantation of S-1635 and commercial silkworm hybrid SK.6  $\times$  SK.7 was utilized for this study. The existing mulberry garden (0.6 acres in 3'  $\times$  3' spacing with low trunk system) was made into two blocks each with three replications and two blocks were pruned as per two schedules under study. The plantation was maintained with recommended package of practices for cocoon production.

Mulberry	Date	Crop Dur.		Silkworm	Date of Brushing		
Crop	Existing	New	ES	NS	Crop	Existing	New
Dec-Feb	1 Dec	15 Dec [15]	87	90	Falguni	30 Jan	19 Feb [20]
Mar-May	25 Feb	15 Mar [18]	60	68	Baishakhi	30 Mar	25 Apr [25]
May - Jul	25 Apr	20 May [25]	80	70	Shravani	20 Jun	5 Jul [15]
Jul-Sept	15 Jul	30 Jul [15]	65	70	Ashwina	25 Aug	15 Sept[20]
Sept-Nov	19 Sep	10 Oct [20]	70	70	Agrahayani	31 Oct	20 Nov [20]

Mulberry	/ sericulture	cron	schedules	for	West	Bengal
mulberry	y sericulture	CIUP	scheuules	101	AAC21	Deliyai

The data on growth, leaf traits and yield of mulberry was recorded on 65-70 days after pruning in both schedules during five seasons. Similarly, larvae, cocoon and silk reeling parameters were recorded for both rearing schedules during different seasons. The new mulberry crop schedule recorded significantly higher fresh leaf weight, length of longest shoot and total shoots over existing schedule during five seasons. Further, new schedule recorded significantly higher total soluble protein and sugar content along with 10-25% higher leaf yield over existing schedule during five seasons.





Leaf yield and Quality traits in new and exisintg mulberry crop schedules
during five seasons under irrigated condition

Mulberry seasons	Sche	Feb	May	May	Jul	Sep
Leaf & Yield traits	dules	2021	2021	2021	2021	2021
Days to sprout (No.)	NS/ES	30/44	10/12	10/11	15/12	10/13
Fresh leaf weight (g)	NS/ES	2.79*/2.67	4.59*/2.89	4.59*/2.89	3.76/3.68	3.96*/3.44
Leaf area (cm <sup>2</sup> )	NS/ES	145.36*/122.92	242.85*/157.60	242.85*/157.60	197.89/182.45	206.15*/172.33
Leaf moisture (%)	NS/ES	72.58/76.53	76.28*/71.94	74.25*/72.90	78.10*/75.90	78.67/77.77
Moisture retention 6hr (%)	NS/ES	82.61*/79.87	91.51*/82.82	88.55*/82.25	86.50/84.80	76.64*/71.31
Total soluble protein (mg/g)	NS/ES	33.11*/30.83	34.26*/31.43	35.88/35.49	37.91*/34.65	35.44*/34.39
Total soluble sugars (mg/g)	NS/ES	33.10/32.40	35.64*/31.37	36.06*/34.16	30.97/31.73	33.43/33.13
Total Chlorophyll (mg/g)	NS/ES	2.94/2.01	3.64/3.32	3.76/3.30	3.25/3.05	2.96/2.55
Leaves /mt. shoot (No)	NS/ES	22/32	22/24	23/22	24*/22	22/24
Primary shoot/ plant (No)	NS/ES	18.67*/13.44	16.11*/11.27	10.44*/8.20	12.22/11.93	11.07*/7.07
Length of longest shoot (cm)	NS/ES	90*/69	116*/98	130*/122	148*/116	75/81
Total shoot length (cm)	NS/ES	1233*/731	1465*/841	1235*/917	1161*/1095	624*/450
Leaf fall at harvest (%)	NS/ES	10.77/11.26	14.90/15.04	18.08*/22.60	25.06*/35.06	13.11*/17.06
Shoot yield (g/plant)	NS/ES	796*/226	1147*/996	1157*/1097	959*/626	519*/414
Leaf to shoot ratio (%)	NS/ES	65.31*/61.69	61.84/58.65	59.37*/50.47	56.58/59.00	70.39/76.53





Silk Cocoon and reeling parameters in new and existing crop schedules during five seasons uner irrigated condition

Silkworm Rearing seasons,	Sche	Feb-2021	May-2021	Jul-2021	Sept-2021	Nov-2021
Cocoon & Yield traits	dules					
Mature larval weight (g/10 No)	NS/ES	33.03*/30.83	28.79/30.51	27.64/25.13	29.45*/27.21	36.54*/32.51
Single Cocoon weight (g)	NS/ES	1.396/1.374	1.099/1.029	1.240*/1.156	1.215/1.326	1.624*/1.509
Single Shell weight (g)	NS/ES	0.227*/0.209	0.151*/0.139	0.204*/0.184	0.212/0.231	0.257*/0.239
Shell weight ratio (%)	NS/ES	16.30/15.19	13.79/13.38	16.46/15.97	17.44/17.41	15.86/15.23
ERR by Number (No)	NS/ES	9760*/8011	2267/2540	5900/5267	7550/7733	9707/9342
ERR by weight (Kg)	NS/ES	12.98*/11.38	9.36/9.09	10.59*/9.28	8.60/8.59	15.15*/13.52
Filament length (cm)	NS/ES	735/646	651/601	542/605	737/676	765/691
NBFL (cm)	NS/ES	735/617	464/478	484/488	737/599	765/647
Denier	NS/ES	1.98/1.66	1.65/1.68	2.24/2.08	2.19/2.29	2.40/2.34
Renditta	NS/ES	7.96/8.49	10.45/11.43	9.82/9.68	9.26/8.93	8.02/8.45
Reelability (%)	NS/ES	76.19/73.38	70.76/65.88	66.92/75.01	74.76/66.81	75.89/69.48
Silk recovery (%)	NS/ES	83/77	69/65	63.77/64.68	61.94/64.33	62.13/65.75
Neatness (%)	NS/ES	90/90	90/90	90/90	85/80	95/90

The present study at small scale revealed significantly higher leaf productivity and nutritive quality when plantation was pruned with new scheduled date during five seasons due to better weather conditions in mulberry-growing season causing minimal stresses and enhanced resource utilization. Among the five seasons, new schedule during Feb-21 crop noticed very high leaf productivity due to lower effect of low-temperature stress resulted from shifts in date of pruning. During Sept-21 crop, new schedule recorded 10% higher leaf yield compared to existing schedule and lower advantage may be due to peak monsoon period. New schedules plantation recorded foliar diseases like as powdery mildew (15-20%), myrothecium leaf spot (4-10%) along with sucking pests *viz.*, whitefly (4-15 No's/leaf), Thrips (4-30 No's/leaf) and tukra (5-30%) which was significantly lower compared to existing schedule.

In silkworm rearing, new schedule recorded significantly higher mature larval weight, cocoon weight, shell weight, ERR (%) along with 12-14% higher cocoon yield compared to existing farmers schedule in three seasons (Feb-21, Jul-21 and Nov-21 crops). The higher cocoon productivity in new schedules due to lower effect of high temperature and RH stresses resulted from shifts in date of rearing dates. During Apr-21 and Sept-21 new schedule recorded higer cocoon yield, shell weight filament length and reelability which was observed to be at par with the existing schedule data.

**Inference:** Determined new mulberry sericulture crop schedules for irrigated West Bengal which yield higher leaf biomass (15-25%) and cocoon productivity (12-15%) over exisiting farmer's schedules.

**Future work plan**: Evaluation of new mulberry sericulture crop schedules for leaf and cocoon productivity along with quality in large scale at farmer's level.

#### **On-going Projects**

## PIE 02002 SI: Evaluation of performance of mulberry genotype C-9 under red and laterite soils.

#### [July, 2019 to June, 2023]

Suresh K. (PI), G.S. Singh, S.Singh, K.Alam (up to Jun-2021) and D.K. Gogoi (from Sept.-2021)

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

Test genotype (C-9 or C-2058) along with two check varieties (S-1 & C-2038) established at three test centers were evaluted for leaf productivity and quality during three seasons of 2021-22. The performance of test genotype was evaluated under red soil (RSRS-Koraput) and laterite soil (REC-Bhandra) along with alluviual soil (RSRS-Imphal) of Eastern & North-Eastern zone during second year. The field experiment was carried out with recommended agronomic practices and as per local commercial crop schedules.



C-9 recorded 10% higher leaf yield (11.36 t/ha/y) over C-2038 (10.28 t/ha/y) and S-1 (7.71 t/ha/y) under red and laterite. C-9 recorded significantly higher leaf moisture (74.62%), leaves per meter shoot, longer shoots (145 cm), more primary shoots per plant (8.35) and total shoots length (676 cm) over C-2038.

Lear quality and yield under rainled red and laterite sol								SOII				
	Genotype	Days t	o spout	FLW	LMC	LMS	LLS	NPS	TSL	LY	LY	%
	Name	Normal	Winter	(g)	(%)	(No)	(cm)	(No)	(cm)	(kg/plot)	(t/ha/y)	gain
	C-9	12	39*	3.096	74.62 <sup>*</sup>	20*	145 <sup>*</sup>	8.35*	676*	15.84*	$11.36^{*}$	10
	S-1	9*	<b>40</b> *	2.318	71.59	20*	125	6.34	558	11.07	7.71	
	C-2038	13	43	3.916	72.94	18	130	7.10	618	14.36	10.28	
	CD@5%	1	3	0.774	1.26	1	12	0.58	40	0.73	0.44	

#### eaf quality and yield under rainfed red and laterite soil

Highest leaf yield potential of 26.35 t/ha/y was recorded in C-9 under rainfed N-E region (alluviual soil) which is 12% higher leaf yield over C-2038 (23.65 t/ha/y). C-9 recorded significantly higher leaves per meter shoot (25 Nos), longer shoots (191 cm), primary shoots per plant (10) and total shoots length (1191 cm). Whitefly and powdery mildew incidence was noticed at RSRS-Imphal and was found to be below ETL.

	200	n quant	y ana y			iaai 50			in region		
Genotype	Days to	spout	FLW	LMC	LMS	LLS	NPS	TSL	LY	LY	%
Name	Normal	Winter	(g)	(%)	(No)	(cm)	(No)	(cm)	(kg/plot)	(t/ha/y)	gain
C-9	10	19*	6.193	74.64	25*	191*	9.90*	1191*	35.24*	26.35*	12
S-1	8*	20*	2.983	67.77	25*	169	8.13	954	21.76	16.38	
C-2038	12	24	5.717	74.24	23	155	8.67	987	31.95	23.65	
CD@5%	1	2	1.57	1.05	1	21	0.42	138	1.22	2.03	

Leaf quality and yield under alluviual soil in North-Eastern region

### PPA 02005 SI: Optimization of spacing and nutrient dose for newly developed high yielding mulberry variety C-2038 under irrigated condition.

#### [October, 2019 to September, 2023]

Yallappa Harijan (PI, from June, 2021), Mahesh, R (PI, upto May, 2021), Suresh, K. (from June, 2021), Deepika, K. U. (from June, 2021), V. Vijay (upto May, 2021).

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

Mulberry Variety Authorization Committee (MVAC) of CSB has authorized the high yielding mulberry variety C-2038 for irrigated & rainfed areas of India. C-2038 is an improved mulberry variety having 20-25 % higher leaf yield potential (53-55 t/ha/y) over S-1635. The recommended dose of nutrients for cultivation of existing variety (S-1635) under irrigated condition is NPK: 336:180:112 kg/ha/y (2'×2'). The present investigation was undertaken to determine the optimum dose of nutrients and spacing for high leaf productivity and quality in new mulberry variety C-2038. Twenty treatments with four different spacing (S<sub>1</sub>: 2'×2', S<sub>2</sub>: 3'×3', S<sub>3</sub>: PRS & S<sub>4</sub>: 6'×6') and five nutrient doses [N<sub>1</sub>:75% RDF (252:135:84); N<sub>2</sub>: 100% RDF (336:180:112); N<sub>3</sub>:110% RDF (370:198:123); N<sub>4</sub>: 120% RDF (403:216:134) & N<sub>5</sub>:130% RDF (437:234:146 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O Kg/ha/yr) were evaluated for leaf yield and quality traits in Strip plot design during five seasons under irrigated condition.

Pooled mean data over five seasons revealed C-2038 cutlivation under  $2' \times 2'$  spacing with 130% RDF recorded highest leaf yield (57.88 t/ha) compared to recommended dose/control (47.99 t/ha) along with higher total soluble protein (43.84 mg/g fw), sugar (43.80 mg/g fw) and leaf moisture (73.34%). C-2038 recorded 20.61% higher leaf yield under 130% RDF with  $2' \times 2'$  spacing compared to control (100% RDF). The improved leaf yield under 130% RDF is due to higher productive shoots per plant, more total shoots length, more fresh leaf weight, chlorophyll content index, & specific leaf area. Furter, disease and pest severity assessment in different seasons revealed lower incidence of Bacterial Leaf spot (LS) (7.36 PDI) & Myrothicium LS (5.24 PDI), powdery mildew (3.96 PDI) & tukra infestation (14.22%). Further, there was significant reduction in leaf yield under 10% reduced application of RDF across all spacings. The performance of C-2038 for leaf yield under four spacing with five different doses of fertilizer in five different seasons is presented below graphically. The percent yield advantage in increased dose of RDF under four different spacing is presented in the below table.

N1 :75% RD

N2 :100% RD

₩N3 :110% RD

N4 :120% RD

N5 :130% RD

Nov,21

Nov,21

■N1 :75% RD

N2:100% RD

■N3 :110% RD

N4 :120% RD

N5:130% RD

Mar,22

Mar,22



#### Seasonal leaf yield performance of C2038 under different spacing and nutrient doses

#### Effect of different spacing and nutrient doses on leaf quality & growth of C2038 under irrigated condition

Nutrient doses (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O, Kg/ha/yr)	Spacing	FLW (g)	SLA (cm²/g)	LMC (%)	CCI	TSP (mg/g FW)	TSS (mg/g FW)
252:135:84	2'×2'	3.76	187	72.78	15.45	40.13	39.10
[75% RDF]	3'×3'	3.64	187	72.91	15.86	42.79	37.23
	PRS	3.52	182	71.84	15.53	42.88	42.32
	6'×6'	3.76	199	71.83	17.83	44.43	42.96
336:180:112	2'×2'	3.99	189	72.40	15.61	42.34	41.32
[100% RDF]	3′×3′	3.71	183	72.49	16.30	36.60	33.98
	PRS	3.59	185	72.37	16.51	42.35	42.30
	6′×6′	3.69	184	72.06	17.72	43.50	41.15
370:198:123	2'×2'	4.14	182	74.06	17.10	42.38	40.60
[110% RDF]	3′×3′	3.72	201	72.26	17.38	39.50	39.98
	PRS	3.81	188	73.11	17.14	42.44	41.93
	6′×6′	3.88	175	71.58	17.38	39.93	44.82
403:216:134	2'×2'	4.03	188	72.90	17.36	42.17	41.45
[120% RDF]	3′×3′	3.92	187	72.76	16.58	40.06	42.08
	PRS	3.88	188	72.52	17.34	41.07	42.89
	6′×6′	4.18	182	72.19	18.90	46.02	42.98
437:234:146	2'×2'	4.29	194	73.34	19.13	43.84	43.80
[130% RDF]	3′×3′	4.11	188	73.58	17.40	38.38	40.94
	PRS	3.90	179	72.14	17.44	44.07	44.21
	6'×6'	4.15	169	71.49	20.33	44.23	43.63
	CD 5%	0.30	10.0	0.92	1.70	3.15	3.46

Contd...

Nutrient doses (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O, Kg/ha/yr)	Spacing	NPS (No.)	LMS (No.)	TSL (cm)	LFH (%)	LYP (g)	ALY (t/ha/yr)
252:135:84	2'×2'	7.63	20.56	560	9.90	326	45.23
[75% RDF]	3'×3'	9.13	21.69	647	11.57	434	26.81
	PRS	8.61	21.79	608	10.28	379	26.29
	6'×6'	10.64	21.25	753	9.74	543	8.38
336:180:112	2′×2′	8.13	20.88	614	11.11	346	47.99
[100% RDF]	3'×3'	9.36	21.62	683	10.50	432	26.66
	PRS	8.85	21.48	613	9.83	398	27.64
	6'×6'	11.45	21.73	920	9.34	643	9.92
370:198:123	2′×2′	8.32	20.83	645	11.14	372	51.70
[110% RDF]	3'×3'	9.93	21.14	751	10.11	491	30.30
	PRS	9.09	21.47	655	10.17	416	28.89
	6'×6'	11.83	22.07	866	9.78	677	10.44
403:216:134	2′×2′	8.36	20.90	652	11.81	392	54.44
[120% RDF]	3'×3'	9.73	21.43	746	10.05	569	35.12
[]	PRS	9.89	21.03	733	9.63	505	35.07
	6′×6′	12.24	21.67	916	9.17	750	11.57
437:234:146	2′×2′	8.77	20.59	692	12.05	417	57.88
[130% RDF]	3′×3′	9.84	20.93	762	9.65	528	32.62
	PRS	9.80	20.55	741	9.81	485	33.70
	6′×6′	12.47	21.75	958	9.13	821	12.67
	CD 5%	1.91	0.64	155	1.18	187	20.92

*FLW: Fresh leaf weight; SLA: Specific Leaf Area; LMC: Leaf Moisture Content; CCI: Chlorophyll content index; TSP: Total Soluble Protein; TSS: Total soluble sugar; NPS: No. of primary shoots/ plant; LMS: No. of leaves/meter length of shoot; TSL: Total Shoot length/plant; LFH: leaf fall at harvest; LYP: Leaf yield per plant & Annual leaf yield (t/ha/year).* 

•								,	
Nutrient doses (N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O; Kg/ha/yr)	2'×2'	Gain%	3'×3'	% gain	PRS	% gain	6'×6'	Gain%	
N <sub>1</sub> : 252:135:84 (75% RDF)	45.23	-5.75	26.01	-2.44	26.29	-4.88	8.38	-15.52	
N₃: 370:198:123 (110% RDF)	51.70	7.73	30.30	13.65	28.89	4.52	10.44	5.24	
N4: 403:216:134 (120% RDF)	54.44	13.44	35.12	31.73	35.07	26.88	11.57	16.63	
N₅: 437:234:146 (130%RDF)	57.88	20.61	32.62	22.36	33.70	21.92	12.67	27.72	
N <sub>2</sub> : 336:180:112 (Control)	47.99		26.66		27.64		9.92		

Improvement of leaf yield (t/ha/yr) over recommended fertilizer dose for different spacing(C2038)

## *PIB 02007 SI: Improvement of mulberry leaf longevity in Eastern & North Eastern states of India.*

#### [June, 2020 to May, 2024]

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

#### **Objectives:**

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

Early leaf senescence & premature abscission makes the availability of quality leaf difficult during the commercial crop seasons in East and other North Eastern states leading to the reduction in silk production. Improving the leaf longevity of mulberry by delaying its senescence & arresting pre-mature abscission ensure more availability of quality leaves during all rearing seasons. The present study aims at understanding the hormonal regulation of senescence in mulberry and determining the role of hormones in maintaining stay-green traits for improving leaf longevity. Different plant growth regulators, nutrients & bioactive substances were investigated for their role in improving leaf longevity along with yield and quality of mulberry.

*In-vitro* studies by floating leaf disc assay with 11 compounds (NAA: Naphthalene acetic acid, IAA: Indole acetic acid, BAP: Benzyl amino purine, AA: Ascorbic acid, SNP: Sodium nitroprusside, Sodium selenate, CAN: Calcium ammonium nitrate, Urea, KNO3 and ZnSO4) along with control (water) was undertaken for two varieties (S-1635 & C-2038) in three doses. Chlorophyll retention was measured using the difference between the initial and final chlorophyll content index (CCI) of leaf discs incubated at 25±2°C under dark conditions. Five compounds (IAA-5 ppm, BAP-20 ppm, KIN0-10 ppm, AA-50 ppm& SNP-30 ppm) retained higher chlorophyll content (>80%) after 7 days in both the varieties. Four formulations [BAP+IAA@10+2 ppm; BAP+AA @10 + 25 ppm; BAP+IAA+AA @10 + 2 + 15 ppm and BAP+SNP @10 +15 ppm] were prepared from best four compounds and were tested under floating leaf disc assay along with their single compounds and absolute control (H<sub>2</sub>O).

BAP (20 ppm), SNP (30 ppm), BAP+IAA (10 + 2 ppm) & BAP+AA (10 + 25 ppm) were found to be most effective in delaying senescence by retaining more than 85% chlorophyll compared to control (34%) in both the varieties. Decrease in total soluble protein was least in case of BAP (47.6%) treated leaf discs followed by SNP (52.9%) compared to control (77.3%). BAP+AA treated leaf encountered least increase in protease activity in both the varieties (51.1%) compared to control (236.8%). AA, BAP & BAP+AA also recorded less increase in IC50 value of DPPH after 7 days of incubation indicating higher antiradical activity in the leaf discs treated with these plant hormones.

	Chl TSP Protease Activity		TSS % increase							
Treatments			\$1635	C2038 S1635 C-2038		S1635 C2038		S-1635 C-2038		
	51055	02050	51055	02050	51055	C 2050	51055	C2050	5 1055	C 2050
BAP+IAA	85.8	87.20	50.8	56.51	124.3	152.91	97.1	111.15	94.4	87.57
BAP+AA	85.6	85.88	50.2	58.08	48.1	54.15	76.1	91.48	49.8	58.02
BAP+IAA+AA	71.2	63.61	64.9	60.70	211.5	180.91	106.5	101.90	106.4	98.38
BAP+SNP	55.4	38.25	70.7	65.45	195.3	218.31	117.7	128.98	115.1	94.23
BAP	87.5	85.13	44.9	50.40	84.6	62.14	83.3	89.28	50.8	61.94
IAA	80.3	81.66	58.3	61.79	108.0	121.59	103.3	100.51	103.5	83.08
AA	83.3	77.77	62.3	53.05	59.8	57.32	114.6	125.15	40.7	55.00
SNP	88.4	87.43	52.0	53.92	83.0	106.47	84.4	88.68	108.0	89.86
Control	31.3	36.68	80.6	74.02	237.5	236.08	155.5	160.59	141.2	122.68
CD at 5%	8.41	7.96	8.60	8.44	35.49	43.76	44.14	37.39	40.42	32.41
CV (%)	6.55	6.44	8.38	8.23	6.04	9.15	14.49	9.51	15.98	12.47

Biochemical estimates of leaf longetivity associated parameters in S1635 & C2038

(Chl: Chlorophyll content, TSP: Total soluble protein and TSS: Total soluble sugar)

Exogenous application of BAP (20 ppm), SNP (30 ppm), BAP+IAA (10 ppm + 2 ppm) & BAP+AA (10 ppm + 25 ppm) on pot plantation of S-1635 & C-2038 for three crop seasons (Sept-21, Nov-21 & Feb-22) revealed that all four treatments able to reduce senescence rate (49%) and improve leaf yield (34%) & quality over control. This study indicates potential role of SNP, BAP, BAP+IAA and BAP+AA in improving mulberry leaf longevity which could be further evaluated under field conditions.

	Leai L	ongevily & Lea	Theid: Percent	. Change over C			
Troatmont	LF % d	lecrease	LSR % (	decrease	LYP % increase		
	S-1635	C-2038	S-1635	C-2038	S-1635	C-2038	
BAP	43.9	53.0	43.6	52.7	23.5	31.8	
BAP+IAA	51.8	37.8	42.7	52.7	19.8	30.9	
BAP+AA	59.7	50.5	46.9	48.0	39.6	27.5	
SNP	53.8	63.5	52.5	53.7	51.5	37.6	
Control	-	-	-	-	-	-	

eaf Longevity & Leaf Yield: Percent change over control

(LF: Leaf Fall, LSR: Leaf Senescence Rate& LYP: Leaf Yield/Plant)



Effect of different compounds on Leaf Senescence Rate (LSR) & Leaf Yield per Plant (LYP)



Seasonal Leaf Yield of the two varieties (S-1635 and C-2038)

Leaf Quality in varieties treated with formation	ns under pot studies
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Trootmont	TSP (m	SP (mg/ g FW)		TSS (mg/ g FW)		g/ g FW)	LMC	LMC (%)	
fredument -	S-1635	C-2038	S-1635	C-2038	S-1635	C-2038	S-1635	C-2038	
BAP	34.76	35.99	40.88	40.01	2.73	2.57	78.40	79.28	
BAP+IAA	35.27	35.22	40.44	36.92	2.63	2.45	80.35	78.48	
BAP+AA	33.88	34.32	39.84	41.62	2.65	2.57	79.07	80.14	
SNP	35.51	35.38	43.18	38.73	2.68	2.58	80.40	79.68	
Control	26.67	30.13	32.11	33.86	1.69	1.50	77.10	77.54	
CD at 5%	3.5	3.4	3.6	NS	0.18	0.17	NS	NS	
CV (%)	5.7	5.4	5.0	7.4	3.9	4.0	4.2	3.9	

(TSP: Total Soluble Protein, TSS: Total Soluble Sugar TCC: Total Chlorophyll Content& LMC: Leaf Moisture Content)

### PIB 02010 SI: Final yield trial of promising high yielding mulberry genotypes for Eastern and North-Eastern India.

#### [February, 2021 to January, 2025]

Suresh K. (PI), Yallappa H., Deepika, K.U., Khasru Alam (upto June, 2021) and Dip Kr. Gogoi (from Sept., 2021)

#### **Objectives:**

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

Seven test genotypes (Drought tolerant: PD-1, PD-7, PD-8 & PD-27 and Physiological growth: PP-8, PP-10 & PP-24) along with two check varieties (S-1635/C-1730 & C-2038) were multiplied at CSRTI-Berhampore and established in RCB design at two test centers. The plantations are being established in low trunk non-fist system of plantation at RSRS Koraput (Drought) and CSRTI-Berhampore (Irrigated). The plantation is being maintained with recommended agronomic practices to evaluate the leaf productivity and quality during different seasons and years.

## PIE 02013 SI: Final yield Trial of newly identified mulberry genotypes for leaf productivity and quality.

#### [December, 2021 to November, 2024]

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

#### **Objectives:**

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

Selected four triploids (C-105, C-252, C-174 & C-131) and three high NRA (B-30, E-13 & A-3) genotypes along with two check varieties (S1635 & C2038) were multiplied and established in RCB Design with three replications at CSRTI-Berhampore. The plantation was established in low trunk fist form system of plantation. Test genotypes were evaluated for growth and leaf yield related traits under irrigated condition during Feb 2022 crop. Mean leaf yield varied from 14.75 to 22.58 kg/plot (49 plants) compared to check varieties S1635 (14.39 kg/plot) & C2038 (18.59 kg/plot). Three test genotypes C-131, B-30 and E-13 recorded 11-22% higher leaf yield over C-2038. The improved leaf yield among test genotypes was due to higher longer shoots, less leaf fall and more leaves per meter length. The biochemical assay revelaed better nutritive and moisture quality among superior genotypes which was at par with check C2038. The thrips population varied from 1 to 12 thrips/ leaf and lower population was noticed in all the test genotypes. Three genotypes C-131, B-30 & E-13 recorded more than 10% higher leaf yield in comparison to check C2038 with better leaf quality and lower pest infestation.

	Growth traits and leaf yield under irrigated condition: Feb, 2022											
CN	FLW	LMS	NPS	LLS	TSL	LSR	LYP	LY	% gain			
GN	(g)	(No.)	(No.)	(cm)	(cm)	(%)	(kg)	(t/ha)	(C2038)			
C-131	3.32	20.37	10.20	97.93ª	819	52.91	22.58ª	5.81ª	22			
B-30	3.73	20.15	11.13	94.53ª	822	59.51	20.91ª	5.38ª	13			
E-13	3.18	19.27	11.53	98.27ª	874 <sup>a</sup>	54.34	20.59 <sup>a</sup>	5.29ª	11			
A-3	3.70	21.20	12.07	92.33ª	878ª	58.13	20.26	5.21	9			
C-105	3.68	24.77 <sup>ab</sup>	10.13	94.33ª	740	57.28	19.62	5.05	6			
C-174	3.26	16.59	13.40 <sup>ab</sup>	74.93	841	54.49	17.80	4.58	-			
C-252	2.63	20.78	10.73	87.33ª	748	63.18	14.75	3.79	-			
<sup>a</sup> S1635	3.32	20.07	11.13	73.53	719	57.19	14.39	3.70				
<i><sup>b</sup>C2038</i>	4.34	18.48	<i>11.33</i>	<i>95.93</i>	<i>781</i>	63.71	18.59	4.78				
CD 5%	1.20	2.86	1.93	12.64	138	8.23	5.92	1.52				

[FLW: Fresh leaf weight (g); NPS: No. of primary shoots/plant; LLS: Length of longest shoot (cm); TSL: Total Shoot length/ plant (cm); LMS: No. of leaves/meter length of shoot; LSR: Leaf shoot ratio (%); LYP: Leaf yield per plot (Kg) & LY: Leaf yield per crop (t/ha)]

Loof quality and next incidence under EVT

		L	ear quanty	and pest incluence	e under FTT	
GN	LMC (%)	MRC (%)	CCI	TSP(mg/g fw)	TSS(mg/g fw)	Thrips/Leaf (No.)
C-131	74.22	77.20	18.70	30.87	51.93	7.53
B-30	76.58	81.49	20.52	33.41	51.82	1.03 <sup>b</sup>
E-13	77.49	77.52	18.91	38.51	52.39	3.23 <sup>b</sup>
A-3	78.29	79.32	15.85	40.85ª	49.27	3.84 <sup>b</sup>
C-105	74.30	76.64	19.20	39.08	51.38	1.95 <sup>b</sup>
C-174	75.54	81.22	17.09	31.80	44.87	3.78 <sup>b</sup>
C-252	75.82	74.88	16.29	46.89 <sup>ab</sup>	47.31	2.02 <sup>b</sup>
°S1635	76.45	81.85	21.29	32.05	48.69	5.30
<sup>b</sup> C2038	76.86	76.68	16.85	36.57	49.71	9.68
CD 5%	3.26	6.19	4.94	8.39	7.59	5.49

[LMC: Leaf Moisture Content (%); MRC: Moisture Retention capacity (%); CCI: Chlorophyll content index; TSS: Total soluble sugar (mg/g FW) & TSP: Total Soluble Protein (mg/g FW)]

## MOE 02015 MI: Evaluation of improved technologies developed in the field of mulberry sector for Eastern & North-Eastern India.

#### [February, 2022 to January, 2025]

Deepika KU (PI:C-I), Suresh, K. (PI:C-II). Yallappa Harijan (PI:C-III), M. Rabha (PI:C-IV), Khasru Alam & In-charges of RSRSs /RECs/Dos Units.

**Component I:** Evaluation of High yielding & Bacterial leaf spot resistant mulberry variety C-2070.

Component II: Evaluation of High yielding & Low temperature stress tolerant varieties C-2060 & C-2065.

**Component III:** Low cost drip fertigation system in mulberry for Eastern and North Eastern India.

Component IV: Evaluation of new Bed Disinfectants 'Seri-Win'

#### **Objectives:**

- 1. To evaluate promising bacterial leaf spot resistant & high yielding genotype C-2070 in E & NE States.
- 2. To evaluate promising high yielding and low temperature stress tolerant genotypes C-2060 & C-2065 in subtropical condition.
- 3. To validate the low cost drip fertigation system for mulberry cultivation at different locations.
- 4. To validate Seri-Win for efficacy in disease management & cocoon productivity and popularize at farmers level in E and NE region.

Progress: Project is just initiated.

## **On-going Projects (Collaborative)**

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

## [May, 2019 to May, 2022]

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

#### **Objectives:**

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

Powdery mildew disease caused by fungus Phyllactinia corylea is a most common and wide spread in mulberry during winter season causing 20-30% leaf yield loss. Disease control through inherent plant resistance is more desirable as it reduce dependence on costly fungicides that damage environment and also silkworms. Mildew resistance locus o (mlo) based resistance is found (as natural mutants) or generated (by induced mutagenesis, gene silencing, and targeted or nontargeted gene knock-out) in a broad range of plant species and known to confer durable broad-spectrum resistance. Mildew resistance locus o (MLO) genes conferring susceptilibility to Powdery mildew disease were identified in mulberry. Powdery mildew disease was phenotyped in two pseudo  $F_2$  ( $F_1$ ) populations of Kajli OP  $\times$  V-1 and S-1  $\times$ Vietnam-2 at CSRTI-BHP under natural epiphytotic condition during November 2021 crop. Wider percentage diseases index (PDI) was recorded in the two populations as compared to parental genotypes (KOP: 4.48; V1: 10.83; Vietnam2: 0.62; S1: 25.95). Powdery mildew resistant population (S-1 × Vietnam-2) observed to have six resistant progenies with leass than 10 PDI. The ten shortlisted germplasm were screened for powdery mildew disease under glasshouse and field condition. Three accessions Vietnam-2, Multicaulis and Thailand lobed were identified has resistant source. Leaf samples from segregating population along with their parents and resistant germplasm were supplied to SBRL-Bangalore for genomic DNA isolation. The identification of candidate genes (MLO) in mulberry is under progress.

	rowaciy milaciy alsouse sevency (i bi) in i seduo i 2 (i i) population (itov, 2021)									
Population	lation N PDI Range		PDI Class	PDI	n	R/S	Top Progenies			
Kajli OP ×	150	2.96-32.55	1-10	2.96- 9.89	84	R	VK- 40, 66, 87, 101 & 128			
V-1			11-25	10.00 – 24.44	63	MS	VK- 34, 111, 115, 97 & 113			
			26-40	26.51 -32.55	3	S	VK- 158, 173 & 136			
S -1 ×	120	4.21-46.42	1-10	4.21 - 9.89	6	R	SV- 39, 4, 21, 26, 3			
Vietnam-2			11-25	10.14 – 24.99	63	MS	SV- 5, 61, 87, 1, 11			
			26-40	25.00 -46.42	51	S	SV- 107, 116, 120, 113,101			

Powdery Mildew disease severity (PDI) in Pseudo F<sub>2</sub> (F<sub>1</sub>) population (Nov, 2021)

# PIE 13001 MI: All India Co-ordinated Experimental Trial for Mulberry Varieties- Phase IV (AICEM-IV)

# [April, 2019 to March, 2024]

Kishor Kumar C.M.(from Aug., 2021), V. Sivaprasad(upto July, 2021), Suresh, K. (Co-PI), CIs: Suresh, K. Deep Kr Gogoi, Y. Debraj, GS Singh, P. Kumaresan, Biswabasu Bagchi, Ram Mina, Irfan Illahi, FCIs: Pooja Makwana, Safi Afroz, Yallappa Harijan, Deepika,KU., Khasru A. Ranjitha Devi, T. & S. Chakraborty.

**Objective:** To identify and authorize suitable mulberry varieties for commercial use in different agroclimatic mulberry cultivation zones of India.

Three candidate mulberry varieties [CBP-1, CMY-1, CPP-1] approved by MVAC along with two check varieties [NC: C-2038 & ZC: S-1635] are planted in eight locations of Eastern Zone under the coordination of CSRTI-Berhampore. The five test genotypes were established in RCB design (3' x 3' spacing with six replications) under low trunk non-fist form plantation system. The cultural and agronomic practices were carried out during each crop season as per AICEM guidelines. The pruning and leaf harvesting was taken as per local crop schedules of the test centers. Test genotypes were evaluated for leaf yield and quality along with pest-diseases severity in different seasons under irrigated (4 seasons) and rainfed (2-3 seasons) conditions.

In irrigated condition, CBP-1 recorded highest mean seasonal leaf yield (30.47 kg/plot) which is at

par with the check C-2038 (29.12 kg/plot) followed by S-1635 (23.68 kg/plot), CMY-1(20.92 kg/plot) and CPP-1(11.11 kg/plot). Highest pooled mean seasonal leaf productivity was recorded in CBP-1 (7.68 t/ha) which is at par with the check C2038 (7.34 t/ha) followed by S-1635 (5.97 t/ha), CMY-1(5.27 t/ha) and CPP-1(2.80 t/ha). CBP-1 and S-1635 observed to have early sprouting during winter and normal



seasons compared C-2038. While, test genotypes CMY-1 and CPP-1 were very late sprouters during winter due to longer bud dormancy. All the test genotypes recorded good fresh leaf moisture (>75%) and moisture content after 6 hrs (>70%). CBP-1 recorded higher total shoots length and primary shoots per plant. While, CMY-1 and CPP-1 recorded higher leaves per meter shoots, leaf to shoot ratio and lower leaf fall at harvest.

Genotype	Days to	spout	LMC	LM6	LFH	LMS	LLS	NPS	TSL	SYP	LSR	LY	LY
Name	Normal	Winter	(%)	(%)	(%)	(No)	(cm)	(No)	(cm)	(kg/plot)	(%)	(kg/plot)	(t/ha)
CBP-1	9*	49	75.38	71.58	17.25	21	146 <sup>*</sup>	8.72	1065*	56.96*	56.80	30.47	7.68
CMY-1	12	83	74.81	69.32	$12.53^{*}$	25*	106	8.07	708	35.72	61.81	20.92	5.27
CPP-1	14	83	74.74	70.04	$10.74^{*}$	24*	100	5.29	453	20.36	$63.10^{*}$	11.11	2.80
C-2038	10	49	74.89	70.31	19.59	20	140	8.15	952	49.40	59.41	29.12	7.34
S-1635	8*	47*	75.16	69.89	19.93	21	137	8.25	903	43.98	54.23	23.68	5.97
CD@5%	1	1	1.68	1.92	3.68	1	10	0.95	90	5.85	2.87	3.31	0.45
CV (%)	19.49	28.22	2.48	2.98	43.01	15.48	19.04	20.38	34.94	40.44	7.05	19.54	19.45

Leaf yield and quality traits under Irrigated condition (CSRTI-Berhampore: 4 crops)

In seven rainfed test centers (JHT: RSRS-Jorhat; BND: REC-Bhandra; KPT: RSRS-Korapur ; AMF: BSF-Ambarifalkata; BLP: DoS-Bilaspur; BSW: DoTs-Boswa; IMP: RSRS-Imphal), CBP-1 recorded highest mean seasonal leaf yield (23.04 kg/plot) which is 12% higher over the check C-2038 (20.47 kg/plot) followed by CMY-1(20.17 kg/plot), S-1635 (16.98 kg/plot), and CPP-1(14.93 kg/plot). Highest pooled seasonal mean leaf



productivity was recorded in CBP-1 (5.81 t/ha) which is 13% higher over the check C2038 (5.16 t/ha) followed by CMY-1(5.08 t/ha), S-1635 (4.28 t/ha) and CPP-1(3.76 t/ha). CBP-1, S-1635 and C-2038 observed to have early sprouting during winter and normal seasons compared CMY-1 and CPP-1 due to longer bud dormancy. All the test genotypes recorded good fresh leaf moisture (>75%) and moisture content after 6 hrs (>70%). CBP-1 recorded higher total and longest shoot length and CMY-1 recorded higher leaves per meter shoots (23 No's), leaf moisture content, and leaf to shoot ratio (59.18%).

