वार्षिक अनुसंधान एवं
प्रसाशनिक प्रतिवेदन
**Annual Research &
Administrative Report 2016-'17**

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर (प बं)
Central Sericultural Research & Training Institute, Berhampore (WB)
(ISO 9001 : 2015 Certified)

वार्षिक अनुसंधान एवं प्रशासनिक प्रतिवेदन

Annual Research & Administrative Report

2016-17

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान

Central Sericultural Research & Training Institute

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प्रस्तावना

केन्द्रीय रेशम उत्पादन अनुसंधान और प्रशिक्षण संस्थान, बहरमपुर, पश्चिम बंगाल के निरंतर प्रयासों के फलस्वरुप पूर्वी एवं उत्तर-पूर्वी क्षेत्रों में रेशम की उत्पादकता में महत्वपूर्ण वृद्धि वर्ष के दौरान हुई। संस्थान, रेशम उद्योग के सतत विकास के लिए उन्नयन के पथ पर अग्रसर होते हुए देश के पूर्वी और उत्तर-पूर्वी क्षेत्रों के कृषकों के ऊर्ध्वमुखी आर्थिक विकास की दिशा में अवश्यकता आधारित अनुसंधान के माध्यम से उत्कृष्टता बनाए रखने हेतु निरंतर प्रयासरत है। साथ ही, सतत उत्पादन सुनिश्चित करने के लिए यह संस्थान कृषकों के प्रक्षेत्रों से जुड़ी विभिन्न समस्याओं के हल करने हेतु सर्वदा प्रयत्नशील है। इसके अतिरिक्त, मृदा स्वास्थ्य कार्ड का डिजिटलीकरण, छोटे फ़ार्मों में यंत्रीकरण को बढ़ावा देने और शहतूत पर्ण के उत्पादन में वृद्धि पर जोर देते हुए सूचना प्रौद्योगिकी व डाटा-बेस तथा प्रौद्योगिकी के विकास के माध्यम से एक सशक्त कार्यक्रम "**प्रयोगशाला से प्रक्षेत्र तक**" पर भी बल दिया गया है।

पूर्वी तथा उत्तर-पूर्वी क्षेत्र के 13 राज्यों में स्थित तीन [3] क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र [क्षेरेउअके], पन्द्रह [15] अनुसंधान विस्तार केन्द्र [अविके], अपने विस्तार जालतंत्र [नेटवर्क] के माध्यम से क्षेत्रों में उनकी स्थलाकृति और कृषि-जलवायु अवस्थाओं में विविधताओं के बावजूद भी पर्णधारियों को सहायता प्रदान करते आ रहे हैं।

मुझे यह कहते हुए प्रसन्नता का बोध हो रहा है कि इस संस्थान के वैज्ञानिकों, अधिकारियों एवं कर्मचारियों के सम्मिलित अथक प्रयासों और उनके उत्कृष्ट कार्यों तथा क्षेत्रों में रेशम कृषि के विकास में महत्वपूर्ण उपलब्धियों के माध्यम से आईएसओ 9001:2015 मानक को कायम रखने में सफलता प्राप्त हुई है।

रिजल्ट फ्रेमवर्क दस्तावेजों [आरएफडी] के अधिदेश समेत रेशम कृषि उद्योग के विविध पहलुओं के समस्याओं के समाधान हेतु संस्थान तथा इसके अधीनस्थ केन्द्रों में 40 अनुसंधान परियोजनाएं, 7 कार्यक्रमों तथा 1 पॉयलट अध्ययन को जारी रखते हुए वर्ष के दौरान कुल 11 परियोजनाओं एवं 1 कार्यक्रम को संपन्न कर 14 परियोजनाएं, 1 पॉयलट अध्ययन तथा 2 कार्यक्रम प्रारंभ की गई। इन परियोजनाओं, कार्यक्रमों और पायलट अध्ययन से उन्नत प्रजातियों, रेशमकीट नस्लों / संकर, उनके प्रबंधन और पेशेवरों तथा पर्णधारियों में क्षमता निर्माण के माध्यम से विस्तार गतिविधियों के विकास में उल्लेखनीय उपलब्धियां प्राप्त की गई । इसके अतिरिक्त, संस्थान द्वारा राष्ट्रीय स्तर पर ख्यातिप्राप्त अन्य संस्थानों के साथ भी अपना अनुसंधानात्मक संबंध स्थापित किए गए हैं।

मैं, प्रबुद्ध अध्यक्ष महोदय और अनुसंधान समन्वय समिति [आरसीसी], अनुसंधान सलाहकार समिति [आरएसी] तथा क्षेत्रीय अनुसंधान सलाहकार समिति [आरआरएसी] के सदस्यों द्वारा हमारे वैज्ञानिकों को क्षेत्र में अनुसंधनात्मक व विकासात्मक लक्ष्य को प्राप्त करने हेतु दिए गए बहुमूल्य मार्गदर्शन के लिए सादर धन्यवाद देती हूँ।

मेरी यह कामना है कि अनुसंधान एवं विकास, विस्तार, मानव संसाधन विकास एवं हितधारकों के लिए सेवा सहायता की मानक और उत्कृष्टता आने वाले वर्षों में भी कायम रहे। साथ ही साथ, मैं, संस्थान तथा इसके अधीनस्थ इकाइयों के वैज्ञानिकों / अधिकारियों / पदधारियों के प्रयास की सराहना करती हूँ। मैं, केन्द्रीय रेशम बोर्ड / रेशम निदेशालय/ वस्त्र निदेशालय द्वारा रेशम उद्योग के हितलाभ हेतु प्रदत्त उनके अमूल्य सहयोग के प्रति अपना आभार प्रकट करती हूँ।