											/
Genotype	e Days to	o spout	LMC	LM6	LMS	LLS	NPS	TSL	LSR	LY	LY
Name	Normal	Winter	(%)	(%)	(No)	(cm)	(No)	(cm)	(%)	(kg/plot)	(t/ha)
CBP-1	12	33	75.78	71.57	20	146*	7.94	923*	54.38	23.04*	$5.81^{*}$
CMY-1	16	41	77.54*	73.49*	23*	115	7.35	722	$59.18^{*}$	20.17	5.08
CPP-1	17	45	76.95	70.92	18	126	5.34	538	57.81	14.93	3.76
C-2038	13	33	76.79	71.79	20	128	7.26	783	56.57	20.47	5.16
S-1635	$11^*$	31	75.29	70.85	20	138	6.90	735	51.98	16.98	4.28
CD@5%	2	3	0.73	1.04	1	8	0.91	48	2.00	1.70	0.43
CV (%)	24.20	23.4	3.31	4.66	11.56	14.30	20.63	29.50	6.34	22.56	22.89

Leaf yield and quality under rainfed conditions: East & North East Zone (2-3 crops)

CBP-1 recorded lowest PDI value for powdery mildew disease during November 21 crop and observed to be highly resistant compared to check C-2038 and S-1635. All test genotypes recorded moderate resistance to leaf spot (MLS & BLS) and rust disease incidence which is at par with the check C-2038 during rainy seasons. Sucking pests such as whitefly and thrips population was found to be at par with the check C2038. Mealybug infestation causing tukra was severely recorded in both the checks and comparatively test genotypes were less infested.

Genotype	PM	MLS	BLS	LR	WF	Thrips	Tukra
Name	(%)	(%)	(%)	(%)	(No/L)	(No/L)	(%)
CBP-1	0.94*	7.69	5.52	21.42	9	6*	14.79
CMY-1	7.63*	6.64	4.20*	15.38	7	7*	15.68
CPP-1	12.32	10.27	6.23	22.08	8	6*	17.37
C-2038	13.13	9.84	6.25	21.68	6	9	24.35
S-1635	19.96	9.14	5.13	25.42	10	7	27.57
CD@5%	3.73	1.61	1.53	2.98	2	1	6.43
CV (%)	25.37	23.17	29.27	19.07	17.04	20.46	12.51

Propagation parameters of three test genotypes and two checks were evaluated from semihardwood stem cuttings obtained after harvesting. The mature stem cuttings (100 No's) of each test genotype were planted in raised nursery bed at a spacing of 15 x 10 cm spacing. The nursery was maintained with recommended agronomic practices for raising three months old healthy saplings. The rooting or survival of cuttings along with growth traits of saplings were recorded at 90days after plantation. In irrigated region, nursery evaluation was carried out during rainy season (May- July 2021) and pre-winter season (Sept.-Dec. 2021). S-1635(92%) recorded highest pooled mean rooting followed by CBP-1(60%), C-2038(60%), CMY-1(34%) and CPP-1(21%). CBP-1 recorded rooting percentage at par with check C2038. The shoot and root fresh weight along with root volume recorded highest in CBP-1 while CPP-1 recorded highest shoot to root weight and root length.

Genotype	Survival	Shoot fresh	Root fresh	Shoot to	Shoot	Root length	Root		
Name	@90DAP	weight (g)	weight (g)	Root eight	length(cm)	(cm)	Volume(cc)		
CBP-1	60	52.96*	9.74	9.38	59.98	27.10	9.90*		
CMY-1	34	32.23	5.27	8.32	39.57	24.07	5.74		
CPP-1	21	35.45	7.84	9.65	57.35	31.93	8.44		
C-2038	60	42.47	8.86	9.57	57.15	28.38	8.18		
S-1635	92	40.97	6.76	7.24	62.87*	24.18	6.47		
CD@5%	6	10.26	2.96	1.36	4.34	5.76	1.07		
CV %	51.24	39.32	46.59	34.17	28.93	22.35	48.74		

#### Mean values of propagation traits: Irrigated (CSRTI-Berhampore)

In three rainfed test centers, mature stem cuttings of test genotype were raised at nursery bed during July-Sept. seasons. The rooting along with growth traits were recorded at 90 days after plantation. Based on three pooled location mean data, CBP-1(80%) recorded highest rooting followed by C2038 (76%), S1635 (75%), CMY-1 (68%) and CPP-1 (64%). CBP-1 recorded highest mean values for shoot and root fresh weight & shoots to root weight ratio which is at par with check C2038. The shoot length and root volume were maximum in S-1635 while C2038 recorded highest root length under rainfed areas.

Mean values of propagation traits: Rainfed (RSRS-Koraput, Jorhat and Bhandra)

Genotype	Survival	Shoot fresh	Root fresh	Shoot to	Shoot	Root length	
Name	@90 DAP	weight(g)	weight(g)	Root weight	length(cm)	(cm)	Root Volume (cc)
CBP-1	80*	31.92	9.90	6.45	52.81	19.11	5.95
CMY-1	68	26.30	9.14	5.10	41.40	17.64	5.84
CPP-1	64	22.26	7.68	5.98	41.98	16.01	4.86
C2038	76	29.17	8.63	5.53	50.16	21.03	7.07
S1635	75	28.37	8.64	4.65	55.08	20.25	7.36
CD@5%	4	4.82	1.40	NS	3.10	2.88	1.77
CV (%)	14.51	26.37	31.53	23.98	20.32	20.54	44.11
CMY-1 CPP-1 <i>C2038</i> S1635 CD@5% CV <b>(%)</b>	68 64 <i>76</i> 75 4 14.51	26.30 22.26 <i>29.17</i> 28.37 4.82 26.37	9.14 7.68 <i>8.63</i> 8.64 1.40 31.53	5.10 5.98 <i>5.53</i> 4.65 NS 23.98	41.40 41.98 <i>50.16</i> 55.08 3.10 20.32	17.64 16.01 <i>21.03</i> 20.25 2.88 20.54	5.84 4.86 <i>7.07</i> 7.36 1.77 44.11

## Continuous/ Other Activities Maintainence of core germplasm accessions and breeding lines of Mulberry

Suresh, K. (PI), Yallappa Harijan and Deepika, K.U.

Germplasm provides the raw material for the breeder to develop varieties suitable for different agro-climatic conditions. Around 354 mulberry genetic resources of twelve species were maintained as high trunk plantaion for utilization in different breeding programme.

Mulberry Genetic Resources maintained at										
Institute										
Species/material Sum Indigenous E										
M. indica Lin.	88	83	5							
M. alba Lin.	71	32	39							
M. latifolia Poir.	31	3	28							
M. bombycis	14	-	14							
M. multicaulis	2	-	2							
Wild species	13	6	7							
Elite clones	101	-	-							
Tetraploids	34	-	-							
Total	354	124	95							

# Maintainance of Breederstock and supply of planting material of mulberry varieties.

Suresh, K. (PI), Deepika, K.U and Yallappa Harijan.

The authorized mulberry varieties for E & NE Zone are maintained as breeder stock e.g., C-2038 (1.00 acre), Tr-23 (0.20 acre), C-2028 (0.50 acre) & C-776 (0.10 acre); maintained with recommended agronomic practices and will serve as planting material for establishment of registered stock at RSRSs of E and N-E India. Around 31 quintals of C-2038 and S-1635 cuttings were supplied to Murshidabad Kissan nursery for rasing saplings. At the institute about 45000 saplings were generated from the said stock for distribution of saplings to farmers under TOT-OFT programme. The programmes were implemented as per specific guidelines and the beneficiaries are selected by the extension units in consultation with DoS.

#### Establishment of co-nodal DUS testing centre at CSRTI Berhampore

Yallappa Harijan (PI, from June, 2021), Vijay V (PI, up to May, 2021) and Suresh, K (from June, 2021).

DUS testing is a way of determining whether a newly bred variety differs from existing varieties within the same species. The Govt. of India opted for *sui generis system* of protection of plant varieties and enacted 'Protection of Plant Varieties and Farmers' Right Act in 2001 to provide protection to breeders' varieties to encourage research, variety development, ensures beeders and farmers rights and growth of seed industry. It is an intellectual property rights designed to safeguard substantial economic investment involved in modern plant breeding. To claim this right the variety has to be distinct, uniform and stable (DUS) and novel. To protect two recently developed mulberry varieties C2038 & Tr-23, Co-Nodal DUS testing centre has been established at CSR&TI Berhampore. The DUS testing plantation consisiting of 8 reference varieties, 27 example varieties and 2 candidate varieties was established as per the guidelines given by Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA), Government of India, New Delhi. The plantation was maintained with recommended cultural practices for recording chracterisitics of candidate and reference varieties.

# BIOTECHNOLOGY

## **Ongoing Project**

**AICO2004CN:** Molecular characterization and assessment of the efficacy of low molecular weight peptides isolated from mulberry leaf against flacherie disease of silkworm [in collaboration with UNB, Siliguri].

## [May, 2019 to May, 2022; extended upto August, 2022]

Pooja Makwana (PI), Soumen Chattopadhyay (till July, 2021), A R Pradeep (fr. August, 2021) & K Rahul (CIs), Suravi Ghosh, JRF and Dr. Palash Mandal (PI), University of North Bengal, Siliguri.

#### **Objectives:**

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

In order to maintain plant defense system, low molecular weight (LMW) antimicrobial peptides (AMPs; 3-10kDa; <50 amino acids) are produced by plants. These AMPs are mainly cationic in nature, rich in cysteine or glycine residues and has broad spectrum of activity against different fungal and bacterial pathogens. Present study aims to identify LMW bioactive peptides from mulberry leaves with antimicrobial activity against bacterial flacherie disease in the mulberry silkworm, *Bombyx mori*. In order to identify and purify the low molecular weight AMPs from mulberry (S1635), leaves are homogenised initially in extraction buffer (pH 7.2; 1:5 w/v). The extract was used for protein precipitation by ammonium sulphate (40%) followed by desalting through Sephadex G-50. To obtain low molecular weight proteins gel filtration chromatography through Sephadex G-25 column was performed. Further purification is achieved by ion exchange chromatography. In addition, antioxidant assays were performed using leaf extract protein, gel-filtration chromatography samples and ultrafiltered protein (3, 5 and 10 kDa) samples. Antioxidant assays like DPPH, Metal Chelating, Nitric oxide, Superoxide and ABTS were performed to determine the free radical scavenging activity of protein samples. Leaf extract sample exhibited IC<sub>50</sub> in range of 11-488 mg/ml, semi-purified protein IC<sub>50</sub> ranged from 22-305 mg/ml protein and ultrafiltrate IC<sub>50</sub> ranged from 3.92-339 mg/ml in different antioxidant assays.

#### Purification and identification of low molecular weight peptides from mulberry leaves:

Semi-purified leaf elutes obtained after gel filtration chromatography were purified further by Ionexchange chromatography using a strong cation exchanger (SP Sepharose) and weak cation exchanger (CM-Sepharose) (Sigma) at a flow rate of 1 ml/min. From both the cation exchangers, a total of 35 fractions were collected and the absorbance of each fraction was read at 280nm. Two separate chromatograms were plotted for both the cation exchangers and peaks in chromatograms were used for assessment of antimicrobial activity against bacterial pathogens causing flacherie disease in silkworm.

The semi-purified gel-filtration sample (G-25 elute) was analysed by LC-MS/MS (C-CAMP, Bangalore). MS analysis revealed presence of peptides associated with defense, antioxidants and lectins. Potential peptides such as non-specific Lipid transfer protein 1, pathogenesis-related protein 1, 18kDa winter accumulating protein, Mannose-binding lectin, Galactose-binding lectin, MLP-like protein, Germin-like protein, MLP-like protein 423, MLP-like protein 328 and Osmotin were identified.

# Assessment of antimicrobial potential of LMW peptide fractions against flacherie causing pathogens:

Bacterial pathogens namely *Staphylococcus aureus*, *Bacillus thuringiensis*, *Bacillus flexus*, *Micrococcus luteus* causing flacherie disease in mulberry silkworms are maintained at Silkworm Pathology section. In addition, four bacteria *Staphylococcus sciuri*, *Micrococcus terreus*, *Enterobactor hormaechi* and *Serratia nematodiphila* were isolated from flacherie- infected silkworms and identified by 16s rRNA gene sequencing. These bacteria cause flacherie in *B. mori* larva on bioassay. The antimicrobial activity of the crude fraction and LMW peptide fractions are determined by well diffusion assay against the different bacterial species. A clear zone of inhibition was developed indicating antibacterial activity of the semi-purified and purified mulberry protein fractions.

In the well diffusion assay, after treatment of bacterial colony with leaf extract, a significant zone of inhibition was observed in *Micrococcus terreus, Micrococcus luteus, Bacillus flexus, Bacillus thuringiensis, Staphylococcus aureus* (zone area of 12-40 mm), *Serratia nematodiphila* (decoloration: 21 mm). The efficacies of crude extract in inhibiting the growth of pathogens *in vitro* found to be effective at 200-350 µg/ml. However, zone of inhibition was not observed with *Staphylococcus sciuri* and *Enterobactor hormaechi in vitro* after 24-48 h.



In SP Sepharose ion-exchange chromate-graphy out of which eight peaks exhibited zone of inhibition in Micrococcus luteus and Micrococcus terreus (14-20 mm). From another sample purified by ion-exchange chromatography with CM Sepharose, six peaks exhibited zone of inhibition in *Micrococcus luteus* and *Micrococcus terreus* (9-12 mm). [Antibacterial activity of (A) SP

Sepharose & CM Sepharose Ion-exchange chromatography fractions determined by well-diffusion assay in *Micrococcus sp.*]

# Validation of disease suppression ability and silkworm quality parameters by the synthesized specific peptide:

Mass spectrometry data of <25kDa polypeptide bands revealed presence of proteins/peptides belonging to metabolic processes, lectins, defense response, antioxidants and antimicrobial peptides. Mass spectrometry data was screened for plausible antimicrobial peptides through BLASTp and identified Non-specific lipid transfer protein-1, Pathogenesis-related protein 1, Galactose-binding lectin, Mannose-binding lectin, Germin-like protein, MLP-like protein 423, MLP-like protein 328, Osmotin and 18kDa winter-accumulating protein. Antimicrobial peptide region within these peptides/proteins was predicted utilising AMP prediction tools. The peptide region with probability >0.9 were selected for further analysis. PlantAMP databases (PlantPepDB & PhytAMP) were searched to obtain the protein sequences with antimicrobial activity in the peptides/protein identified from the Mass spectrometry. Multiple sequence alignment was performed for the predicted AMPs and sequences retrieved from the Plant AMP databases. Peptide Logo analysis was performed to check the residue preference. Peptide synthesis will be performed and tested against the bacterial pathogens for antibacterial activity.



Sequence Logo analysis of non-specific Lipid transfer protein 1 showing residue preference

# AIT 02008 SI: Identification of high humidity tolerant silkworm breeds/ hybrids for Eastern & North Eastern India.

# [June, 2020 to May, 2024]

Raviraj V.S. (PI), Pooja Makwana, A.R. Pradeep, Harish Babu and Zakir Hossain (RSRS Kalimpong).

**Objective**: To Identify markers for tolerance to high temperature and high humidity in silkworm.

Bivoltine silk production is significantly low in E & NE India mainly due to non-availability of bivoltine hybrids and suitable foundation crosses. Extreme climatic conditions (high temperature & high humidity) also contribute to low cocoon yield. To find out stable genetic markers associated with high temperature and high humility tolerance, few SSR markers are identified for high temperature tolerance at CSRTI-Mysore (S0803 & S0816). Preliminary studies indicated association of *pyrexia* gene encoding a transient receptor potential channel with high humidity tolerance in silkworm. To overcome the harsh climatic conditions at E and N E region, studies were planned to integrate conventional breeding by

directional selection for improved productivity with advanced genetic methods using marker assisted selection (MAS) for tolerance to extreme environmental conditions.

#### Markers for high humidity stress:

Two potential single nucleotide polymorphism (SNP) markers associated with high humidity tolerance are identified from *Pyrexia* gene sequences (Pyx3 & Pyx4). Presence of these markers was validated in different populations which have survived under simulated conditions of high humidity and



(a) Marker amplification in the shortlisted bivoltine breeds.(b) Selection of dfls based on absence or presence of markers from a SK7 population.

high temperature. Pyx3 & Pyx4 gene sequences have been registered with NCBI (Accession Nos.: MT221438 & MT221439). Primers of these sequences are being utilized further to screen populations /broods with tolerance to high humidity. PCR based multiplexing assay were developed targeting two SNP markers (Pyx3 & Pyx4) and a STR marker S0803 to make the detection of high temperature and high humidity silkworm breeds in single reaction which can be used for detection of thermo tolerant and high humidity silkworm breeds.

## Shortlisting of high humidity and high temperature tolerance breeds :

On the basis of SNP markers and survival rate/pupation rate, five breeds have been shortlisted viz. SK7HH, B.Con4HH, N5HH, HTH10HH and WB1HH as high temperature and high humidity tolerant breeds. These breeds showed tolerance to simulated high temperature and high humidity (36°C and 85% RH) conditions in environmental chamber and in unfavorable seasons (33°C-35°C and 75-90% RH) of WB region. The shortlisted breeds showed an average pupation rate of 56- 66% shown below: -

				· · · g · · · · · · · · · · · ·		-,	
Brood	Season	Pupation	Cocoon	Shell	Shell	Ν	1AS
Diccu	Season	(%)	Wt.(g)	Wt.(g)	Ratio (%)	HH	HT
	Aug-Sept 2021	51	1.252	0.242	19.31		$\checkmark$
SK7HH	Oct-Nov 2021	69	1.590	0.283	17.77		$\checkmark$
	Jan-Feb 2022	77	1.525	0.285	18.69		$\checkmark$
	Aug-Sept 2021	48	0.980	0.170	17.32	$\checkmark$	$\checkmark$
B.Con4HH	Oct-Nov 2021	67	1.379	0.245	17.78	$\checkmark$	$\checkmark$
	Jan-Feb 2022	71	1.527	0.255	16.70	$\checkmark$	$\checkmark$
	Aug-Sept 2021	51	0.926	0.164	17.72	√	√
HTH10HH	Oct-Nov 2021	67	1.331	0.252	18.36	$\checkmark$	$\checkmark$
	Jan-Feb 2022	68	1.490	0.277	18.59	$\checkmark$	✓
	Aug-Sept 2021	45	0.960	0.173	17.96	$\checkmark$	$\checkmark$
N5HH	Oct-Nov 2021	60	1.403	0.263	18.75	$\checkmark$	$\checkmark$
	Jan-Feb 2022	65	1.649	0.324	19.62	$\checkmark$	$\checkmark$
_	Aug-Sept 2021	58	1.248	0.198	15.83	√	√
WB1HH	Oct-Nov 2021	71	1.386	0.253	18.77	$\checkmark$	$\checkmark$
	Jan-Feb 2022	69	1.563	0.310	19.83	$\checkmark$	$\checkmark$

Performance of Biv-Silkworm	Breeds with High	ah Humidity	(85±5%) & Hig	gh Temperature	(35±5°C	) Tolerance
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#### Gene Expression in high humidity tolerant breeds:

Gene expression studies are carried out using different tissue viz. Brain, Midgut and Fatbody collected from Day3-Day5 of V instar larvae of the shortlisted breeds to check the expression pattern of the candidate genes. The qPCR analysis revealed up-regulation of *pyrexia* gene expression in brain and fatbody of the shortlisted breeds. An up-regulation of two-fold increase is observed on day 3 & 4 and the expression decreases as it passes on to day 5. The expression patterns were compared with that of breeds reared under natural conditions.





Fold change in expression (mean ± SD) of <u>Pyrexia</u> gene in B.Con4, a shortlisted humidity tolerant breed. Sigmoid curve from RT-PCR analysis showing expression variation.

#### Interacting partners of Pyrexia gene:

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Bioinformatics analysis tools are used to identify the interacting partners of pyrexia. Protein. Cytoscape, online software was used to develop possible interactive network of pyrexia amino acid sequence translated from the gene sequence with SNPs. The analysis revealed that the interaction of pyrexia was highly towards other Transient receptor potential (TRPs). The software also provided us other interacting partners and its functionality at diverse levels.

On NCBI-BLAST CDD analysis of the translated amino acid sequence of *Pyrexia* gene with SNPs, two conserved regions are identified viz., ion transport protein (PFam 00520) and transient receptor potential channel, vanilloid subfamily, Type 5 and 6 (Acc No.cd 2212) (Fig.3). Further, Bioinformatics analysis also indicated that the identified SNPs are present at conserved region of pyrexia gene.



Conserved regions in the amino acid chain translated from pyrexia gene (with SNP) showing two conserved regions (obtained by NCBI-BLAST)

# *AIT02012CI: Characterization of mulberry silkworm, Bombyx mori L. mutants for tolerance to flacherie syndrome through genome editing tools* [DST-JSPS-CSB funded collaborative with Japan].

## [October, 2021 to September, 2023]

India: Sivaprasad V (**PI**), CSB, Bengaluru; K. Rahul & Pooja Makwana (CIs), CSRTI, Berhampore Japan: Katsuhiko Ito (PI), Tokyo University of Agriculture & Technology, Tokyo and Jun Kobayashi, Yamaguchi University, Yamaguchi, Japan

#### **Objectives:**

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

Flacherie caused by BmDNV1, BmDNV2, BmIFV and bacteria belonging to the genera *Streptococcus*, *Staphylococcus* or a mixed infection is the most complex silkworm disease. Present study aims to develop mutants tolerant to flacherie utilizing CRISPR/Cas genome editing tool.

To identify different bacterial pathogens causing flacherie, silkworms exhibiting flacherie disease symptoms were collected. Seven bacterial strains were isolated from silkworms showing typical symptoms of flacherie and their pathogenicity to silkworms was ascertained by bioassay employing Koch's postulates. The pathogenic strains were identified by 16S rRNA gene sequence analysis and were belonging to the genera *Staphylococcus, Micrococcus, Serratia* and *Bacillus*. In order to screen the bivoltine breeds for DNV infectivity, BHP3, BHP2, BHP 3x2, SK6, SK7, SK6x7, BCon1, BCon4, BCon1x4, BHP8, BHP9, BHP8x9 were inoculated with BmDNV1 and survival (%) was recorded. SK7 showed highest survival (89%) after BmDNV infection whereas BHP3 exhibited lowest survival rate (50%). Survival rate of all the BmDNV infected breeds was significantly (P<0.05) lower (50-89%) than the respective control (non-infected; 75-100%).

#### **Continuous / Other Activities:**

#### Standardization of Sericin extraction procedure from Nistari cocoons.

Pooja Makwana, Soumen Chattopadhyay (upto July, 2021), K. Rahul, A.R. Pradeep, Vidya Niranjan, V Sivaprasad.

Sericin protein is a natural protein found in silk produced by silkworms. Sericin encloses core fibroin to form a single silk filament. Sericin is a globular protein, soluble in water and comprised of polar amino acids with serine most frequent. Sericin has low immunotoxicity, abundant modifiable moieties and biodegradable. Therefore, its application in tissue engineering and biomedicine has increased recently. The present study aims to standardize the extraction of sericin from cocoons of Nistari usingdifferent buffers (citric acid, sodium



[Fig.Best protein model of Sericin 1 predicted by I-TASSER] carbonate, Tris and urea) and *in silico* characterization of sericin protein. Sequence of Sericin 1 (P07856) is retrieved from UniProt database for structure prediction analysis by I-TASSER (Iterative Threading ASSEmbly Refinement) an online hierarchical approach (*https:// zhanggroup.org/ I-TASSER*). The *ab inito* modelling of sericin 1 protein through I-TASSER revealed secondary structure of the protein and ligand binding sites in the protein. The secondary structure of sericin 1 protein comprised coil and helix in few regions. The solvent accessibility prediction revealed buried residues such as glycine, isoleucine, leucine, cystein, phenylalanine and tyrosine. The best model on the C-score, TM-value and RMSD was selected for further analysis. The best template showed identity 0.11 and normalized Z- score 2.33 and the best model had a C-score -4.75 stereochemical quality and stability of the protein is checked via

Procheck. Twenty-one ligand binding sites were predicted.

# SILKWORM BREEDING AND GENETICS

#### **Concluded Project**

# AIB 3602: Development of thermotolerant bivoltine hybrids of silkworm, Bombyx mori through MAS.

#### [November, 2016 to April, 2021]

N. Chandrakanth (PI), V. Lakshmanan, A. K. Verma (upto Dec., 2020), V. S. Raviraj, Gautam Mitra (upto Dec., 2020) and Sahadeb Roy (JRF)

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

Based on the previous reports (Moorthy *et al.*, 2007; Chandrakanth *et al.*, 2015), two thermotolerant bivoltine silkworm breeds *viz*. SK4C and BHR3 along with two productive bivoltine breeds *viz*. GEN-3 and D6M from CSRTI-Berhampore were used as breeding material. Eight different combinations were obtained including reciprocals, whose DNA was tested with markers linked to thermotolerance (S0803 and S0816). The selected parents showed the thermo-tolerant banding pattern. SK4C & BHR3 (Thermo-tolerant) breeds were selected as donor parents while Gen-3 & D6M used as recurrent productive parents. The tolerant and productive bivoltine breeds were crossed for  $F_1$  generation followed by backcrossing and inbreeding. In each generation, progenies were selected based on microsatellite markers (S0803 and S0816) linked to thermo-tolerant condition. Thus, developed breeds were utilized for preparation of double hybrids as the involvement of four parents can have more advantages than the two in single hybrids. The developed double hybrids were evaluated in different seasons of WB at CSRTI-Berhampore. Under OST, hybrids along with the controls were tested in 5 different locations (RSRS: Kalimpong, Koraput, Jorhat and REC: Mothabari & Dimapur).

**Selection of Parents:** Based on the earlier reports, BHR-3 and SK4C were shortlisted as thermotolerant breeds from the germplasm of CSRTI-Berhampore for further confirmatory studies. The confirmatory studies were carried out through phenotypic as well as molecular approach. Phenotypic confirmation of thermotolerance was done by rearing these breeds at high temperature (from V instar 3rd day to till spinning at 36°C). The pupation percentage of 58% and 60% was showed by BHR-3 and SK4C at high temperature. In contrast, GEN-3 and D6M showed lower pupation percentage of 40% and 42% at high temperature but the cocoon traits had a higher value. The molecular screening of DNA of the selected breeds showed homozygous thermo-tolerant banding pattern for BHR-3 and SK4C, and homozygous thermo-susceptible banding pattern for GEN-3 and D6M with S0803 and S0816 markers. This indicates that the BHR-3 and SK4C can be used as donor thermo-tolerant parents with GEN-3 and D6M being recurring productive parents in marker assisted breeding.

	Performance of parents at normal and $36\pm1^{\circ}C$ (May-June 17)												
Prood	Focundity	Hatching	Pupation %		ERR (wt.)(kg)		SCV	SCW(g)		SSW(g)		Shell ratio (%)	
Breed	Fecunality	(%)	25°C	36°C	25°C	36°C	25°C	36°C	25°C	36°C	25°C	36°C	
BHR-3	569	88	89	58	11.5	7.06	1.365	1.225	0.240	0.191	17.58	15.59	
SK4C	534	92	91	60	11.2	6.25	1.443	1.124	0.267	0.178	17.30	15.84	
GEN-3	572	86	85	40	12.3	4.53	1.578	1.106	0.310	0.177	19.64	16.00	
D6M	484	95	87	42	12.7	5.61	1.590	1.210	0.300	0.191	18.86	15.79	



M-50 bp DNA ladder; 1:SK4C; 2: BHR3; 3: GEN3; 4: D6(M) Fig. DNA profile of the selected parents with S0803 and S0816 markers

#### Marker Assisted Selection Breeding:

The MAS breeding program was initiated by crossing thermo-tolerant parents and productive parents in all possible combinations even reciprocal crosses were also included. Eight different combinations of F<sub>1</sub>s were prepared by using these breeds as parents. Out of them, four combinations involving GEN-3 as parent were gone for  $F_2$  generation, where only plain larvae spinning oval shaped cocoons were selected. Afterwards, all the combinations were backcrossed (BC) with their respective productive parents resulting in BC<sub>1</sub>F<sub>1</sub>. The BC<sub>1</sub>F<sub>1</sub> populations were designated as WB1 to WB8 as mentioned below. In each generation, combination wise female mother moths were collected and their DNAs were amplified by markers (S0803 and S0816). Likewise, the breeding program was continued till BC<sub>6</sub>F<sub>3</sub> generation, where the developed breeds are found to be in thermo-tolerant homozygous condition. After completion of breeding plan ( $@BC_6F_3$  generation), WB1 and WB3 (dumbbell) and WB5 and WB7 (oval) breeds were found performing better in terms of pupation rate under high temperature conditions. Based on overall performance, four breeds viz., WB2, WB4, WB6 and WB8 were not utilized for hybrid preparation and were maintained at RSRS-Kalimpong. Selected thermo-tolerant breeds (dumbbell: WB1 & WB3; oval: WB5 & WB7) along with one more thermo-tolerant breed, KA19 identified from RSRS-Kalimpong were maintained at CSRTI-Berhampore for further hybrid preparation and evaluation.

			-
#	BC <sub>1</sub> F <sub>1</sub>	Cocoon Shape	Designated
1	(SK4C x D6M) x D6M	Dumbbell	WB1
2	(BHR3 x D6M) x D6M		WB2
3	(D6M x SK4C) x D6M		WB3
4	(D6M x BHR3) x D6M		WB4
5	(SK4C x GEN-3) x GEN-3	Oval	WB5
6	(GEN-3 x SK4C) x GEN-3		WB6
7	(BHR3 x GEN-3) x GEN-3		WB7
8	(GEN-3 x BHR3) x GEN-3		WB8

#### **Details of the new Backcross combinations**

BCcEa	Fecundity	Hatch	ERR	ERR wt.	SCW	SSW	Shell
DC61 3	(No.)	%	(No)	(kg)	(g)	(g)	%
WB1	495	93.66	8122	13.543	1.494	0.293	19.61
WB2	535	93.05	7776	11.529	1.332	0.236	17.71
WB3	534	94.33	8880	14.321	1.421	0.298	20.97
WB5	550	96.66	7489	12.889	1.399	0.276	19.72
WB6	541	93.66	7800	12.210	1.377	0.249	18.08
WB7	526	96.66	8022	14.101	1.463	0.309	20.42
WB8	591	93.33	3722	5.311	1.344	0.236	17.55
CD @ 5%	9.18	2.69	32	0.063	0.015	0.004	0.410
CV%	6.66	2.52	8.68	7.88	2.95	9.01	7.35

#### Rearing performance of $BC_6F_3$ populations at normal temperature

#### Rearing performance of $\mathsf{BC}_6\mathsf{F}_3$ populations at high temperature

BC <sub>6</sub> F <sub>3</sub>	Pupation (%)	ERR wt. (Kg)	SCW(g)	SSW(g)	Shell %
WB1	65	8.321	1.342	0.236	17.57
WB2	42	6.650	1.364	0.246	18.02
WB3	68	8.550	1.250	0.234	18.72
WB5	65	7.650	1.226	0.233	19.00
WB6	55	7.100	1.235	0.236	19.10
WB7	71	8.100	1.196	0.229	19.88
WB8	55	7.300	1.385	0.259	18.70
Mean	60.14	7.67	1.29	0.24	18.71
t value	15.80**	29.25**	44.78**	61.81**	65.95**

#### Performance of Foundation Crosses (FCs) at Normal (25°C) and High Temperature (36°C)

Foundation Cross (FC)	Season	Fec. (No.)	Rearing Temp.	ERR (No.)	ERR Wt. (kg)	Cocoon Wt.(g)	Shell Wt.(g)	Shell Ratio(%)
		480	25°C	90	13.41	1.533	0.289	20.11
VVDI X VVD3			36°C	72	11.04	1.437	0.286	18.65
		525	25°C	91	13.12	1.514	0.303	20.01
VVD/ X VVDJ		525	36°C	70	10.20	1.417	0.263	18.56
	Oct-Nov	495	25°C	84	11.11	1.415	0.279	19.71
KATA X MD2	2019		36°C	54	8.31	1.301	0.210	16.14
		512	25°C	75	9.558	1.384	0.257	18.56
SKU X SK7			36°C	68	7.764	1.292	0.208	16.09
B Con 1 x B Con4		501	25°C	70	8.331	1.398	0.263	18.81
B.COII 1 X B.COII4		501	36°C	45	5.972	1.211	0.204	15.70
CD @ 104		Temp.		0.635	0.08	0.008	0.004	0.316
	Т	emp. x FC	2	1.099	0.14	NS	0.007	0.547

Foundation crosses were made accordingly (dumbbell: WB1 × WB3; oval: WB7 × WB5; KA19 × WB5) and evaluated for rearing performance at 25°C and 36°C. At 36°C, KA19 x WB5 showed the lowest pupation rate of 54% whereas WB1 x WB3 and WB7 x WB5 showed pupation rate of >70%. These FCs were utilized to produce two thermo-tolerant double hybrids, WB1.3 × WB7.5 and KA19.WB5 × WB1.3. SK6 × SK7 and B.Con1 x B.Con4 were maintained as control combinations for comparison.

`The performance of double hybrids along with the controls was recorded at different seasons of West Bengal

Hybrids	WB-DH1		WB-DH2		SK6 x SK7		Bcon 1 x BCon 4		Improvement of WB-DH1 (%) Over			
	(WB1.3 X	WB7.5)	(KA19.W	(B5 X WB1.3)				_	SK6	х7	BCoi	n1x4
	FS	UFS	FS	UFS	FS	UFS	FS	UFS	FS	UFS	FS	UFS
Fecundity (No)	583	528	511	521	489	518	495	491	19.22	1.93	17.78	7.54
ERR (No.)	8900	6524	7800	6081	7850	5184	6533	4478	13.38	25.85	36.23	45.69
ERR (Wt. Kg)	14.52	9.18	12.31	9.64	10.25	7.06	9.25	6.72	41.67	30.03	56.97	36.61
Cocoon Wt.(g)	1.661	1.505	1.517	1.447	1.303	1.240	1.314	1.283	27.48	21.37	26.41	17.30
Shell Wt. (g)	0.347	0.282	0.301	0.271	0.217	0.207	0.215	0.217	59.91	36.23	61.40	29.95
Shell Ratio (%)	20.89	18.69	19.84	18.71	16.65	16.65	16.36	16.84	25.47	12.25	27.69	10.99
Reelability (%)	81	79	79	72	77	72	75	71	5.19	9.72	8.00	11.27
F. Length (m)	826	781	725	685	783	690	781	682	5.49	13.19	5.76	14.52
Silk Recovery%)	78	72	72	70	76	69	73	69	2.63	4.34	6.84	4.34

#### Comparative Laboratory Performance of WB-DH hybrids (2020-21) Avg. Temp. (32.9°C; 27-38°C) & Relative Humidity (83.3%; 78-95%)

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

Two productive thermo-tolerant double hybrids, WBDH1(WB 1.3 × WB 7.5) and WBDH2 (KA19.WB5 × WB 1.3) were developed by utilizing the selected FCs. Both the hybrids exhibited higher thermo-tolerance with >70% pupation and >45 kg of cocoon yield/100 dfls at high temperature ( $36\pm1^{\circ}$ C). These hybrids were also evaluated further in different seasons in on-station trials (OST) at the main institute as well as five locations (RSRS-Kalimpong, RSRS-Koraput, RSRS-Jorhat, REC-Mothabari and REC-Dimapur). At CSRTI-Berhampore, WB 1.3 × WB 7.5 performed significantly better than SK 6.7

	UST OF CHERINO-COLERANCES INWORM GOUDIE HYDRIGS (2020-21)										
Centre	Hybrids (10/5dfls)	Crops (No.)	ERR (No.)	Yield/ 10000 Larvae (kg)	SCW (g)	SSW (g)	Shell (%)	Reel- ability (%)	FL (m)	Silk Recovery (%)	
CSRTI- BHP	WB13 x WB75		7712	11.85	1.583	0.314	19.79	80	803	75	
	KA19.WB5 x WB1.3	6	6941	10.98	1.482	0.286	19.28	75	705	71	
	SK6 x SK7		6517	8.63	1.272	0.212	16.65	74	736	73	
	BCon1 x BCon4		5506	7.986	1.299	0.216	16.60	73	732	71	
	WB13 x WB75	3	9238	15.85	1.725	0.317	18.41	61	757	61	
RSRS-	KA19.WB5 x WB1.3		8938	16.13	1.765	0.324	18.41	63	700	58	
Koraput	SK6 x SK7	-	8320	13.80	1.685	0.261	15.52	62	728	60	
	BCon1 x BCon4		9150	17.56	1.802	0.291	16.23	63	741	66	
	WB13 x WB75		9036	17.52	1.995	0.413	20.69	56	502	47	
RSRS-	KA19.WB5 x WB1.3	2	8168	16.59	2.019	0.425	21.03	56	489	47	
Kalimpong	SK6 x SK7	2	9222	16.34	1.849	0.313	16.94	59	817	55	
	BCon1 x BCon4		8843	16.37	1.717	0.292	17.00	64	654	56	

#### OST of thermo-tolerant silkworm double hybrids (2020-21)

Contd.....

Centre	Hybrids (10/5dfls)	Crop (No.)	ERR (No.)	Yield/ 10000 Larvae(kg)	SCW (g)	SSW (g)	Shell (%)	Reel- ability (%)	FL (m)	Silk Recovery (%)
	WB13 x WB75		8689	12.62	1.500	0.300	19.78	79	709	79
RSRS-	KA19.WB5 x WB1.3	1	5700	8.62	1.510	0.310	20.38	75	635	78
Jorhat	SK6 x SK7	T	6433	8.52	1.400	0.250	17.80	76	624	80
	BCon1 x BCon4		8933	12.82	1.350	0.250	18.53	76	590	61
RFC-	WB13 x WB75		5964	8.89	1.484	0.289	19.53	81	700	80
Mothabari	KA19.WB5 x WB1.3	3	6684	10.55	1.534	0.290	18.84	77	712	76
MOUIDDDII	SK6 x SK7		6378	9.58	1.367	0.212	15.38	72	734	71
	WB13 x WB75		8558	11.51	1.430	0.301	21.04			
REC-	KA19.WB5 x WB1.3	1	7800	10.62	1.480	0.300	20.27	Reelin	g sampl	le was not
Dimapur	SK6 x SK7	T	7436	9.22	1.400	0.288	20.57	collecte	d due to COVID	o pandemic 019
	BCon1 x BCon4		7888	9.92	1.350	0.260	19.25			
	WB13 x WB75		8200	13.04	1.620	0.322	19.87	71	694	68
Mean	KA19.WB5 x WB1.3	3	7372	12.25	1.632	0.323	19.70	69	648	66
	SK6 x SK7	- 10	7384	11.02	1.496	0.256	17.14	69	728	68
	BCon1 x BCon4		8064	12.93	1.504	0.262	17.52	69	679	64

and BCon1 x BCon4 with improvement in survival (14% @ 89%), shell ratio (10% @ 20.89%), filament length (5% @ 826m), reelability (5% @ 81%), raw silk recovery (7% @ 72%) and average cocoon yield (35% @ 72kg). The results of on-station trials clearly showed the dominant performance of the double hybrid WB 1.3 × WB 7.5 both in terms of thermotolerance and productivity. On-station trials conducted at 5 research stations revealed that WB 1.3 × WB 7.5 had higher thermotolerance and productivity (cocoon yield/ 10000 larvae) at RSRS-Kalimpong (90.36% and 17.52 kg), RSRS-Koraput (92.38% and 15.85 kg), RSRS-Jorhat (86.89% and 12.62 kg) and REC-Dimapur (85.58% and 13.04 kg) while at REC-Mothabari, KA19.WB5 × WB 1.3 was superior (66.84% and 10.55 kg). The overall performance with respect to on-station trials spanning 16 seasons at different regions showed that WB 1.3 × WB 7.5 had higher thermotolerance with 82% pupation and cocoon yield of 13.04 kg per 10000 larvae. Not only in rearing traits but WB 1.3 × WB 7.5 was also superior in reeling parameters studied like reelability (71%), filament length (694 m) and silk recovery (68%). Therefore, thermo-tolerant double hybrid, WB 1.3 × WB 7.5 performance was superior to existing bivoltine hybrids/foundation crosses and is suitable for rearing throughout the year in E & NE India.

## Inference:

- WBDH1 double hybrid performance was more stable and better than the other hybrid and controls.
- At CSRTI-Berhampore, WBDH1 showed an increase of 13% in ERR by number over SK6 x SK7 in favourable seasons (2 crops) and around 25% in unfavourable seasons (4 crops).
- Results of OST trials revealed that WBDH1 had an improvement of 18.12% over SK6 x SK7 and 16.43% over B.Con1 x B.Con4 in terms of cocoon yield/ 100 dfls.



(WB1.3) × (WB7.5)

**Future Plan:** On farm trials of the thermo-tolerant bivoltine silkworm double hybrid, WBDH: (WB1.3) x (WB7.5) with the farmers of E & NE India needs to be taken up for generating the data to propose for authorization trials.

# AIE 06002MI: Evaluation of bivoltine silkworm genetic resources for tolerance to abiotic stress in selected ho t spots.

#### [March, 2019 to March, 2022]

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

#### **Objectives:**

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

CSGRC-Hosur has screened the bivoltine silkworm germplasm resources for presence of markers linked to thermo-tolerance. Among the screened genetic resources, 10 bivoltine silkworm breeds with markers linked to thermo-tolerance and better economic traits were selected. These ten bivoltine silkworm breeds needs to be evaluated against abiotic stress by rearing them at different agroclimatic conditions and to identify a suitable Bv breed to the selected hot spots. Under this objective, CSRTI-Berhampore was selected for evaluation of selected breeds that will help the breeders for wider choice to include in suitable breeding programs.

Acc.	Breed	Cocoon Shape	10 Larval wt. (g)	Yield/ 10000 L (No.)	Yield/ 10000 L (kg)	Pupation rate (%)	SCW (g)	SSW (g)	SR (%)	Mean EI	
BBI-86	KPG-A	Oval	25.16	5920	6.97	59.20	1.227	0.204	16.59	48.82	
BBE-184	SMGS-2	<u>)</u>	22.93	3306	4.06	33.07	1.232	0.206	16.69	40.23	
BBI-301	YS-7		29.21	5633	6.90	56.33	1.365	0.244	17.90	57.22	
BBI-339	DD-2		25.51	3113	3.42	31.13	1.247	0.226	18.15	44.02	
BBI-044	NB4D2	Dumbbell	31.53	6515	6.59	62.08	1.226	0.225	18.63	56.80	
BBI-334	APS-4		27.32	6208	7.23	62.08	1.155	0.211	18.18	51.75	
BBI-336	APS-8		26.82	6320	7.23	63.20	1.194	0.228	19.11	54.47	
BBI-338	DD-1		29.18	7680	9.14	76.80	1.261	0.243	19.29	62.58	
BBI-343	NK-3		27.75	4913	5.90	49.13	1.236	0.212	17.17	48.87	
BBI-0358	CSR26		25.54	3653	8.12	36.53	1.096	0.177	16.23	41.20	
Control	SK6		25.79	6780	8.12	70.67	1.145	0.175	15.27	47.34	
Control	SK7		25.55	6481	7.23	69.62	1.106	0.180	16.28	46.71	
		<b>Overall Mean</b>	26.86	5543	6.74	55.82	1.21	0.21	17.46	-	
		Std. Deviation	2.31	1476	1.63	15.19	0.07	0.02	1.27	-	

**Overall Rearing Performance of Bivoltine Breeds (Two crops)** 

overall Reeling renormance of bivortine breeds (Two crops)										
Acc.	Breed	FL (m)	Denier (d)	Renditta (kg)	Reel- ability (%)	Raw silk recovery(%)	Neatness (%)			
BBI-0086	KPG-A	662	2.13	9.27	69.89	70.38	92			
BME-0184	SMGS-2	740	2.65	8.80	68.15	67.25	90			
BBI-0301	YS-7	661	2.09	7.82	76.17	74.24	92			
BBI-0339	DD2	569	2.14	7.64	69.36	67.29	92			
BBI-0044	NB4D2	614	1.72	9.29	66.37	63.55	90			
BBI-0334	APS-4	797	2.15	8.34	69.28	69.40	92			
BBI-0336	APS-8	582	2.08	9.38	66.36	61.73	87			
BBI-0338	DD1	671	2.06	8.84	67.56	62.05	90			
BBI-0343	NK3	738	2.02	9.00	70.65	69.08	92			
BBI-0358	CSR26	639	1.96	9.24	66.99	57.11	90			
BBI-0371	SK6	596	2.41	10.18	68.92	61.18	90			
BBI-0372	SK7	602	2.43	10.28	69.96	60.48	90			
	Average	656.1	2.15	9.01	69.14	65.31	90.83			
	SD	70.98	0.24	0.81	2.64	5.03	1.63			
	CV %	10.82	11.30	8.94	3.82	7.70	1.79			

Overall Beeling	Dorformance of Rivelting Prood	c (Two crops	١
	Periorinance of Divolume Dieeu	5 ( I WU CI UPS	,

Two trials were conducted at CSRTI-Berhampore (Nov.-Dec.-2020 and Feb.-Mar.-2022) with 10 bivoltine breeds. Selected silkworm breeds were reared at prevailing temperatures and humidity along with control. The data on rearing and reeling parameters were collected. The overall rearing performance of the selected bivoltine breeds along with the controls (SK6 and SK7) showed that BBI-338 (DD-1) accession had performed better than the controls and other breeds in terms of survival (76.80%) and cocoon traits (19.29%). Among the oval breeds, BBI-301 (YS-7) exhibited highest survival (56.33%) and highest cocoon weight (1.365 g) and shell weight (0.244 g). Among the dumbbell breeds, BBI-338 exhibited highest survival (76.80%), highest cocoon weight (1.261 g) and shell weight (0.243 g). Multiple trait evaluation index ranked BBI-338 (62.58) followed by BBI-301 (57.22) in the top spots. Among the oval breeds, BBI-301 had better silk filament and among dumbbell breeds, BBI-338 had better silk filament than that of other breeds as well as controls.

#### Inference:

Based on overall performances of bivoltine breeds, BBI-0338 (DD-1; Dumbbell) and BBI-0301 (YS-7; Oval) bivoltine breeds were identified as better genotypes over control in terms of cocoon traits.

# **Ongoing Projects**

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

## [June, 2020 to May, 2024]

#### Kishor Kumar, C.M. (Coordinator)

Thangjam Ranjita Devi (PI), A. K. Verma (till Dec., 2020), Gautam Mitra (upto Nov., 2020), K. Rahul (upto Sept., 2021), Pooja Makwana, Mihir Rhaba and Chandra Shekar (CI CSRTI-Mysuru)

#### **Objectives:**

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

Seaso		ance of Mistari Mai	<i>Neu Lilles (2021-22)</i>	
	Fec. (No.)	Pupation (%)	Cocoon Wt.(g)	FL (m)
Benchmark Trait Value:	392-400	81-83	0.9-1.1	300-350
Expected Trait Values	410-450	> 90	1.2-1.3	400-450
June-July	509	97	1.27	439
Sep-Oct	470	96	1.31	463
Nov-Dec	480	97	1.38	410
Jan-Feb	476	98	1.29	452
Mean	484	97	1.31	441
SD	17.32	0.81	0.04	22.88
CV (%)	3.58	0.84	3.64	5.18

Season-wise Performance of Nistari Marked Lines (2021-22)
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#### Season-wise Performance of Nistari Plain Lines (2021-22)

	Fec. (No.)	Pupation (%)	Cocoon Wt.(g)	FL (m)
Benchmark Trait Values	382-390	86-88	0.9-1.21	300-350
Expected Trait Values	400-450	> 90	1.2-1.3	400-450
June-July 21	481	96	1.25	457
Sep-Oct 21	461	97	1.26	500
Nov-Dec 21	466	97	1.26	425
Jan-Feb 21	471	97	1.22	420
Mean	470	97	1.25	451
SD	8.53	0.57	0.01	36.85
CV (%)	1.81	0.59	1.51	8.17

Best performing Nistari Marked and Plain lines were reared in different seasons to assess the performance of economic traits. Directional selection was adopted to estimate different parameters viz; fecundity, cocoon shape, volume, built & uniformity; cocoon weight & filament length. Care was taken not to compromise the original qualitative characteristics of the Nistari lines during the process of selection. Mono cold reeling was adopted for the selection of pupae with longest filament length. The male and female individuals corresponding to longest filament length were preserved for further metamorphosis after cold reeling which are utilized as parents for next generation.

Survival (%) of Nistari lines against BmPV infection (2021-2	:2)

Line	May-June, 2021	June-July, 2021	Aug Sept., 2021	Jan Feb., 2022
Nistari Marked	70	73	75	79
Nistari Plain	25	32	44	71

To access the tolerance of Nistari Lines against BmNPV, 3rd instar larvae were inoculated with BmNPV (per oral @ 60,000 PIBs / larvae). The survival percentage of Nistari Marked Lines ranges from 70-79% and Nistari Plain Lines showed an improvement from 25% to 71%. Late moulting population of Nistari Marked and



Plain lines were segregated and maintained as separate lines as long larval duration lines. Long larval duration populations of Nistari lines show 1-2 days extension in larval duration in comparison with control Nistari lines. These lines will be utilized for marker assisted selection of long larval duration.

# AIB 01009MI: Evaluation of new bivoltine double hybrid, TT21 x TT56 at farmers level for authorisation for commercial exploitation. [April, 2020 to March, 2023]

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

**Objective:** To evaluate the performance of bivoltine hybrid, TT21 x TT56 in field for productivity and silk quality.

CSRTI-Mysuru has developed a robust thermo-tolerant bivoltine double hybrid, TT21 x TT56 through DNA marker assisted selection. After the successful on farm trials of TT21 x TT56, the double hybrid was recommended for authorization trials across India. As proposed part of the program, the field performance of TT21 x TT56 hybrid has to be done at eastern and North Eastern India. Totally, 19700 and 1500 dfls of TT21 x TT56 hybrid was tested with the farmers of West Bengal and Tripura, respectively. As a result, the double hybrid TT21 x TT56 had a remarkable improvement over the control bivoltine combinations. The TT21 x TT56 has performed better in West Bengal (Eastern) and Tripura (North Eastern) in all the four crops. Higher cocoon yield per 100dfls of 58.2 kg with an improvement of

	JEasi	011-00120	e Perior	mance u	1 1 1 2 1 /	V 1130 L			AAC21	benyai a	nu mpu	la	
State	Hybrid	Crop	Dfls	Farmer (no)	Yield/ 100 dfls	SCW (g)	SSW (g)	SR (%)	FL (m)	Denier (d)	Reel- ability (%)	Ren- ditta (kg)	Raw silk (%)
West Bengal	TT21 × TT56	04	19700	239	58.21	1.761	0.388	21.47	922	2.93	68	7.46	13.5
- J*	SK6×SK7		2500	38	44.34	1.606	0.326	20.07	/03	2.67	/1./5	9.24	10.9
	<b>IOC %</b>				21.70	24.67	46.43	16.40	8.81	13.52	0.78	-13.2	15.3
Tripura	TT21 × TT56	01	1500	30	42.58	1.579	0.36	22.79	901	2.82	80	6.9	14.5
	SK6×SK7		100	2	38	1.63	0.31	19.01	736	2.7	85	7.6	13.2
	IOC %				12.05	-3.13	16.13	19.88	22.4	4.44	-5.88	-9.21	9.85

Season-wise Performance of TT21  $\times$  TT56 Double Hybrid in West Bengal and Tripura

21.7% over control while in Tripura it was 42.58 kg with 12.05% improvement over control. The performance of TT21 x TT56 hybrid was higher in all the economically important rearing traits when compared to the controls. Even the reeling performance of TT21 x TT56 was higher especially the renditta and raw silk were notably better than the control. So far, the TT21 x TT56 hybrid performance in Eastern and North Eastern India is satisfactory and acceptable.

# AIB 02009MI: Authorization of trials silkworm hybrid, 12Y x BFC1 in Eastern and North-Eastern India.

# [August, 2020 to July, 2022]

CSRTI-Berhampore: N Chandrakanth (PI); AK Verma (upto Dec, 2020) & T Ranjita Devi; SSPC-Berhampore: S N Bagchi; CSTRI-Bengaluru: A Reddy

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

Authorization trials of  $12Y \times BFC1$  was conducted in seven states of Eastern and North Eastern India. A total of 2.29 lakh dfls of  $12Y \times BFC1$  was produced in collaboration of SSPC-Berhampore, NSSO unit. All the 2.29 lakh dfls were tested in the field conditions of West Bengal covering 6 crops and other Eastern (Jharkhand and Odisha) and North Eastern states (Assam, Arunachal Pradesh, Nagaland and Tripura) covering two crops.

Irrespective of the seasons,  $12Y \times BFC1$  has performed better than the control [N x (SK6XSK7)] in all the tested states. The highest potential for  $12Y \times BFC1$  in terms of yield/100 dfls was observed in Arunachal Pradesh (57.11 kg) followed by West Bengal (50.26 kg) and Jharkhand (44.87 kg). Similarly, highest shell ratio for  $12Y \times BFC1$  was recorded in Tripura (18.03%) followed by Nagaland (17.72%) and West Bengal (17.46%). The state-wise rearing performances of  $12Y \times BFC1$  is presented below.

			-				
State	Farmer (No.)	Crop (No.)	No. of dfls	Yield/100dfls (kg)	Single cocoon wt.(g)	Single shell wt. (g)	Shell (%)
West Bengal	1679	6	165400	50.26	1.631	0.286	17.46
Tripura	1115	6	58500	42.72	1.513	0.275	18.03
Nagaland	20	2	1100	40.15	1.359	0.243	17.72
Assam	28	3	1300	40.19	1.319	0.218	16.60
Odisha	8	2	800	41.88	1.456	0.217	14.96
Arunachal Pradesh	9	2	750	57.11	1.531	0.262	17.24
Jharkhand	38	3	1550	44.87	1.352	0.227	16.80
Average/Total	2897	24	229400	45.31	1.449	0.248	17.05
Control[N x (SK6XSK7)]	2273	24	177600	40.28	1.371	0.225	16.48
Improveme	nt over con	trol (%)		12.49	5.69	10.22	3.46

State	wise	performance	of	12Y	x	BFC1
State	11130	periormanee	<b>U</b> 1		~	

The performance of P1 rearing of parental breeds (12Y and BFC1) has been recorded in all the crops. The result shows significant variations in the performances of 12Y and BFC1. The yield/ 100 dfls for 12Y was ranging between 20.32 to 33.75 kg while for BFC1 it was ranging between 20.8 and 45.8 kg in West Bengal conditions. One P1 crop was taken at Madanapalle (Andra Pradesh) which showed 52 kg and 60 kg cocoon yield for 12Y and BFC1, respectively. The data is presented below.

			-			-		
Seed Crop	Breed	Dfls	Farmer (no)	Yield/ 100 dfls	SCW (g)	SSW (g)	SR (%)	Chit
Dec. 20	12Y	850	08	21.93	1.114	0.143	12.87	797
Dec., 20	BFC1	650	03	40.47	1.48	0.28	19.32	686
Eab 21	12Y	800	06	28.44	1.161	0.171	14.77	861
Feb., 21	BFC1	600	03	45.80	1.50	0.30	19.96	664
May 21	12Y	500	08	20.32	1.198	0.144	12.02	780
May, ∠1	BFC1	200	02	35.09	1.459	0.298	20.42	695
Cont 21	12Y	200	02	29.90	1.29	0.20	15.57	820
Sept., 21	BFC1	100	01	20.80	1.538	0.302	19.64	650
	12Y	2000	35	33.75	1.104	0.137	12.41	908
Dec., 22	BFC1	1000	06	38.82	1.51	0.29	18.87	652
Overall	12Y	4350	59	26.87	1.173	0.159	13.53	833
Overall	BFC1	2550	15	36.19	1.497	0.294	19.65	669
			CD @ 1%	8.60	0.17	0.07	3.32	91.58
			CV (%)	26.52	12.72	30.80	19.49	11.86
		P1 Rearir	ng Performanco	e of 12Y and	BFC1 in Sou	uth India		
	12Y	500	01	52	1.36	0.22	16.17	749
Dec., 22	BFC1	300	01	60	1.687	0.33	19.56	655

P1 Rearing Performance of 12Y and BFC1 in West Bengal

Seasonal variations in the grainage parameters of  $12Y \times BFC1$  was also studied in comparison with control. In all the seasons,  $12Y \times BFC1$  showed highest pairing percentage as well as egg recovery over the control. The highest egg recovery of  $12Y \times BFC1$  was observed in the March 21 (52.11 g/ kg) followed by Oct 20 (46.94 g/ kg). Statistical analysis revealed significant differences in the grainage parameters between  $12Y \times BFC1$  and control in October season of both the years as shown below. In addition to the field testing of the hybrid  $12Y \times BFC1$ , P1 dfls of 12Y and BFC1 were also supplied to the state sericulture department of Tripura on demand.

Season-wise grainage performance of 12Y X BFC1								
Grainage	Hybrid	Pair	Dfls Recovery	Dfls Recovery	Dfls	C:D Ratio		
Season	-	(%)	(%)	(g/кg)	(no.)			
Oct 20	12Y x BFC1	28.04*	23.04*	46.94*	2300	5.65:1		
000., 20	N x (SK6xSK7)	20.17*	11.11*	25.40*	-	9.00:1		
lan 21	12Y x BFC1	30.05	21.04	46.89	32900	4.75:1		
Jan., 21	N x (SK6xSK7)	31.96	20.11	45.04	-	4.97:1		
DO March 31	12Y x BFC1	32.16	24.27	52.11	41500	4.12:1		
March, 21	N x (SK6xSK7)	32.04	22.47	50.00	-	4.45:1		
Juna 21	12Y x BFC1	27.55	18.68	41.18	14100	5.11:1		
June, 21	N x (SK6xSK7)	26.98	18.56	42.50	-	5.23:1		
Oct 21	12Y x BFC1	26.72*	18.95*	41.81*	13000	5.28:1		
00., 21	N x (SK6xSK7)	22.00*	14.09*	32.06*	-	7.10:1		
lan 21	12Y x BFC1	27.30	20.60	46.40	68900	4.86:1		
Jan., 21	N x (SK6xSK7)	26.40	18.50	41.00	-	5.41:1		
	CD @ 1%	2.97	4.20	7.21	-	-		
	CV (%)	12.64	24.44	19.34	-	-		
Jan., 21	12Y x BFC1	30.10	32.90	61.50	54500	-		
	Grainage Season Oct., 20 Jan., 21 March, 21 June, 21 Oct., 21 Jan., 21	Grainage Season   Hybrid     Oct., 20   12Y x BFC1 N x (SK6xSK7)     Jan., 21   12Y x BFC1 N x (SK6xSK7)     March, 21   12Y x BFC1 N x (SK6xSK7)     June, 21   12Y x BFC1 N x (SK6xSK7)     Oct., 21   12Y x BFC1 N x (SK6xSK7)     Jan., 21   12Y x BFC1 N x (SK6xSK7)     Jan., 21   12Y x BFC1 N x (SK6xSK7)     Jan., 21   12Y x BFC1 N x (SK6xSK7)	Grainage Season   Hybrid   Pair (%)     Oct., 20   12Y x BFC1   28.04*     N x (SK6xSK7)   20.17*     Jan., 21   12Y x BFC1   30.05     March, 21   12Y x BFC1   32.16     June, 21   12Y x BFC1   27.55     N x (SK6xSK7)   26.98     Oct., 21   12Y x BFC1   26.72*     N x (SK6xSK7)   26.09     June, 21   12Y x BFC1   26.72*     N x (SK6xSK7)   22.00*     Jan., 21   12Y x BFC1   27.30     N x (SK6xSK7)   26.40     CD @ 1%   2.97     CV (%)   12.64	Grainage Season   Hybrid   Pair (%)   Dfls Recovery (%)     Oct., 20   12Y x BFC1   28.04*   23.04*     N x (SK6xSK7)   20.17*   11.11*     Jan., 21   12Y x BFC1   30.05   21.04     March, 21   12Y x BFC1   32.16   24.27     June, 21   12Y x BFC1   32.04   22.47     June, 21   12Y x BFC1   27.55   18.68     N x (SK6xSK7)   32.04   22.47     June, 21   12Y x BFC1   27.55   18.68     N x (SK6xSK7)   26.98   18.56     Oct., 21   12Y x BFC1   26.72*   18.95*     N x (SK6xSK7)   22.00*   14.09*     Jan., 21   12Y x BFC1   27.30   20.60     N x (SK6xSK7)   26.40   18.50   18.50     CD @ 1%   2.97   4.20   124     Jan., 21   12Y x BFC1   30.10   32.90	Season-wise granage performance of 127 x BrC1Grainage SeasonHybridPair (%)Dfls Recovery (%)Dfls Recovery (g/kg)Oct., 2012Y x BFC128.04*23.04*46.94*N x (SK6xSK7)20.17*11.11*25.40*Jan., 2112Y x BFC130.0521.0446.89N x (SK6xSK7)31.9620.1145.04March, 2112Y x BFC132.1624.2752.11N x (SK6xSK7)32.0422.4750.00June, 2112Y x BFC127.5518.6841.18N x (SK6xSK7)26.9818.5642.50Oct., 2112Y x BFC126.72*18.95*41.81*N x (SK6xSK7)22.00*14.09*32.06*Jan., 2112Y x BFC127.3020.6046.40N x (SK6xSK7)26.4018.5041.00Jan., 2112Y x BFC130.1032.9061.50	Season-wise graninge performance of 127 x BFC1Grainage SeasonHybridPair (%)Dfls Recovery (%)Dfls Recovery (g/kg)Dfls (no.)Oct., 2012Y x BFC128.04*23.04*46.94*2300N x (SK6xSK7)20.17*11.11*25.40*-Jan., 2112Y x BFC130.0521.0446.8932900N x (SK6xSK7)31.9620.1145.04-March, 2112Y x BFC132.1624.2752.1141500June, 2112Y x BFC127.5518.6841.1814100N x (SK6xSK7)26.9818.5642.50-Oct., 2112Y x BFC126.72*18.95*41.81*13000N x (SK6xSK7)22.00*14.09*32.06*-Jan., 2112Y x BFC127.3020.6046.4068900N x (SK6xSK7)26.4018.5041.00-Jan., 2112Y x BFC130.1032.9061.5054500		

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

Lakshmanan .V., Sivaprasad, V and Kishor Kumar, C.M.

Bivoltine male parents are utilized in M x Bi hybrids typically to exploit hybrid vigour and express better silk quality parameters in addition to improve productivity. The agro-climatic conditions in E & NE India are not being conducive for bivoltine hybrids and as a result only crossbreeds are preferred by the farmers (>95%) especially in WB. Currently, foundation crosses, SK6.7 and BCon1.4 are utilized to produce N x Bi hybrids. The productivity potential of SK6.7, is very moderate and the resultant Nistari crossbreed is also with moderate productivity. West Bengal is unable to generate bivoltine seed cocoons due to limitations and still not self-sufficient. Utilizing productive bivoltine breeds of southern origin is fraught with problems as their adoptability in E & NE India is not satisfactory. The improvement in the productivity of Nistari crossbreeds in this region is quite necessary and is a demand of stakeholders. Realizing the need to increase the remuneration of N x Bi silk, development of new productive bivoltine male component were attempted at CSRTI, Berhampore. The popular regional bi-breeds SK6, SK7, BCon1 and BCon4 were utilized as maternal parental and productive bivoltine breeds from southern region (4S, BMFD1, CSR16, CSR51) for introgression of productive traits. A project on "Identification of superior Bivoltine foundation cross as a male component to improve crossbreed productivity in E & NE India" has been initiated (AIE02018SI). The new breeding line *e.g.*, BFC1 derived from research, has shown good promise with better productivity with 12Y. Further hybrid evaluation is under progress with other multivoltine breeds. Analysis of F11/F12 performance of Eleven new lines indicates superior productivity merits in all new lines compared to popular breeds, as also a good survival in nine new

lines (NFC6 (Dull), NFC8 (Dull), NFC8 (W), NFC11 (Dull), NFC12 (W), NFC18 (Dull), NFC 19(Dull), NFC R (Dull) & NFC R(W)).

	Performan	ce of NFCs (	@ F11/F1	2 (Falguni,	22)		
Breed	Parentage	Larval Marking	ERR By No	ERR by Wt.(Kg)	SCW (g)	SSW (g)	Shell (%)
NFC6 Dull <sup>#</sup>	SK7 x CSR51	Plain	8338	11.384	1.270	0.246	19.37
NFC8 Dull	BCon1 x CSR16	Plain	8000	11.666	1.183	0.208	17.58
NFC8 White <sup>\$</sup>	BCon1 x CSR16	Plain	8000	11.666	1.232	0.241	19.56
NFC11 Dull	BCon1 x 4S	Plain	8740	15.100	1.339	0.244	18.22
NFC12 White	BCon1 x BMFD1	Marked	8906	13.666	1.310	0.237	18.09
NFC18 White	(BCon4.4S) x (BCon1.BMFD1)	Marked	7525	9.850	1.092	0.193	17.67
NFC18 Dull	(BCon4.4S) x (BCon1.BMFD1)	Plain	8388	13.111	1.272	0.244	19.18
NFC19 Dull	(BCon4.4S) x (BCon1.BMFD1)	Plain	8986	12.266	1.237	0.228	18.43
NFC19 White*	(BCon4.4S) x (BCon1.BMFD1)	Plain	7626	12.562	1.191	0.217	18.22
NFC (R) Dull	-	Plain	8186	11.600	1.259	0.241	19.14
NFC (R) White <sup>*</sup>	-	Plain	7930	11.300	1.278	0.266	20.81
Popular Breeds							
SK6		Plain	7735	11.050	1.340	0.218	16.27
SK7		Plain	8210	12.050	1.338	0.219	16.36
BCon1		Plain	7480	11.566	1.531	0.254	16.59
BCon4		Plain	7222	10.371	1.392	0.249	17.88
	CD 5%		294	0.724	0.057	0.011	0.71
	CV(%)		6.52	10.86	7.90	8.30	6.94

#### Continuous/Other Activities:

**Maintenance of Multivoltine Germplasm:** Multivoltine germplasm breeds of *Bombyx mori* are maintained for 3 generations in this year. The rearing performance is documented below. The fecundity of the multivoltine accessions ranged from 309-506 whereas hatching was >95% and pupation >90% in all germplasm accessions maintained showing better fitness traits under the rearing conditions employed

Race/ Breed	Stat	Fecundity	Hatching	Cocoon Wt (a)	Shell Wt (a)	Shell	ERR (kg)	Pupation
Diccu	Ανα	299	96.20	0.93	0.24	26.97	10.34	94.02
Cambodge	CV(%)	37.58	1.68	23.82	82.13	93.92	87.14	4.49
CDE	Avg	309	95.30	0.96	0.16	16.59	5.22	93.97
CB5	CV(%)	21.51	3.68	31.15	39.02	38.82	66.62	5.48
	Avg	343	96.61	0.95	0.13	12.77	7.87	96.93
G	CV(%)	2.73	1.08	31.81	56.12	23.18	46.82	0.99
	Avg	385	96.26	1.06	0.12	10.93	7.51	97.69
M12W	CV(%)	20.92	1.58	12.42	34.45	21.48	21.47	0.23
	Avg	377	97.70	1.14	0.15	13.10	8.74	97.10
M6M81	CV(%)	23.12	1.09	20.36	34.55	14.36	21.63	0.28
	Avg	419	97.47	1.00	0.12	12.14	8.48	97.23
M6DPC	CV(%)	13.06	0.88	18.18	25.28	10.87	30.75	0.64
	Avg	388	97.03	0.99	0.14	14.49	8.34	97.10
M.Con 1	CV(%)	15.78	1.44	16.79	16.21	9.34	22.46	0.27
	Avg	506	97.59	1.21	0.20	16.38	9.49	96.56
M.Con 4	CV(%)	4.99	0.75	8.28	12.65	6.13	38.19	1.16
	Avg	363	95.89	1.05	0.14	12.93	8.74	97.20
M15	CV(%)	12.18	1.22	6.46	16.59	11.26	20.80	0.84

Rearing performance of multivoltine germplasm accessions

Contd....

	Δνα	304	97.07	1.06	0 14	13 35	8 81	97 19
		20 51	1.00	1.00	0.14	12.55	2.40	0.24
MODPC(Gr)	CV(%)	20.51	1.00	4.70	9.60	12.20	3.49	0.34
	Avg	435	98.28	1.49	0.23	15.52	9.81	96.74
OS616	CV(%)	32.38	1.22	6.52	10.05	5.10	39.20	0.65
	Avg	324	97.84	1.08	0.14	12.57	8.36	97.11
0	CV(%)	2.95	0.89	13.29	22.91	10.72	19.84	0.40
	Avg	367	96.23	1.07	0.14	13.59	8.01	96.68
Sarupat	CV(%)	21.77	1.00	0.91	10.48	10.45	22.22	0.99
	Avg	451	97.56	1.23	0.17	13.99	7.15	96.21
Nistari (M)	CV(%)	6.66	1.22	4.23	12.93	8.62	16.46	0.43
	Avg	498	97.67	1.15	0.16	13.60	8.62	96.75
Nistari (P)	CV(%)	3.41	1.72	1.11	0.23	0.61	26.37	0.33
Nistari	Avg	481	97.22	1.14	0.16	14.22	9.83	97.00
(Debra)	CV(%)	14.77	0.48	18.33	23.17	5.10	3.41	0.04
Nistari	Avg	488	97.69	1.20	0.17	14.10	9.99	96.96
(Chalsa)	CV(%)	2.61	1.14	6.04	7.55	1.48	11.45	0.17

#### Maintenance of Bivoltine Germplasm:

A total of 26 bivoltine silkworm germplasm stocks are maintained at CSRTI -Berhampore. Batches are reared in Baisakhi-21 and Agrahayani-21 (3 composite batches; 250 larvae after III moult) following standard rearing conditions. The cocoons confirming to original breed characteristics were selected for oviposition and dfls were produced. The layings were preserved under various schedules hibernation as per the requirement of all the experimental purposes. The variations observed in ERR by number among the bivoltine germplasm breeds in Baisakhi, 2021 and Agrahayani, 2021 are presented in the graphical form revealing seasonal effects on survival. The breeds which are performing better in respective seasons could become resources for future breeding programmes

#### Rearing performance of Germplasm Stock (2021-22)

Race / Breed	Fec	ERR	ERR	Cocoon	Shell	Shell
	(No)	(No)	Wt (Kg)	Wt (g)	Wt (g)	(%)
<b>Oval Breeds</b>	;					
KPG A	452	7840	9.820	1.230	0.210	17.07
Gen 3	472	5060	7.126	1.384	0.276	19.94
CSN	442	6810	8.510	1.210	0.241	19.92
NBO 1	422	6220	8.440	1.343	0.219	16.31
NBO 4	408	5840	7.980	1.376	0.252	18.31
SB 1	436	7640	10.450	1.345	0.235	17.47
SK3	406	7240	9.410	1.248	0.213	17.07
KSO 1	472	8840	13.210	1.505	0.266	17.67
Dumbbell B	reeds					
BHR 1	502	6360	8.750	1.368	0.236	17.25
BHR 3	512	7740	10.220	1.349	0.250	18.53
SK (SL)Y	412	6650	7.840	1.163	0.203	17.45
NB18	442	6340	8.950	1.372	0.228	16.62
NP2	432	7050	8.380	1.133	0.221	19.51
D6(P)N	414	8020	8.910	1.099	0.194	17.65
SK4C	438	6640	8.740	1.253	0.215	17.16
Chinese PN	462	7310	9.510	1.257	0.208	16.55
CSR 47	438	5240	6.310	1.112	0.192	17.27
SK4	406	6120	7.950	1.237	0.203	16.41
DUN 22	512	7840	9.410	1.196	0.220	18.39
NB4D2	462	7160	9.320	1.252	0.222	17.73
YB	424	7250	9.480	1.298	0.236	18.18
RSJ 11	416	5460	7.680	1.350	0.279	20.67
SK6	472	6240	8.740	1.393	0.229	16.44
SK7	442	7820	10.930	1.376	0.225	16.35
B Con 1	512	6810	10.280	1.518	0.242	15.94
B Con 4	416	5040	7.580	1.489	0.272	18.27



**Basic Seed Supply** : A total of 6425 P1/P2 dfls of multivoltine (M6DPC: 750; M12W: 200; MCon4: 50 dfls; Nistari: 5425 dfls) and 7935 dfls of bivoltine (SK6, SK7, BCon1, BCon4, FCs) basic seeds were supplied to NSSO, DoSs and Registered Seed Producers in different seasons based on demand.

# **REARING AND SEED TECHNOLOGY SECTION**

#### Dr. Satadal Chakraborty

This Section has been established in 2021 with the function to supply of quality seed cocoons / dfls to nested units for R&D support/ Race Authorization Programme and under Transfer of Technology. It reared 275 dflls (Bivoltine BFC1 and Multivoltine 225 dfls) during 2021-22.

## FARM MANAGEMENT

## Dr. Satadal Chakraborty

The farm management unit maintains 14.778-acres of mulberry plantation, propagation and supply of quality leaves for silkworm rearing purpose within the institute. The unit produced and supply of 64.430 tonnes of mulberry leaf (Leaf 3.92 tonnes and Leaf with Twig 60.30 tonnes) to rear 3941 dfls for silkworm rearing under Silkworm Breeding & Genetics Section, Rearing & Seed Technology Section, Silkworm Pathology Section, Biotechnology Section, Training Division etc. during 2021-22.

# **MULBERRY PATHOLOGY/ ENTOMOLOGY**

## Concluded Projects:

# PRP 02003 SI: Studies on the management of mulberry root rot disease in Eastern and North Eastern India.

## [May, 2019 to May, 2021]

V. Sivaprasad (Co-Ordinator), Anil Pappacchan (PI), V. Vijay and G. C. Das (Till 30.04.2021)

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

Root rot of mulberry caused by *Fusarium sp* is alarming because of its epidemic nature and potentiality to completely kill the plants. The disease appears in all types of soil and climate. Initially the disease appears on couple of plants that acts as source of inoculum, then spreads to neighboring plants very fast causing its death. Study revealed that root rot caused by *Fusarium* sp.is present in all the major Sericultural districts of WB and incidence was found to be in the range of 13.5 to 40% in sporadic manner. Following chemicals like combination of Carbendazim (12%) and Mancozeb (63%) @ 0.20% outcome from the project (PPS-3504), Carbendazim 50% WP the existing recommendation along with "Rot*fix"* (an ecofriendly formulation developed by CSRTI, Mysore) were evaluated under the project to validate effective root rot management under field conditions.

Root rot infected samples were collected from the farmers' fields from the different states of Eastern and North eastern India. Fungal pathogens were isolated in PDA media followed by following standard procedure. Isolated funagal isolates were identified initially based on the morphological

charcters like colour of the colony, morphology of conidia and Chlamydospores etc. Molecular identity of the pathogens was further confirmed based on the ITS sequence through blast analysis.

	5	•
#	Fungus	Location
1	Fusarium soalni	Karjora (West Bengal)
2	Lasiodiplodia theobromae	Balashpur (West Bengal)
3	Lasiodiplodia theobromae	Kolasib (Mizoram)
4	Fusarium soalni	Jorhat (Assam)
5	Fusarium soalni	Sille (Arunachal Pradesh)

Fungi identified from E & NE India associated with root rot disease of mulberry

Eevaluation of	fungicides	and Rot <i>fix</i>	under glass	shouse again	st root rot	
Treatment	Survival	Wilting	Rotting	LLS (cm)	TSL	Biomass
Carbendazim 12% + Mancozeb	100.0*	17.3	13.3	95.2 <sup>ab**</sup>	167.3ª	87.5 <sup>b</sup>
Carbendazim 50 % WP	100.0	20.1	16.4	79.6 <sup>bc</sup>	123.5 <sup>b</sup>	73.7 <sup>bc</sup>
Rot <i>fix</i> (0.5%)	100.0	16.8	13.5	97.7 <sup>ab</sup>	191.3ª	107.8ª
Control (Inoculated)	55.6	65.9	60.6	64.4 <sup>c</sup>	108.9 <sup>b</sup>	54.9 <sup>c</sup>
Control (Healthy)	100.0	0.0	0.0	98.2ª	196.5ª	114.3ª
SEm±				6.9	17.1	17.6
CV				17.4	12.2	7.1
CD (0.05)				18.4	32.8	21.0

\*Average of three experiments \*\* means with the same letter are not significantly different

The pathogenicity of the fungal isoplates were confirmed by inoculating healthy saplings root with a conidial suspension of  $10^6$  ml<sup>-1</sup>. Glasshouse trials indicate that application of fungicides and ecofriendly formulation "Rot*fix"* prevented the death of plants against 44.4 % mortality in untreated control.



Effect of Rotfix against root rot under field conditions

In addition, treatment with Rot*fix* significantly increased length of longest shoot-LLS (cm), total shoot length-TSL (cm) and biomass yield (g/plant) by 51.7%, 76.1 % and 96.4% respectively. Rot*fix* was found to be most suitable for the management of root rot as it is ecofriendly whereas fungicides like carbendazim and mancozeb are facing imminent ban.

Based on the result of the glass house Rot*fix* was selected for further evaluation under field conditions against root rot disease of mulberry. A total of 231 farmers' fields infected with root rot were identified from different villages of West Bengal. On an average root rot incidence was found to be 13.0 % in the infected gardens ranging from 2 to 75%. Root rot infected plants were treated with Rot*fix* and recovery was recorded. Field studies revealed that application of Rot*fix* resulted on an average 91.5 % survival or recovery of treated plants. Only 8.5% of the treated plants succumbed to the disease which might be due to advance stage of infection.

#### **Concluded TOT programme**

# Demonstration of biocontrol agent Chrysoperla zastrowi sillemi for ecofriendly management of thrips in E& NE.

## [April, 2020 to March, 2022]

Anil pappachan (up to May, 2021), Khasru Alam (From July, 2021) and Shafi Afroz

Objective: Popularization of biocontrol agents at field level for ecofriendly management of thrips.