मुझे यह विश्वास है कि केरेउअवप्रसं की 2016-17 की वार्षिक रिपोर्ट एक बहुमूल्य सूचनाप्रद खजाना के साथ ही यह नीति निर्मताओं एवं कृषकों के लिए एक मार्गदर्शक के रूप में भी सहायक सिद्ध होगा।

[डॉ. कणिका त्रिवेदी]

निदेशक

FOREWORD

The continuous efforts of Central Sericulture Research and Training Institute, Berhampore West Bengal resulted considerable enhancement of silk productivity during the year in the Eastern and North Eastern region. The institute is consistently improving for sustainable development of sericulture industry and trying to maintain excellence through need based research towards vertical economic growth of the farmers of Eastern and North-Eastern region of the country. The institute is continuously striving to solve different issues related to farmers' fields to ensure sustainable production. Stress has been laid for digitization soil health card, promotes mechanization of small farms and increase mulberry leaf production, and emphasized for a strong **'Lab-to-Land'** programme through information technology & development of data base and technology.

Through extension network *viz.* three Regional Sericultural Research Stations (RSRSs) and fifteen Research Extension Centres (RECs) located at 13 states of Eastern and NE region, support are being provided to the stakeholders with variations in topography and agro climatic conditions.

I am happy to say that this Institute's scientists, officers and officials through their untiring efforts as a team established and maintained the Institute ISO 9001: 2015 quality standard and dedicated to support to the sericulture farmers/ stakeholders in the region. With the mandated Results Framework Documents (RFD), 40 research projects, 07 programmes and 1 pilot study were continued at the Institute and its nested units for addressing problems in various aspects of sericulture industry, of which, 14 projects, 1 pilot study and 2 programmes were just initiated and 11 projects + 1 prog. were concluded. These projects, programmes and pilot studies made remarkable achievements in development of improved varieties, silkworm breeds/hybrids, their management and extension activities through capacity building in professionals and stakeholders. In addition, the institute has also tied up its research with other nationally reputed institutes.

Sincerely acknowledged the valuable guidance rendered by the learned Chairpersons and members of the Research Coordination Committee (RCC), Research Advisory Committee (RAC) and Regional Research Advisory Committee (RRAC) to the scientist for achieving the R & D aimed in the region.

I wish the standard and quality of R&D, Extension, HRD and service support for the stakeholders will stand with the years to come and appreciate the efforts of the scientists, officers and officials of this institute and nested units. Supports from CSB/ DoS/DoT acknowledged for the benefit of the sericulture industry.

I am confident that Annual Report of 2016-17, CSR&TI would be a valuable information treasure and would guide policy makers and farmers alike.

[Dr. Kanika Trivedy]
Director

1a. मुख्य सारांश

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर अपने तीन अधीनस्थ क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्रों [क्षेरेउअके] तथा 15 अनुसंधान विस्तार केन्द्रों [अविके] के साथ पूर्वी तथा उत्तर-पूर्वी राज्यों में रेशम उद्योग के विकास में उल्लेखनीय योगदान करते आ रहा है। अनुसंधान व विकास का ध्यान पूर्वी [5] तथा उत्तर-पूर्वी [8] राज्यों के रेशम निदेशालय/रेशम उद्योगो के साथ घनिष्ठ संबंध स्थापित कर रेशम कृषकों तथा हितधारकों के लाभार्थ क्षेत्रीय अवश्यकताओं, विस्तार व मानव संसाधन विकास आधारित प्राथमिकताओं पर मुख्य रुप से केन्द्रित था। अनेकों काल तक, देश के पूर्वी भाग समेत पश्चिम बंगाल जलवायु आपदाओं के कारण द्विप्रज रेशम कृषि के लिए प्रतिकूल क्षेत्र के तौर पर जाना जाता था लेकिन अनुसंधान एवं विस्तार गतिविधियों के अथक प्रयासों से उन सभी अजैविक दबावों पर काबू पाने के फलस्वरूप इस क्षेत्र में द्विप्रज रेशम उत्पादन में गति आई है। अवधि के दौरान रेशम उद्योग के विविध समस्याओं के समाधान से संबंधित 31 अनुसंधान परियोजानाएं एवं कार्यक्रम [26 परियोजनाएं तथा 5 कार्यक्रमों] जारी थे। वर्ष के दौरान, कुल 11 परियोजनाएं एवं 1 कार्यक्रम को संपन्न करते हुए कुल 14 परियोजनाएं, 1 पॉयलट अध्ययन तथा 2 कार्यक्रम प्रारंभ की गई। वर्ष 2016-17 के दौरान प्राप्त मुख्य उपलब्धियाँ निम्नानुसार हैः