A total of 1,71,593 *Chrysoperla zastrowi sillemi* eggs were mass produced in laboratory during the entire ToT programme period in two years of which 94,639 Chrysoperla eggs were released among 228 farmers field in Nadia, Birbhum, Murshidabad, & Malda Districts for the management of thrips. Remaining eggs were released at different plots at CSRTI BHP as well as used for mass multiplication. Biocontrol agent was released at Kalyanpur (15), Purapara (18), Senpara (24), Kanupur (21), Pipulkhola (40), Barbakpur (30), Makrampur (20), Rampur (24), Sahebnagar (24) and Garia Nagar (12) villages coinciding with thrips incidence at the field. On an average release of biocontrol agent resulted in 70.71 % reduction of thrips over untreated control.

	Lincacy of	Cill ysoperia zas		agamst timps	under neid condit	
	Farmers	BC	Α	C	ontrol	_
Districts	Covered	Pre release	Post release	Pre release	15 days after release	Reduction over control I (%)
Nadia	148	7.02	3.91	7.28	12.31	68.24
Birbhum	44	21.04	6.58	21.66	23.58	72.09
Murshidabad	24	19.53	8.34	20.34	20.70	59.71
Malda	12	13.30	3.25	13.58	18.91	82.81
Total/Avg.	228	15.22	5.52	15.71	18.87	70.71

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







Egg Card Chrysoperla larvae Field release of chrysoperla Demonstration and field release of Chrysoperla zastrowi sillemi for management of thrips

#### **Continuous/Other Activities:**

#### Surveillance and forewarning of mulberry diseases and pests of E & NE India.

Khasru Alam (PI), Anil pappachan, I/C of RSRSs & RECs of CSRTI-BHP

#### **Objective:**

Surveillance of mulberry diseases and pests in E & NE India and providing forewarning services to the farmers for effective management of mulberry diseases and pests in Eastern & North Eastern India.

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

Maximum PDI (2021-2022)							
State	Unit	BLS	MLS	PLS	PMLD	BLR	YLR
	CSRTI-BHP	11.51(Jul)	11.91(Aug)	9.11(Nov)	12.54(Jan)		
Wost Pongal	Malda	8.65(Jul)	3.98(Aug)	0.63(Aug)	8.85(Dec)		
West Beliga	Kalimpong				6.28(Jul)	8.37(Jul)	7.16(Sep)
Odisha	Koraput				5.15(Nov)	3.17(Nov)	
Mizoram	Aizawl				3.56(Sep)		
Manipur	Imphal				4.21(Oct)		
Meghalaya	Shillong				2.76(Nov)	2.88(Nov)	

Similarly, data on pest incidence was collected from the farmers' fields of different locations as well as Institute field. Collection of data were made from ten randomly selected plants per sample and the seasonal incidence of major mulberry pests *viz.*, thrips (*Pseudodendrothrips mori*), mealy bug (*Maconellicoccus hirsutus*), whitefly (*Dialeuropora decempuncta* & *Aleuroclava pentatuberculata*) and root mealy bug (*Paraputo* spp.) at weekly intervals along with meteorological data. From each plant three twigs (shoots) were selected for recording the data. From each twig, number of thrips per leaf (from top 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, leaf) was recorded. Incidence of Tukra was worked out based on the percentage of shoots damaged in ten plants per holding. Five affected shoots per holding were collected from the field for counting egg masses, nymphs & adults of mealy bug. Whitefly incidence was recorded based on adult & late nymph population from top, middle & bottom two leaves from three twigs/ plant.

Seasonal occurrence of major pests in mulberry Ecosystem (2021-22)

Thrips (No./	'leaf)												
Location	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Range
Institute	6.00	7.78	5.40	7.50								5.84	0-11.24
Malda	6.10											4.25	0-7.22
Koraput					1.50		3.84	3.87				4.48	0-4.38
Tukra (%)													
Institute		6.38	5.98	4.56	2.26							5.84	0-10.25
Malda	2.5												0-4.58
Kalimpong (RMG*)	1.30	2.43	4.06	5.52	3.56	3.56	4.02	3.97	2.83			1.38	0-9.2
Koraput					1.83	3.20	2.84	5.19				6.01	0-5.38
Whitefly (no./	leaf)												
Institute					2.65			3.89	1.8				0-14.4
Koraput								3.61	3.40			3.48	0-4.25
Imphal					0.37	0.62	0.68						0-0.72

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## SILKWORM PATHOLOGY

# Concluded Project ARP3630: Evaluation of new room and silkworm bed disinfectants. [June 2018 to May 2021]

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

#### **Objectives:**

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

Disinfection is an imperative activity in sericulture for successful harvest of silkworm cocoon crops. Significant proportion of the sericulture farming fraternity of Eastern and North Eastern India disinfect their rearing house, its surroundings as well as appliances by using bleaching powder (5%) or chlorine dioxide solution before initiating rearing. These disinfectants are efficient against major silkworm pathogens however, they are environmentally hazardous and non-user friendly. In order to address these limitations of the disinfectants being currently employed, present study was undertaken in which different eco-friendly compounds/chemicals were assessed to identify promising substances that could neutralize all the major silkworm pathogens. Oxidizing and wetting agents inactivate all the major silkworm pathogens as evident by *in vitro* inactivation studies.

## Development and evaluation of eco-friendly room disinfectant:

A formulation was developed by delineating the effective concentrations /combinations of the eco-friendly compounds/chemicals and named as NIRMOOL, the efficacy of which is evaluated by laboratory experiments and in-house validation trials. Effect of NIRMOOL<sup>™</sup> on cellular morphology of major silkworm pathogens was assessed by treating the silkworm pathogens with NIRMOOL<sup>™</sup> for 10 minutes, followed by centrifugation and washing the pathogen pellet with sterile distilled water in order to remove the traces of disinfectant. Light microscopy studies of the treated pathogens showed that NIRMOOL<sup>™</sup> completely dissolved BmNPV polyhedral bodies, disintegrated bacterial, fungal and microsporidian pathogens. In vitro studies against bacterial and fungal pathogens were conducted, wherein bacterial (Staphylococcus sp.) and fungal (Beauveria bassiana) pathogens treated with NIRMOOL<sup>™</sup> were inoculated in respective nutrient medium and no visible growth was observed. *In vivo* studies further indicated that NIRMOOL<sup>™</sup> treated pathogens, when inoculated to silkworms didn't inflict any diseases. Simulated contamination studies further confirmed the antipathogen activity and effectiveness of NIRMOOL<sup>™</sup>. Comparative efficacy studies are conducted in rearing rooms disinfected with NIRMOOL<sup>™</sup> or 5% bleaching powder as control. Five dfls of crossbreed silkworms (Nistari x SK6.SK7) were reared following standard rearing conditions across three seasons and in-house validation trials that showed NIRMOOL<sup>™</sup> is as effective as 5% bleaching powder. Apart from being effective in successful harvest of cocoon crops, NIRMOOL<sup>™</sup> is eco-friendly, non-corrosive, has longer shelf life, readily soluble in water, easy to prepare & apply and cost effective. The cost-benefit ratio is 1:1.93. The yield and the cocoon traits did not show significant differences (P<0.919NS; Student's t-Test) between Nirmool disinfection and 5% bleaching powder used as control.

rearing house and r	earing appliances	5	
Bleaching Powder	Nirmool	Р	Sia @ 5%
(5%)	(2%)	value	Slg.@ 5%
8303	8293	0.93	NS
12.28	12.61	0.02	*
1.453	1.501	0.25	NS
0.244	0.253	0.23	NS
16.79	16.85	0.87	NS
638	648	0.87	NS
2.63	2.62	0.62	NS
73	73		NS
	rearing house and r   Bleaching Powder   (5%)   8303   12.28   1.453   0.244   16.79   638   2.63   73	rearing house and rearing appliances     Bleaching Powder   Nirmool     (5%)   (2%)     8303   8293     12.28   12.61     1.453   1.501     0.244   0.253     16.79   16.85     638   648     2.63   2.62     73   73	Pearing house and rearing appliances     Bleaching Powder   Nirmool   P     (5%)   (2%)   value     8303   8293   0.93     12.28   12.61   0.02     1.453   1.501   0.25     0.244   0.253   0.23     16.79   16.85   0.87     638   648   0.87     2.63   2.62   0.62     73   73

Comparative efficacy of NIRMOOL and 5% bleaching powder used for disinfection of silkworn
rearing house and rearing appliances

\*P<0.05; NS: non-significant.

#### Efficacy of NIRMOOL afterdisinfection of silkworm rearing house and rearing appliances: Evaluation of rearing performance

			Disinfection with							Disinfection with				
	E a backier	Silkworm			2% Ni	rmool				5% Bl	eaching P	owder		
#	Evaluation	Breed/		ERR	ERR	Cocoon	Shell	Shell	ERR	ERR	Cocoon	Shell	Shell	
	Onic	Hybrid	Date	By	by	Wt.	Wt.	Ratio	By	by	Wt.	Wt.	Ratio	
		•		No.	Wt.(kg)	(g)	(g)	(%)	No.	Wt.(kg)	(g)	(g)	(%)	
	Multivoltine.	Nistari	Jan,	9767	13.08	1.34	0.20	14.92	9347	10.008	1.078	0.115	10.66	
1	CSRTI-BHP	M12W	2020	9433	11.03	1.17	0.15	12.82	9366	10.976	1.181	0.153	12.95	
2	P2-BSF (NSSO) K'subarna, WB	Nistari	Mar, 2020	9227	9.6	1.06	0.13	12.26	9391	9.5	1.06	0.126	11.89	
		SK6	Apr,	8240	11.56	1.43	0.243	17.04	8286	10.96	1.31	0.222	16.94	
2	Bivoltine,	SK7	2020	9010	12.36	1.40	0.236	16.80	8964	11.99	1.30	0.220	16.87	
2	CSRTI-BHP	BCon1		8640	12.63	1.49	0.249	16.65	7630	10.70	1.31	0.226	17.25	
		BCon1		8060	11.09	1.37	0.250	18.22	6397	08.69	1.28	0.222	17.38	

Validation studies through 'On Station Trials' (OST) of Nirmool disinfection are carried out at different units of CSB and DoS across eight states of E & NE India. An average of 82.8% ERR was recorded across different seasons in 27 test locations. At Mothabari, bivoltine hybrids BHP-DH, KDH-1 and KDH2 showed lower ERR of ~45-50% during Falguni and Bishakhi seasons.



Performance of NIRMOOL<sup>™</sup> across different RSRSs and RECs of E & NE India

#### Development & evaluation of eco-friendly bed disinfectant

Bed disinfectant compositions were formulated by employing requisite proportions of eco- and user friendly chemicals that are non-toxic to silkworms as well as effective against all known major silkworm pathogens in combination with suitable carrier material. The new formulation was named as "Seri-Win". The development of the bed disinfectant initiated with selection and evaluation of a suitable carrier material. Three carrier materials (C1, C2 & C3) in solitude and in combination (CF4, CF5, CF6 & CF7) were evaluated for toxicity to healthy silkworms at every instar. Slaked lime was used as control.

Evaluation of the formulations along with the existing bed disinfectants against silkworm diseases through disease spread experiments conducted across five seasons (May-June/ July-Aug/ Sep-Oct/ Nov-Dec of 2020 and Jan-Feb of 2021) showed that two formulations were as effective as the existing disinfectants in controlling the spread of silkworm diseases. However, the recorded data indicated formulation II to be effective over formulation I.

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

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

Further experiments were performed with Formulation II and the same was named as **"Seri-win"**. The ERR% recorded in the laboratory trials conducted to evaluate the efficacy of Seri-Win showed on par effectiveness of the same with the existing bed disinfectants shown below. Seri-Win suffices all the ideal characteristics as the other existing bed disinfectants tested. However, unlike its counterparts, Seri-Win is eco- and user friendly. OST trials are in progress to evaluate the efficacy of the Seri-Win across different test locations.

Laboratory trials on the efficacy of Seri-Win						
Treatment		ERR%				
realment —	NISTARI	N x (SK6 x SK7)*	M6DPC x (SK6 x SK7)*			
Seri-Win	82.66	88.33	90.66			
Labex	83.33	90.00	89.00			
Sericillin	81.66	86.66	89.66			
Vijetha	80.66	89.66	91.00			
Control	67.33	71.00	72.00			
(Without treatment)						
CD@5%	7.00	2.27	4.77			
SE(m)	2.19	0.71	1.49			

## Inference

- An eco-friendly and user friendly formulation suitable for disinfection of silkworm rearing room and rearing appliances, "NIRMOOL<sup>™</sup>" was developed. A patent application for "A disinfectant composition against silkworm pathogens (NIRMOOL<sup>™</sup>)" to disinfect silkworm rearing room and rearing appliances is filed (TEMP/E1/55625/2020-KOL dated 17-11-2020).
- An eco-and user-friendly formulation suitable for disinfection of silkworm body and rearing seat "Seri-Win" (bed disinfectant) was developed.
- Both Nirmool and Seri-Win are effective against pathogens on par with existing disinfectants.

## **Ongoing Project (Collaborative):**

AIT08005MI: Development and evaluation of Bidensovirus resistant silkworm hybrids developed from marker assisted breeding lines- Phase II (Collaboration from SBRL-Kodathi and with CSRTI-Mysore)

## [March, 2020 to February, 2023]

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

#### **Objectives:**

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

A total of 20 Bivoltine breeds and 6 multivoltine breeds developed at CSRTI-Berhampore were screened for BmBDV resistance marker. Out of 20 bivoltine breeds, 10 bivoltine breeds (SK6, SK7, SK6xSK7, B.Con 1, B.Con 4, NFC8, NFCR, BHP8, BHP9 and BHP FC2) were found positive for the BmBDV resistance marker. Out of 6 multivoltine breeds only one multivoltine breed (12Y) was found positive for BmBDV resistant marker. Bioassay was performed for the bi- and multivoltine breeds with BmBDV

resistance marker using BmBDV inoculum on 100 larvae each with three replications/ treatment. A control batch without viral exposure was maintained for each hybrid. The larvae were administered with the BmBDV virus (DNV2) on day 0 of 3<sup>rd</sup> instar and were regularly observed till spinning. Mortality was recorded daily

Survival rate (%) after BmBDV viral exposure					
Name of Breeds	Survival (%);	Survival (%);			
	1 <sup>st</sup> crop (Sep-Oct)	2 <sup>nd</sup> crop (Jan- Feb)			
BHP-8	27.05	46.05			
SK6 x SK7	4.75	25.10			
SK6 (SBRL)	6.45	31.50			
SK7 (SBRL)	3.80	29.00			
NFC-R	2.70	07.00			
BHP9	20.00	27.25			
12Y	0.00	Not survived			

throughout larval, pupal and moth stages. Survival rate was 27% and 20% for BHP8 and BHP9 respectively in the first crop whereas it increased significantly (P< 0.05) in the second crop. In the uninfected control, the survival was more than 80% in in both the crops. The work is under progress, subsequent bioassay will be performed in the forthcoming rearing.

## **Continuous/Other Activities:**

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

Co-Ordinator: Dr. Kishor Kumar C.M., Director-CSRTI-Berhampore

M. Rabha **(PI)**, K. Rahul and A. R. Pradeep, L. Somen Singh (RSRS-Imphal), Z. Hossain & H. Babu (RSRS, Kalimpong), D. Gogoi (RSRS, Koraput), P. Kumaresan (RSRS, Jorhat), B. V. Naidu (REC, Mothabari), N. Sakthivel (REC, Aizwal), K. Neog (REC, Dimapur), N. Balachandran (REC, Shillong), B. Basumatary (REC, Mangaldai), L. Sonowal (REC, Sille), I. Illahi (P3-Basic seed farm, Amabari falakata), H.R. Ahmad (P2-basic seed farm, Karnasubarna), D. Das (BSF, Dhubulia), S.N. Bagchi (SSPC Berhampore) & P.L. Abhilash (SSPC Dakshinbhavanipur)

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

#### **Objectives:**

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

Silkworm disease monitoring programme across Eastern and North-Eastern India was undertaken with an aim to manage incidence of silkworm diseases co-ordinated by Central Silk Board (CSRTI-Berhampore & NSSO-Bangalore) and respective state DoS. A total of 400 seed crop samples were examined during the year in West Bengal and no pebrine incidence was recorded. Mortality recorded due to grasserie and flacherie was highest in all the crops with an average incidence of <5.44% (Fig.). However, a highest grasserie incidence of <15.5% was reported in Bhaduri P1 crop followed by P1 Shravani crop. Muscardine incidence was recorded during P1-Falguni (2%); and P1 Baisakhi (1.5%). The basic seed farms were suggested to follow appropriate preventive and remedial measures to minimize disease incidence/spread and prevent outbreak(s) in the particular crop as well as next crops.



Silkworm disease incidence of seed and commercial crop in West Bengal

The disease incidence recorded in commercial cocoon crops in West Bengal across all the seasons was <10% except during Jaistha when 10.5% grasserie incidence was reported. There was a surge in muscardine incidence (5.97%) during Falguni commercial crop. Mortality was high due to grasserie followed by flacherie under high temperature (>35°C) coupled with high humidity (>85%) conditions in

seasons Baishakhi to Bhaduri. Incidence of muscardine was recorded especially during Agrahayani and Falguni crop seasons, when low temperatures and high humidity prevailed.



Fig.Silkworm disease incidences of spring and autumn crop in East and Northeast region



Disease monitoring and sample collection of commercial Crop in WB crop commercial crop

Seed crop monitoring at DOS farms of West Bengal



Distribution of Nirmool to the farmers of West Bengal

Supply of Seri-Win at DOS farm in West Bengal

# **PMCE** Division

Dr. Dipesh Pandit, Scientist-D

# *MOE 020014SI: Popularization of Improved Sericultural Technologies for Eastern and North-Eastern India*

## Feb.-2022 – Jan.-2025

Execitive Authority: Dr. Kishor Kumar C.M., Director

Co-ordinator : Dr. Dipesh Pandit, Scientist-D, PMCE

Component-I: Popularization of New Mulberry Varieties (C-2038, Tr-23/BC259 & C-2028)

PI: Dr. Suresh K, Scientist-C & CI: Dr. Deepika K U, Scientist-B (Host Plant Division, CSRTI-Berhampore) and Incharges RSRSs & RECs

Component-II: Popularization of Bio-Control Agents for the management of mulberry pests

PI: Mr. Khasru Alam, Scientist-B (Mulberry Protection, CSRTI-Berhampore) and Incharges RSRSs & RECs

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

PI: Dr. Rahul K, Scientist-C & CI: Dr. Mihir Rabha, Scientist-B (Silkworm Pathology, CSRTI-Berhampore) and Dr. L Somen Singh, Scientist-D (RSRS-Imphal) and Incharges RSRSs & RECs

Component-IV: Popularization of Chawki, Shoot/Shelf rearing & Plastic collapsible mountages

PI : Dr. Srinivasa G, Scientist-D & CI : Dr. Shafi Afroz, Scientist-C(SEEM Division, CSRTI-Berhampore) and Incharges RSRSs & RECs

Component-V: Popularization of Sampoorna

PI: Dr. Rahul K, Scientist-C & CI: Dr. Mihir Rabha, Scientist-B (Silkworm Pathology, CSRTI-Berhampore) and Dr. L Somen Singh, Scientist-D (RSRS-Imphal) and Incharges RSRSs & RECs

## **Objectives:**

Component-I:	:	(1)	Popularization of new mulberry varieties among the farmers in E & NE India
		(2)	Impact assessment with regard to cocoon crop productivity
Component-II	:	(1)	Popularization of bio-control agents at field level for eco-friendly management of thrips and mealy bugs in mulberry.
		(2)	Impact assessment with regard to cocoon crop productivity
Component-III	:	(1)	Popularization of Nirmool, a general disinfectant with sericulture farmers of E & NE India
		(2)	Impact assessment at farmers level
Component-IV	:	(1)	Popularization of proven silkworm cocoon production technologies like Chawki and Shoot feeding/ Shelf rearing and usage of Plastic collapsible mountages among the farmers' in E & NE India
		(2)	Impact assessment on cocoon productivity at farmers' level
Component-V	:	(1)	Popularization of Sampoorna, a phytoecdysteroid formulation in E & NE India
		(2)	Impact assessment of Sampoorna on cocoon productivity at farmers' level

**Progress:** Project is just initiated as mega project

# **CAPACITY BUILDING & TRAINING**

# S. Sarkar (upto Feb. 2022) and Parameswaranaik, J.

Systematic training was imparted to the respective stakeholders on different activities of sericulture along with practical demonstrations and hands-on training programmes. A structured course, 15-months Post Graduate Diploma in Sericulture (PGDS) is offered to the participants across the country under affiliation to Kalyani University (Kalyani, West Bengal). A total of 2072 candidates were trained against the target of 1900 through PGDS, FST, TOP, STEP, TTP, EDP, intensive training, exposure visit, non-CBT & need based programmes etc. Coordination of Seri Resource Centres (SRCs; 6 Nos in West Bengal & Bihar) established to train farmers under Silk Samagra were undertaken.

# MOT 02016 EF: Seri-entrepreneurship development in Aspirational districts of North-Eastern India (DBT funded).

## [February, 2022 to January, 2024]

Parameshwarnaik J. (PI) and S. Sarker (upto Feb., 2022)

## **Objectives:**

- Promotion of 100 Seri-enterprises in aspirational districts of North-Eastern India.
- Assessment of socio-economic benefits of developed seri-enterprises.

#### **Progress:**

- Beneficiary selection is under progress in both the selected districts (Manipur & Tripura)
- Kisan nursery has been established to supply the improved mulberry saplings to the beneficiaries.
- Interview of two Project Assistants (PAs) recruitment has been done by the interview committee.
- Development of Kissan Nurseries for sapling production.
- Interview schedule development for benchmark survey.

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

PGDS Admissions (2020-21 & 21-22)				
State	Sept 2020	July 2021		
Sidle	Batch(28)	Batch(16)		
Arunachal	02	01		
Pradesh	02	01		
Assam	09	08		
J&K	04	-		
Mizoram	03	- 06		
Nagaland	09			
Jharkhand	-	01		
Meghalava	01	-		

The PGDS course includes two semesters and dissertation work with well-planned and comprehensive syllabus covering all aspects off mulberry sericulture in coordination with Kalyani University. It also includes 15-day exposure visit in each semester to major mulberry & non-mulberry sericulture areas. Majority of the students are self funded candidates and few sponcered by DoS of respective State Governments. The students are taught by experience scientific personnel working

in CSRTI-Berhampore (CSB) and honorary faculties from reputed institutions. The students are evaluated through semester-end examinations (theory and practical). They also have to undergone three months dissertation work under the supervision of experienced faculty in various disciplines and submit a report, which is evaluated by a set of examiners nominated by the Kalyani University. Successful candidates are awarded PGDS degree. Top three students are felicitated by Central Silk Board (Bangalore) by conferring Gold, Silver & Bronze medals, besides Rs. 15,000 cash award provision to the toppers.

#	Student	Title	Supervisor	
1	B. Nejeny Chakma	A promising fruit for human benefits.	Dr. Yallappa Harijan	
2	Sabili Sarma	Cross infectivity of microsporidia from insect/ pests io <i>Bombyx mori</i> L.	Bombyx	
3	Akhumbay Yimchunger Phylogenetic affiliation of Bacillus species casuing bactriosis in mulberry silkworm, <i>Bombix mori</i> . L			
4	Arentor Jamir	SWOC analysis of commercial chwaki rearing certre in Murshidabad, West Bengal.	Dr. Shafi Afroj	
5	Atul Raina (Left incomplete)	-		
6	Cheno Tep	Environmental factors for successful silkworm ( <i>Bombyx mori</i> . L) crop	Dr. T. Ranjita Devi	
7	Chngmei N Phom	A Bioinformatic approach to study the immune pathways in viral flacherie disease of silkworm.	Dr. Pooja Makwana	
8	Dhiramani Hazowary	Vision based identification & quantification of leaf surface injury & its scope in mulberry	Dr. KhasruAlam	
9	Innam Taba	Biogenic synthesis of nanoparticals from mulberry leaf	Dr. Deepika K. U.	
10	Jahnabi Das	SWOC Analysis of Ser-Entrepreneurship Development	Dr. Parameswara-Naik J	
11	Jeolam	Breeding approaches applied to develop thermo- tolerant silk worm breeds of Bombyx mori	Dr. N. Chandrakanth	
12	Jonathan Lalhruaitluanga	Mutation Breeding for Mulberry Improvement	Dr. Yallappa Harijan	
13	Lesuthong M. Yimchunger	Effects of high temperature & high humidity on Bivoltine silkworm cocoon characteristice I E & NE India.	Dr. T. Ranjita Devi	
14	Lolenyangla S Chang	Profitabality of shoot rearing in mulberry sericulture at Nagaland.	Dr. Shafi Afroj	
15	Mohidur Islam Sarkar	Effect of climate change on sericulture	Dr. Deepika, K. U.	
16	Mumpi Ering	Studies on idel characteristics of disinfection for mulberry sericulture	Dr. Mihir Rabha	
17	Parash Moni Saikia	Overview of Indian Sericulture Industry for development of seri enterprise	Dr. Parameswara-Naik J	
	Contd			

#### **Dissertation Topics of PGDS Students (2021-22)**
18	Partha Protim Neog	Status of mulberry sericulture in north east region.	Dr. S. Chakraborty
19	Pikaho Kawomi	Micro & Small scale enterprise in sericulture	Dr. Parameswara naik J
20	Rabindra Hanse	Pharmaceutical Importance of by product from mulberry sericulture	Dr. Mihir Rabha
21	Rahul Sharma	Application of molecular marker in silkworm Breeding.	Dr.A.R. Pradeep.
22	Shahnaz Khatun	Progress in Improvemet of mulberry foliage quality current status & future prespective.	Dr. K. Suresh
23	Shubam Sharma	Effect of high temperature on mulberry silkworm Bombyx mori	Dr. N. Chandra-kantha
24	Suruj Prakash	Molecular markers associated with resistance against flacherie in silkworm: A review	Dr. Pooja Makwana
25	Susmita Devi	Genetic Improvement in mulberry present status & future strateges	Dr. K. Suresh
26	Tamal Das	Mazor sucking pests of mulberry & their Biological control	Shri Khasru Alam
27	Temshinok Longkumer	Mulberry sericulture for enviornmental protection	Dr. Deepika K. U.
28	Vanlalsawmi	Bioinformatic Analysis on transient receiptor potential gene pyrexia in silkworm <i>Bombyx mori</i> L.	Dr. Raviraj V.S.

**Farmers Skill Training (FST) :** The objective of Farmers' Skill Training programme is to enhance the knowledge of sericulture farmers through theoretical and practical training, which assist them to improve the income levels. FST duration is of 5-10 days and **150** farmers were trained on various aspects of Mulberry cultivation and silkworm rearing. FST programmes were also organized in nested units of the institute REC-Dimapur (Nagaland), REC, Mothabari (W.B) and REC, Agartala (Tripura) for the benefit of the Eastern and North Eastern farmers.

**Technology Orientation Programme:** Technology Orientation Programmes (TOP) were organized with a duration of 3-5 days. These programmes were aim to upgrade the knowledge of officers/officials working in CSB/DoS with the recent technologies developed by the Institute. The main purpose of TOPs is to promote the silk enterprise to achieve the set targets in different states. A total of **211** personnel were trained against the set target of 200 in various disciplines. In the similar line, the collaborative training programmes were also organized with MANAGE-Hyderabad through virtual mode.

**Hands on Training Programme:** Hands on Training Programmes were conducted with an objective to update the practical knowledge to farmers in silkworm rearing both in chawki and late age stages. Total 02 nos of training programme were conducted in northeastern states of the country. The duration of the programme was of 10 days having 20 participants in each batch; accordingly total **40** farmers were benefitted from the programme.

**Intensive Training Programme:** Intensive training programmes (30 days or more than that) are scheduled with an objective to impart basic training on overall aspects of mulberry sericulture to officials/officers.**Twenty one (21)** personnel were trained in two batches out of set target 20 on all round aspects of mulberry sericulture.

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

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

**Trainers'Training Programme (CBT):** According to the MoU with ICAR and CSB, this institute arranged for five (5) days Trainers' Training Programme for the ICAR-KVK scientists of various states of E & NE India to update sericultural technologies for further dissemination to the field level. A total of **08** Scientists from various state undergone the training on different aspects of sericultural activities from the faculty members /experts of this Institute.

**Faculty Development Training programme:** As per the guideline of Central Office-Bangalore, the institute has organized a two (2) days Training programme on application of statistical tools in sericulture for scientists of institute and its nested units. A total of **31** scientists of CSR&TI-Berhampore and its sub units got benefitted from the training programme. That training programme was blended with hands on experience and theoritical knowledge. Subject experts were invited from from reputed University to impart the training lectures.

**Exposure Visits:** Exposure visits were conducted (1-3 days) in best sericulture practicising areas with an aim to impart the innovative knowledge on mulberry sericulture and latest technologies to the farmers/students of different states. A total of **one hundred ten (110)** trainees had undertaken the exposure visit programme (Non-CBT).

**Need Based Training Programmes :** This 5-10 days training has been organized as per demand of various state departments for imparting training on latest technologies in mulberry sericulture to the farmers /officers /officials /students and/or other stakeholders of sericulture on payment basis (Non-CBT). A total of **285** personnel were trained in 11 training programmes.

**Collabrative Online Training Programme:** This programme has been organized with Department of Zoology, University of Kalyani with 25 trainees. It was funded by RUSA component 10 of Kalyani University. Training was focused on entrepreneurship development in Chawki Silkworm Rearing. It was inaugarated with an exhibition of sericultural activities at University campus and rest of the training was conducted at CSR&TI-Berhampore. The virtual training programme was organized in collabartaion with National Institute of Agricultural Extension Management (MANAGE), Hyderabad on "Extension Management Approaches for Promotion of Sericulture Industry". The training programme was organised with an intent to upskill/reskill the extension officials of sericulture industry across the country with latest technologies for further infiltration in the grassroot level.



## Stakeholders Feedback on Training Programmes

Special Activities on Women Empowerment & Development of SC/ ST/ Weaker Sections													
Drog			Male	2			Female						
Prog.	Gen	SC	ST	OBC	Total	Gen	SC	ST	OBC	Total	Total		
PGDS (2021-22)	01	01	04	01	07	0	0	08	01	09	16		
FST	11	02	0	10	23	20	20	80	07	127	150		
TTP	05	0	01	0	06	02	0	0	0	02	08		
TOP	59	36	28	23	146	24	10	18	13	65	211		
HOT	01	07	15	03	26	0	05	08	01	14	40		
Statistical Training	20	03	02	03	28	03	0	0	0	03	31		
ITP	14	07	0	0	21	0	0	0	0	0	21		
SRC	110	73	13	267	463	326	133	05	273	737	1200		
NBT Trg (Non-CBT)	48	36	04	95	183	15	69	04	14	102	285		
Non-CBT Expo.Visit	35	16	04	18	73	13	07	06	11	37	110		
Total=	304	181	71	420	976	403	244	129	320	1096	2072		



FST @ REC-Dimapur



Need Based Training for UP Farmers



Collaborative Training Programme



Faculty Development Training Programme



Hands On Training



Trainers Training Programme

## SERICULTURAL EXTENSION ECONOMICS AND MANAGEMENT

Dr.T.D. Biswas (upto April 2021), Shri G.C. Das (upto April 2021), Dr. G. Srinivasa (from July 2021) & Dr. Shafi Afroz

Extension plays a critical role in transfering technologies developed by CSRTI-Berhampore to the ultimate users i.e. farmers through RSRSs & RECs.

### **On-going Research Projects**

## MOE02011EF: Development of Seri-Entrepreneurship through sericulture chawki business by setting up 02 Chawki Rearing Centers (CRC) as demonstrative units in Murshidabad district, West Bengal

## [April, 2021 to March, 2024]

Dr. Shafi Afroz (PI), Dr. Parameshwar Naik J, Dr. Manjunatha G.R, Dr. Srinivasa G, and Dr. Dipesh Pandit

## Budget: 20.89 lakh [NABARD: 9.37 & CRCs : 11.52]

#### **Objectives**

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



**Progress:** Concept of commercial chawki rearing introduced in Murshidabad for first time with the funding of NABARD-Murshidabad (NABARD, RO, Kolkata). It is introduced as demonstration units in Khargram and Nabagram block of Murshidabad with a brushihng capacity of 5000 dfls/batch. Almost all the farmers are rearing silkworm through direct brushing which is an old practice. Therefore, 10 awareness programmes were organized in villages of Khargram and Nabagram blocks to motivate farmers to use chawki reared silkworms in place of direct brushing.

Parameters	CRC-Khagram	CRC-Nabagram
Garden size	1 Bigha	1 Bigha
Mul. variety	S1635	S1635
TSS	33.44	36.06
TSP	32.08	35.44
Leaf moisture (%)	76.51	80.11
*mg/g.FW); TSS- Total s	solubale sugar; TSP- Tota	al solubale protein; 1 Bigha:
0.33 ac.		

Quality mulberry leaves are very much vital in chawki rearing, and hence 2 Chawki gardens (0.33 acre each) of S1635 mulberry variety with recommended package of practices were established at farmers' field in both the blocks.

With the financial support of NABARD, equipment & machines required for 5000 dfls chawki rearing were supplied to both CRCs. Total 16000 dfls of N×SK6.7 were brushed (Agrhayani-21 and Falguni-22). These chawki worms were purchased by 172 farmers (50-200 dfls) and the average yield per 100 dfls was 51 kg (Agrahayani-21) and 50 kg (Falguni-22).



Information	Particulars	Frequency (%)	Information	Particulars	Frequency (%)
	<35 years	9 (18%)	Coniculture	<20 years	22 (44%)
	35-45 years	17 (34%)	Sericulture	20-40 years	28 (56%)
Age Category	45-55 years	16 (32%)	experience	>40 years	
	>55 years	8 (16%)		<0.5 acre	40 (80%)
	Mean	43.2 yrs	Mulberry land	>0.5 acre	10 (20%)
	<4 members	6 (12%)		Mean <sup>#</sup>	0.33 acre
Family size	4-6 members	14 (28%)		S1635	29 (58%)
	>6 members	30 (60%)		S1635 + S1	5 (10%)
	Illiterate	17 (34%)	Mulberry variety	S1635/S1+local	9 (18%)
	Func. Literate	6 (12%)		S1	3 (6%)
Education	Pri. school	11 (22%)		Local	4 (8%)
	Sec. school	13 (26%)		Dala rearing	40 (80%)
	College & Above	3 (6%)	Rearing method	Shelf rearing	6 (12%)
	<0.5 acre	17 (34%)		Both	4 (8%)
Farming land	>0.5 acre	33 (66%)	Labour	Only family labor	39 (78%)
	Mean*	0.69 acre	Labour	Family + hired	11 (22%)
Main cource of	Sericulture	96%		Silkworm seeds	30 (60%)
incomo	Farming	4%	Rearing Materials	Chawki worms	14 (28%)
income	Business			Both	6 (12%)
	3 crops	3 (6%)	Boaring capacity	<100 dfls	34 (68%)
Crops / Annum	4 crops	9 (18%)		100-200 dfls	14 (28%)
	5 crops	38 (76%)	/ стор	>200 dfls	2 (4%)

## Before commencement of the project, benchmark survey in the project area was made with 50 farmers. Detailed information is presented below

	Multimedia Activities (2021-22)	
Units	Topics	Langauge & Channel
Radio programme		
	Biological control of mulberry pests	Bengali
CONTEDIT	Pests and diseases of mulberry and control measures	(AIR-MSD)
Live Facebook pro	ogramme	
RSRS-Kalimpong	Seed Act Awareness Prog. Telecast on face book through Gorkha Channel	Nepali
Twitter @ CsrtiBe	rhampore	
Instagram @ CSR	TIBERHAMPORE	
Facebook @ East	North East Silk	
Whatsapp @ CSR	TI-Berhampore and Sub-units of CSRTI-Berhampore	

## **Extension Communication Programmes (ECP):**

	-		•								(Numbe
Chata		AP		Prevention of the second secon		TD		RKM		Total	
State	Unit	#	F	#	F	#	F	#	F	#	F
	CSRTI-BHP	24	1020	5	400	4	80			33	1500
West Bengal	RSRS-Kalimpong	4	216	4	231	2	40			10	487
	REC-Mothabari	6	633			6	158			12	791
Jharkhand	REC-Bhandra	3	179			1	25			4	204
Odisha	RSRS-Koraput	2	115	5	279	2	59			9	453
Assam	RSRS-Jorhat	2	100	6	305	3	60	1	200	12	665
incl. BTC	REC-Mangaldoi	4	211			4	92			8	303
Sikkim	REC-Mamring	3	159	1		3	82	1		6	241

Contd.....

Mizoram	REC-Aizwal	3	150			4	81			7	231
Tripura	REC-Agartala	4	202			4	90			8	292
Meghalaya	REC-Shillong	3	150			4	83			7	233
Nagaland	REC-Dimapur	4	205			4	100			8	305
Ar. Pradesh	REC-Sille	3	167			3	66			6	233
Total		65	3507	20	1215	44	1016	1	200	130	5938

Note: #: Events; F: Farmers; AP: Awareness prog.; FFD: Farmers' Field day; TD: Technology demos; RKM: Resham Krishi Mela







Demonstration of shoot rearing technology



Demonstration of chawki rearing technology

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

CSB in association with DoS of various states has introduced the concept of Cluster Promotion Programme with an ambitious plan of producing bivoltine raw silk. The Institute administered 8 mega clusters through it's nested units in 8 Eastern and North Eastern states (West Bengal-2; Assam &

Nagaland-2; Manipur-2; one each in Mizoram & Tripura). Accordingly, group of villages were selected by each of the Cluster Development Facilitator (CDF) based on the potentiality of the area for practicing bivoltine sericulture. Various improved technologies were introduced in the cluster villages and were managed and supervised directly by the scientists jointly with the DoS counter part, especially with the co-operation and participation of farmers. Under each of these clusters' farmers were facilitated for bivoltine



technology adoption with an effective Research-Extension-Farmer linkage. As a result, the cocoon productivity levels in the cluster area and and thereby the income has increased at farmer's level.

**Performance of clusters:** The 08 Mega clusters of Eastern & North Eastern zone have produced 956.63 MT of cocoons and recorded 110.34 MT (53.30%) of raw silk production (BV: 55.72 MT & ICB: 54.64 MT) against the target of 207 MT; which was 35.69 MT less as compared to the previous year (2020-21), which may be attributable to COVID-19 pandemic situation. During 2021-22, a total of 22.20 Lakh dfls (BV: 10.10 & ICB: 12.10) were reared against the target of 34.30 Lakh dfls (BV: 26.30 & ICB: 8.00) with an achievement of 76.21%. The graphical representation of performance of clusters in the last nine years is incidated in the figure.