शहतूत सुधार और उत्पादकता

- पूर्वी तथा उत्तर-पूर्वी राज्यों के 7 परीक्षण केन्द्रों में एआईसीएम चरण – III के अधीन 5 शहतूत जीनप्ररुपों [3 प्रजातियां अर्थात् सी-2038, जी-4 तथा सुवर्णा 2+2 नियंत्रित अर्थात् विशाला एवं एस-1635] की जाँच की गई। परीक्षित जीनप्ररुपों में से सी-2038 सिंचित और वर्षाश्रित दोनों ही अवस्थाओं में [नियंत्रण एस-1635 की तुलना में 21-23%] क्रमशः 53.8 टन/हे/वर्ष तथा 17-21 टन/हे/वर्ष पर्ण उपज के साथ अधि-उत्पादक प्रजाति के तौर उभर कर सामने आई है। क्षेरेउअके, कलिम्पोंग स्थित अन्य जाँच केन्द्रों [पश्चिम बंगाल की पहाड़ियों] में 6 जीनप्ररुपों [4 प्रजातियां अर्थात् की सी-2038, जी-4, सुवर्णा, तथा टीआर-23 + 2 चेक्स अर्थात् विशाला एवं एस-146] की जाँच कर टीआर-23 को सर्वाधिक उपज वाली प्रजाति [चेक एस-1635 की तुलना में 10-12 टन/हे/वर्ष - 42%] के तौर पर दर्ज किया गया।

- 7 परीक्षित जीनप्ररुप का चयन सिंचित अवस्था के कम उर्वरक मिट्टी के अधीन किया गया। उक्त में से सी-9 में, क्रमशः अनुशंसित उर्वरक की मात्रा [आरएफडी] [एनः पीः केः: 336:180:112 कि.ग्रा./हे/वर्ष] तथा आरएफडी का 50% का उपयोग कर 52.81 टन एवं 34.11 टन/हे/वर्ष अधिकतम पर्ण उपज दर्ज की गई।

- 15 जीनप्ररूप में से 7 त्रिगुणित जीनप्ररूप का चयन किया गया तथा चेक जीनप्ररूप [एस-1635: 297.7 ग्रा/पौध/फसल] की तुलना में इसकी पर्ण उपज की रेंज 390.8 – 433.4 ग्रा/पौध/फसल पाया गया।

- 2190 संततियों में से 224 जीनप्ररूपों का चयन शुष्क सहिष्णु शहतूत प्रजाति के तौर पर सीमित सिंचाई के अधीन किया गया। संततियों में पर्ण उपज [136 से 512 ग्रा.पौध], क्लोरोफिल कंटेट [5.7 – 42 µgcm^2], विशिष्ट पर्ण क्षेत्र [107 – 631 सेमी^{2}/ग्रा.] तथा आर्द्रता कंटेट [35 – 92 %] की महत्वपूर्ण विविधता पायी गई।

- विशाला और एस-1635 में क्रमशः [96.6%] [96.32%] की उत्तरजीविता दर्ज करते हुए इसे समरुप पाया गया। एस-1635 एवं विशाला के मध्य पर्ण का स्वाद, वृद्धि तथा लार्वा अवधि में गैर-महत्वपूर्ण परिणाम दर्ज किया गया।

- ओडिशा के वर्षाश्रित अवस्था में मवेशियों से होनेवाली हानि की रोकथाम, रख-रखाव व्यय में कटौती तथा चराई की समस्याओं टालते हुए सर्वोत्तम पर्ण उपज प्राप्त किया गया। ऊँची झाड़ी एवं पेड़नुमा शहतूत पौधरोपण का संस्थापन क्रमशः 5' x 5', 6' x 6' एवं 8' x 8' के अंतराल पर कर एस-1635 में **4.46, 3.3** एवं **2.12** प्रति हे/वर्ष अधिकतम पर्ण उपज दर्ज की गई।

शहतूत संरक्षणः

- जैव-प्रौद्योगिकी पहल द्वारा एफवाईटी के अधीन 8 चूर्णिल आसिता प्रतिरोधी आशाजनक शहतूत संततियों का मूल्यांकन किया गया। उपरोक्त में से 3 संततियों में 16-26% अधि-पर्ण जैवमात्रा उपज क्षमता समेत कृषि योग्य एस-1635 की अपेक्षा उल्लेखनीय तौर पर रोग प्रतिरोधी पाई गई। उनमें से 4 अनुमानित चूर्णिल आसिता प्रभावीय स्कार [SCAR] एवं एसएसआर [SSR] मार्कर संततियों में प्रतिक्रिया स्वरुप फेनोटाइपिक रोग के साथ ≥76% पारस्परिक-संबंध पाया गया। विकसित संतति [F2] के जीवाणु पर्ण चित्ती (बीएलएस) प्रतिरोध के मूल्यांकन के अंतर्गत चिह्नित एसएसआर का उपयोग कर बीएलएस प्रतिरोधी लाइनों की पहचान एमएएस आधारित उपयोग के लिए मार्कर-ट्रेट लिंक स्थापित करने हेतु की गई गई। प्रचलित कृषि योग्य एस-1635 एवं दो संततियों में पाइप लाइन सी-2038 की अपेक्षा पर्ण जैवमात्रा में उल्लेखनीय विविधता पायी गई।

- पूर्वी तथा उत्तर-पूर्वी क्षेत्र में पर्णीय शहतूत रोगों एवं पीड़कों के रोग सर्वेक्षण व निगरानी के अंतर्गत पूर्वानुमान मॉडल की सहायता से पूर्व-संसूचना देने वाली एक कैलेंडर विकसित की गई। रेशम कृषकों को सीधे लाभ पहुँचाने की दृष्टि से पर्णीय शहतूत रोगों एवं पीड़कों से जुड़ी पूर्व-संसूचना समेत प्रतिकारी उपाय "एम-किसान पोर्टल" संदेश के माध्यम से कृषकों तक प्रसारित की जाती है।