State / Mega Cluster	Bivoltine	ICB
West Bengal (Malda & Murshidabad)	• SK6×SK7 / BHP-DH / TT21xTT56	<ul> <li>12YxBFC1 / N×(SK6×SK7)</li> </ul>
Assam & Nagaland (Assam-Lower & Assam-Upper)	SK-hybrids / Double hybrids	
Manipur (Plain & Hill)	<ul> <li>FC1×FC2 /C×J /CSR2×CSR4</li> <li>SK-hybrids</li> </ul>	
Mizoram (Aizawl)	• SK-hybrids / J112	• N×J112
Tripura (West)	FC1×FC2 /SK-hybrids	<ul> <li>12YxBFC1/ PM×FC2</li> <li>M6DPC×(SK6×SK7)/ N×(SK6×SK7)</li> </ul>

Improve	Improved Cross Breed (ICB) performance under CPP in East & North East Zone (2021-22)													
Mega Cluster	Dfls (Lakh)		Cocoon	Yield/100 dfls	Raw Silk (MT)									
	Target	Ach.	Production(MT)	(kg)	Target	Ach.	% Ach.							
West Bengal														
Malda	4	6.1105	253.927	41.56	16	25.393	158.71							
Murshidabad	4	4.103	189.305	46.14	16	20.859	130.37							
Tripura														
West Tripura		1.880	74.558	39.66		08.386								
Total/Avg.	8.00	12.094	517.79	42.81	32.0	54.638	170.74							

Bivoltine hybrids' performance of under CPP in East & North East zone(2021-22)										
Mega Cluster	Dfls (	Lakh)	Cocoon	Yield/		Raw Silk (MT)				
	Tar.	Ach.	Production (MT)	100 dfls (kg)	Tar.	Ach.	% Ach.			
West Bengal										
Malda	3.5	1.149	54.325	47.28	28.4	7.754	27.32			
Murshidabad	3.25	1.201	65.508	54.54	26.6	9.347	35.14			
Manipur		· · · · · ·								
Manipur-Plain	2.75	1.670	61.69	49.35	17.50	7.65	43.71			
Manipur-Hill	2.75	1.250	60.98	48.78	17.50	7.55	43.14			
Assam & Nagaland		·								
Assam-Lower	4.5	1.945	71.661	44.24	30.0	8.71	29.03			
Assam-Upper	4.25	0.564	13.279	23.54	24.0	1.644	6.85			
Mizoram		·								
Aizawl	2.80	2.3	110.4	48.0	16.0	12.98	81.13			
Tripura				·						
West Tripura	2.50	0.02	0.994	49.7	15.0	0.117	0.78			
Total/Avg	26.3	10.100	438.837	43.45	175.0	55.752	31.86			

Mega Clusters	CSB	DoS
West Bengal	·	
Malda	Boya Vijaya Naidu, Sci-D, REC-Mothabari; <u>recmothabari@gmail.com</u> ; 9441984340 Dr. S.N. Bagchi, Sci-D, SSPC- BHP <u>bagchisnb5@gmail.com</u> , 8900383227	Shri Santosh Kumar, DD(T)[I/C], Malda; <u>malseri2@gmail.com;</u> 9732119762 Dr. T. Mukherjee, DD(T)[I/C], Birbhum; <u>birseri@gmail.com;</u> 8250893776
Murshidabad       Dr. Srinivasa G., Sci-D, CSRTI-Berhampore; <u>extn.csrtiber@gmail.com;</u> <u>bvcell.csrti@gmail.com;</u> 9907547467		Shri S. Goswami, DD(T)[I/C], BHP; <u>berseri1@gmail.com;</u> 9434723095 Mr. Supratim Das, AD(T), Nadia; <u>nadiseri@gmail.com;</u> 9830105014
Assam & Nag	aland	
Assam-Lower	Dr. B. K. Basumatary, Sci-D, REC-Mongaldoi, Darrang <u>basumatary.bene@yahoo.com</u> ; 9435304453	Mr. Jagesh C. Talukder, ADS-Mongaldoi, <u>adsofficemld@gmail.com;</u> 9101407835 Shri Anjan Kumar Chakraborty, AD(Seri)- Udalgiri; 9435181586
Assam-Upper	Dr. P. Kumaresan, Sci-D, RSRS-Jorhat; <u>rsrsjor.cdsb@nic.in;</u> 8903264292 Dr. Kartik Neog, Sci-D, REC-Dimapur; <u>recdimapur.nagaland@gmail.com;</u> 7085055608	Shri Kishore Sharma, ADS-Jorhat; kishores <u>armabordoloi@gmail.com;</u> 9435518260 Mr. Yashimeren, DSO-Dimapur, <u>yashilongchar@gmail.com;</u> 9436436237
Manipur	1	
Manipur-Plain Manipur-Hill	Dr. L. Somen Singh, Sci-D, RTRS-Imphal; <u>somenlaishram@yahoo.com</u> ;9436033596	Sri C. M. Paul, DD-Ukhrul; 7085164519 Mr. G. Vunglian, AD-Churachandpur; 9862113806
Mizoram	·	
Aizawl	Dr. Sakthivel, N, Sci-D, REC-Aizawl; <u>recaizawl2017@gmail.com;</u> 9842761789	Shri V. Zothansanga, District Sericulture Officer, <u>Aizawl, dsoproject@gmail.com</u> , 878752415
Tripura		
West Tripura	Dr. N. Biswas, Sci-D, REC-Agartala; <u>sgbcrsti@rediffmail.com;</u> 9615179959	Mr. Jyoti Bikash Chakma, SS-Agartala; 9436509681

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

## **REGIONAL SERICULTURAL RESEARCH STATIONS (RSRSs) & NESTED UNITS**

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

## Mandate of the RSRSs:

- Identify region specific problems, undertake research studies and feedback analysis in consultation with respective DoS and allied units.
- OST and OFT for test verifying the technologies developed by main research institutes and suggest fine tuning/ modifications of such technologies to provide solutions to region specific problems.
- Conduct on-farm trials (OFT)/ demonstration of the selected technologies with selected farmers in coordination with DOS.

- Popularize the proven technologies using various extension methods through cluster area approach.
- Conduct training for both grass root level extension staff of DOS and farmers on advanced technological aspects.
- Crop monitoring and troubleshooting / crisis management.
- Conduct survey on crop yield, economics and disease & Pest surveillance for forecasting/ forewarning.
- Coordination of Cluster Promotion |Programme.
- Soil health analysis and database maintenance of sericulture farmers.

#### Mandate of the RECs:

- Frontline demonstration of technologies through selected farmers in coordination with DoS.
- Resource centre for critical inputs & seri. appliances such as mulberry cuttings, silkworm seed, chemicals etc.
- Conduct farmers' training on various technological inputs.
- Coordination with DoS and allied Department in all extension activities.
- Conservation of eco races prevailing in the region.
- Collection of feedback on technologies/services, analysis and crop monitoring.

Unito			Admin 9		Farm based Units		
& Command Area	Scientists	Tech. Staff	supp. Staff	TSFW/ SFW	Total Area (Acres)	Mulberry (Acres)	
RSRS-Kalimpong (West Bengal)	Mr. Zakir Hossain, Sci-D Dr. Harish Babu, Sci-B	7	6	18	15.785+ 14.585	4.0+ 3.0 (muga)	
REC-Mamring (Sikkim)	STA Incharge	3	1	-	-	-	
RSRS-Koraput (Odisha)	Dr. Dip Kumar Gogoi, Sci-D	8	7	13	50.00	6.50	
RSRS-Jorhat (Assam)	Dr.P. Kumaresan Sci-D	4	2	19	12.10	7.50	
REC Agartala (Tripura)	Dr. Narayan Biswas Sci-D	3	-	2	1.00	0.50	
REC Aizawl (Mizoram)	Dr. N. Shaktivel Sci-D	1	1	-	-	-	
REC Dimapur (Nagaland)	Dr. Kartik Neog Sci-D	4	2	4	10.00	0.50	
REC Mongaldoi (BTC)	Mr.B. K. Basumatary Sci-D	2	2	1	7.00	3.30	
REC Shillong (Meghalaya)	Dr. N. Balachandran Sci-D	2	1	1	2.00	1.00	
REC Sille (Arunalchal Pradesh)	Mr. Lohit Sonowal Sci-C	3	2	4	1.5	1.20	
REC-Mothabari (West Bengal)	Mr. Boya Vijoya Naidu Sci-D	5	1	5	2.43	0.66	
REC-Bhandra (Jharkhand)	STA Incharge	3	1	20	11.35	6.25	

## Manpower of RSRSs & Nested RECs

## **RSRS KALIMPONG:**

RSRS, Kalimpong is situated at an elevation of 3550 feet above and is ideal for bivoltine sericulture. Three prominent rearing seasons of this region are Spring, Summer and Autumn. Temperature varies from 5°C to 33°C and relative humidity from 33-100%. Annual rainfall ranges from 1600-2500 mm distributed over 96-110 days. RSRS, Kalimpong initiated its journey on 15<sup>th</sup> October, 1943. This station has made a place for itself as **RESHAMBARI** in the tourist map of Kalimpong in sub-Himalayan belt of India.

## **On-going Research Project**

## MTL 02017 CN: Study on sericulture based IFS in hilly region of West Bengal

## [March, 2022 to February, 2024]

## **Objectives:**

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

## **Progress:**

The project is just initiated. 60 numbers of farmers (30 experimental farmers+30 Benchmark) were identified and preparation of questionnaire for primary data collection through personal interview method is under progress.

## **Routine Programmes:**

## A. Maintenance and evaluation of Bivoltine/Multivoltine germplasm breeds

Bivoltine germplasm breeds collected from various sources maintained at RSRS, Kalimpong were reared during Spring (April-May) crop. The cellular rearings were conducted following standard rearing technology/conditions. Data on rearing performance and cocoon characteristics were documented and verified against the passport data. The selected cocoons were utilized for seed production and dfls were preserved in different hibernation schedules. During Spring season, 50 germplasm breeds, 12 hybrids and 22 breeds received from CSR&TI BHP were reared for evaluation and 3395 dfls produced and 2795 dfls (502 dfls Multivoltine, 565 dfls pure breeds and 1728 hybrids) supplied to CSR&TI BHP and 150 dfls supplied to DoS, Chhattishgarh. In summer crop 4 Nistari lines, one 12 Y and 2 FC lines were reared. During autumn season 30 dfls of 12 Y and 2 dfls of each of Nistari lines were reared. 450 dfls produced during Spring crop 21 were preserved in cold storage for utilization for next spring season 2022. During summer crop 1787 dfls produced (1050 dfls of Nistari lines, 189 dfls of 12 Y and 548 dfls of BHP FC lines) and while during autumn crop rearing 1147 dfls produced (825 dfls Nistari lines and 323 dfls of 12 Y). During the year 5897 dfls (Bivoltine hybrid, double hybrid, FC line, 12 Y and Nistari lines) were supplied to CSR&TI, BHP.

## **B.** Extension Activities:

RSRS-Kalimpong along with REC-Mamring have undertaken various extension / Training/ Technological Demonstration /developmental activities/programmes in the hilly regions of WB & Sikkim

## **Other Activities:**

- To increase the mulberry acreage in the Kalimpong and adjoining state of Sikkim, BC<sub>2</sub>59 cuttings are being supplied to the nterested farmers through KVK Namthang, Sikkim.
- One radio programme in All India Radio, Kurseong, Darjeeling was delivered in local vernacular Nepali.
- Regular cleanliness work under Swachhata abhiyan programme and conducted Swachhata Pakwada from 01.03.2022 to 15.03.2022.
- Directorate of Sikkim along with Sericulture farmers visited this station on 27.12.2021.
- Member Secretary Visited to RSRS Kalimpong on 27.09.2021.
- Director, CSR&TI, BHP visited and attended the Central Seed Act programme at RSRS Kalimpong on 17.03.2022 as resource person.
- Uploading of various programmes in the social networking site regularly



Visit of MS, CSB to RSRS Kalimpong on 27.09.2021



FFD at Changdung, Kalimpong on 17.12.2021



Aw. Prog. on 22.12.2021 with KVK Namthangat at Sukraboray village, Sikkim. Shri Shiva Koti I/c KVK Namthang addressing the Farmers.

#### Photographs of the activities



TD conducted at Saku, Sikkim on 23.10.2021



Aw. Prog. at Rabitar, Sikkim on 25.11.2021



Director CSR&TI, BHP interacting with farmers during Central Seed Act Prog. on 17.03.2022 at RSRS Kalimpong

**REC, Mamring, Sikkim** is working under RSRS, Klimpong and discharging R&D activities related to the bi-voltine mulberry sericulture at the farmers level in association with DoS Sikkim. Apart from bi-voltine mulberry sericulture DoS will conduct Muga and Eri rearing too where our unit extended all kind of support and because of it, this unit has been designated as Multi Tasking Unit.

## **RSRS Koraput**

Regional Sericultural Research Station, Koraput (Odisha) was established to provide R & D support to the mulberry a sericulture industry in the state of Odisha. The station is rendering technical service to the mulberry Sericultural farmers of the state. It also caters the technical services to the states of Chhatisgarh It also extends technical support to the farmers through two Cluster Promotion Programmes in Kashipur and Ghatagaon clusters in coordination with the Directorate of Textiles and handlooms, Government of Odisha.

**Maintenance of Bi and Multivoltine silkworm races/breeds :** Bi and Multivoltine breeds/races collected from various sources are maintained at RSRS-Eri BSF, Koraput. Another 10 local bivoltine breeds (Kora1 to 10) were also maintained in the station, however they were discontinued from January' 2022 as per the instruction of main institute. Multivoltine races were not reared for the crop May-June' 2021. Maintenance has been carried out through cellular rearing and by adopting the existing standard procedure. Rearing performance data were recorded in four different crop seasons of the year (2021-22) and selected cocoons were utilized for seed production.

**Maintenance of Eri silkworm races/breeds :**The Eri silkworm breed C-02 has been maintained at RSRS-Eri BSF since October' 2021. Maintenance has been carried out through cellular rearing and by adopting the existing standard procedure.

Rearing performance C-02 Eri silkworm breed in different crops during 2021-22.										
Breed/	Crop	Nos of	Hatching	Сосоо	n yield	Yield	Cocoon	Shell	SR	ERR
Race		dfls	(%)	Wt. (kg)	No.	(No)/kg	wt. (g)	wt. (g)	(%)	(%)
C-02	Oct-Nov' 21	50	80	34.67	10403	300	2.90	0.38	13.10	78
C-02	Dec'21- Jan'22	20	78	10.14	4421	436	2.24	0.27	12.05	88
C-02	Feb-Mar' 22	10	90	8.20	3600	439	2.28	0.30	13.10	83

## **Collaborative R&D Projects and Activities:**

- > Evaluation of the performance of mulberry Genotype C-9 under red and laterite soils (PIE- 02003SI)
- All India co-ordinated experimental trial for mulberry varieties phase IV (PIE 13001MI: AICEM-IV)
- Final yield trial of promising high yielding mulberry genotypes for Eastern and Northeastern India (PIB02010SI).

Exte	Extension Communication Progm.							
#	Particulars	No.						
1.	Resham Krishi mela	-						
2.	Technology Awareness	02						
3.	Field Day	05						
4.	Technology Demonstration	02						

- > Survey and Surveillance (Forewarning) of mulberry diseases of Eastern and North Eastern India.
- > Survey and Surveillance of Mulberry Pests in the Eastern and North Eastern Regions of India
- Survey, Surveillance and monitoring of Silkworm diseases in seed & commercial crops in Eastern and North Eastern India

**Extension Activities:** Undertaken various extension /Training/Technological Demonstration /developmental activities /programmes

## **RSRS** Jorhat

The Regional Sericultural Research Station, Jorhat is engaged in Research and Development activities in mulberry sericulture under the technical and administrative control of CSRTI-Berhampore. To improve production and productivity in mulberry sericulture in N.E. States, six Research Extension Centers namely, Shillong (Meghalaya), Aizwal (Mizoram), Dimapur (Nagaland), Agartala (Tripura), Mangaldoi (Assam) and REC Sille, Arunachal Pradesh were established by Central Silk Board under the control of Regional Sericultural Research Station, Jorhat. These extension centers are constantly working towards the extension & development activities in mulberry sericulture in particular.

## **Concluded Project**

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

## [July, 2018 to June, 2021]

P. Kumaresan (PI) and Manjunatha, G. R.

## **Objectives:**

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

## **Outcome of the project**

Efficacy of Spinosad 45%SC was studied on Pink Mealy bug from Ist fortnight of April, 20 to IInd fortnight of Dec., 2020 with 18 Trial studies. On an average the Higher Pest Reduction % was recorded in Barrier with Neem cake (T3) 88.63% in 15 days interval observation, followed by T4 (78.17%), T2 (77.22%), T1 (76.12%) compared to control/ T5 (56.17). Bio assay study for efficacy of Spinosad sprayed leaves on rearing with Sk6,7 was done during Early Autumn (Oct., 2020), which revealed that there is no any significant variation found between Treatment vs control when reared 30 days after spray. But when reared 15 days after spray found serious effect on silkworm mortality. Hence the safety period of Spinosad 45% SC is decided as 30 days. The final report has been submitted on 9.07.2021 in RMIS-10 format. The Revised-Final report including Cost: Benefit ratio on avoidable leaf loss and cost of production on cocoon production was estimated.

	Performances of barrier systems against pink mealybug across seasons									
Treatments & Seasons	% Incidence	PIOC	% Damage Index	PDOC	% Reduction	PROC				
T1	58.93	-6%	33.91	13%	68.24	43%				
T2	61.78	-1%	35.61	18%	72.70	52%				
Т3	59.69	-5%	36.80	22%	85.60	79%				
T4	56.61	-10%	31.04	3%	75.35	58%				
T5 (Ctrl)	62.69		30.07		47.73					
SEm±	0.566		0.348		0.407					
CD@5%	1.649		1.013		1.184					
Summer (S)	62.73	0%	45.10	50%	66.20	39%				
Rainy (R)	53.96	-14%	23.43	-22%	68.22	43%				
Winter (W)	63.13	1%	31.92	6%	75.35	58%				
SEm±	0.731		0.449		0.525					
CD@5%	2.129		1.307		1.529					

S x T1	61.48	-2%	42.38	41%	66.39	39%
S x T2	67.48	8%	50.14	67%	75.08	57%
S x T3	57.77	-8%	52.66	75%	83.82	76%
S x T4	59.67	-5%	42.36	41%	72.51	52%
S x T5	67.28	7%	37.99	26%	33.20	-30%
R x T1	53.39	-15%	26.78	-11%	63.20	32%
R x T2	56.75	-9%	24.85	-17%	65.46	37%
R x T3	56.78	-9%	24.04	-20%	84.26	77%
R x T4	49.21	-22%	20.39	-32%	75.78	59%
R x T5	53.65	-14%	21.11	-30%	52.42	10%
W x T1	61.92	-1%	32.58	8%	75.14	57%
W x T2	61.11	-3%	31.85	6%	77.55	62%
W x T3	64.53	3%	33.69	12%	88.72	86%
W x T4	60.95	-3%	30.36	1%	77.77	63%
W x T5	67.13	7%	31.11	3%	57.56	21%
SEm±	1.266		0.778		0.909	
CD@5%	3.687		2.265		2.647	

Correlation of pink mealybug population with average temperature across months



Correlation of pink mealybug population with average RH across months



Correlation of pink mealybug population with rainfall across months



pes	ciciue sprayeu muibe	ily leaves	
Parameters	Treatment	Control	P-value (t-stat)
Fecundity (No)	529	531	0.932
Hatching (%)	97.60	96.10	0.085
10 matured Larval Wt. (g)	31.53	31.9	0.703
ERR by 10k larvae (No)	6800	6766	0.906
Cocoon Yield/100 dfls (kg)	45.01	44.78	0.902
Cocoon Wt. (g)	1.401	1.403	0.766
Shell Wt. (g)	0.251	0.25	0.633
Shell (%)	17.90	17.80	0.496
Note: P<0.05 signals the significar	nt at 5%		

#### Bio-assay Performances with SK6xSK7 between treated & untreated pesticide spraved mulberry leaves

#### Estimation of cost of production on avoidable leaf loss

#	Parameter	Qty./ha	Cost (Rs.)
Ι	In put Cost involved:		
1	Avg. Leaf yield [MT/Ha/]	8.934 MT	Rs. 26802.00
2	Cost of Spinosad 45% SC (@20 lit/Acre @Rs.4850.00/Lit)	790ml/ ha	Rs.3831.00
3	Cost of Neem cake (@ Rs.230.00/Kg. @ 10 Kg/Acre)	25 kg/ha	Rs.5750.00
4	Hand Sprayer (@Rs.2500.00)	1 No.	Rs.2500.00
5	Man power (@10 Mandays @ Rs.500/MD)	10 MD	Rs.5000.00
	Total In put cost:		Rs.43883.00
II	Cost of Avoidable leaf loss:	Qty./ha	Cost (Rs.)
a.	Leaf yield of infected plot [MT/Ha]	5.896 MT	Rs.17688.00
			Loss: (- Rs.9114.00)
b.	Avoidable Leaf yield loss in Control (Spinosad45% SC only)	1.720 MT	Rs.5160.00
			Profit (a):Rs.3954.00
с.	Avoidable Leaf yield loss in Treatment (Spinosad45%SC + Neem cake)	0.447 MT	Rs.1341.00
			Profit(a):(Rs.7773.00)

## Estimation of Cost of production on Cocoon production

#	Parameter				Cost invo	lved (Rs.)			
		No	rmal	Tukra I	nfected	Cor	ntrol	Trea	ated
		Plant	tation	plantation		(Spinosad only)		(Spinosad+Neem cake)	
		Unit	Amount	Unit	Amount	Unit	Amount	Unit	Amount
		(Qty.)	(Rs.)	(Qty.)	(Rs.)	(Qty.)	(Rs.)	(Qty.)	(Rs.)
i.	Dfls Required (@Rs.700/100dfls)	600/ha/ crop	4200	393/ha/ crop	2751	480/ha/ crop	3360	570/ha/ crop	3990
ii	Leaf Required (@Rs.3.0/kg)	8934 kg/ha	26802	5896 kg/ha	17688	7214 kg/ha	21642	8487 kg/ha	25641
iii	Cost of Rearing items & disinfetants		20000		15000		18000		20000
iv	Fixed Cost Depriciation value of Building & equipments		5000		5000		5000		5000
Tot	al In-Put Cost:		56002		40439		48002		54631

i	Cocoon yield/ 100 dfls (240kg/ 600 dfls)		34kg/100 dfls (15% Crop loss)		38kg/100 dfls (5% Crop loss)		40kg/100 dfls (0% Crop loss)	
ii	Cocoon Cost	96000	134 kg @Rs.400 /kg	53600	182.4 kg @Rs.400 /kg	72960	228 kg @Rs.400 /kg	91200
iii	Return from by-products	5000		2000		4000		5000
Tota Cos	al Return t	101000		55600		76960		96200
Net	Return Cost	44998		15161		28958		41569
Cos rati	t:Benefit o	1.24:1		2.67:1		1.66:1		1.31:1

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

## [March, 2020 to June, 2021]

Co-ordinators: CSB: Satyanarayana K, Prashanth S & Kumeresan P;

AAU-Jorhat: Gogoi A. S., Barua S. C., M Deka & P. Das; TTRI-Jorhat: R C Gogoi & D. J. Hazarika

## **Objectives:**

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

**Role of RSRS, CSB, Jorhat, Assam:** To supply the mulberry leaf to TTRI, Jorhat and AAU, Jorhat for production of mulberry Tea and mulberry green tea and necessary evaluation. During the period under report a total of 180.50 kg leaves, comprised of 48.5 kg T1(S-1635), 89.5 kg T2(K2), 24.5 kg T3(BC-<sub>2</sub>59) and 8.0kg T4(C-2038) have been supplied from RSRS, Jorhat in 46 spells). The second phase of project has been initiated by TTRI, Jorhat. A total 50 kg of BC<sub>2</sub>59 & K2 tender leaves have been supplied to TTRI, Jorhat. The project has been concluded, the final report has been submitted to CSB-Bangaluru by AAU, Jorhat.

**Collaborative R&D Projects/Activities:** RSRS-Jorhat has the following two collaborative projects and other continuous activies with the main institute. The unit is involved in the collection of data from experiments/farmers/DoS and the respective information is reported discipline wise.

- AICEM-IV (All India Co-ordinated Experimental Trial for Mulberry varieties)
- Forewarning of mulberry/silkworm pest & diseases of Eastern and North Eastern India

## New Nursery plantation Technologies:

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





RKM- RSRS-Jorhat



Inaugural of Hands-On-training Programme



Demonstration & Training on leaf cutting for brushing / feeding



Brushing demonstration of BHP-DH



Demonstration on resumption after 1st moult out



Demonstration on application of Bed disinfectant Labex dusting



Demonstration on Bed cleaning after Ist moult out

## **EXTENSION ACTIVITIES:**

Activities	Achievements
ТоТ	<ul> <li>Popularisation of New Mulberry variety; Sapling: 4100 distributed ; covered 2.128 acre &amp; 99 farmers; variety: C-2028, C-2038</li> <li>Popularization of new silkworm hybrid : ToT-OFT 1600 dfls</li> <li>Popularisation of shelf rearing: Farmer-80 Nos; Beneficiary : 46.5 kg and Control: 43.5 kg per 100 dfls</li> <li>Validation of Seriwin more effective and on par with the Labex as bed disinfectant.</li> </ul>
ECPs	<ul> <li>✓ ECP 62 events (2503 Participants)</li> <li>✓ Resham Krishi Mela (RKM): 200 farmers; Awarded best farmers: 6; Phamplet released:1</li> </ul>
СРР	<ul> <li>✓ 6 Clusters in NE States</li> <li>✓ BV: 38.65 t raw silk ; dfls: 7.749 lakh 43.94 kg/100 dfls</li> </ul>
NERTPS	✓ Technical guidance (ISDP & IBSDP) in NE States
Training	<ul> <li>Programmes- EDP, Hands on training, Exposure vist, Demonstration etc</li> </ul>

## Events organized at REC=Agartala, Tripura:

A Technology Orientation Programme on Pebrine detection was organized by REC, CSB, Agartala on 17.02.2022 at Indranagar, Agartala, Tripura. Total 25 (twenty-five) persons attended in the training nominated by Director, DHHS, Govt.of Tripura. Course materials were distributed to the participant. In the valedictory session the participants actively interacted with the Scientist of CSB and DHHS officers. At the end of the programme the participants appeared in evaluation test and their scoring was very good.



Shri N. Murasingh, J.D, DHHS, Tripura interacting with trainee



Dr.N. Biswas, Sci-D, REC, Agartala, Tripura interacting with trainee



Sri P.K. Saha, SDO, DHHS, Tripura interacting with trainee



Shri D. Saha, SDO, DHHS, Tripura delivering his lecture



Mother moth for method demonstration of Pebrine detection



Method demonstration of Pebrine detection

## **TRANSFER OF TECHNOLOGY**

The following ToT rogrammes were undertaken for popularizing the recently developed sericultural technologies into the field in E & NE zone through on farm trails (OFT) and on station trial (OST) during 2021-22. The programmes were implemented as per the specific guidelines and the beneficiaries were selected by the extension units in consultation with respective DoS.

## *OST-1:* Evaluation of High yielding and Bacterial leaf spot resistant mulberry genotype C-7.

Deepika KU (PI-CI) & In-charges of RSRSs /RECs

#### **Objectives:**

To evaluate promising bacterial leaf spot resistant & high yielding genotype C-2070 in E & NE States.

Experimental plantations of test genotypes C-2070 along with two checks S-1635 & C-2038 was established in six locations (Irrigated: CSRTI-Berhampore & REC-Mothabari; Rainfed: RSRS-Koraput, REC-Mamring, Mangaldoi and Dimapur). The plantation was pruned as per local crop schedule and mainatained with recommended agronomic practices at six locations in E & NE States. Evaluated C-2070 along with checks for leaf productiivty and bacterial leaf spot severity during Mar 2021 crop under one irrigated and five rainfed centers. C-2070 recorded 4.20 t/ha under irrigated which was on par with the check variety C-2038 (5.49 t/ha). In rainfed (Koraput) bacterial disease seveity not observed in test genotypes and low incidence in check varieties (<1 PDI). Further, leaf yield of C-2070 (4.21 t/ha) was on par with the check variety C-2038 (4.72 t/ha).

	Leaf & Y	rield para	ameters	under ir	rigated c	condition	ו (CSRTI	-Berham	ipore)	
Variety	LMC	MRC	LA	CCI	LMS	LFH	NPS	LLS	TLS	LY
	(%)	(%)	(cm <sup>2</sup> )		(nos)	(%)	(nos)	(cm)	(cm)	(t/ha)
C-2070	76.10	74.70	157.8	19.5	20	28.6	15	89*	793	4.2
S-1635	76.89	74.40	114.7	21.5	19	29.3	11	77	784	4.0
C-2038	79.80	75.40	214.6	18.3	18	26.2	14	77	876	5.5
CD 5%	2.90	NS	9.3	NS	NS	NS	3	7	NS	NS
CV (%)	1.60	1.10	25.02	10.9	4.3	9.9	20.2	3.8	7.0	18.8

<sup>[</sup>LA: Leaf area, LMC, Leaf moisture content, MRC: Moisture retention capacity, CCI: Chlorophyll content index, LMS: Leaf per meter shoot, LFH: Leaf fall at harvest, NPS: No. of primary shoots, LLS: Length of longest shoot, LY: Leaf yield]

## *OST-2: Evaluation of High yielding and Low temperature stress tolerant varieties C-2060* & *C-2065.*

## Suresh, K., and In-charges of RSRSs/ RECs

#### **Objectives:**

To evaluate promising high yielding and low temperature stress tolerant genotypes C-2060 & C-2065 in subtropical condition.

Low-temperature stress (LTS) is one of the major abiotic stresses that affect mulberry crop growth and ultimately decrease leaf yield, especially in the cooler seasons of subtropical regions. The

plants remain dormant during November to Febrauray and sprouting of buds along with growth of plants starts when temperatures increase above 13°C in subtropical climate. The development of mulberry varieties with early spouting and low-temperature stress tolerance is necessary for improving silk productivity. Experimental plantations of two test genotypes C-2060 (C-01) & C-2065 (C-11) along with two checks S-1635 & C-2038 or BC<sub>2</sub>59/S-146 & Tr-23 was established in three of five locations (Irrigated: CSRTI-Berhampore Rainfed: RSRS-Jammu & Sahaspur). The plantation was pruned as per local crop schedule and mainatained with recommended agronomic practices for evaluation of leaf productivity and quality under irrigated condition.

## OST-3: Low cost drip fertigation system in mulberry for Eastern and North Eastern India

Yallappa Harijan (PI, from Oct. 2021), Suresh K (Jun-Sept, 2021), R. Mahesh (upto May, 2021), P. Kumaresan, B.K. Basumatary, K. Neog & Zakir Hossain, K. Alam (upto June, 2021), D KGogoi (from Sept. 2021), Chakraborthy, S (upto Jun, 2021) & Vijaya Naidu (from Aug, 2021)

## **Objective:**

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

Mulberry productivity and quality can be greatly improved with efficient water and nutrient management. In this regard, the developed package for low-cost drip fertigation systems (DTF& DKF) based mulberry cultivation was validating at different in E& NE states. The low trunk S-1635 plantation with 3'×3' spacing at five test centres and medium trunk BC<sub>2</sub>59 plantation at RSRS Kalimpong was utalized for evaluating for leaf producitivty and quality under low cost drip fertigation based cultivation system. The seasonal mean leaf yield under LCDF system and conventional system of cultivation at six test centres was recorded. The pooled leaf yield ranged from 247 g/plant (RSRS-Jorhat) to 637 g/plant (REC Mangaldoi). Drum kit fertigation recorded higher leaf yield in S-1635 at CSRTI-BHP (34.74%), RSRS-JHT (24.75%), RSRS Koraput (48.98%), REC- Mangaldai (32.99%) and REC Dimapur (35.81%) compared to conventional system of cultivation. Similary in Hills, BC<sub>2</sub>59 recorded higher leaf yield (26.97%) under Drum kit fertigation compared to conventional system of cultivation at RSRS- Kalimpong. Overall, Drip tape & drum-kit fertigation systems recorded 36% & 34% higher leaf yield over control at CSRTI-Berhampore and rainfed areas of E & NE states respectively.

Performance Drip fertigation system based cultivation							
Tost contros		Leaf yield (g	/plant)				
Test centres	Drip fertigation	Control	% Improvement				
CSRTI- BHP	574	426	34.74				
RSRS- Jorhat	247	198	24.75				
RSRS- Kalimpong	532	419	26.97				
RSRS-Koraput	584	392	48.98				
REC-Mangaldai	637	479	32.99				
REC-Dimapur	493	363	35.81				
Mea	n 511	379	34.04				

**Inference:** Drip tape & Drum-kit fertigation system based mulberry cultivation recorded 36% & 34% higher leaf yield over conventional system/control at irrigated and rainfed areas of E & NE states respectively.

## OST-4: Evaluation of new Bed Disinfectants 'Seri-Win'

## M. Rabha (PI), K. Rahul, K. Alam, Incharges of RSRS & RECs

## **Objective:**

To validate Seri-Win for efficacy in disease management & cocoon productivity and popularize at farmers level in E and NE region

Validation studies are carried out through On Station Trials (OST) of the newly developed rearing bed disinfectant formulation "Seri-Win". It is a broad spectrum, cost-effective, non- corrosive eco-friendly, user-friendly disinfectant and is non-toxic to silkworms. The suitability test for disinfecting silkworms and silkworm rearing bed was carried out at different units of CSB and DoS across eight states of East & North- East India. An average ERR of 81.68% has been recorded across different seasons in 14 test locations. The performance of Seri-Win is found 4.23% higher than that of existing bed disinfectant Labex (ERR 76.35%) showing at par (P< 0.186; T Test, NS) or better efficiency in preventing infection of bivoltine and multivoltine breeds.



On station evaluation of 'Seri-Win'at different CSB and DoS units across E & NE India did not show significant variation in ERR% (P < 0.186; T Test) between SeriWin and Labex

## OFT-1: *Popularization of Newly Authorized Mulberry Variety C-2038 including C-2028 & Tr-23 / BC*<sub>2</sub>59

## Suresh K., Deepika K.U. and Incharges of RSRSs & RECs

## **Objectives:**

• To popularize new mulberry varieties C-2038, C-2028 and Tr-23/BC<sub>2</sub>59 in E and NE India

Mulberry Variety Authorization Committee (MVAC) of Central Silk Board recently authorized the high yielding mulberry varieties *viz.*, C-2038 for irrigated & rainfed plains & Tr-23 for subtropical hills and also recommended for popularization at field level. Further, MVAC (X<sup>th</sup>meeting) suggested undertaking systematic evaluation of specific varieries in the relevant hotspots/areas for *Suo-moto* authorization. C-2028 is a mulberry variety tolerant to water logging conditions has been identified earlier by CSRTI-BHP and could be popularized in water logged conditions of Assam, West Bengal and Bihar. BC<sub>2</sub>59 is the popular hill variety in hilly regions of Eastern India and was not popularized in North Eastern hills which also found to be suitable for preparation of mulberry tea beverage in the recent studies conducted in TTRI & AAU-Jorhat. To meet the greater demand of improved varieties in plains

and hill regions of E & NE India, three new mulberry varieties, C-2038, C-2028 and BC<sub>2</sub>59 were included in the ToT programme. The Breeder stock plantations of these varieties were established form nucleus stock of concerned Breeding section and maintained at CSRTI-Berhampore with recommended agronomic practices. The foundation stock was established at RSRS located across E & NE states and from this certified stock was also established in RECs/ Kissan nursery farmers for effecting regular multiplication and supply of planting materials. The programme envisages popularization of thes improved mulberry varieties developed by CSRTI-BHP of Central Silk Board for improvement of silk productivity and production in Eastern & North Eastern states in coordination with DoS's.

## Popularization of new mulberry varieties C-2038, C-2028 & Tr-23/BC<sub>2</sub>59 in E - NE India

Sericulture technology transfer plays a chief role in transforming mulberry and cocoon productivity in rural areas especially in the current setting where silk demand surpasses the production capacity. ToT in sericulture is currently focused on key interventions at different stages of the crop from improved mulberry and silkworm varieties, crop management & protection and post-cocoon management to marketing. The varietal cutting stocks of C-2038 were raised at CSRTI-Berhampore, RSRS-Koraput & Jorhat, REC-Mothabari, Mangaldoi, Agartala, Bhandra; C-2028 at Berhampore & Jorhat; Tr-23 at Berhampore & Kalimpong and BC<sub>2</sub>59 at Berhampore, Kalimpong & Dimapur. The extension units of CSB in consultation with DoS identified the beneficiaries as per target. The mulberry saplings were raised in advance by each unit and were supplied to the selected beneficiary field during the planting season. The saplings were planted in pit system in  $3' \times 3'$  under rainfed and  $2' \times 2'$  under irrigated condition. Recommended package of practices for cultivation of mulberry under respective conditions were followed for proper establishment. The respective extension units supervised the plantation in every two months and necessary gap filling was taken for uniform establishment of Mulberry garden. The plantation was well established with 90-95% survival and good uniformity. The benefecieries were guided on recommended agronomic practices of mulberry establishment and cultivation. After proper establishment of garden (after 6 months duration) the allocated inputs for maintenance were procured and supplied to the farmers by the respective extension units. Three new varieties were popularized among 290 farmers (38 acres) in 8 states of E&NE states. Among the three, C-2038 was popularized among 190 farmers (20.72 acres) of eight states in E&NE states. Mulberry variety C-2028 was popularized among 20 farmers (1.64 acres) in waterlogged areas of Majuli, Assam and BC259 was popularized among 80 farmers (15.30 acres under initiative of NGO, Samruddi) in Hills of Nagaland.

CSB Units	Units State		Farmers selection (Nos)		Saplings F	Production	Area covered (acres)	
	State	rancey	Target	Achiv	Target	Achiv	Target	Achiv
CSRTI - BHP	WB, Bihar	C2020	100	81	90000	78000	8.00	12.00
REC-Mothabari	Northern WB	C2038	60	23	54000	9200	4.80	1.84
RSRS- Koraput	Odisha		30	15	27000	6000	2.40	1.20
REC-Bhandra	Jharkhand		30	9	27000	3600	2.40	0.72
RSRS-Jorhat	Upper Assam		30	11	27000	4400	2.40	0.88
REC-Mangaldoi	Lower Assam		30	20	27000	8000	2.40	1.60
REC-Aizwal	Mizoram		30	10	27000	4000	2.40	0.80
REC-Agartala	Tripura		30	11	27000	4400	2.40	0.88
REC-Shillong	Meghalaya		30	10	27000	4000	2.40	0.80
REC-Dimapur	Nagaland		5		4500		0.40	
REC-Sille	Arunachal		5		4500		0.40	
REC-Dimapur	Nagaland	BC <sub>2</sub> 59	90	80	81000	37000	7.20	15.30
RSRS-Jorhat	Assam	C2028	30	20	27000	8000	2.40	1.64
			500	290	450000	166600	40.00	37.66

Mulberry Varieties popularized in East & North-Eastern India during 2019-2
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#### Impact assessment of new varieties on leaf and cocoon yield at farmer's level.

The mulberry varieties S-1 and S-1635 have a leaf yield potential of 30-45 t/ha/yr at farmers'. New mulberry varieties C-2038 and Tr-23 are superior to the existing varieties and recorded 20-30% higher leaf yield over existed varieties under research farms. Further, C-2028 and BC<sub>2</sub>59 are more suitable varieties for water logged areas and hilly regions, respectively with very high leaf yield potential over the existing varieties. After establishment period of two years, the data on leaf and cocoon yield was recorded (Oct-Nov, 2021) from new and existing varieties at each of the farmer's field planted during 2019. In irrigated farmer's field of Murshidabad, new varieity C-2038 (3858 kg) recorded 34% higher leaf yield per acre over existing S-1635 (2878 kg) and silkworm fed with new variety also recorded 11% higher cocoon yield (55.65 kg) compared with S-1635(50.28 kg/100 DFLs). In rainfed Assam region, C-2038 recorded 19% higher leaf yield per acre (2605 kg) over existing S-1635 (2188 kg) along with 12% higher cocoon yield (48 kg) compared with S-1635 (2006 kg) and BC<sub>2</sub>59 recorded 10% higher leaf yield per acre (2190 kg) over existing S-1635 (2288 kg).



#### Performace of new varieties for leaf and cocoon yield at farmers level

Variety	Condition		Leaf Pro	ductivity		Cococ	n Product	ivity
Variety	Condition	Values	C-2038	S-1635	% YA	C-2038	S-1635	% YA
C-2038	Irrigated	Mean	3858	2878	34%	55.65	50.28	11%
	_	Range	4273-2878	3626-2451	1			
	Rainfed	Mean	2605	2188	19%	47.87	42.30	12%
		Range	2864-2321	2469- 1926		53-43	47-37	
BC259	Rainfed Hills	MV	BC259	Local	10%	BC259	Local	
		Mean	2508	2288				
C2028	Rainfed	MV	C2028	S1635		C2028	Local	
		Mean	2190	2006	9%			
		Range	3865-1986	3180-1861				

**Inference:** Three new varieties were popularized among 290 farmers (38 acres) in 8 states of E & NE states. New variety C-2038 recorded 20-30% higher leaf yield along with 10-12% higher cocoon yiled over existing variety S-1635, C-2038 and BC<sub>2</sub>59 recorded 10% more leaf yield over exisiting varieties in the specific regions.

## **OFT-2** : Demonstration of Bio-control Agent

## Khasru Alam and Incharges of RSRSs & RECs

## **Objectives:**

 Popularization of bio-control agents for eco-friendly management of Thrips & Mealy Bugs in mulberry

A total of 1,71,593 *Chrysoperla zastrowi sillemi* eggs were mass produced in laboratory during the entire ToT programme period in two years of which 94,639 Chrysoperla eggs were released among 228 farmers field in Nadia, Birbhum, Murshidabad, & Malda Districts for the management of thrips. Remaining eggs were released at different institute plots as well as used for mass multiplication. Biocontrol agent was released at Kalyanpur (15), Purapara (18), Senpara (24), Kanupur (21), Pipulkhola (40), Barbakpur (30), Makrampur (20), Rampur (24), Sahebnagar (24) and Garia Nagar (12) villages coinciding with thrips incidence at the field. On an average release of biocontrol agent resulted in 70.71 % reduction of thrips over untreated control.

Efficacy of Chrysoperla zastrowi sillemi against thrips under field conditions							
	Farmore	B	CA	Co	Poduction over		
Districts	Covered	Pre release	Post release	Pre release	15 days after release	control (%)	
Nadia	148	7.02	3.91	7.28	12.31	68.24	
Birbhum	44	21.04	6.58	21.66	23.58	72.09	
Murshidabad	24	19.53	8.34	20.34	20.70	59.71	
Malda	12	13.30	3.25	13.58	18.91	82.81	
Total/Avg.	228	15.22	5.52	15.71	18.87	70.71	

## OFT-3: Popularization of Chawki Rearing

## Srinivasa G, Shafi Afroz and RSRSs & RECs

## **Objectives:**

Popularization of collapsible plastic mountages & shoot feeding for better productivity

Ten CRCs, (capacity of 1000 dlfs/crop) were identified (beneficiaries) and supported for 2 crops during 2021-22 in West Bengal (2), Odisha (1), Assam BTC (2), Tripura (1), Nagaland (1), Mizoram (1), and Meghalaya (1). They were supplied with disinfectants and other inputs used in chawki rearing to make them adopt bivoltine rearing. The person who is rearing Chawki worms in the village is provided with a cash of Rs.6000 /CRC/crop. The chawki worms were distributed to the farmers after 2<sup>nd</sup> moult. The cocoon production /100 dfls of chawki worms was compared with that of direct brushing.

It was observed that the above OFT has recorded highr cocoon yield in the range of 2.03% to 8.71% under different sub units. The average increased in yield was 6.56% over the control.

				Hatching		Larval Missing		Yield/100 dfls (kg)		
Unit	CRC	Season	Hybrid	(%)	growth* (g)	larvae (%)	larvae (%)	CRC	Direct	Gain (%)
	1	Agrahyani' b.		92.5	2.66	2.40	1.8	40 37	46.0	7 33
CSKTI-DITP	L	2021 &	N X SKU.7	90.5	2.53	2.08	1.5	-9.J/	-0.0	7.55
REC-Mothabari	1	Falguni' 2022	N x SK6.7	95.5	2.23	4.13	1.3	41.01	37.76	8.61
RSRS-Koraput	1	Oct-Nov'21 & Mar-Apr'22	SK6.7	91.0	3.10	2.88	0.00	42.95	42.09	2.03
DEC Mangaldai	<b>_</b>		CK Uubrid	91.5	3.55	5.0	5.0	46 72	11 11	E 1E
REC-Manyaluoi	2		SK HYDHU	93.0	3.63	4.0	3.0	40.75	44.44	5.15
REC-Agartala	1	A t	12Y×BFC1	89.5	2.65	2.9	2.0	42.34	39.40	7.46
REC-Dimapur	1	Spring'22	BHP-DH	82.5	4.25	2.8	0.9	47.02	44.05	6.73
REC-Aizawl	1	-	SK6.7; BHP-DH	96.2	3.57	3.2	2.3	48.75	44.85	8.71
REC-Shillong	1		SK hybrid	96.0	3.68	2.4	4.0	47.42	44.55	6.44
*weight of hundred larvae under 2 <sup>nd</sup> moult 6.56										

Unit wise cocoon yield and cocoon parameters are recorded as follows

## OFT-4: Popularization of Collapsible plastic mountages & Shoot feeding

## Srinivasa G, Shafi Afroz and RSRSs & RECs

## **Objectives:**

Popularization of collapsible plastic mountages & shoot feeding for better productivity

Shoot feeding technology was extended to 190 farmers against the target of 200 farmers in West Bengal (Agrhayani'21 & Falguni'22 crop), Odisha, Assam BTC, Tripura, Nagaland, Mizoram, Meghalaya and Arunachal Pradesh during Autumn, 2021 and Spring, 2022 crop. For rearing 100 dfls, each of the beneficiary was assisted with shelf preparation cost @₹8500; bed disinfectant @7kg/crop; lime @7kg/crop; bleaching powder @2kg/crop; bed cleaning net @50nos.; collapsible plastic mountage @50nos. The number of benificiaries, hybrid reared, season, yield and cocoon parameters recorded under the programme are given below.

Unit	Faacan	Uybrid	Hybrid Beneficiary		v. Yield(kg/100 dfls)			SSW	SR%	Mkt
Unit	Season	пурна	Bellericialy	Shelf	Dala	Gain(%)	(g)	(g)		rate(Rs.)
CSRTI-BHP	Agrahyani' 2021 &	N x SK6.7	45	49.37	46.0	7.33	1.23	0.19	15.40	450.0
REC-Mothabari	Falguni' 22	N x SK6.7	50	41.25	37.8	9.26	1.86	0.31	17.94	420.0
RSRS-Koraput	Oct-Nov' 21 & Mar-Apr'22	SK6.7	15	42.95	42.1	2.03	1.84	0.34	18.6	300.0
REC-Mangaldoi		Sk Hybrid	30	46.73	44.44	5.15	1.29	0.22	16.8	264.0
REC-Agartala	Autumn'21	12Y×BFC1	15	42.34	39.40	7.46	1.75	0.33	18.85	280.0
REC-Dimapur	Autumin 21 & Spring/22	DH-BHP; 12Y×BFC1	15	47.02	44.03	6.79	1.39	0.28	19.89	300.0
REC-Aizawl	Spring 22	SK6.7; DH-BHP	10	48.75	44.85	8.71	1.54	0.26	17.17	350.0
REC-Shillong		SK hybrid	10	47.42	44.55	6.44	1.54	0.29	18.87	300.0
Avg. 40.65 38.12 5.91										

The average cocoon yield obtained through shoot reating was found to be 40.65 kg/100 dfls as compared to rearing in dalas (38.12 kg/100 dfls) registering an overall icrease of 5.91% in yield. Further, it was observed that there is marginal increase in reeling parametrs.

## OFT-5: *Popularization of 'Sampoorna' a Phyto-Ecdysteriod hormone for uniform maturation of silkworms:*

## Rahul K. (Now in Post Doctoral Progrm.), M. Rabha, L Somen Singh and RSRSs & RECs

## **Objectives:**

• Popularization of Sampoorna, a phytoecdysteroid formulation in Eastern & North Eastern India

'Sampoorna' is a phytoecdysteroid formulation, helps in uniform larval maturation leading to synchronization of spinning process without affecting the economic cocoon traits. The formulation, developed by CSRTI-Mysore is highly popular for achieving the uniform spinning. Crop losses due to



Application of 'Sampoorna' at different locations of E & NE region



Effect of Sampoorna on ERR during autumn crop (October -November)



Effect of Sampoorna on cocoon yield during Falguni crop (Feb.-Mar.) in WB

non-uniform maturation, delayed spinning and non-spinning syndrome are very common which hampers the success of cocoon crop across E & NE states. In this regard, application of Sampoorna, a proven technology for mitigating the current challenges might play a vital role. The proposed study will not only facilitate the impact analysis of Sampoorna on uniform larval maturity and cocoon productivity at farmer's level, but also address the non-spinning syndrome. The 'Sampoorna' was distributed to 650 beneficiaries across Eastern and Northeastern states in Agrahayani and Falguni seasons in West Bengal and in autumn crop, in the Northeast. It has been reported that application of 'Sampoorna' supported uniform maturity and significantly (P < 0.001) reduced mountage period from 48 h to 24-30 h (Figure 1) whereas the yield was at par with the normally matured larvae (NS: P < 0.507).

## OFT-6: Evaluation of BHP Double Hybrid, (BHP3.2) x (BHP8.9)

V.Lakshmanan, N Chandrakanth, and RSRSs & RECs

A total of 29,125 dfls of BHP DH (474 crops) along with 4,455 dfls of SK6.SK7 (75 crops) and 1,180 dfls of BCon1.BCon4 (22 crops), the popular bivoltine combinations were evaluated at different locations of E & NE region. Analysed data indicates that the new bivoltine double hybrid, BHP DH is superior over the popular bivoltine combinations, exhibiting 14.15 to 22.2% higher cocoon yield per 100 dfls, 11.47 to 14.04% higher cocoon weight, 19.7 to 28.8 % higher shell wt and 7.57 to 14.03% higher shell percentage shown below.

Evaluation of BHP DH with farmers @ E & NE – Overall performance (2020-22)											
Hybrid	Dfls	Crops	Yield Range	Avg Yield / 100 dfls (kg)	Cocoon (g)	Shell Wt (g)	Shell (%)	AVFL (m)	Rend	Reel (%)	Neat (Pts)
BHP-DH	29,125	471	34-88	51.38	1.681	0.322	19.18	918	6.74	76	95
SK6.SK7	4,455	75	10-60	42.08	1.474	0.250	16.82	714	8.32	74	92
BCon1.4	1,180	22	20-57	45.01	1.508	0.269	17.83	721	7.94	72	90
	% Imp Ove	r SK6.7		22.20	14.04	28.80	14.03	28.5	18.9	2.7	3.26
9	6 Imp over	BCon1.4		14.15	11.47	19.70	7.57	27.3	15.1	5.5	5.55

> Avg-49(%); >Control-1-84 (%); > Control-2-81 (%).



Analysed data indicates that the new bivoltine double hybrid, BHP DH is superior over the popular bivoltine combinations, exhibiting 14.15 to 22.2% higher cocoon yield per 100 dfls (51.38 kg Vs

45.01 Vs 42.08 kg), 11.47 to 14.04% higher cocoon weight (1.681 g Vs 1.508 g Vs 1.474 g), 19.7 to 28.8 % higher shell wt (0.322 g Vs 0.269 g Vs 0.250 g) and 7.57 to 14.03% higher shell percentage (19.18% Vs 17.83% Vs 16.82%) over BCon1.4 & SK6.7.

Frequency distribution of cocoon yield per 100 dfls reveals that in case of new bivoltine hybrid, about 47% of crops yielded more than the average cocoon production, ie. > 52.18 Kgs; about 82 (%) of crops yielded > 42.08 kgs of Control-1, SK6.SK7, and about 80 (%) of crops yielded > 45.01 kg of Control-2, BCon1.Bcon4.



- About 41(%) of cocoon crops of new bivoltine double hybrid BHP DH has recorded in the range of 50-60 kg/100 dfls, about 11(%) crops in the range of 61-70 kg and about 7% crops in the range of 71-88 kgs/100 dfls indicating good productivity potential.
- West Bengal: The performance of 9050 Dfls of BHP DH along with 1925 dfls of control during favourable seasons (Agrahayani & Falguni) and 2800 Dfls of BHP DH along with 350 dfls of control during unfavourable seasons (Jaistha & Baisakhi) were analysed. New hybrid BHP DH has outperformed the check (SK6.SK7 & BCon1.Bcon4) during favourable as well as unfavourable seasons. Realization of higher cocoon wt and shell wt during Agrahayani & Falguni over Jaistha and Baisakhi indicates the effect and impact of favourable climate. Lower CV(%) obtained in new bivoltine double hybrid BHP DH, in cocoon yield indicates its better crop stability and higher fitness.
- North-Eastern region: The performance of 8700 dfls of BHP DH along with 1365 dfls of check during Autumn season and 8575 dfls of BHP DH along with 1955 dfls of check during spring season were analysed. New hybrid BHP DH has registered higher performance over check (SK6.SK7 & BCon1.Bcon4) during Autumn as well as Spring seasons. Marginally higher cocoon yield (49.17 Kgs Vs 47.47 Kgs) observed during spring season over Autumn indicates higher survival during spring season.

**State-wise performance**: Among the states, Arunachal Pradesh has recorded a highest cocoon yield (61.00 Kgs), while West Bengal has registered, the second best (56.90 kg). Significantly Higher yield improvement of was registered with Assam farmers (30.32%), followed by Sikkim (29.02%) and West Bengal (28.00%) in new bivoltine double hybrid, BHP DH and the least yield of improvement with farmers of Orissa (6.80%) over check.



## NORTH EAST REGION TEXTILE PROMOTION SCHEME (NERTPS)

Kishor Kumar C.M., D. Pandit and Incharges of NE untis

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

**Nagaland:** Areas under NERTPS scheme **"Development of Eri and Oak Tasar culture in Aspirational District of Kiphire, Nagaland"** were visited by Scientist In-Charge for verification. A verification report has been submitted to Central Office, CSB, Bangalore for further necessary action. Conducted physical verification and assessment of training centres under SAMARTH Scheme, DoS, Nagaland along with DoS officials and scientists of CSB w.e.f. 14.09.2021 to 15.09.2021 and submitted the report to C.O., CSB, Bangalore. The Joint Verification Team (JVT) comprising officials of CSB including the In-Charge REC, Dimapur and State Department visited Mokokchung, Nagaland for joint verification of progress achieved in implementation of Post Cocoon Technology Project under NERTPS. The project was implemented by M/s Samvrudi association with Department of Sericulture, Govt. of Nagaland during the year 2016-17 and 2017-18. The JVT visited the project implementation areas on 24<sup>th</sup>& 25<sup>th</sup> February, 2022. Assisted Dept of Textiles, Govt of Meghalaya in Project monitoring, technical supervision, assessment, report preparation, etc of NERTPS projects and State programmes:

- i. Intensive Bivoltine Sericulture Development Project IBSDP (NERTPS).
- ii. Integrated Sericulture Development Project ISDP (NERTPS- Mulberry (600 farmers), Eri (750 farmers) and Muga (700 farmers). This scheme includes "*In-situ* conservation of Muga silkworm".
- iii. Integrated scheme for development of Eri Silk Industry in Ri-Bhoi under Aspirational District. Covering 433 Eri farmers.
- iv. Silk Samagra (Skill upgradation) covering 750 farmers in 5 districts of Meghalaya.
- v. Integrated Textile Tourism Project in Ri-Bhoi District
- vi. Planning of seeds requirement, consumption and production of the State
- vii. Implementation of In-situ conservation of Muga Silkworm under NERTPS at East Jaintia Hills District

**Tripura:** Under IBSDP one Exposure visit was undertaken at CSR&TI, Berhampore with 39 lead farmers of Dhalai district, Tripura. NERTPS project at Sepahijala District, Tripura has started during 2020-21. Total project cost is Rs. 3110.66 cr. (Central share is Rs. 2763.85 cr. and the beneficiary share is, Rs. 346.81 cr.) & 12.37 crore has been released under Central share during 2020-2021 & 2021-2022. Under this project 250 acres plantation has been covered (100%). A total of 666 farmers have been covered during 2020-2021 & 2021-2022. Total 20 acres area under raising of mulberry sapling is covered. Total 239-unit irrigation system has been made covering 4 farmers per unit. A total of 475 rearing houses have been provided to the farmers and 240 vermi compost tanks have been provided to the farmers.



**Assam:** At present IBSDP under NERTPS are in under implementation and covered 1000 women beneficiaries @ 0.5 acres HYV (BC<sub>2</sub>59) mulberry plantation in 500 acres are completed and all they are under production stage.

#	District	No. of beneficiaries covered	Remarks
		(20 farmers /SHG)	
1	West	(514 farmers) 26 SHG	Existing farmers is 107 +893= 1000
2	South	(259 farmers) 13 SHG	farmers.
3	East	(120 farmers) 06 SHG	
		Total: 893 farmers 45 SHG	

REC officials along with DoS engaged consistent effort and field visit is needed during crop seasons and to cover every farmer is tedious task but sille unit and DoS makes a headway to support through technological means through smart phones. Using all the possible technical and technological gadgets help may bridge the gap of our production expectations.

## राजभाषा अनुभाग की उपलब्धियाँ (वर्ष 2021- 2022)

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान,बहरमपुर (प.बं.) में वर्ष 2021-22 के दौरान संघ की राजभाषा नीति का सम्यक अनुपालन किया गया। राजभाषा अधिनियम की धारा-3(3) एवं राजभाषा नियम-5 जैसे अनिवार्य प्रावधानों का शत-प्रतिशत अनुपालन सुनिश्चित किया गया है। राजभाषा हिन्दी के अन्य महत्वपूर्ण कार्यान्वयन बिन्दुओं/प्रावधानों पर भी कार्रवाई की गई। संस्थान में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगति/कमियों की समय-समय पर समीक्षा, हिन्दी कार्यशाला का आयोजन हिन्दी पखवाड़ा/दिवस का आयोजन,हिन्दी भाषा प्रशिक्षण, हिन्दी पुस्तक/पुस्तिकाओं का संपादन,हिन्दी प्रतियोगिता का आयोजन एवं प्रोत्साहन योजनाओं का कार्यान्वयन किया गया। संस्थान द्वारा आलोच्य अवधि के दौरान विभिन्न कार्यान्वयन बिन्दुओं पर की गई कार्रवाई का ब्यौरा निम्नवत है:

- धारा-3(3) का अनुपालन : राजभाषा अधिनियम की धारा-3(3) के अर्न्तगत आने वाले सभी कागजात यथा सामान्य आदेश,निविदा,नियम,सूचना,अधिसूचना एवं संविदा करार विज्ञप्ति तथा प्रशासनिक एवं अन्य रिपोर्ट आदि अनिवार्य रुप से दविभाषी में जारी किए गए।
- 2. हिन्दी पत्राचार : वर्ष के दौरान 'क', क्षेत्र में स्थित केन्द्र/ राज्य सरकार को क्रमश: 85.35%,तथा 'ग' क्षेत्र में स्थित केन्द्रीय सरकार के कार्यालयों को 67.49% पत्र हिन्दी में भेजें गए। इस प्रकार पत्राचार के मद में निर्धारित लक्ष्य से अधिक पत्राचार किया गया।
- 3. हिन्दी प्रशिक्षण:आलोच्य अवधि के दौरान अधिकारियों/कर्मचारियों को हिन्दी शिक्षण के योजना के अधीन प्रशिक्षण कार्य जारी है। अब तक संस्थान के कुल 97.95% अधिकारी/कर्मचारी इस योजना के अन्तर्गत प्रशिक्षित हो चुके है।
- 4. राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन : राजभाषा नियम/अधिनियम के प्रावधानों के सम्यक अनुपालन एवं समय-समय पर राजभाषा कार्यों की प्रगति/कमियों की समीक्षा हेतु संस्थान में प्रत्येक तिमाही के दौरान विभागीय राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन कर कार्यान्वयन की दिशा में आने वाली कठिनाइयों का निदान किया जाता है। वर्तमान वर्ष 2021-22 के अंतर्गत राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन कर कार्यान्वयन की दिशा में आने वाली कठिनाइयों का निदान किया जाता है। वर्तमान वर्ष 2021-22 के अंतर्गत राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन कर कार्यान्वयन की दिशा में आने वाली कठिनाइयों का निदान किया जाता है। वर्तमान वर्ष 2021-22 के अंतर्गत राजभाषा कार्यान्वयन समिति की चार बैठकों का नियमित आयोजन क्रमशः दिनांक 29.06.2021, 29.09.2021, 30.12.2021 एवं 29.03.2022 को किया गया तथा बैठक में लिए गए निर्णयों पर अनुवर्ती कारवाई की गई।
- 5. हिन्दी कार्यशाला का आयोजन: संस्थान में कार्यरत अधिकारियों/कर्मचारियों को हिन्दी में कामकाज करने में सुगमता हेतु प्रत्येक वर्ष हिन्दी कार्यशाला का आयोजन किया जाता है। कार्यशाला का आयोजन कर्मचारियों की कार्य प्रकृति के अनुसार अलग-अलग समूहों में किया जाता है। तकनीकी तथा प्रशासनिक संवर्ग के अधिकारियों/पदधारियों के लिए राजभाषा के विविध पहलुओं पर क्रमशः 29.06.2021, 29.09.2021, 23.12.21 एवं 29.03.2022 को हिंदी कार्यशाला आयोजित कर संस्थान के कुल 53 पदधारीगण राजभाषा हिन्दी में प्रशिक्षितकिए गए तथा आगे भी यह क्रम जारी है।
- 6. अधीनस्थ कार्यालयों/केन्द्रीय रेशम बोर्ड के अन्य कार्यालयों आंबटित कार्यालयों में हिन्दी कार्यशाला: संस्थान की संबद्ध इकाइयों में भी संघ की राजभाषा नीति के सफल कार्यान्वयन हेतु हिन्दी कार्यशालाओं का आयोजन किया जाता है। इस क्रम में संस्थान के कुल 03 अधीनस्थ केन्द्रों में भी हिन्दी कार्यशालाओं का आयोजन किया गया।

- 7. राजभाषा प्रोत्साहन योजना का कार्यान्वयन: संस्थान एवं इसके संबद्ध/अधीनस्थ केन्द्रों में कार्यरत अधिकारियों तथा कर्मचारियों में राजभाषा हिन्दी के प्रति अभिरूचि जगाने हेतु समय-समय पर विभिन्न राजभाषा कार्यक्रम/प्रतियोगिता का आयोजन किया जाता है। इन कार्यक्रमों द्वारा कर्मचारियों को प्रोत्साहित/पुरस्कृत करने के अलावा हिन्दी में मूल रूप से टिप्पण-आलेखन करने वाले अधिकारियों/कर्मचारियों के लिए केन्द्रीय रेशम बोर्ड की उदारीकृत प्रोत्साहन योजना को भी लागू किया गया है जिसके अर्न्तगत निर्धारित शब्द संख्या हिन्दी में लिखने पर अनुपातत: नगद प्रोत्साहन राशि (महत्तम रू 5000.00) प्रदान की जाती है। हिन्दी दिवस/पखवाड़ा,2021 के अवसर पर वर्ष 2020-21 के दौरान मूल रूप से हिन्दी में कामकाज करने हेतु कुल 09 पदधारियों को पुरस्कृत किया गया।
- 8. हिन्दी पुस्तक/ पुस्तिकाओं का प्रकाशन: संघ की राजभाषा नीति के अनुसार संस्थान में अंग्रेजी प्रकाशनों के अनुरूप वैज्ञानिक एवं तकनीकी/प्रशासनिक प्रकाशनों का हिन्दी रूपांतरण तथा मूल रूप से हिंदी में लिखित पुस्तकें आवश्यकतानुसार प्रकाशित की जाती है। वर्तमान वर्ष के अंतर्गत संस्थान की वार्षिक वैज्ञानिक एवं प्रशासनिक रिपोर्ट वर्ष 2020-21 का सारांश हिंदी में प्रकाशित करने के अतिरिक्त आलोच्य अवधि के दौरान सेरी-विन [हिंदी, अंग्रेजी व बंगला] व संपूर्णा नामक पैम्फलेट [हिंदी, अंग्रेजी व बंगला] प्रकाशित की गई।
- 9. नगर राजभाषा कार्यान्वयन समिति का गठन एवं उसकी बैठकों का आयोजन: वर्ष 1997-98 के शुरूआत में ही राजभाषा विभाग, भारत सरकार,नई दिल्ली द्वारा संस्थान के निदेशक की अध्यक्षता में नगर राजभाषा कार्यान्वयन समिति के गठन,बैठकों के नियमितआयोजन तथा बहरमपुर नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों आदि में संघ की राजभाषा नीति के सफल कार्यान्वयन का अतिरिक्त दायित्व निहित किया गया। समिति के प्रयास से नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों आदि में संघ की राजभाषा नीति के सफल कार्यान्वयन का अतिरिक्त दायित्व निहित किया गया। समिति के प्रयास से नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों आदि में संघ की राजभाषा नीति के सफल कार्यान्वयन कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों आदि ते प्रयास से नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों विधि के प्रयास से नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों विदि के प्रयास के नगर क्रिति के प्रयास ते नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों के राजभाषा गतिविधियां बढ़ी है। इसके अतिरिक्त,नगर के सदस्य कार्यालय अपने-अपने कार्यालयो में हिन्दी दिवस, प्रतियोगिता,संगोष्ठी कार्यशाला एवं बैठकों का आयोजन कर रहे है। समिति की उक्त गतिविधियों के संचालन से संस्थान में राजभाषा कार्यान्वयन संबंधी कार्यमात्रा में भी अत्याधिक वृद्धि हुई है।
- 10. राजभाषा नियम 10(4)के अर्न्तगत अधीनस्थ कार्यालयों को अधिसूचित किया जाना: संस्थान के संबद्ध/अधीनस्थ केन्द्रों में कार्यरत 80% कर्मचारियों को हिन्दी प्रशिक्षण दिलाने के पश्चात ऐसे कार्यालयों को मंत्रालय द्वारा राजभाषा नियम-10(4) के अधीन अधिसूचित करने की कार्रवाई की जाती है। इस क्रम मेंसंस्थानके 05 संबद्ध कार्यालयों को अधिसूचित कराया जा चुका है।
- 11. हिन्दी प्रतियोगिता का आयोजन : वर्ष 2021-22 के दौरान दिनांक 01.09.21 से 14.09.21 तक आयोजित हिन्दी पखवाड़ा के अन्तर्गत विभिन्न हिन्दी प्रतियोगिता एवं मुख्य समारोह का आयोजन किया गया। इन प्रतियोगिता में संस्थान के अधिकारियों/ कर्मचारियों ने उत्साह से भाग लिया। इस दौरान कुल 04 हिन्दी प्रतियोगिताओं क्रमश: शब्दावली 01/09/2021, निबन्ध 02/09/2021, सुलेख व श्रुतिलेख 03/09/2021 तथा हिंदी टिप्पण व आलेखन प्रतियोगिता 04/09/21 का आयोजन किया गया। प्रत्येक प्रतियोगिता के सर्वश्रेष्ठ प्रतिभागियों को प्रथम,द्वितीय,तृतीय एवं सांत्वना प्रस्कार से प्रस्कृत किए गए।
- 12. कंप्यूटर पर हिन्दी में कार्य: राजभाषा अधिनियम-1963 की धारा 3(3) का अनुपालन,फार्म/प्रपत्र का द्विभाषीकरण, संबद्ध/ अधीनस्थ केन्द्रों की तिमाही रिपार्ट का समेकीकरण एवं अनुभागीय प्रगति रिपोर्ट

के तुलनात्मक विवरण आदि के संकलन एवं पत्रिका के प्रकाशन/ संपादनका कार्य तथा नगर राजभाषा कार्यान्वयन समिति की गतिविधियों संबंधी कार्य को कंप्यूटरपर सुचारू रूप से किया जा रहा है। राजभाषा कार्यान्वयन के विभिन्न पहलुओं में कंप्यूटर के प्रयोग की शुरूआत से राजभाषा कार्यान्वयन के कार्य में गति आई है। साथ ही साथ संस्थान की राजभाषा कार्यान्वयन समिति की बैठको में हिन्दी प्रगति से संबंधित आकड़ों का प्रस्तुतीकरण पावर-प्वाइंट के जरिये किया जा रहा है। ज्ञातव्य है कि संस्थान में बहुआषी पैकेज "यूनिकोड" का संस्थापन कंप्यूटर पर किया गया है जिससे शब्द प्रक्रमण के अलावा आकड़ों के प्रक्रमण, आरेखीय निरूपण,आंकड़ों के समेकीकरण में सहलियत एवं गति आई है।

## क्षेत्रीय रेशम उत्पादन व अनुसंधान केंद्र, कोरापुट, ओड़ीशा

इस संस्थान में अधिकतर तकनीकी तथा प्रशासनिक कार्य यथा कार्यालय आदेश, परिपत्र हिन्दी मे किया जाता हैं । दिनांक 14.09.21 से 28.09.21 तक इस संस्थान में एक पक्षकालीन हिन्दी पखवाड़ा की आयोजन किया गया था जिसमे विभिन्नविषय पर हिन्दी प्रतियोगिता एवं मुख्य समारोह का आयोजन किया गया। एक दिवसीय हिन्दी कार्यशाला की आयोजन दिनांक 28.09.2021 को आयोजित किया गया हैं । श्री दीपक सिंह, पीजिटी (हिन्दी) एवं श्री एम एम पात्र, पीजिटी, जवहर नवोदय विद्यालय को इस कार्यशाला मे संशाधन व्यक्ति के रूप मे आमंत्रित थे । सर्वश्रेष्ठ प्रतिभागियों को विदाय सत्रह मे पुरस्कार से से पुरस्कृत किए गए। इसके अलावा, राजभाषा नियम/अधिनियम के प्रावधानों के सम्यक अनुपालन एवं समय-समय पर राजभाषा कार्यों की प्रगति/कमियों की समीक्षा हेतु संस्थान में प्रत्येक तिमाही के दौरान बैठकों का आयोजन कर कार्यान्वयन की दिशा में आने वाली कठिनाइयों का निदान किया जाता है।

## क्षेत्रीय रेशम उत्पादन व अनुसंधान केंद्र, कलिमपोंग, पश्चिमवंग

चार राजभाषा कार्यान्व-यन समिति (ओएलआईसी) की बैठकें दिनांक 23.04.2021, 24.09.2021, 18.12.2021 और 01.3.2022 को आयोजित की गईं। COVID-19 महामारी के कारण किसी भी नगर समिति राजभाषा कार्यान्वयन (TOLIC) की बैठक आयोजित करना संभव नहीं था। इसके अलावा, यूनिट में खराब इंटरनेट सुविधा के कारण उसी की वर्चुअल मीटिंग भी संभव नहीं थी। दिनांक 14.09.2021 से 28.09.2021 तक हिंदी पखवाड़ा मनाया गया। दिनांक 20.09.2021 और 21.09.2021 को 'हिंदी पखवाडे' के दौरान इस कार्यालय के स्टाफ सदस्यों को शामिल करते हुए दो प्रतियोगिताएं आयोजित की गईं।



Organization of competition among the staffs in OL during Hindi Pakhwada 2021-22



Organization of Hindi Workshop during Hindi Pakhwada 2021-22

STAFF P as c	ਕਰਟ / Buo 2021-2	lget 2					
Designation	MI	RSRSs	RECs	Total		 राशि/	
Director	1	-	-	1	heaH/ म्रीह	Amount	
Scientists						(रु. लाख़ में/	
Scientist-D	5	2	7	14		Rs. in lakh)	
Scientist-C	5	-	1	6	प्लान-वतन	דד דדרר	
Scientist-B	6	2	-	8	(पाएलएस)/ Plan-	2277.77	
Technical		1			Saldry (PLS) अनुमूचित जाति		
Deputy Director (Comp)	1	-	-	1	वेतन (एममिएम)		
Deputy Director (OL)	1	-	-	1	/Schedule Caste	399.30	
Sr. Technical Asst.(STA)	38	11	17	66	Salary (SCS)		
Junior Engineer	2			2	ਪਤਾਇਤ ਤਰਤਾਰ		
Sr. Field Asst.			1	1	वेतन (एमरीएम) /		
Field Asst.	2	5	7	14	Schedule Tribe	341.58	
Technician	6	1		7	Salary (STS)		
Asst. Technician	3	1	1	5	उवावाप् (010) उत्तर-पर्वी-तेनन (NE-		
Multi Tasking Staff	7	17	8	32	Salary (NE-S)	528.00	
Skilled Farm Worker	30	12	6	48	उत्तर-पूर्वी <b>-</b> जनजाति		
Skilled Farm Worker (TS)	22	43	28	93	े. वेतन/ NE-ST-Salary	182.25	
Accounts & Administrati	on	1	1		(NE-TS)		
Asst. Director	2	-	-	2	प्लान-सामान्य /	382 95	
Superintendent	1	-	-	1	Plan-Gen (PLG)		
Asst. Supdt.	12	1	-	13	उत्तर-पूर्वी <b>-</b> सामान्य		
Stenographer -Grade-I	2	-	-	2	(ਧੀएलजੀ) / NE-Gen	24.00	
Jr. Translator (Hindi)	1	-	-	1	(NE-G)		
Staff Car Driver Grade-I	_	2	-	2	प्लान-कापटल	כר כר	
UDC	5	1	-	6	(पाएलास) / Plan-	25.25	
Stenographer-Grade-II	-	1	-	1			
Cook	1	-	-	1	(एनर्डसि) / NE-Can	0.50	
					(NEC)		
Total	153	99	76	328	कुल <b>/Total</b>	4159.58	

## **R & D PERSONNEL**

## CSRTI-BERHAMPORE Director

Dr. Kishor Kumar C.M. (from 09.08.2021) Dr. V. Sivaprasad (upto 31.07.2021)

## Scientist-D

Dr. Dipesh Pandit Mr. Gopal Chandra Das (upto 30.04.2021) Dr. Lakshmanan Velusamy Dr. Pradeep A.R. Dr. Satadal Chakraborty (from 05.07.2021) Dr. Srinivas G. (from 13.07.2021) Dr. Soumen chattopadhyay (upto31.07.2021) Dr. Sukhabrata Sarkar (upto28.02.2022)

Dr. Tapati Dutta (Biswas) (upto 30.04.2021)

## Scientist-C

Dr. Anil Pappachan (upto 13.05.2021) Dr. Chandrakanth N Dr. Mahesh, R. (upto 13.05.2021) Dr. Manjunatha G.R. (upto 13.05.2021) Dr. Pooja Makwana Dr. Rahul K Dr. Shafi Afroz Dr. Suresh K Dr. Vijay V (upto 15.05.2021)

Scientist-B Dr. Aparna Kopparapu (upto 13.05.2021) Dr. Deepika Kumar Umesh Mr. Khasru Alam (from 03.07.2021) Dr. Mihir Rabha Dr. Parameshwaranaik, J Dr. Raviraj, V.S Dr. Thangjam Ranjita Devi Dr. Yallappa Harijan

## RSRS-KALIMPONG

Mr Zakir Hossain, Scientist-D Dr. S. Harish Babu, Scientist-B

## **RSRS-KORAPUT**

Dr. Dip Kumar Gogoi, Scientist-D (from 13.09.2021) Mr. Khasru Alam, Scientist-B (upto 02.07.2021)

## **RSRS-JORHAT**

Dr. P. Kumaresan, Scientist-D

## **REC-MOTHABARI**

Dr. Satadal Chakraborty (upto 01.07.2021) Mr. B.V. Naidu, Scientist-D (from 01.06.2021)

## **REC-BHANDRA**

Dr. G. S. Singh, Scientist-D (upto 31.03.2022)

**REC-MAMRING (RONGPO)** Senior Technical Assistant

**REC-DIMAPUR** Dr. Karthik Neog, Scientist-D

**REC-MONGALDAI** Mr. B. K. Basumatary, Scientist-D

## **REC-SHILLONG**

Dr. Collin Z. Rentheli, Scientist-D (upto 19.08.2021) Dr. N. Balchandran, Scientist-D (from 18.08.2021)

## **REC-AIZWAL**

Dr. L. Pachuau, Scientist-D (upto 31.07.2021) Dr. N. Shaktivel, Scientist-D (from 23.07.2021)

## **REC-SILLE**

Mr. Lohit Sonowal, Scientist-C

## **REC-AGARTALA**

Dr. Narayan Biswas, Scientist-D

## **ADMINISTRATIVE PERSONNEL**

- Mr. Prasad P. K., DD (Comp.) Mr. Ram Briksh Choudhary, DD (OL)
- Mr. Abdul Latif Qureshi, AD (A&A)
- Mr. Khemraj Nishad, AD (A&A)

## **RESEARCH ADVISORY COMMITTEE (RAC)**

RAC is a body for evaluation of research projects at Institute level consisting of specialist in different subject matter from reputed institute/universities. The tenure of the committee shall be for 3 years (6 meetings), the committee will meet once in six months for evaluation of meeting.