- भारत के 13 पूर्वी एवं उत्तर-पूर्वी राज्यों के रेशमकीट तथा शहतूत पीड़कों के लिए समाकलित पीड़क प्रबंधन मॉड्यूलों को विकसित व उन्नत किया गया। बदलते जलवायु परिदृश्य में, फसल हानि के निवारण हेतु मौसम आधारित पूर्वानुमान / पूर्वानुमान मॉडल को उन्नत बनाया गया है।

- शहतूत के मूल विगलन रोग [फुसरियम सोलानी] के अध्ययन के तहत एसएसएएफ [कार्बनडेजिम 12% + मैंकोजेब 63%] का 0.1%, 0.15%, एवं 0.20% के उपचारक अनुप्रयोग क्रमशः 84%, 88% तथा 94.4% की दर से फुसरियम सोलानी के सबसे प्रभावी विकास अवरोधक के तौर पर पाया गया। जैव-कवकनाशी त्रिचोदेरमा विरिड का अनुप्रयोग वृद्धि अवरोधन को नियंत्रित करता है।

रेशमकीट सुधार और उत्पादकता

- सात बहुप्रज लाइनों समेत उच्च एसएसआर [> 17%] तथा उच्च स्वच्छता [> 80 points] [M.Con.1x MH1 (M1) - श्वेत; M.Con.4 x MH1 (M2) – येलो; Nistari x MH1 (M3) – येलो; Gen3 x M.Con.4 (M4) – येलो; (SK6xSK7) x M.Con.4 (M5) – येलो; M6DPE x MH1 (M6) – येलो and MH1 x BHB (M7) –श्वेत] विकसित की गई। इसके अलावे, दो बहु x बहु संकरों [अर्थात् M4 x M.Con.4 and M1 x M9A] तथा दो बहु x द्वि संकरों [अर्थात् M2 x B.Con.4 and M1 x MC4(O)] की भी पहचान की गई।

- अधि-कवच भार के लिए छह द्विप्रज प्रजातियों का संकरण कर दो अभिमुखित जीन पूल तथा अधि-उत्तरजीविता हेतु तीन बहुप्रज अभिमुखित जीन पूल आनुवंशिक सुघट्यता हेतु विकसित किए गए।

- पाँच नए अण्डाकार एवं पाँच नए डंबलाकार आकार की नस्लें छह स्थानों अर्थात् केरेउअवप्रसं, बहरमपुर; क्षेरेउअके, कलिम्पोंग; क्षेरेउअके, कोरापुट; क्षेरेउअके, जोरहाट; अविके, भंडरा तथा अविके शिलांग में विकसित कर शटल प्रजनन पहल द्वारा बेहतर आनुवंशिक सुघट्यता की प्राप्ति हुई।

- प्राधिकरण परीक्षण के अधीन कुल 1,61,000 रोमुच का परीक्षण कर नियंत्रण 44.85 कि.ग्रा. [Nistari x (SK6 x SK7)] की तुलना में M6DPC x (SK6 x SK7) का उत्पादन/100 रोमुच 47.56 कि.ग्रा. दर्ज किया गया। B.Con.1 x B.Con.4, के मामले में, नियंत्रण[SK6 x SK7]. के 48.9 कि.ग्रा. की अपेक्षा 52.4 कि.ग्रा. प्रति 100 रोमुच पाया गया।

- विभिन्न प्रजनन केन्द्रों से एकत्रित किए गए नस्लें उच्च तापक्रम (35 ±1° से.) एवं उच्च आर्द्रता (85 ±5%) के परीक्षणाधीन थे। कोशितीकरण के दर पर विशेष रुप से जोर देते हुए समग्र प्रदर्शन के आधार पर 10 नस्लों का चयन संसाधन सामग्री के तोर पर किया गया। 5 अंडाकार एवं 5 डंबलाकार आकृति के आधारी संकरण का संपोषण कर उच्च तापक्रम (35 ±1° से.) और उच्च आर्द्रता अवस्था के अधीन जाँच की गई। उपरोक्त नस्लों को प्रजनन सामग्री के तौर पर उपयोग कर 25 अंडाकार x डंबलाकार संकरों को सूचीबद्ध किया गया।

रेशमकीट संरक्षण

- अविके, महेशपुर राज [झारखंड], अविके, कामनगर, मिदनापुर, मोथाबाड़ी, उत्तर दिनाजपुर एवं दक्षिण दिनाजपुर एवं पश्चिम बंगाल के बीरभूम तथा क्षेरेउअके, रांची [झारखंड], क्षेरेउअके कोरापुट [ओडिशा] तथा क्षेरेउअके, जोरहाट के अधीन उत्तर-पूर्वी राज्यों के 6 केन्द्रों में रेशमकीट रोगों का सर्वेक्षण कर 3-25% ग्रेसरी; 0.5-5% फ्लैचरी; <1% मस्कर्डिन; 1-17.2% गैटिन तथा 0.5-1.5% पेब्रिन रोग दर्ज कर इसके प्रतिकारी उपायों के बारे में भी सलाह दी गई।

- रेशमकीट लार्वा के रोगजनक जीवाणु के संक्रमण के फलस्वरुप हीमोलीम्फ के नमूने एकत्रित किए गए। उक्त में आण्विक भार 10, 15, 24, 40, 45 तथा 50 किलो डाल्टन [केडीए] वाले छह प्रोटीन की प्राप्ति हुई जिसका शोधन व अनुक्रमण करने के पश्चात प्रतिजीवाणु प्रोटीनों से समानता पाई गई। अतः उक्त का उपयोग क्लोनिंग हेतु किया जा सकता है।

लागत में कमी

- फोल्डिंग प्लास्टिक चन्द्रिका डिवाइस [यंत्र]: प्लास्टिक के चन्द्रिकाओं की फोल्डिंग व पैकिंग तथा इसके विसंक्रमण हेतु डिजाइन [अभिकल्पित] किया गया है। 3 लॉकरो समेत डिवाइस का आकार 6'x 1'x 6" है। साथ ही, उक्त डिवाइस में एक ही साथ 10 प्लास्टिक की चन्द्रिकाओं को फोल्ड/पैक करके रखने की क्षमता है। उक्त डिवाइस को 0.6 से.मी. व्यास वाले ऑयरन रॉड से बनाया गया जिसकी लागत रुपये 150.00 है। इसके अनेकों लाभ है यथा इसका उपयोग आसान और टिकाऊ होने के साथ ही और लागत प्रभावी है।

- सिंचित अवस्था के अधीन पार्थिव कार्बन पृथक्करण, घास आच्छादित हल्की जुताई की अनुशंसा, मृदा परीक्षण आधारित एनपीके उर्वरकों समेत 20 टन/हे/वर्ष की दर से कीटपालन अवशिष्ट कम्पोस्ट के द्वारा शहतूत पर्णसमूह के उत्पादन लागत को कम तथा निरन्तर अधि-उत्पादकता एवं गुणवत्ता युक्त शहतूत पर्ण की प्राप्ति की जा सकती है। लाभः- पर्ण उपज 38.7 टन/हे/वर्ष, 40.1 एमजी/हे/वर्ष मृदा जैविक कार्बन स्टॉक [एसओसीएस] समेत पार्थिव पृथक्करण क्षमता – 6.9 टन/हे/वर्ष है।

- कोसा धागाकरण क्षमता में उन्नयन के लिए रीलीबूस्ट [सतही सक्रिय कारक (एसएए) एवं वेटिंग (Wetting) कारक] विकसित कर कम निवेश करते हुए गुणवत्ता युक्त रेशम उत्पादन के साथ ही साथ कोसा के धागाकरण क्षमता में 5-15% तक वृद्धि दर्ज की गई। इसके पेटेंट के लिए आवेदन किया गया है।

- संस्थान तथा क्षेरेउअके में **"ड्रम किट ड्रिप सिंचाई प्रणाली"** का पुनः संस्थापन, जल संसाधन के प्रभावी उपयोग एवं शहतूत कृषि की लागत को कम करने के लिए किया गया है।

प्रौद्योगिकी हस्तांतरण

- प्रौद्योगिकी हस्तांतरण की दृष्टि से, देश के पूर्वी तथा उत्तर-पूर्वी क्षेत्रों में चिह्नित 18 आदर्श रेशम ग्रामों में सफलतापूर्वक प्रौद्योगिकी हस्तांतरण क्रियान्वित किया गया। 1800 लाभार्थियों में उनके प्रक्षेत्र स्तर पर अलग-अलग प्रौद्योगिकी पैकेज [वर्षाश्रित एवं सिंचित] का प्रचार-प्रसार किया गया। अवधि के दौरान, सिंचित अवस्था के अधीन 44.74 टन/हे/वर्ष एवं वर्षाश्रित अवस्था के अधीन 12.81 टन/हे/वर्ष पर्ण उपज दर्ज की गई। सभी लाभार्थियों द्वारा कुल 3,20,825 रोमुच [बहु x द्विः 27,000 एवं द्वि x द्विः 50825] का कीटपालन किया गया। वर्षाश्रित अवस्था के अधीन औसतन कोसा उपज [द्वि x द्वि] 41.89 कि.ग्रा/रोमुच तथा सिंचित अवस्था के अधीन औसतन कोसा उपज [बहु x द्वि] 49.04 कि.ग्रा./100 रोमुच दर्ज की गई।

प्रौद्योगिकियों की लोकप्रियताः चार प्रौद्योगिकियों का प्रचार-प्रसार 685 कृषकों के प्रक्षेत्र में निदर्शन के माध्यम से लोकप्रिय बनाया गया।

- श्वेत मक्खी प्रबंधन हेतु थायोमेथोक्सम [0.015%] का अनुप्रयोग 150 कृषकों के प्रक्षेत्र में लोकप्रिय बनाया गया जिसके परिणामस्वरूप 8.1-13.8% पर्ण हानि की बचत देखी गई।

- प्रमुख शहतूत पीड़कों के प्रबंधन हेतु येलो स्टिकी ट्रैप्स 250 कृषकों के प्रक्षेत्र में में लोकप्रिय बनाया गया जिसके परिणामस्वरुप 6-10.6% पर्ण हानि में कमी देखी गई।

- शहतूत प्रक्षेत्र में उत्पादकता तथा गुणवत्ता सुधार हेतु 185 कृषकों में मृदा परीक्षण आधारित सल्फर उर्वरक का अनुप्रयोग लोकप्रिय बनाया गया। फलतः उपज रेंज में 8.7-12.4% की वृद्धि दर्ज की गई।

- वर्षाश्रित अवस्था के अधीन नमी बनाये रखने के लिए शहतूत प्रक्षेत्र में 1% पोटेशियम क्लोराइड [जलसंजीवनी] का पर्णीय छिड़काव 100 कृषकों में लोकप्रिय बनाते हुए उपज में 4.3-5.9% की वृद्धि दर्ज की गई।