### CHAIRMAN

Dr. Chirantan Chattopadhyay, Principal Scientist & Joint Director (Academic) ICAR-Indian Institute of Agriculture Biotechnology Garhkhatanga, **Ranchi - 834 003,** Jharkhand, India

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Dr. Debabrata Basu, Professor & Head, Department of Agricultural Extension, Bidhan Chanadnra Krishi Viswavidyalaya (BCKV), <b>Mohanpur -741 252</b> , Nadia, West Bengal	Dr. S. Nirmal Kumar, Director (Rtd)-CSB, #1169, II Main, II Cross, SRIRAMPURA, IIStage, <b>Mysore -570 023,</b> Karnataka
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Joint Secretary & Director, Deptt. of Handlooms Handicrafts & Sericulture, Govt. of Tripura, Indra Nagar, PO- Kunjaban, <b>Agartala - 799 006,</b> Tripura	Commissioner, Textiles & Sericulture, Govt. of West Bengal, New Secretariat Building, 6 <sup>th</sup> Floor, Block-A, 1 Kiran Sharkar Ray Road, <b>Kolkata - 700 001,</b> West Bengal
Director of Sericulture, Govt. of Manipur, Project Management Complex, Sangaipat, Imphal East, Imphal - <b>795 004</b> , Manipur	Director, National Silkworm Seed Organization (NSSO), Central Silk Board, CSB Complex, BTM Layout, Madiwala, <b>Bengaluru - 560 068,</b> Karnataka
Director (Technical), Central Silk Board, CSB Complex, BTM Layout, Madiwala, <b>Bengaluru - 560 068,</b> Karnataka	Scientist-D & Head, Research Coordination Section, Central Silk Board, CSB Complex, BTM Layout, Madiwala, <b>Bengaluru - 560 068,</b> Karnataka

## MEMBER CONVENOR

Director, CSRTI-Berhampore
#	पदधारी /Employee	पदनाम /Designation	सेवानिवृत/ Retirement
1.	श्री गोपाल चन्द्र दास /Shri Gopal Chandra Das	वैज्ञानिक-डी /Scientist -D	30-04-2021
2.	श्रीमति <b>(</b> डॉ.) तपती दत्त विस्वास / Smt. (Dr.) Tapati Datta Biswas	वैज्ञानिक-डी /Scientist -D	30-04-2021
3.	श्री अखिल कुमार रॉय / Shri Akhil Kumar Roy	वरिस्ठ तक. सहा. /Sr. Tech. Asst.	31-05-2021
4.	श्री गोपीनाथ वडामुंडी / Shri Gopinath	एम.टी.एस/MTS (आरएसआरएस-एरी-	30.06.2021
	Badamundi	वीएसएफ/RSRS-Eri-SF, कोरापुट/ Koraput	
5.	डॉ. सौमेन चट्टोपाध्याय / Dr. Soumen Chattopadhyay	वैज्ञानिक-डी /Scientist -D	31-07-2021
6.	श्री प्रशांत कुमार वासू / Shri Prasanta Kumar Basu	वरिस्ठ तक. सहा. /Sr. Tech. Asst.	31-07-2021
7.	विधुमुखी गुरुङ / Bidhumukhi Gurung	एमटीएस /MTS <b>(</b> REC Mamringi)	Expired; 28.09.2021
8.	श्रीमति दीपाली ब्रहमा दास / Smt. Dipalee Brahma Das	वरिस्ठ तक. सहा. /Sr. Tech. Asst.	30-11-2021
9.	श्री छिदाम चंद्र मण्डल/ Shri Schidam Chandra Mandal	एमटीएस /MTS <b>(</b> REC Mothabari)	30-11-2021
10.	श्री समीर कुमार रॉय /Shri Samir Kumar Roy	अधीक्षयक (सहा.) /Asst. Supdt.	31-12.2021
11.	श्रीमति मेरि ख्वास /Smt. Mary Khawas	एमटीएस /MTS (आरएसआरएस/ RSRS, कलिमपोंग /Kalimpong <b>)</b>	31.12.2021
12.	श्री सौमाभों रॉय / Shri Soumavo Roy	वरिस्ठ तक. सहा. /Sr. Tech. Asst.	31-12-2021
13.	श्री प्रदीप कुमार घोष / Shri Pradip Kr. Ghosh	Staff Car Driver Gr-1	31-12-2021
14.	श्री अमर कुमार साहा / Shri Amar Kumar Saha	वरिस्ठ तक. सहा. /Sr. Tech. Asst.	31-01-2022
15.	श्रीमति रीता दिवाली /Smt. Rita Diyali	अधीक्षयक (सहा.) /Asst. Supdt.	31.01.2022
16.	श्रीमति संगीता सिंह /Smt. Sangita Singh	अधीक्षयक (सहा.) /Asst. Supdt.	01-01-2022 (VRS)
17.	डॉ. सुखव्रत सरकार / Dr. Sukhabrata Sarker	वैज्ञानिक-डी /Scientist -D	28-02.2022
18.	श्री मदन मोहन मूखार्जी / Shri Madan Mohan Mukherjee	वरिस्ठ तक. सहा. /Sr. Tech. Asst.	28-02-2022
19.	मह. बदरुल ओणम /Md. Badrul Onam	वरिस्ठ तक. सहा. /Sr. Tech. Asst.	28-02-2022
20.	श्री सुवल कृष्ण दे /Shri Subal Krishna Dey	वरिस्ठ तक. सहा. /Sr. Tech. Asst.	28-02-2022
21.	श्री रामवृक्ष चौधुरी / Shri Ram Briksh Chaudhuri	उप निदेशक (राजभाषा)  / Dy. Director <b>(</b> OL)	31-03-2022

# केरेउअवप्रसं-बहरमपुर की/ CSRTI-Berhampore's आभार-विदाई / Grateful Farewell

# PUBLICATIONS

## Research Papers (International):

- 1. Alam, K., Babu, H., Monir, S. and Sivaprasad, V. (2021). Evaluation of bivoltine silkworm breeds (*Bombyx mori* L.) for cocoon and associated characters under Koraput conditions, Odisha. *Journal of Entomology and Zoology Studies*, 9(3): 218-222.
- Alam, K., Raviraj, V. S., Chowdhury, T., Bhuimali, A., Ghosh, P. and Saha, S. (2021). Application of biotechnology in sericulture: Progress, scope and prospect. *The Nucleus* (1-22), https://doi.org /10.1007/s13237-021-00355-2 (Springer).
- 3. Chakrabarty, S., Saha, A. K., Nirmal Kumar, S. and Kishor Kumar, C.M. (2022). Role of Synbiotic Induction to Prevent Common Diseases of Silkworm, *Bombyx Mori* L. *Int. Journal of All Research Education and Scientific Methods (IJARESM),* ISSN: 2455-6211, 10 (2): Feb., 2022.
- 4. Chakrabarty, S., Hussain, Z., Kishor Kumar, C.M., Saha, A. K. and Nirmal Kumar, S. (2022). Studies on various sources responsible for spread of pebrine disease in traditional districts of West Bengal, India. *Int. Journal of All Research Education and Scientific Methods (IJARESM),* ISSN: 2455-6211, 10(3): Mar., 2022.
- 5. Chandrakanth, N., Devi, T.R., Verma A.K., Lakshmanana, V., Pradeep, A. R. and Sivaprasad, V. (2021). Improved cross breed of silkworm, *Bombyx mori* suitable for Eastern India, developed through congenic breeding. *Sericologia*, 61: 1-13.
- 6. Kumaresan, P., Sivaprasad, V. and Manjunatha, G.R. (2021). Efficacy of integrated barrier system for management of pink mealy bug *Maconellicoccus hirsutus* (Green) in mulberry. Biological Forum-*An International Journal. ISSN No.(Online)*.0975-1130, ISSN No.(Print):2249-3239: 13(4)537-541.
- Makwana, P, Dubey, H., Pradeep, A. R., Sivaprasad, V., Ponnuvel, K. M. and Mishra, R. K. (2021). Dipteran endoparasitoid infestation actively suppressed host defense components in hemocytes of silkworm *Bombyx mori* for successful parasitism. *Animal Gene*, 22, 2021. <u>https://doi.org/10.1016</u> /j.angen.2021.200118.
- Manjunatha, G. R, Lalrinnungi, Kiran Kumar, Patil, R., Parameshwarnaik, J. and Sivaprasad, V. (2021). Employability of Sericulture PG Diploma Holders in East and North-East India. *Sericologia*. 61 (1&2): 34-44.
- Mandal, A.K., Sarkar, B., Mandal, H., Chakraborty, A. P., Das, P.K., Dam, M. P., Mondal, R., Some, S., Sadat, A., Ghati, A., Neog, K., Mandal, S. and Ince, I. A. (2022). Draft genome sequence of a multi-drug resistant strain Enterobacter sp. ASE isolated from the gut of an infected *Bombyx mori* L. *Microbiology, an international journal* (accepted).
- Pegu, B. K., Kardong, D. and Gogoi, D. K. (2021). Purification and characterization of a-Lrhamnosidases from *Bacillus amyloliquefaciens*-D1. *Asian J. of Biol. & Life Sci.* Vol. 10 (2): 455-458.

- 11. Pegu, B. K., Kardong, D., Chutia, J. and Gogoi, D. K. (2021). Microbial naringinase and its applications in debittering technology A mini review applications of microbial naringinase. *Biosc. Biotech. Res. Comm.* 14 (2): 493-498.
- 12. Makwana, P., Rahul, K., Chattopadhyay, S. and Sivaprasad, V. (2021). Effect of thermal stress on antioxidant responses in *Bombyx mori L. Chemical Science Review and Letters*, 10(38): 288-294.
- *13.* Ranjita Devi, T., Chandrakanth, N., Verma, A.K., Sivaprasad, V. and Kishor Kumar, C.M. (2022). Development of productive multivoltine and bivoltine congenic breeds suitable for Eastern and North-Eastern India. *Int. Journal of All Research Education and Scientific Methods (IJARESM), 10 (3):1401-1407.*
- Prabhuling, S.H., Makwana, P., Pradeep. A.N.R., Vijayan, K. and Mishra, R.K. (2021). Release of mediator enzyme β-hexosaminidase and modulated gene expression accompany hemocyte degranulation in response to parasitism in the silkworm, *Bombyx mori. Biochemical Genetics.* 59(4):997-1017.
- 15. Suresh, K., Harizon. Y., Pappachan, A., Laskar, M., Manjunath, G.R. and Sivaprasad, V. (2021). Selection of Mulberry Genotypes for Rainfed Conditions through Principal Component Analysis. *Int. J. Curr. Microbiol. App. Sci.* 10(01), 2762-2778.
- Sivaprasad, V., Satish, L., Mallikarjuna, G., Chandrakanth, N., Mary Josepha, A.V. and Moorthy, S.M. (2021). A field-friendly loop-mediated isothermal amplification (FF-LAMP) method for rapid detection of *Nosema bombycis* in silkworm, *Bombyx mori* L. *Invertebrate Survival Journal*, 18:66-74.

## Research Papers (National):

- 1. Afroz, S., Singh, R., Nain, M. S. and Mishra, J. R. (2022). Determinants for Agripreneurship Development under Agriclinics and Agribusiness Centers (ACABC) Scheme, *Indian Journal of Agricultural Sciences* (IJAS), Vol. 92 (2): 258–262.
- Afroz, S., Singh, R., Nain, M. S., Mishra, J. R., Kumar, P., Khan, S. A. and Iquebal, M. A. (2021). SWOT-Analytic Hier, archy Process (AHP) of Agriclinics and Agribusiness Center (ACABC) Scheme, *Indian Journal of Agricultural Sciences*, Vol. 91 (6): 900–904.
- 3. Chakrabarty, S., Manna, B. and Saha, A.K. (2021). *Nosema asamensis*: A pathogen causing pebrine disease of muga silkworm and recent strategy adopted for sustainable development of muga culture in North Eastern India. *Journal of Experimental Zoology*, 24:7-13.
- Jagadish, A., Dubey, H., Kamatchi, I., Pradeep, A. R., Subrahmanyam, G., Rakesh, K. Mishra, K., and Ponnuvel, M. (2021). Transcriptome analysis of *Nosema assamensis* infecting muga silkworms (*Antheraea assamensis*) reveals insights into candidate pathogenicity related genes and molecular pathways required for pathogenesis. *Annals of Parasitology* 67(4), 671–682.
- 5. Harijan, Y., Deepika, K.U., Padmini, B., Suresh, K., Laskar, M. and Sivaprasad, V. (2021). Physiological and biochemical profiling of different mulberry genotypes developed for Eastern and North Eastern India. *Journal of Crop and Weed*, 17(3): 176-184.
- 6. Chakrabarty, S., Manna, B. and Saha, A.K. (2021). *Nosema asamensis*: A pathogen causing pebrine disease of muga silkworm and recent strategy adopted for sustainable development of muga culture in North Eastern India. *Journal of Experimental Zoology*, 24:7-13.

- 7. Kabiraj, D., Chetia, H., Nath, A., Sharma, P., Mosahari, P. V., Singh, D., Dutta, P., Neog, K. and Bora U. (2022). Mitogenome-wise codon usage pattern from comparative analysis of the first mitogenome of *Blepharipa* sp. (Muga uzifly) with other Oestroid flies. [Paper #SREP-18-46385B]. *Scientific Reports*.
- 8. Sakthivel. N. (2022). Sericulture and livelihood security of Mizos in North-East India. *Just Agriculture*, 2(6):1-7.

## **Popular Articles:**

- 1. Chandrakanth, N. (2021) Sericulture: Scientists inspect trial rearing of hybrid silkworm published in *Tripura Times*, a local English newspaper on 2<sup>nd</sup> Dec., 2021.
- 2. Neog, K., Manjunath, G.R., Pandit, D. and Sivaprasad, V. (2021). Mulberry Sericulture in Nagaland, *Indian Silk*, May-June, 2021. 12(1): 14-17.
- 3. Neog, K. and Sivaprasad, V. (2021). Role of Women in Sericulture Industry of Nagaland. *Indian Silk*.
- 4. Parameswaranaik J and Shafi Afroz (2021). Teacher who became a role model in Sericulture. *Food and Scientific Reports*. 2(8): 44-45. ISSN:2582- 5437

### Success story:

- 1. Thangjam Ranjita Devi and Parameswaranaik J (2022). A story of a sericultural woman with a will to succeed. *Agriculture & Environment*, 3: 32-33.
- 2. Kartik Neog (2022). Mulberry Sericulture Bringing smiles to many: A success Story of Erika Jigdong. *Indian Silk*.
- 3. Sakthivel. N. (2022). Intercropping with mulberry in hilly tracts of Mizoram for additional income: Success story of a women sericulturist. *Just Agriculture*, (Press).

## **Book Chapter**

- 1. Bhuyan, P.M., Nath, P. K., Kardong, D. and Gogoi, D. K. (2021). Muga Silkworm: An approach towards climate resilient sericulture for promoting sustainable development. In: *Pollution and Environment*, Edited by Dr. S. Das. pp. 28-36 (ISBN: 978-93-90847-02-0).
- Chandrakanth N, Makwana P, Satish L, Rabha M, Sivaprasad V (2021) Molecular approaches for detection of pebrine disease in sericulture. In: Gurtler V and Subrahmanyam G (eds), Methods in Silkworm Microbiology, *Elsevier Academic Press*, Cambridge, USA. Vol. 49, pp. 47-78.
- 3. Rahul, K., Manjunatha G.R., and Sivaprasad, V. (2021). Pebrine monitoring methods in sericulture. In V. Gurtler & G. Subrahmanyam (Eds.), Vol. 49. Methods in Microbiology. pp. 79-96. New York: *Academic Press*.
- 4. Sivaprasad V, Rahul K, Makwana P (2021). Immunodiagnosis of silkworm diseases. In: Gurtler V and Subrahmanyam G (eds), Methods in Silkworm Microbiology, *Elsevier Academic Press*, USA. pp. 27-46

- 5. Sivaprasad, V., Rahul, K. and Makwana, P. (2021). Immunodiagnosis of silkworm diseases. In V. Gurtler & G. Subrahmanyam (Eds.), Vol. 49. Methods in Microbiology. pp. 27-46. New York: *Academic Press*.
- 6. Suresh, K. (2022). Career Opportunities in Sericulture. Book Career Opportunities in Entomological sciences. *International Books and periodicals supply services*. ISBN: 978-93-90425-99-0, pp. 55-74.

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

Proceedings of Autumn Conference of the Korean Society of Sericultural Science, held on 4<sup>th</sup> & 5<sup>th</sup> November, 2021 at Daejeon city, Korea.

- 1. Rahul K, Pappachan A, Makwana P, Devi WS, Sivaprasad V, Kweon HY (2021) Aspergillus flavus isolated from Myllocerus viridanus causing mycosis in Bombyx mori L. B3-10
- 2. International web Confernce on Advances in Science and Technology (ICAST) organised by CSIR, NAL, Bengaluru, the Institute of Innovations (A MSME of Govt. of India) during 2-3<sup>rd</sup> April, 2021.
- 3. Rahul, K., Behera, G. K. and Pappachan, A. (2021). Bacillus flexus isolated from Harmonia axyridis (Pallas) causing bacteriosis in Bombyx mori L.

International Web Conference on Innovative and Current Advances in Agriculture and Allied Sciences (ICAAAS-2021) organized by Society for Scientific Development in Agriculture and Technology, Meerut, Uttar Pradesh during 19<sup>th</sup> -21<sup>st</sup> July, 2021

1. Suresh K., Chattopadhyay, S., Deepika, K.U. and Sivaprasad, V. (2021). Genetic analysis and selection of superior clones with higher nitrate reductase activity in inter-specific population of mulberry, pp.371-372.

International Web Conference on global research initiatives for sustainable agriculture & allied sciences (GRISAAS-2021) at SKRAU-Bikaner, Rajasthan during 13-15<sup>th</sup> December, 2021

1. Suresh, K., Ghosh, M.K., Shiv Nath, Deepika K.U., Sivaprasad, V. and Kishor Kumar, CM (2021). Development of high yielding and low temperature stress tolerant mulberry genotypes suitable for sub-tropical sericulture, p.87.

National web Conference organized by Department of Entomology, Veer Kunwar Sigh College of Agriculture, under BAU, Sabour through ZOOM platform on 8<sup>th</sup> June, 2021.

1. Suresh K., S. Chattopadhyay, and V. Sivaprasad (2021). Delivered a lecture on Career opportunities Entomological Science through Sericulture.

ISEE National Seminar on Transforming Indian Agriculture through Pluralistic and Innovative Extension Approach for Self-Reliant India organized by Banaras Hindu University, Uttar Pradesh during 4-6<sup>th</sup> October, 2021.

1. Parameswaranaik, J., Shafi, A., Srinivasa, G. and Pandit, D. (2021). Scope of Sericultural Entrepreneurship in North-Eastern India.

2. Afroz, S., Parameshawar Naik, J., Manjunatha, G.R., Srinivasa, G., and Pandit, D. (2021). Prospects of Seri-preneurship through Chawki Rearing Center (CRC) in West Bengal.

### **Online Research Programme / Training Programme attended / participated:**

Five days online training programme on "**Leadership and Organisation Development for Women Scientists**" conducted by Centre for Organization Development, Hyderabad held from  $25^{th} - 29^{th}$  October, 2021.

Dr. Pooja Makwana, Scientist-C

One day training programme on **"Disciplinary Proceedings**" held on 27<sup>th</sup> Oct. 2021 organized by Central Silk Board, Bengaluru.

Yallappa Harijan, Scientist-B

Two days online training programme on **"Introduction to Genomics & Bioinformatics**" organized by C-CAMP & Bengaluru Genomics Centre from 13<sup>th</sup> & 14<sup>th</sup> August, 2021.

Dr. Pooja Makwana, Scientist-C

Two days online training programme on **"Introduction to Genomics & Bioinformatics**" organized by C-CAMP & Bengaluru Genomics Centre from 22<sup>nd</sup> to 24<sup>th</sup> Sept, 2021.

Yallappa Harijan, Scientist-B

Three (3) days long online training programme on **"Extension Management Approaches for promotion of Sericulture Industry"** organized by MANAGE, Hyderabad during 15<sup>th</sup> -18<sup>th</sup> June, 2021 **D**r. Narayan Biswas, Scientist-D, REC, Agartala

CSR&TI, Berhampore and MANAGE, Hyderabad organized training programme on **"Development** of Entrepreneurial skills for promotion of sericulture industry" during 27<sup>th</sup> -30<sup>th</sup> September, 2021.

Dr. N. Sakthivel, Sci – D, REC, Aizwal

CSR&TI, Berhampore organized a Virtual Workshop cum Training programme on **"Application of Statistical tools on sericulture**" during 5<sup>th</sup> & 6<sup>th</sup> January, 2022.

- Dr. V. Lakshamanan, Sci-D, CSRTI-BHB
- Dr. G.Srinivasa, Sci-D, CSRTI-BHB
- Dr. A.R.Pradeep, Sci-D, CSRTI-BHB
- Dr. Dipesh Pandit, Sci-D, CSRTI-BHB
- Dr. Satadal Chakraborty, Sci-D, CSRTI-BHB
- Dr. Sukhabrata Sarker, Sci-D, CSRTI-BHB
- Dr. Suresh K, Sci-C, CSRTI-BHB
- Dr. Safi Afroz, Sci-C, CSRTI-BHB
- Dr. N. Chandrakanth, Sci-C, CSRTI-BHB
- Dr. Pooja Makwana, Sci-C, CSRTI-BHB
- Dr. Yallappa Harijan, Sci-C, CSRTI-BHB
- Dr. P. Naik J, Sci-C, CSRTI-BHB
- Mr. Khasru Alam, Sci-C, CSRTI-BHB
- Dr. Ranjita Devi, Sci-C, CSRTI-BHB
- Dr. V. Raviraj, Sci-C, CSRTI-BHB
- Dr. Deepika Kumar Umesh, Sci-C, CSRTI-BHB

- Dr. Mihir Rabha Sci-C, CSRTI-BHB
- Dr. Narayan Biswas, Sci-D, REC-Agartala, Tripura
- Dr. Ghanashyam Shing, Sci-D, REC-Bhandara, Jharkhand
- Dr. N. Balachandran, Sci-D, RECShillong, Meghalaya
- Mr. Lohit Sonowal, Sci-C, REC-Sille, Arunachal Pradesh
- Dr. Harish Babu, Sci-C, RSRS-Kalimpong, West Bengal
- Dr. Zakir Hossain, Sci-D, RSRS-Kalimpong, West Bengal
- Dr. N Sakthibhel, Sci-D, REC-Aizwal
- Mr. B Vijay Naidu, Sci-D, REC-Mothabari, WB
- Mr. R Dilip Kumar Gogoi, Sci-D, RSRS-Korapur, Odisha
- Dr. B Basumatary Sci-D, REC-Mangaldoi
- Dr. Kartik Neog, Sci-D, REC-Dimapur, Nagaland
- Dr. P Kumaresan, Sci-D, RSRS, RSRS-Jorhat,
- Dr. S. Sarkar, Sci-D, CSRTI-BHB
- Mr. Prenesh Kumar Prasad Dy. Director , CSRTI-BHB

# PAMPHLETS/FOLDERS (Bengali/Hindi/English)

#### বাংলা পামপ্লেট

১২ (ওয়াই) x বি এফ সি -১ – পূর্ব ও উত্তর পূর্ব ভারতের জন্য উন্নততর শংকর প্রজাতি

বিএইচপি –ডিএইচ – দ্বিপ্রজ যুগ্ম শংকর পূর্ব ও উত্তর পূর্ব অঞ্চলের জন্য উন্নতমানের নিস্তারী লাইন - অধিক বেঁচে থাকার ক্ষমতা এবং উচ্চতর রেশম উতপাদনশীলতা

গ্রঁডা পলুপালনের পদ্ধতি (সফল রেশম চামের জন্য)

সেরিউইন – রেশম চাষের জন্য একটি পরিবেশ বান্ধব জীবাণুনাশক সম্পূর্ণা – রেশম কীটগুলির অভিন্ন পরিপঞ্চতার জন্য একটি ফাইটো-ইকডিস্টেরযেড হরমোন প্রযোগ

#### हिंदी पैम्फलेट

12 (Y) x BFC1: पूर्वी और उत्तर पूर्वी क्षेत्र के लिए बेहतर क्रॉसब्रीड बीएचपी-डीएच:पूर्वी और उत्तर-पूर्वी क्षेत्र के लिए द्विप्रज युग्म शंकर

बेहतर निस्तारी लाइनें (उच्च उत्तरजीविता और रेशम उत्पादकता)

रेशमी कोसा की सफल फसल के लिए चाकी पल्पालन

सेरिउईन - रेशम उत्पादन के लिए एक पर्यावरण के अनुकूल कीटाण्नाशक

संपूर्णा - रेशमकीटों की एकसमान परिपक्वता के लिए फाइटो -एक्डीस्टेरॉइड हार्मोन का अनुप्रयोग

#### **English pamphlets**

12 (Y) x BFC1: Improved crossbreed for Eastern & North Eastern zone

BHP-DH: Bivoltine Double Hybrid for Eastern & North-Eastern region

Improved Nistari lines (Higher survival & silk productivity)

Chawki rearing for successful silk cocoon crops

Seriwin - an eco-friendly disinfectant for Sericulture

Sampoorna – a Phyto-Ecdysteroid Hormone Application for Uniform Maturation of Silkworms