आईटी पहलः डाटा बेस एवं प्रौद्योगिकी का विकासः

- कुल 3015 कृषकों का डाटा बेस तैयार कर **"एम-किसान पोर्टल"** के माध्यम से 115 संदेशों का संप्रसारण विभिन्न भाषाओं [अर्थात् बंगला, हिंदी, उड़िया, नेपाली, खासी एवं अंग्रेजी लिपि] में रेशम फसल की सफलता संबंधी पूर्वसूचना एवं तद्विषयक निवारक उपायों को अपनाने हेतु वर्ष 2016-17 के दौरान क्या गया।

- **"रेशम-5के"** पोर्टल में कुल 6815 कृषकों का पंजीयन कर फसल-वार डाटा अपलोड किया गया है।

- अनुसंधनात्मक व विकासात्मक गतिविधियों के ई-मॉनिटरिंग हेतु संस्थान के वेबसाइट [www.csrtiber.res.in] पर सभी जारी एवं संपन्न अनुसंधान परियोजनाओं का डाटा अपलोड किया गया है।

- **"किसान नर्सरी"**, **"रेशम कृषि में नारी शक्ति"** तथा **"द्विप्रज रेशम कृषि"** पर तीन वृत-चित्र [15 मिनट] प्रसारण हेतु बनाए गए।

- कृषकों में नवीनतम प्रौद्योगिकियों के प्रचार-प्रसार हेतु रेशमकृषि उन्नयन पर 16 संख्यक **"रेशम कथा"** का प्रसारण आकाशवाणी के माध्यम से करने के साथ ही रेशम कृषि के विकास से जुड़ी 2 एफएम को भी प्रसारित किया गया।

- हाल ही में, विभिन्न भाषाओं में प्रकाशित सभी ब्रोचरों/पैम्फलेट संस्थान के वेबसाइट www.csrtiber,res.in पर अपलोड कर दिया गया है।

- संस्थान में सुसंस्थापित वीडियो कॉन्फ्रेंसिंग पर कार्य का शुभारम्भ दिनांक 14.02.2017 से प्रारम्भ हो गया है

- पीएफएमएस पोर्टल द्वारा डीबीटी के 100% प्रसारण के लिए निरंतर प्रयास किए गए।

विस्तार संचार कार्यक्रम [ईसीपी]

- कृषकों की आवश्यकताओं की पूर्ति एवं प्रक्षेत्र संबंधी किसी भी आगामी समस्या की पूर्व-सूचना देने की एक बहु-आयामी दृष्टि के साथ प्रक्षेत्र स्तर पर विभिन्न विस्तार संसूचना कार्यक्रमों अर्थात् जागरुकता कार्यक्रम, श्रव्य-दृश्य कार्यक्रम, प्रदर्शनी, प्रक्षेत्र दिवस आदि का आयोजन किया जा रहा है। 273 विस्तार संचार कार्यक्रमों द्वारा कुल 16,375 हितधारकों को [51 जागरुकता कार्यक्रम (3294), 31 श्रव्य-दृश्य कार्यक्रम (1141), 44 प्रदर्शनी (3991), 39 प्रक्षेत्र दिवस (1753), 59 समूह चर्चा (1827), 37 तकनीकी निदर्शन (1493) तथा 15 रेशम कृषि मेला / लघु रेशम कृषि मेला / कार्यशाला (2876)] जानकारी दी गई। इसके अतिरिक्त, 35 कृषक प्रशिक्षण कार्यक्रम (2279) एवं 2 प्रशिक्षक प्रशिक्षण कार्यक्रम (15) आयोजित किए गए।

द्विप्रज क्लस्टर प्रवर्धन कार्यक्रम

- पूर्वी और उत्तर-पूर्वी क्षेत्रों के अंतर्गत 8 राज्यों अर्थात पश्चिम बंगाल (4), ओडिशा (2), बिहार (1), असम (3), मणिपुर (2), मिजोरम (1), नागालैंड (1) और त्रिपुरा (1) में पंद्रह द्विप्रज क्लस्टरों का आयोजन सफलतापूर्वक किया गया है। **29.45 लाख** [द्वि **22.50 लाख**; आईसीबी **6.95 लाख**] रोमुच के कुल लक्ष्य की तुलना में 48.534 लाख [द्वि **18.83 लाख**; आईसीबी **29.7 लाख**] रोमुच का कीटपालन किया गया। कुल कोसा उत्पादन 1816.3 टन [द्वि 513.8 टन; आईसीबी 1302.5 टन] तथा कच्चे रेशम का उत्पादन 203.7 टन [द्वि 79.3 टन; आईसीबी 124.4 टन] दर्ज करते हुए 168.3 टन के लक्ष्य की तुलना में 21% अधि-वृद्धि देखी गई।

मानव संसाधन विकास [एचआरडी]

- रेशम कृषि के सतत विकास के लिए प्रौद्योगिकी हस्तांतरण हेतु विविध मानव संसाधन विकास कार्यक्रमों का आयोजन किया गया।

- संरचनात्मक पाठ्यक्रम के अंतर्गत कुल 24 छात्रों [2015-16 बैच] ने पीजीडीएस पाठ्यक्रम संपन्न किए तथा 13 नए छात्रों ने [2016-17 बैच] कल्याणी विश्वविद्यालय, नदिया [प.बं.] से संबद्ध 15 महीने के पीजीडीएस पाठ्यक्रम में नामंकन करवाएं। संरचनात्मक पाठ्यक्रम के अलावे पश्चिम बंगाल एवं ओडिशा के कुल 264 कृषकों को विभिन्न प्रशिक्षण कार्यक्रमों यथा रोग एवं पीड़क प्रबंधन, चॉकी कीटपालन, उत्तरावस्था कीटपालन आदि में प्रशिक्षित किया गया । कृषकों को मुफ्त भोजनालय व आवास और मजदूरी मुआवजा की प्रतिपूर्ति डीबीटी द्वारा की गई । दोनों अर्थात् राज्य तथा रेशम कृषि से जुड़े केन्द्र सरकार के कुल 94 सरकारी पदधारीगण प्रौद्योगिकी अभिविन्यास कार्यक्रम [टीओपी] शीर्ष के अंतर्गत विभिन्न विशिष्ट प्रशिक्षण कार्यकलापों पर प्रशिक्षित किए गए।

- आवश्यकता आधारित प्रशिक्षण कार्यक्रम के अंतर्गत बिहार तथा उत्तर प्रदेश के कुल 1465 संख्यक कृषकों को शहतूत कृषि पर प्रशिक्षण दिया गया ।

- 3 रेशम संसाधन केन्द्रों की स्थापना बरबकपुर [नदिया], अलीनगर [मालदा] एवं बंकीपुर [मुर्शिदाबाद] में कर कुल 609 कृषक प्रशिक्षित किए गए।

- उत्तर-पूर्वी राज्यों से कुल 107 कृषकगण पश्चिम बंगाल और इसके आस-पास के क्षेत्रों में की जा रही रेशम कृषि के परिदर्शन हेतु इस संस्थान के दौरा पर आए। केन्द्रीय रेशम बोर्ड के वैज्ञानिकों एवं तकनीकी कार्मिकों को रेशम कृषि पर व्यावहारिक जानकारी पुनश्चर्या कार्यक्रम के माध्यम से दी जाती है। रेशम निदेशालय, पश्चिम बंगाल के अधीन पदधारीगण तथा पंजीकृत बीज उत्पादकों [आरएसपी] को सूक्ष्मदर्शीय शलभ की जाँच तथा परीक्षण उपकरणों के उपयोग करने की विधि पर प्रशिक्षित किए गए। रेशम निदेशालय, नागालैंड के पदधारियों तथा चॉकी कीटपालन पर नागालैंड के कृषकों को प्रशिक्षित करने के लिए वैज्ञानिकगण नियुक्त किए गए थे।

स्वच्छ रेशम ग्राम

- आदर्श स्वच्छ रेशम ग्राम कार्यक्रम के क्रियान्वयन हेतु अंगीकृत मल्लिकपुर दियारा ग्राम में कुल 330 कृषक परिवार अपने आजीविका के प्रमुख स्त्रोत के तौर पर रेशम कृषि की खेती [बेसलाइन डाटा के आधार पर] कर रहे हैं।

प्रकाशन

- संस्थान की अर्धवार्षिकी आर एंड डी न्यूज बुलेटिन "न्यूज एंड व्यूज" का दो संस्करण प्रकाशित किए गए।

- तिमाही रेशम कृषि बुलेटिन "रेशम कृषि वार्ता" का चार संस्करण बंगला भाषा में प्रकाशित की गई।

- **29** अंतरराष्ट्रीय एवं राष्ट्रीय शोध पत्रों, **2** लोकप्रिय लेखों, **6** पुस्तिकाओं/बुक चैप्टर तथा **27** विस्तार साहित्य [स्थानीय भाषा में यथा बुलेटिन / सार संग्रह / विवरणिका / पैम्फलेट / विस्तार संहिता / लीफलेट] प्रकाशित किए गए।

राजभाषा कार्यान्वयन

- दिनांक **11.11.2016** को गंगटोक [सिक्किम] में आयोजित **"भारत के पूर्व एवं पूर्वोत्तर राज्यों के क्षेत्रीय राजभाषा सम्मेलन"** में संस्थान को वर्ष 2015-16 के दौरान राजभाषा नीति के उत्कृष्ट कार्यान्वयन व अनुपालन हेतु समारोह के मुख्य अतिथि **माननीय गृह राज्य मंत्री, श्री किरण रिजुजु तथा सिक्किम के राज्यपाल, श्री श्रीनिवास दादासाहेब पाटिल महोदय** के कर-कमलों से **द्वितीय पुरस्कार** से सम्मानित किया गया।

- दिनांक **20.01.2017** को **"शहतूती रेशम का विकास – नयी तकनीकियों के साथ"** विषयक एक दिवसीय राजभाषा संगोष्ठी का आयोजन इस संस्थान में किया गया। संगोष्ठी में रेशम उद्योग से जुड़े विविध विषयों पर **28 शोध-साराशों का एक प्रोसिडिंग** भी प्रकाशित किया गया। संगोष्ठी में केरेबो के विभिन्न केन्द्रों से **52 अधिकारियों/पदधारियों** समेत प्रगतिशील कृषकों ने भी भाग लिया।

- नगर राजभाषा कार्यान्वयन समिति, बहरमपुर [प.बं.] की **31वीं एवं 32वीं** बैठक संस्थान की निदेशक महोदया, डॉ. कणिका त्रिवेदी, की अध्यक्षता में क्रमशः दिनांक **29.04.2016 एवं 23.09.2016** को अपराह्न 3.00 बजे केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर के बैठक कक्ष में संपन्न हुई। इस बैठक में राजभाषा विभाग से उपनिदेशक [कार्यान्वयन] भी उपस्थित थे जिन्होंने राजभाषा की दिशा में संस्थान तथा नराकास, बहरमपुर के सदस्य - कार्यालयों को बहुमूल्य सुझाव दिए।