# **METEOROLOGICAL DATA**

Month		CSR	TI-Berha	ampore(	WB)				RSRS-	Jorhat					RSRS-K	Coraput		
S	Temp	(°C)	RH	1%	Rair	nfall	Temp	) (°C)	RH	%	Rair	nfall	Temp	) (°C)	RH	%	Rair	nfall
	Max	Min.	Max	Min.	mm	Days	Max	Min.	Max	Min.	mm	Days	Max	Min.	Max	Min.	mm	Days
Apr,21	39.0	18.4	81.0	40.0	4.0	01	26	18	92	59	21	4	33.9	20.3	92	32	68.0	7
May,2	38.8	24.0	92.0	59.0	246.1	12	29	22	92	52	58	14	34.0	21.0	84	34	87.7	8
Jun,21	38.8	23.6	92.0	59.0	248.00	12	30	21	92	52	49	15	31.0	22.0	92	62	153.3	23
Jul,21	37.0	23.4	92.0	69.0	327.00	14	30	22	85	54	36	8	29.2	21.7	96	70	164.6	18
Aug,21	36.4	23.4	91.0	67.0	81.00	13	32	22	85	59	44	17	28.8	21.0	96	75	193.5	18
Sep,21	35.6	21.4	94.0	71.0	68.00	7	30	24	84	55	22	8	28.2	21.0	100	73	294.3	19
Oct,21	34.6	20.0	87.0	61.0	12.00	4	30	20	92	48	26	8	28.4	18.0	96	61	60.4	8
Nov,21	31.2	14.6	96.0	64.0	7.00	2	29	15	75	40	4	1	26.5	14.4	100	50	33.8	3
Dec,21	28.6	10.0	94.0	57.0	1.00	1	28	14	74	23	6	3	25.4	10.5	100	48	3.6	3
Jan,22	26.6	9.2	94.0	51.0	8.00	3	26	12	56	19	13	6	25.5	10.9	90	31	24.5	3
Feb,22	28.4	10.4	90.0	58.0	11.00	2	27	12	56	18	44	6	28.9	11.4	91	14	-	-
Mar,22	37.4	16.0	86.0	37.0	0.00	0	32	14	64	32	13	6	33.8	16.5	84	16	1.0	1
Total	-	-	-	-	1013.1	71	-	-	-	-	336.5	96	-	-	-	-	1084.7	111
Months		F	RSRS-Ka	limpono	]				REC-Mc	thabari					REC-	Shille		
	Temp	(°C)	RH	1%	Rair	nfall	Temr	) (°C)	RH	%	Rair	nfall	Temp	) (°C)	RH	%	Rair	nfall
	Max.	Min.	Max.	Min.	mm	Davs	Max.	Min.	Max.	Min.	mm	Davs	Max.	Min.	Max.	Min.	mm	Davs
Apr.21	33.0	13.0	98	19	34.0	3	37	20	92	61	18.8	5	28	22	77	65	-	-
Mav.21	33.0	16.0	100	35	227.0	11	41	21	89	64	282.9	9	29	24	87	78	-	-
Jun.21	31.0	19.0	100	50	561.3	18	40	20	88	63	187.4	7	30	27	89	81	-	-
Jul.21	31.0	21.0	100	54	831.2	26	37	21	89	68	292.3	17	31	23	85	79	-	-
Aug.21	33.0	20.0	100	50	420.3	23	36	18	91	64	148.8	19	30	27	88	84	-	-
Sep,21	33.0	19.0	100	38	152.3	14	37	18	93	69	10.80	2	31	27	82	79	-	-
Oct,21	32.0	15.0	100	34	323.8	7	35	21	88	64	135.4	8	30	26	81	71	-	-
Nov,21	28.0	12.0	97	25	3.2	0	31	21	93	62	-	-	28	21	76	60	-	-
Dec,21	26.0	7.0	100	28	17.6	2	29	14	91	56	5.2	2	24	16	72	61	-	-
Jan,22	24.0	6.0	95	31	3.9	0	25	08	87	50	-	-	18	15	78	61	-	-
Feb,22	22.0	4.0	100	27	53.9	3	29	12	92	53	-	-	25	19	75	54	-	-
Mar,22	30.0	14.0	99	25	1.5	0	33	15	93	61	37.1	4	25	21	84	78	-	-
Total	-	_		_	2630	107	_				1110 7	72						
i otai			-		2030	107		-	-	-	1110./	/3	-	-	-	-	-	-
Months			REC-M	amring	2030	107		-	- REC-S	- hillong	1118.7	/3	-	-	- REC-A	- Aizwal	-	-
Months	Temp	• (°C)	REC-M RH	amring 1%	Rair	nfall	Temp	- • (°C)	- REC-S RH	- hillong %	Rair	nfall	- Temp	- • (°C)	- REC-A RH	- Aizwal %	- Rair	- nfall
Months	Temp Max.	o (°C) Min.	REC-M RH Max.	amring 1% Min.	Rair	nfall Days	Temp Max.	- ) (°C) Min.	- REC-S RH Max.	- hillong % Min.	Rair mm	nfall Days	- Temp Max.	- ) (°C) Min.	- REC-A RH Max.	- Aizwal % Min.	- Rair mm	- nfall Days
Months Apr,21	Temp Max. 31	0 (°C) Min. 18	REC-M RH Max. 91	amring I% Min. 52	Rair mm 30	nfall Days	Temp Max. 26	- 0 (°C) Min. 16	REC-S RH Max. 77	hillong % Min. 71	Rair mm 228	nfall Days	- Temp Max. 33.5	- 0 (°C) Min. 16	REC-A RH Max. 90	- Aizwal % Min. 24	- Rair mm 85.5	- nfall Days 7
Apr,21 May,21	Temp Max. 31 31	0 (°C) Min. 18 24	REC-M RH Max. 91 85	amring I% Min. 52 74	Rair mm 30 350	nfall Days 1	Temp Max. 26 23	• (°C) Min. 16 13	REC-S RH Max. 77 93	hillong 1% Min. 71 84	Rair mm 228 545	nfall Days -	- Temp Max. 33.5 34	- 0 (°C) Min. 16 15	- REC-A RH Max. 90 85	Aizwal 1% Min. 24 30	- Rair mm 85.5 164.2	- nfall Days 7 19
Apr,21 May,21 Jun,21	Temp Max. 31 31 32	0 (°C) Min. 18 24 24	REC-M RH Max. 91 85 89	amring 1% Min. 52 74 75	Rair mm 30 350 480	nfall Days 1 14 16	Temp Max. 26 23 26	) (°C) Min. 16 13 16	REC-S RH Max. 77 93 91	- hillong % Min. 71 84 81	Rair mm 228 545 132	13 nfall Days - - -	Temp Max. 33.5 34 32.5	- 0 (°C) Min. 16 15 17	REC-A RH Max. 90 85 95	- Aizwal % Min. 24 30 40	- Rair mm 85.5 164.2 466.5	- nfall Days 7 19 28
Apr,21 May,21 Jun,21 Jul,21	Temp Max. 31 31 32 31	0 (°C) Min. 18 24 24 24 24	REC-M RH Max. 91 85 89 93	amring 1% Min. 52 74 75 84	Rair mm 30 350 480 618	nfall Days 1 14 16 19	Temp Max. 26 23 26 28	) (°C) Min. 16 13 16 17	REC-S RH Max. 77 93 91 91	- hillong % Min. 71 84 81 83	Rair mm 228 545 132 514	73 nfall Days - - - -	Temp Max. 33.5 34 32.5 32.5	- 0 (°C) Min. 16 15 17 17	REC-A RH Max. 90 85 95 90	- Aizwal % Min. 24 30 40 17	- Rair mm 85.5 164.2 466.5 619.7	- nfall Days 7 19 28 28
Apr,21 May,21 Jun,21 Jul,21 Aug,21	Temp Max. 31 31 32 31 31	(°C) Min. 18 24 24 24 24 23	REC-M RH Max. 91 85 89 93 93	amring 1% Min. 52 74 75 84 85	Rair mm 30 350 480 618 725	107 nfall Days 1 14 16 19 24	Temp Max. 26 23 26 28 28 28	0 (°C) Min. 16 13 16 17 16	REC-S RH Max. 777 933 91 92 93	- hillong % Min. 71 84 81 83 82	Rair mm 228 545 132 514 246	73 nfall Days - - - - -	- Temp Max. 33.5 34 32.5 32.5 32.7	- 0 (°C) Min. 16 15 17 17 17 19	REC-A RH Max. 90 85 95 90 95	Aizwal Min. 24 30 40 17 40	- Rair mm 85.5 164.2 466.5 619.7 654.7	- Days 7 19 28 28 27
Apr,21 May,21 Jun,21 Jul,21 Aug,21 Sep,21	Temp Max. 31 31 32 31 31 31 32	(°C) Min. 18 24 24 24 24 23 23	REC-M RH Max. 91 85 89 93 93 93 92	amring 1% Min. 52 74 75 84 85 85	Rair mm 30 350 480 618 725 485	107 nfall Days 1 14 16 19 24 17	Temp Max. 26 23 26 28 28 28 27	0 (°C) Min. 16 13 16 17 16 16	REC-S RH Max. 777 93 93 91 92 93 91	- hillong % Min. 71 84 81 83 83 82 86	Rair mm 228 545 132 514 246 339	73 nfall Days - - - - - - -	- Temp Max. 33.5 34 32.5 32.5 32.7 32.7	- 0 (°C) Min. 16 15 17 17 19 15.7	REC-A RH Max. 90 85 95 90 95 87	Aizwal % Min. 24 30 40 17 40 37	- Rair mm 85.5 164.2 466.5 619.7 654.7 438.7	- Days 7 19 28 28 27 23
Apr,21 May,21 Jun,21 Jul,21 Aug,21 Sep,21 Oct,21	Temp Max. 31 31 32 31 31 32 32 31	(°C) Min. 18 24 24 24 24 23 23 17	REC-M RH Max. 91 85 89 93 93 93 92 96	amring 1% Min. 52 74 75 84 85 85 85	Rair mm 30 350 480 618 725 485 37	107 nfall Days 1 14 16 19 24 24 17 10	Temp Max. 26 23 26 28 28 28 27 28 27 28	0 (°C) Min. 16 13 16 17 16 16 16 11	REC-S RH Max. 777 933 91 92 93 93 91 90	- hillong % Min. 71 84 81 83 83 82 86 73	Rair mm 228 545 132 514 246 339 100	73 nfall Days - - - - - - - - -	- Temp Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 31	- Min. 16 15 17 17 19 15.7 16	REC-A RH Max. 90 85 95 90 95 87 87	- Nizwal % Min. 24 30 40 17 40 37 50	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2	- nfall Days 7 19 28 28 28 27 23 13
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21	Temp Max. 31 31 32 31 31 32 31 32 31 26	0 (°C) Min. 18 24 24 24 23 23 17 12	REC-M RH Max. 91 85 89 93 93 93 92 96 85	amring 1% Min. 52 74 75 84 85 85 85 80 72	Rair mm 30 350 480 618 725 485 37	nfall Days 1 14 14 16 19 24 17 10	Temp Max. 26 23 26 28 28 28 27 28 27 28 27	o (°C) Min. 16 13 16 17 16 16 16 11 7	REC-S RH Max. 777 933 911 92 933 911 900 777	- hillong % Min. 71 84 81 83 82 86 73 60	Rair mm 228 545 132 514 246 339 100 0	73 nfall Days - - - - - - - - - - -	- Temp Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 31 27	- Min. 16 15 17 17 19 15.7 16 15	REC-A RH Max. 90 855 95 90 95 87 96 99	- xizwal % Min. 24 30 40 17 40 37 50 40	- Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72	- nfall Days 7 19 28 28 27 23 23 13 4
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21	Temp Max. 31 31 32 31 31 31 32 31 26 21	(°C) Min. 18 24 24 24 23 23 17 12 9	REC-M RH Max. 91 85 89 93 93 93 93 93 92 96 85 89	amring 1% Min. 52 74 75 84 85 85 85 80 72 73	Rair mm 300 3500 4800 618 725 485 377 	nfall Days 1 14 14 16 19 24 17 10 - 2 2	Temp Max. 26 23 26 28 28 27 28 27 28 27 28 27 21	0 (°C) Min. 16 13 16 17 16 16 11 7 5	REC-S RH Max. 77 93 91 92 93 91 90 77 83	- hillong % Min. 71 84 81 83 82 86 73 60 63	Rair mm 228 545 132 514 246 339 100 0 4	73 nfall Days - - - - - - - - - - - - - -	- Temp Max. 33.5 32.5 32.5 32.7 32.7 32.7 32.7 31 27 24	- Min. 16 15 17 17 19 15.7 16 15 11	REC-A RH Max. 900 855 900 955 877 966 999 977	- xizwal % Min. 24 30 40 17 40 37 50 40 40 40 40 40 40 40 40 40 4	- Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 77	- nfall Days 7 19 28 28 27 23 13 13 4 3
Apr,21           May,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21           Jan,22	Temp Max. 31 31 32 31 31 31 32 31 26 21 19	(°C) Min. 18 24 24 24 23 23 17 12 9 8	REC-M RH Max. 91 85 89 93 93 93 93 93 93 93 93 93 93 93 93 93	amring [% Min. 52 74 75 84 85 85 80 72 73 75	Rair mm 300 3500 4800 6188 7255 4855 377 - - - - - - - - - - - - - - - - - -	nfall Days 1 14 16 19 24 17 10 - - 2 1	Temp Max. 26 23 26 28 28 28 27 28 27 28 27 21 10	0 (°C) Min. 16 13 16 17 16 16 16 11 7 5 4	REC-S RH Max. 777 933 911 922 933 911 900 777 833 911	- hillong % Min. 71 84 83 83 82 86 73 60 63 58	Rair mm 228 545 132 514 246 339 100 0 0 4 3	73 nfall Days - - - - - - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 31 27 24 24 27	- Min. 16 15 17 17 19 15.7 16 15 11 9	REC-A RH Max. 900 855 900 955 877 966 999 977 966	- iizwal % Min. 24 30 40 17 40 37 50 40 40 55	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 77 3	- nfall Days 7 19 28 28 28 27 23 13 4 3 4 3 1
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21           Jan,22           Feb,22	Temp Max. 31 31 32 31 31 31 32 31 26 21 19 16	(°C) Min. 18 24 24 23 23 17 12 9 8 7	REC-M RH Max. 91 85 89 93 93 93 93 93 93 93 92 96 85 89 90 90 93	amring [% Min. 52 74 75 84 85 85 80 72 73 75 66	Rair mm 300 3500 4800 6188 7255 4855 377 - - - - - - - - - - - - - - - - - -	nfall Days 1 14 16 19 24 17 10 - 2 2 1 1	Temp Max. 26 23 26 28 28 28 27 28 27 28 27 21 10 8	o (°C) Min. 16 13 16 17 16 16 16 11 7 5 4 3	REC-S RH Max. 777 933 911 922 933 911 900 777 833 911 900	- hillong % Min. 71 84 83 82 86 73 60 63 58 62	Rair mm 228 545 132 514 246 339 100 0 4 33 10	73 nfall Days - - - - - - - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 32.7 31 27 24 27 24 27 24	- Min. 16 15 17 17 19 15.7 16 15 11 9 10	REC-A RH Max. 900 855 900 955 877 966 999 977 966 994	- iizwal % Min. 24 30 40 17 40 37 50 40 40 40 55 32	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 77 3 17.2	- nfall Days 7 19 28 28 28 27 23 13 4 3 13 4 3 1 3
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21           Jan,22           Feb,22           Mar,22	Temp Max. 31 31 32 31 31 32 31 31 26 21 19 16 28	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 8 7 9	REC-M RH Max. 911 855 899 933 933 933 933 933 945 899 900 933 955	amring [% Min. 52 74 75 84 85 80 72 73 75 66 73	Rair mm 300 3500 4800 6188 7255 4855 377 - - - - - - - - - - - - - - - - - -	nfall Days 1 14 16 19 24 17 10 - 2 2 1 1 - 2 02	Temp Max. 26 23 26 28 28 27 28 27 28 27 21 10 8 27 21 10 8 9 19	o (°C) Min. 16 13 16 17 16 16 11 7 5 4 3 8	REC-S RH Max. 777 933 911 922 933 911 900 777 833 911 900 831	- hillong % Min. 71 84 83 82 86 73 60 63 60 63 58 62 45	Rair mm 228 545 132 514 246 339 100 0 4 33 100 8	73 nfall Days - - - - - - - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 32.7 31 27 24 27 24 27 24 30	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 10 15	REC-A RH Max. 900 855 900 955 877 966 999 977 966 944 955	- iizwal % Min. 24 30 40 17 40 37 50 40 40 55 32 30	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3	- nfall Days 7 19 28 28 28 27 23 13 4 3 13 4 3 5
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21           Jan,22           Feb,22           Mar,22           Total	Temp Max. 31 32 31 31 32 31 26 21 19 16 28	e (°C) Min. 18 24 24 23 23 17 12 9 8 7 9 8 7 9	REC-M RH Max. 911 855 899 933 933 933 933 933 935 899 900 933 955	amring [% Min. 52 74 75 84 85 80 72 73 75 66 73 -	Rair mm 300 3500 4800 6188 7255 4855 377 - - - - - - - - - - - - - - - - - -	nfall Days 1 14 16 19 24 17 10 - 2 10 - 2 10 - 2 106	Temp Max. 26 23 26 28 28 27 28 27 28 27 21 10 8 9 19	o (°C) Min. 16 13 16 17 16 16 11 7 5 4 3 8 8 -	REC-S RH Max. 777 933 911 922 933 911 900 777 833 911 900 831 900 811	- hillong % Min. 71 84 81 83 82 86 73 60 63 60 63 58 62 45 45	Rair mm 228 545 132 514 246 339 100 0 4 3 10 4 3 10 8 2129	73 nfall Days - - - - - - - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 32.7 31 27 24 27 24 27 24 30	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 -	REC-A RH Max. 900 855 900 955 877 966 999 977 966 999 977 966 944 955	- iizwal % Min. 24 30 40 17 40 37 50 40 40 55 32 30 30 -	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3 2807	- nfall Days 7 19 28 28 28 27 23 13 4 3 13 4 3 1 3 5 5 161
Apr,21 May,21 Jun,21 Jul,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months	Temp Max. 31 31 32 31 31 32 31 26 21 19 16 28 -	(°C) Min. 18 24 24 23 23 17 12 9 8 8 7 9 9 8 7 9	REC-M Max. 911 855 899 933 933 933 933 932 966 855 899 900 933 955 - REC-D	amring [% Min. 52 74 75 84 85 80 72 73 75 66 73 - imapur	Rair mm 300 3500 4800 618 7255 4855 377 - 188 355 - 755 28533	107 nfall Days 1 14 16 19 24 17 10 - 2 10 - 2 10 - 02 106	Temp Max. 26 23 26 28 28 27 28 27 28 27 21 100 8 19 -	o (°C) Min. 16 13 16 17 16 16 11 17 5 4 4 3 8 8 -	REC-S RH Max. 777 933 911 922 933 911 900 777 833 911 900 811 	- hillong % Min. 71 84 83 82 86 73 60 63 58 60 63 58 62 45 - ngaldoi	Rair mm 228 545 132 514 246 339 100 0 4 3 100 4 3 100 8 2129	73 nfall Days - - - - - - - - - - - - -	- Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	) (°C) Min. 16 15 17 17 19 15.7 16 15 11 9 10 10 15 -	REC-A RH Max. 90 85 95 90 95 87 96 99 97 96 99 97 96 94 95 - REC-A	- iizwal % Min. 24 30 40 17 40 37 50 40 40 55 32 30 - gartala	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3 2807	- nfall Days 7 19 28 28 28 27 23 13 4 3 13 4 3 5 161
Apr,21 Months Apr,21 Jun,21 Jul,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months	Temp Max. 31 31 32 31 31 32 31 26 21 19 16 28 	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 -	REC-M Max. 911 855 899 933 933 933 933 932 966 855 899 900 933 955 - REC-D RH	amring [% Min. 52 74 75 84 85 80 72 73 75 66 73 - imapur %	Rair mm 300 3500 4800 618 7255 4855 377 - - - - - - - - - - - - - - - - - -	nfall Days 1 14 14 16 19 24 17 10 - 2 10 - 2 10 - 02 106	Temp Max. 26 23 26 28 28 27 28 27 28 27 21 100 8 19 - - 7 21 100 8 19	o (°C) Min. 16 13 16 17 16 16 111 7 5 4 3 8 - 0 (°C)	REC-S RH Max. 777 933 911 922 933 911 900 777 833 911 900 811 900 811 	- hillong % Min. 71 84 83 82 86 73 60 63 63 60 63 58 62 45 - ngaldoi %	Rair mm 228 545 132 514 246 339 100 0 4 3 100 4 3 100 8 2129 Rair	73 nfall Days - - - - - - - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 -	REC-A RH Max. 90 85 95 90 95 87 96 99 97 96 99 97 96 99 97 96 94 95 - REC-A RH	- iizwal % Min. 24 30 40 17 40 37 50 40 40 55 32 30 - gartala %	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3 2807 Rair	- nfall Days 7 19 28 28 27 23 13 4 3 13 4 3 5 161
Apr,21 Months Apr,21 Jun,21 Jul,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months	Temp Max. 31 31 32 31 31 32 31 26 21 19 16 28 	e (°C) Min. 18 24 24 23 23 17 12 9 8 8 7 9 - - - - - - - - Min.	REC-M Max. 91 85 89 93 93 93 93 93 92 96 85 89 90 93 95 - REC-D RH Max.	amring [% Min. 52 74 75 84 85 80 72 73 75 66 73 75 66 73 - imapur % Min.	Rair mm 300 3500 4800 618 725 485 377 - 188 357 - 755 28533 Rair mm	nfall Days 1 14 16 19 24 17 10 - 2 10 - 2 10 02 106 nfall Days	Temp Max. 26 23 26 28 28 27 28 27 21 10 8 9 - - - - - - - - - - - - - - - - 	o (°C) Min. 16 13 16 17 16 16 16 11 7 5 4 3 8 8 - 0 (°C) Min.	REC-S RH Max. 77 93 91 92 93 91 90 77 83 91 90 81 90 81 - REC-Ma RH Max.	hillong % Min. 71 84 83 82 86 73 60 63 58 60 63 58 60 63 58 62 45 - ngaldoi % Min.	Rair mm 228 545 132 514 246 339 100 0 4 3 100 4 3 100 8 2129 Rair mm	73 nfall Days - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - -	REC-A RH Max. 90 85 95 90 95 87 96 99 97 96 99 97 96 94 95 - REC-A RH RH Max.	- iizwal % Min. 24 30 40 17 40 37 50 40 40 55 32 30 40 55 32 30 - gartala % Min.	- Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3 2807 Rair mm	- nfall Days 7 19 28 28 28 27 23 13 4 3 13 4 3 5 161 5 161 bays
Apr,21 Months Apr,21 Jun,21 Jun,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months	Temp Max. 31 31 32 31 31 32 31 26 21 19 16 28 - - - - - - - - - - - - - - - - - -	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 - (°C) Min. 23	REC-M Max. 91 85 89 93 93 93 93 93 93 93 95 89 90 93 95 - REC-D RH Max. 73	amring % Min. 52 74 75 84 85 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 66 73 66 73 66 73 66 73 66 73 74 75 66 73 75 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 75 75 75 75 75 66 73 75 75 75 75 66 73 75 75 75 75 75 75 75 75 75 75	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - - - - - -	nfall Days 1 14 16 19 24 17 10 - 2 10 2 10 02 106 nfall Days -	Temp Max. 26 23 26 28 28 28 27 28 27 21 10 8 19 - - - - - - - - - - - - - - - - - -	o (°C) Min. 16 13 16 17 16 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15	REC-S RH Max. 77 93 91 92 93 91 90 77 83 91 90 77 83 91 90 81 - - REC-Ma RH Max. 85	- hillong % Min. 71 84 83 82 86 73 60 63 58 60 63 58 60 63 58 62 45 - ngaldoi % Min. 53	Rair mm 228 545 132 514 246 339 100 0 4 3 100 4 3 100 8 2129 Rair mm 91	73 nfall Days - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - - - - - - - - - - - - - - - - - -	REC-A RH Max. 90 85 95 90 95 87 96 99 97 96 99 97 96 99 97 96 94 95 - REC-A RH Max. 88	- iizwal % Min. 24 30 40 17 40 37 50 40 40 55 32 30 - - - - - - - - - - - - -	- Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 175.2 72 77 3 17.2 53.3 2807 Rair mm 3	- nfall Days 7 19 28 28 27 23 13 4 3 13 4 3 13 5 161 5 161 nfall Days 1
Apr,21 Months Apr,21 Jun,21 Jun,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months Apr,21 May,21	Temp Max. 31 31 32 31 31 32 31 26 21 19 16 28 - - - - - - - - - - - - - - - - - -	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 -	REC-M Max. 91 85 89 93 93 93 93 93 92 96 85 89 90 93 95 - REC-D RH Max. 73 78	amring % Min. 52 744 755 844 855 800 722 733 755 666 733 	Rair mm 30 350 480 618 725 485 37 - - 18 35 - - 75 2853 - - 75 2853 - - 75 2853	nfall Days 1 14 16 19 24 17 10 - 2 10 - 2 10 02 106 - 106 - - - - -	Temp Max. 26 23 26 28 28 28 27 28 27 21 10 8 19 - - - - - - - - - - - - - - - - - -	o (°C) Min. 16 13 16 17 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21	REC-S RH Max. 77 93 91 92 93 91 90 77 83 91 90 81 90 81 - REC-Ma RH Max. 85 92	hillong % Min. 71 84 81 83 82 86 73 60 63 58 60 63 58 60 63 58 62 45 - ngaldoi % Min. 53 59	Rair mm 228 545 132 514 246 339 100 0 4 3 100 4 3 100 8 2129 Rair mm 91 269	73 nfall Days - - - - - - - - - - - - -	- Max. 33.5 34 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - - - - - - - - - - - - - - - - - -	REC-A RH Max. 90 85 95 90 95 87 96 99 97 96 99 97 96 99 97 96 94 95 - REC-A RH Max. 88 92	<ul> <li>-</li> <li>-&lt;</li></ul>	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3 2807 Rair mm 3 104	- nfall Days 7 19 28 28 28 27 23 13 4 3 13 4 3 5 161 5 161 Days 1 bays 1 8
Apr,21 Months Apr,21 Jun,21 Jun,21 Jun,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months Apr,21 May,21 Jun,21	Temp Max. 31 31 32 31 31 32 31 26 21 19 16 28 - - - - - - - - - - - - - - - - - -	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 -	REC-M Max. 91 85 89 93 93 93 93 93 93 93 95 89 90 93 95 - REC-D RH Max. 73 78 79	amring % Min. 52 74 75 84 85 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 66 73 66 73 66 73 66 73 66 73 66 73 74 75 66 73 75 75 75 66 73 75 75 75 75 75 66 73 75 75 75 75 66 73 75 75 75 75 66 73 75 75 75 66 73 75 75 75 66 73 75 73 75 66 73 75 66 73 75 66 73 75 75 66 73 75 75 75 75 75 75 75 75 75 75	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - 75 2853	nfall Days 1 14 16 19 24 17 10 - 2 10 2 10 02 106 - 106 - - - - - - -	Temp Max. 26 23 26 28 28 28 27 28 27 21 10 8 19 - - - - - - - - - - - - - - - - - -	o (°C) Min. 16 13 16 17 16 16 17 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22	REC-S RH Max. 77 93 91 92 93 91 90 77 83 91 90 81 90 81 - REC-Ma RH Max. 85 92 92 92	- hillong % Min. 71 84 81 83 82 86 73 60 63 58 60 63 58 60 63 58 62 45 - ngaldoi % Min. 53 59 62	Rair mm 228 545 132 514 246 339 100 0 4 3 100 4 3 100 8 2129 Rair mm 91 269 978	73 nfall Days - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - - - - - - - - - - - - - - - - - -	REC-A RH Max. 90 85 95 90 95 87 96 99 97 96 99 97 96 99 97 96 94 95 - REC-A RH Max. 88 92 92	<ul> <li>kizwal</li> <li>%</li> <li>Min.</li> <li>24</li> <li>30</li> <li>40</li> <li>17</li> <li>40</li> <li>37</li> <li>50</li> <li>40</li> <li>40</li> <li>55</li> <li>32</li> <li>30</li> <li>40</li> <li>55</li> <li>32</li> <li>30</li> <li>40</li> <li>40</li> <li>55</li> <li>32</li> <li>30</li> <li>40</li> <li>40</li> <li>55</li> <li>32</li> <li>40</li> <li>40</li> <li>55</li> <li>40</li> <li>40</li> <li>74</li> <li>72</li> </ul>	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3 2807 Rair mm 3 104 131	- nfall Days 7 19 28 28 27 23 13 4 3 13 4 3 13 5 161 5 161 Days 1 8 11
Apr,21 Months Apr,21 Jun,21 Jun,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months Apr,21 May,21 Jun,21 Jun,21 Jun,21	Temp Max. 31 31 32 31 31 32 31 26 21 19 16 28 - - - - - - - - - - - - - - - - - -	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 -	REC-M Max. 91 85 89 93 93 93 93 93 93 93 93 93 95 889 90 93 95 - REC-D RH Max. 73 78 79 87	amring % Min. 52 74 75 84 85 85 80 72 73 75 66 73 75 75 66 73 75 75 66 73 75 75 66 73 75 75 75 75 66 73 75 75 75 66 73 75 75 66 73 75 75 75 75 75 75 75 75 75 75	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 2853 - - 75 2853 - - 75 2853 - - - 75 2853 - - - - - - - - - - - - - - - - - - -	nfall Days 1 14 16 19 24 17 10 - 2 10 - 2 10 - 2 106 - - - - - - - - - - -	Temp Max. 26 23 26 28 28 28 27 28 27 21 10 8 19 - - - - - - - - - - - - - - - - - -	o (°C) Min. 16 13 16 17 16 16 17 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22 22	REC-S RH Max. 777 933 911 922 933 911 900 777 833 911 900 811 	hillong % Min. 71 84 83 82 86 73 60 63 58 60 63 58 62 45 - ngaldoi % Min. 53 59 62 62 63	Rair mm 228 545 132 514 246 339 100 0 4 3 100 4 3 100 8 2129 Rair mm 91 269 978 318	73 nfall Days - - - - - - - - - - - - -	Temp Max. 33.5 34 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - - - - - - - - - - - - - - - - - -	REC-A RH Max. 90 85 95 90 95 87 96 99 97 96 99 97 96 99 97 96 94 95 - REC-A RH Max. 88 92 92 92	- iizwal % Min. 24 30 40 17 40 37 50 40 40 55 32 30 - - - - - - - - - - - - -	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3 2807 8 8 77 3 17.2 53.3 2807 8 8 77 3 17.2 53.3 2807 8 7 7 17.2 53.3 2807 8 7 104 104 131 354	- nfall Days 7 19 28 28 27 23 13 4 3 3 13 4 3 5 161 5 161 Days 1 8 11 15
Apr,21 Months Apr,21 Jun,21 Jun,21 Jun,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months Apr,21 May,21 Jun,21 Jun,21	Temp Max. 311 322 311 312 311 322 311 266 211 199 166 288 	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 - (°C) Min. 23 28 28 30 28 30 28	REC-M Max. 91 85 89 93 93 93 93 93 93 93 93 93 92 96 85 89 90 93 95 - - REC-D RH Max. 73 78 79 87 87	amring % Min. 52 74 75 84 85 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 75 66 73 75 75 75 75 80 72 75 80 72 75 80 72 75 80 72 73 75 80 72 73 75 66 73 75 75 66 73 75 75 66 73 75 75 75 75 75 75 75 75 75 75	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 2853 - - - 2853 - - - - - - 150 - - - 747 135	nfall Days 1 14 16 19 24 17 10 - 2 10 0 2 10 6 - 106 - - - - - - - - - - - - -	Temp Max. 26 23 26 28 28 28 27 28 27 28 27 21 10 8 19 - - - - - - - - - - - - - - - - - -	o (°C) Min. 16 13 16 17 16 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22 22 24	REC-S Max. 777 933 911 922 933 911 900 777 833 911 900 777 833 911 900 811 - REC-Ma 81 - REC-Ma 85 92 92 92 92	- hillong % Min. 71 84 84 83 86 73 86 73 60 63 58 60 63 58 62 45 - ngaldoi % Min. 53 59 62 63 63 63	Rair mm 228 545 132 514 246 339 100 0 4 3 100 4 3 100 8 2129 Rair mm 91 269 978 318 139	73 nfall Days - - - - - - - - - - - - -	- Temp Max. 33.5 34 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - - - - - - - - - - - - - - - - - -	REC-A Max. 900 855 950 955 877 966 999 977 966 999 977 966 999 977 966 999 977 966 999 977 966 999 977 966 999 972 920 933 922	- izzwal % Min. 24 30 40 17 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 40 37 50 40 40 37 50 40 40 37 50 40 40 37 50 40 40 40 37 50 40 40 40 40 40 40 40 40 40 4	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 77 3 17.2 53.3 2807 Rair mm 3 104 131 354	nfall Days 7 19 28 28 27 23 13 4 3 13 4 3 13 13 13 5 161 Days 161 Days 11 5 11
Apr,21 Months Apr,21 Jun,21 Jun,21 Jun,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months Apr,21 May,21 Jun,21 Jun,21 Jun,21 Sep,21	Temp Max. 311 322 311 312 311 322 311 266 211 199 166 288 	e (°C) Min. 18 24 24 23 23 17 12 9 8 7 9 - (°C) Min. 23 28 28 30 28 28 30 28 28	REC-M Max. 91 85 89 93 93 93 93 93 93 93 92 96 85 89 90 93 95 - - REC-D RH Max. 73 78 79 87 87 86 85	amring % Min. 52 74 75 84 85 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 80 72 73 75 80 72 75 80 72 75 80 72 75 80 72 75 80 72 75 80 72 75 80 72 75 80 72 75 80 72 73 75 80 72 75 80 72 75 80 72 75 80 72 75 80 75 80 72 73 75 80 72 73 75 80 80 73 75 80 75 80 73 75 80 80 77 75 80 80 77 75 80 80 80 77 75 80 80 80 80 80 77 75 80 80 80 80 80 80 80 80 80 80	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 747 135 60	nfall Days 1 144 16 19 24 17 10 - 2 10 0 2 10 0 2 10 6 - - - - - - - - - - - - - - - - - -	Temp Max. 26 23 26 28 28 27 28 27 28 27 21 10 8 27 21 10 8 19 - - - - - - - - - - - - - - - - - -	o (°C) Min. 16 13 16 17 16 16 11 17 5 4 3 8 - 0 (°C) Min. 15 21 22 24 24 -	REC-S Max. 777 933 911 922 933 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 912 92 92 92 92	- hillong % Min. 71 84 84 84 83 82 86 63 63 60 63 63 63 63 63 63 63 63 63 63 63 63 63	Rain mm 228 545 132 514 246 339 100 0 4 3 100 0 4 3 100 0 4 3 3 100 0 4 3 3 100 0 4 3 3 100 0 9 7 8 318 318 139 153	73 nfall Days - - - - - - - - - - - - -	- Temp Max. 33.5 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - - - - - - - - - - - - - - - - - -	REC-A Max. 900 855 950 955 950 955 877 966 999 977 966 999 977 966 999 977 966 999 977 966 999 977 966 999 92 92 933 922 933	- iizwal % Min. 24 30 40 17 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 40 37 50 40 40 37 50 40 40 37 50 40 40 37 50 40 40 40 55 32 30 - 75 30 40 40 40 40 40 40 40 40 40 4	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 77 3 17.2 53.3 2807 Rair mm 3 104 131 354 171 220	- nfall Days 7 19 28 28 28 27 23 13 4 3 3 13 4 3 3 5 161 Days 161 Days 11 5 11 15 11
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21           Jan,22           Feb,22           Mar,22           Total           Months           Apr,21           Jun,21           Aug,21           Sep,21           Oct,21           View	Temp Max. 311 322 311 312 311 322 311 266 211 199 166 288 - - - - - - - - - - - - - - - - - -	e (°C) Min. 18 24 24 23 23 17 12 9 8 7 9 - (°C) Min. 23 28 28 30 28 28 28 27 -	REC-M Max. 91 85 89 93 93 93 93 93 92 96 85 89 90 93 95 - - REC-D RH Max. 73 78 79 87 86 85 88 9	amring % Min. 52 74 75 84 85 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 66 73 75 80 72 75 80 77 77 75 80 77 77 77 77 75 80 77 77 77 77 77 77 77 77 77 7	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 747 135 60 210	nfall Days 1 144 16 19 24 17 10 - 2 106 - 106 - 106 - 106 - - - - - - - - - - - - - - - - - - -	Temp Max. 26 23 26 28 28 28 27 28 27 28 27 28 27 21 10 8 9 7 21 10 8 9 7 21 10 8 37 39 38 39 38 39 38	o (°C) Min. 16 13 16 17 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22 24 24 24 24 21	REC-S Max. 777 933 911 922 933 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 912 92 92 92 92 92		Rain mm 228 545 132 514 246 339 100 0 4 3 100 0 4 3 100 0 4 3 100 0 4 3 3 100 0 8 2129 8 8 2129 8 78 318 139 153 64	73 nfall Days - - - - - - - - - - - - -	- Max. 33.5 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	<ul> <li>(°C)</li> <li>Min.</li> <li>16</li> <li>15</li> <li>17</li> <li>17</li> <li>19</li> <li>15.7</li> <li>16</li> <li>15</li> <li>11</li> <li>9</li> <li>10</li> <li>15</li> <li>11</li> <li>9</li> <li>10</li> <li>20</li> <li>24</li> <li>25</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> </ul>	REC-A Max. 900 855 950 955 957 955 877 966 999 977 966 999 977 966 999 977 966 999 977 966 999 927 920 933 922 933 922	- izwal % Min. 24 30 40 17 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 70 70 76 74 72 70 76 79 70 76 79 70 76 70 70 76 79 70 76 70 70 76 70 70 70 70 70 70 70 70 70 70 70 70 70	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 77 3 17.2 53.3 2807 Rair mm 3 104 131 354 171 220 161	- nfall Days 7 19 28 28 27 23 13 4 3 13 4 3 11 3 5 161 Days 1 8 11 15 11 17 9 9
Apr,21 Months Apr,21 Jul,21 Jul,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months Apr,21 May,21 Jul,21 Aug,21 Sep,21 Oct,21 Nov,21	Temp Max. 311 322 311 312 311 322 311 266 211 199 166 288 	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 - (°C) Min. 23 28 28 30 28 28 30 28 28 27 26 26 27 26 26 28 27 28 28 28 28 28 28 28 28 28 28	REC-M Max. 91 85 89 93 93 93 93 93 92 96 85 89 90 93 95 	amring % Min. 52 74 75 84 85 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 80 77 75 80 77 75 80 73 75 80 77 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 80 77 75 75 75 80 77 75 75 75 75 75 75 75 75 75	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 747 135 60 210 - -	nfall Days 1 144 16 19 24 17 10 - 2 106 - 106 - 106 - 106 - - - - - - - - - - - - - - - - - - -	Temp Max. 26 23 26 28 28 28 27 28 27 28 27 21 10 8 27 21 10 8 27 21 10 8 37 39 38 39 38 39 38 27 7	o (°C) Min. 16 13 16 17 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22 24 24 24 21 13 	REC-S Max. 777 933 911 922 933 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 912 92 92 92 92 92 92 92 92 92		Rain mm 228 545 132 514 246 339 100 0 4 3100 0 4 3 100 0 4 3 3100 0 4 3 3100 0 8 2129 8 8 2129 8 78 318 139 153 64 -	73 nfall Days - - - - - - - - - - - - -	Temp Max. 33.5 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	<ul> <li>(°C)</li> <li>Min.</li> <li>16</li> <li>15</li> <li>17</li> <li>17</li> <li>19</li> <li>15.7</li> <li>16</li> <li>15</li> <li>11</li> <li>9</li> <li>10</li> <li>15</li> <li>11</li> <li>9</li> <li>10</li> <li>20</li> <li>24</li> <li>25</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>27</li> <li>26</li> <li>25</li> <li>26</li> <li>27</li> <li>28</li> <li>29</li> <li>29</li> <li>21</li> <li>21</li> <li>22</li> <li>23</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>27</li> <li>28</li> <li>29</li> <li>29</li> <li>21</li> <li>21</li> <li>22</li> <li>23</li> <li>24</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>26</li> <li>27</li> <li>28</li>     &lt;</ul>	REC-A Max. 900 855 900 955 877 966 999 977 966 999 977 966 999 977 966 999 977 966 999 977 966 999 920 920 933 922 933 922 966 966 991	- izzwal % Min. 24 30 40 17 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 70 70 70 70 70 76 79 72 55 72 55 72	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 77 3 17.2 53.3 2807 Rair mm 3 104 131 354 171 220 161 10	- fall Days 7 19 28 28 27 23 13 4 3 13 4 3 11 3 5 161 Days 11 15 11 17 9 3 2 1 1 17 19 19 19 19 19 19 19 19 19 19
Apr,21 Months Apr,21 Jul,21 Jul,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21 Jan,22 Feb,22 Mar,22 Total Months Apr,21 May,21 Jul,21 Aug,21 Sep,21 Oct,21 Nov,21 Dec,21	Temp Max. 311 322 311 312 311 322 311 266 211 199 166 288 	(°C) Min. 18 24 24 23 23 17 12 9 8 7 9 - (°C) Min. 23 28 28 28 30 28 28 27 26 19 -	REC-M Max. 91 85 85 89 93 93 93 93 92 96 85 89 90 93 95 	amring % Min. 52 74 75 84 85 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 80 77 83 77 83 72 25 80 77 83 72 75 83 72 75 83 72 75 83 72 75 83 72 75 83 75 83 75 83 75 83 75 83 75 83 75 83 75 83 75 83 75 83 75 84 85 85 85 85 85 85 85 85 85 85	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 747 135 60 210 - -	nfall Days 1 144 16 19 24 17 10 - 2 106 - 106 - 106 - 106 - - - - - - - - - - - - - - - - - - -	Temp Max. 26 23 26 28 28 28 27 28 27 28 27 21 10 8 9 7 21 10 8 9 7 21 10 8 37 39 38 39 38 39 38 27 28 27 28 27 28 27 28 27 28 28 27 28 28 28 27 28 28 28 28 28 28 28 28 28 28 28 28 28	o (°C) Min. 16 13 16 17 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22 24 24 24 21 13 10 0 0 0 0 0 0 0 0 0 0 0 0 0	REC-S Max. 777 933 911 922 933 911 900 777 833 911 900 777 833 911 900 777 833 911 900 811 		Rain mm 228 545 132 514 246 339 100 0 4 3100 0 4 3 3100 0 4 3 3100 0 4 3 3100 0 4 3 3100 0 4 3 3100 0 9 7 8 318 318 3139 153 64 - -	73 nfall Days - - - - - - - - - - - - -	- Max. 33.5 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- (°C) Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - - 0 (°C) Min. 20 24 25 25 25 26 25 17 17 19 10 15 11 10 15 11 15 11 15 11 15 11 15 11 15 11 15 11 15 11 15 15	REC-A Max. 900 855 900 955 877 966 999 977 966 999 977 966 999 977 966 999 977 966 999 929 920 933 922 933 922 933 922 933	- izwal % Min. 24 30 40 17 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 70 70 70 70 70 76 79 72 55 67 79 72	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 77 3 17.2 53.3 2807 Rair mm 3 104 131 354 171 220 161 10 -	nfall Days 7 19 28 28 27 23 13 4 3 13 4 3 13 13 13 13 13 14 3 11 5 161 Days 11 5 111 15 11 17 9 3 0
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21           Jan,22           Feb,22           Mar,22           Total           Months           Apr,211           Jun,211           Jun,211           Jun,211           Jun,211           Jun,211           Sep,211           Oct,211           Nov,211           Dec,211           Jour,211           Oct,211           Nov,211           Dec,211           Jan,222	Temp Max. 311 322 311 312 311 322 311 266 211 199 166 288 	e (°C) Min. 18 24 24 23 23 17 12 9 8 7 9 - (°C) Min. 23 28 28 28 28 20 28 28 28 27 26 19 11 -	REC-M Max. 91 85 85 89 93 93 93 93 93 92 96 85 89 90 93 95 	amring % Min. 52 74 75 84 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 80 77 83 72 83 72 68 83 72 83 72 83 72 83 72 83 72	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - - 747 135 60 210 - - - 747 135 60 210 - - - - 747 135 60 210 - - - - 747 - - - - - - - - - - - - - -	nfall Days 1 144 16 19 24 17 10 - 2 106 - 106 - 106 - 106 - - - - - - - - - - - - - - - - - - -	Temp Max. 26 23 26 28 28 28 27 28 27 28 27 21 10 8 9 7 21 10 8 27 21 10 8 37 39 38 39 38 39 38 27 28 25	o (°C) Min. 16 13 16 17 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22 24 24 24 21 13 10 08 8	REC-S Max. 777 933 911 922 933 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 811 		Rain mm 228 545 132 514 246 339 100 0 4 310 0 4 3 100 0 4 3 310 8 2129 8 8 2129 8 8 318 139 153 64 - - 300 2 5 3 153 64	73 nfall Days	- Max. 33.5 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	- (°C) Min. 16 15 17 17 19 15.7 16 15 11 9 10 15 - 11 9 10 15 - 25 25 25 25 25 26 25 17 13 13 -	REC-A Max. 900 955 900 955 877 966 999 977 966 999 977 966 999 977 966 999 977 966 999 929 920 920 933 922 933 922 933 922 933		Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 72 77 3 17.2 53.3 2807 8 807 8 807 8 104 131 354 171 220 161 10 - - 6 -	- nfall Days 7 19 28 28 27 23 13 4 3 13 4 3 13 14 3 11 15 11 17 9 3 0 1 -
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21           Jan,22           Feb,22           Mar,22           Total           Months           Apr,211           Jul,21           Jun,21           Jun,22           Feb,22           Feb,22           Total           Jan,22           Feb,22           Total	Temp Max. 311 322 311 322 311 322 311 266 211 199 166 288 - - - - - - - - - - - - - - - - - -	e (°C) Min. 18 24 24 24 23 17 12 9 8 7 9 - (°C) Min. 23 28 28 28 28 30 28 28 28 27 26 19 11 12 22 22 22 22 22 22 22 22	REC-M Max. 91 85 89 93 93 93 93 93 92 96 85 89 90 93 92 96 85 89 90 93 95 	amring % Min. 52 74 75 84 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 80 77 83 72 68 68 68 68 68	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - - 747 135 60 210 - - 747 135 60 210 - - - 747 135 60 210 - - - 747 135 60 210 - - - 747 135 60 210 - - - 747 - - - 747 - - - - 747 - - - -	nfall Days 1 144 16 19 24 17 10 - 2 2 10 - 02 10 6 - - - - - - - - - - - - - - - - - -	Temp Max. 26 23 26 28 28 27 28 27 28 27 21 10 8 9 7 21 10 8 27 21 10 8 37 39 38 39 38 39 38 39 38 27 28 25 27	o (°C) Min. 16 13 16 17 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22 24 24 24 21 13 10 08 08 08 08 08	REC-S Max. 777 933 911 922 933 911 900 777 833 911 900 811 839 892 922 922 922 922 922 922 922 922 92	- hillong % Min. 71 84 84 83 82 86 73 60 63 58 62 45 - 73 60 63 58 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 63 63 59 63 63 63 59 63 63 63 63 63 63 63 63 63 63 63 63 63	Rain mm 228 545 132 514 246 339 100 0 0 4 4 339 100 8 2129 Rain mm 91 269 978 318 139 153 64 - - 30 44	73 nfall Days	Temp Max. 33.5 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	<ul> <li>(°C)</li> <li>Min.</li> <li>16</li> <li>15</li> <li>17</li> <li>17</li> <li>19</li> <li>15.7</li> <li>16</li> <li>15</li> <li>11</li> <li>9</li> <li>10</li> <li>15</li> <li>11</li> <li>9</li> <li>10</li> <li>20</li> <li>24</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>17</li> <li>13</li> <li>13</li> <li>11</li> </ul>	REC-A Max. 900 955 977 966 999 977 966 999 977 966 999 977 966 999 977 966 999 977 966 999 977 966 991 922 933 922 933 922 956 966 911 911 911 911	- iizwal % Min. 24 30 40 17 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 70 70 70 70 70 70 70 70 70 70 70 76 79 72 55 67 53 43	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 77 3 17.2 53.3 2807 8 8 17.2 53.3 2807 8 8 17.2 53.3 2807 104 131 354 171 220 161 10 - 6 7 7	- fall Days 7 19 28 28 27 23 13 4 3 11 3 5 161 Days 1 161 Days 1 15 11 17 9 3 0 1 2 2 2 2 2 2 2 2 2 2 2 2 2
Apr,21           May,21           Jun,21           Jul,21           Aug,21           Sep,21           Oct,21           Nov,21           Dec,21           Jan,22           Feb,22           Mar,22           Total           Months           Apr,211           Jun,211           Jun,212           Jour,211           Jun,211           Dec,211           Jan,222           Feb,222           Mar,222           Feb,222           Mar,222           Feb,222           Mar,222           Feb,222           Mar,222           Peb,222           Mar,222           Mar,222	Temp Max. 311 312 311 312 311 322 311 266 211 199 166 288 - - - - - - - - - - - - - - - - - -	e (°C) Min. 18 24 24 24 23 17 12 9 8 7 9 - (°C) Min. 23 28 28 28 30 28 28 30 28 28 27 26 19 11 12 20	REC-M Max. 911 855 899 933 933 932 966 855 899 900 933 925 	amring % Min. 52 74 75 84 85 80 72 73 75 66 73 75 66 73 75 66 73 75 66 73 75 80 77 83 72 68 68 68 68 67	Rair mm 30 350 480 618 725 485 37 - 18 35 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - 75 2853 - - - 747 135 60 210 - - - 747 135 60 210 - - - - 747 135 60 210 - - - - - - - - - - - - - - - - - - -	nfall Days 1 144 16 19 24 17 10 - 2 2 10 - 02 10 0 - 2 10 6 - - - - - - - - - - - - - - - - - -	Temp Max. 26 23 26 28 28 27 28 27 28 27 21 10 8 27 21 10 8 27 28 37 39 38 39 38 39 38 39 38 27 28 25 27 28 25 27 36	o (°C) Min. 16 13 16 17 16 16 16 11 7 5 4 3 8 - 0 (°C) Min. 15 21 22 24 24 21 13 10 08 08 13	REC-S RH Max. 777 933 911 922 933 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 777 833 911 900 811 	- hillong % Min. 71 84 81 83 82 86 73 63 63 63 58 62 45 - 73 63 63 58 63 59 62 63 63 59 62 63 63 59 62 63 63 59 62 63 59 62 63 59 62 63 59 62 63 59 62 63 59 63 63 59 63 59 63 59 63 59 63 59 63 59 63 59 63 59 63 59 63 59 63 59 63 59 63 59 59 59 63 59 59 59 59 59 55 59 55 59 55 59 55 59 55 59 55 59 55 59 55 59 55 59 55 59 55 55	Rain mm 228 545 132 514 246 339 100 0 4 4 339 100 8 2129 7 8 8 2129 7 8 8 2129 978 318 139 153 64 - - 30 44 199	73 nfall Days	Temp Max. 33.5 32.5 32.5 32.7 32.7 32.7 32.7 32.7 32.7 32.7 32.7	<ul> <li>(°C)</li> <li>Min.</li> <li>16</li> <li>15</li> <li>17</li> <li>19</li> <li>15.7</li> <li>16</li> <li>15</li> <li>11</li> <li>9</li> <li>10</li> <li>15</li> <li>11</li> <li>9</li> <li>10</li> <li>20</li> <li>24</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>26</li> <li>25</li> <li>13</li> <li>13</li> <li>11</li> <li>22</li> </ul>	REC-A Max. 900 855 950 905 877 966 999 977 966 999 977 966 999 977 966 999 977 966 999 977 966 991 920 920 933 922 933 922 966 961 911 911 911 900 922	- iizwal % Min. 24 30 40 17 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 37 50 40 40 37 50 40 40 37 50 40 40 55 32 30 - 55 67 53 43 53 43 53 43 53	Rair mm 85.5 164.2 466.5 619.7 654.7 438.7 155.2 72 72 72 77 3 17.2 53.3 2807 8 807 8 17.2 53.3 17.2 53.3 17.2 53.3 2807 8 17.2 53.3 17.2 53.3 2807 8 104 131 354 171 220 161 10 - 6 7 7 225 6 7 2 5 3	nfall Days 7 19 28 28 27 23 13 4 3 11 3 3 5 161 Days 161 Days 11 5 111 17 9 3 0 0 1 12 3 0 0

States	2017-18	2018-19	2019-20	2020-21				
Arunachal Pradesh	140	300	278	218				
Assam & BTC	8594	2783	2539	2653				
Bihar	557	598	577	530				
Chhattisgarh	261	261	242	244				
Jharkhand	472	502	606	545				
Manipur	3590	3300	3300	3291				
Meghalaya	3209	3209	3289	3300				
Mizoram	4094	4094	1698	1658				
Nagaland	290	394	694	570				
Odisha	464	537	537	465				
Sikkim	185	185	300	179				
Tripura	2184	1935	2064	1944				
West Bengal	16480	15400	15721	15853				
India	223927	235001	239676	237578				
E & NE Share (%)	18%	14%	13%	13%				

Mulberry acerage (ha) in East & North East India

# Mulberry raw silk production (ton) in East & North East Indi

States	2017-18	2018-19	2019-20	2020-21
Arunachal Pradesh	2.3	3	3	1
Assam & BTC	59	69	69	16
Bihar	17	8	2	2
Chhattisgarh	8.3	9	8	8
Jharkhand	3	3	3	1
Manipur	92.5	137	150	111
Meghalaya	39	49	54	56
Mizoram	75	83	93	37
Nagaland	12	13	12	6
Odisha	3	3	2	1
Sikkim	0.001	0.4	1	0.08
Tripura	87	230	94	112
West Bengal	2570	2365	2428	850
India (Mulberry Silk)	22066	25345	25384	23896
E & NE Share	13%	12%	11%	5%
India (Raw Silk)	31906	35468	36152	33739
Mulberry Silk Share	69%	71%	70%	71%

# **CSRTI-BERHAMPORE**

# **Extension Network**









Continuation continuation



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East North East Silk