सहयोगात्मक अनुसंधान परियोजनाएं

- शहतूत एवं रेशमकीट उत्पादकता में सुधार हेतु कुछेक सहयोगी अनुसंधान परियोजनाएं [10] प्रतिष्ठित संस्थानों/संगठनों [अर्थात् एपीएसएसआरडीआई, हिंदुपूर, आन्ध्र प्रदेश; इसरो, एनईएसएसी, मेघालय; एनबीएआईआर, आईसीएआर, बेंगलूर; एनबीएसएस व एलयूपी, आईसीएआर, जोरहाट; सीएसजीआरसी, होसूर, तमिलनाडु एवं एसबीआरएल, कोढ़ती, एनएसएसओ, सीएसटीआरआई, बेंगलूर] के साथ जारी रखा गया।

अन्य महत्वपूर्ण उपलब्धि

- वर्ष के दौरान आईएसओ 9001:2015 प्रमाणन की मान्यता देने के लिए जाँच लेखा परीक्षा आयोजित की गई।

क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र [क्षेरेउअके]
क्षेरेउअके, कलिम्पोंग [पश्चिम बंगाल]

- आई. एस. ओ. 9001:2008 प्रमाणन जारी रखा गया।

- शहतूत पर्णीय रोगों एवं पीड़कों के प्रबंधन हेतु रोग पूर्वानुमान व पूर्व-सूचना प्रणाली का अनुसरण किया गया।
- 81 द्विप्रज रेशमकीट जननद्रव्य एक्शेसनों का संपोषण किया गया।
- कलिम्पोंग पहाड़ियों के आदर्श रेशम ग्राम के कुल **70** कृषकों का चयन किया गया तथा शरत फसल, **2016** के दौरान उक्त किसानों का औसत कोसा उपज/**100** रोमुच **34.70** कि.ग्रा. दर्ज की गई।
- प्रौद्योगिकी के प्रचार-प्रसार के अधीन कुल 819 कृषक/रेशम पर्णधारियों को 13 विस्तार संसूचना कार्यक्रमों अर्थात् रेशम कृषि मेला, जागरुकता कार्यक्रम, श्रव्य-दृश्य कार्यक्रमों, प्रदर्शनी, प्रक्षेत्र दिवस, समूह चर्चा, प्रौद्योगिकी निदर्शन कार्यक्रम आदि में प्रशिक्षित किया गया ।

क्षेरेउअके, कोरापुट [ओडिशा]
- आई. एस. ओ. **9001:2008** प्रमाणन जारी रखा गया।
- कृषक स्तर पर शहतूत पर्णीय रोग के आपतनों का सर्वेक्षण व निगरानी एवं आवश्यक पूर्वोपाय नियंत्रण तथा संसूचना प्रणाली को अपनाकर विभिन्न पर्णीय रोगों के रोग सूचकांक प्रतिशत (पीडीआई) का रख-रखाव आर्थिक-सीमा [economic threshold] स्तर के नीचे बनाए रखा गया।
- ओडिशा के पूर्वी घाट के उच्च भूमि क्षेत्रों में शहतूत पर्ण और कोसा उत्पादन उपज में अंतराल पर एक नई परियोजना आरंभ की गई है।
- भारत के पूर्वी तथा उत्तर-पूर्वी क्षेत्रों में बीज एवं व्यावसायिक फसलों में रेशमकीट रोगों का सर्वेक्षण, निगरानी व मॉनिटरिंग कर ग्रेसरी, फ्लैचरी एवं मस्कार्डिन रोगों की औसतन प्रधानता दर्ज की गई है। फसल हानि को कम करने हेतु प्रतिकारी उपाय सुझाए गए हैं।
- विविध प्रौद्योगिकी पहलुओं के क्रियान्वयन हेतु क्लस्टर संवर्धन कार्यक्रम के अधीन दो क्लस्टरों अर्थात् काशीपुर एवं घटगांव का मॉनिटरिंग तथा सर्वेक्षण किया जा रहा है।
- रेशम निदेशालय, ओडिशा के 9 तकनीकी कार्मिकों को प्रशिक्षण प्रदान करने हेतु क्षेरेउअके, कोरापुट के परिसर में प्रशिक्षु प्रशिक्षण कार्यक्रम [टीटीपी] का आयोजन किया गया। नवीनतम प्रौद्योगिकियों पर कृषक प्रशिक्षण कार्यक्रम [एफटीपी] के अंतर्गत तीन बैचो में कुल 36 कृषक प्रशिक्षित किए गए। कृषक प्रक्षेत्र स्कूल के अधीन कुल 99 कृषकों समेत दो लीड कृषक भी प्रशिक्षित किए गए। आयोजित 44 विस्तार संसूचना कार्यक्रमों में 2013 कृषकों ने भाग लिया तथा प्रौद्योगिकियों के संबंध में जागरूकता लाने हेतु उनके स्थानीय भाषा में पैम्फलेट [12 संख्यक] एवं फ्लैक्सी बैनरों [13 संख्यक] को कृषकों के मध्य पारिचालित किए गए।
- पुरस्कार एवं मान्यताः पूरी में दिनांक 04.06.2016 से 08.06.2016 तक राष्ट्रीय स्तर पर आयोजित कृषि मेला में प्रथम पुरस्कार प्राप्त हुआ। साथ ही, वर्ष 2016-17 के लिए नगर राजभाषा कार्यान्वयन समिति, कोरापुट द्वारा क्षेरेउअके, कोरापुट को नगर स्तर पर राजभाषा के

उत्कृष्ट कार्यान्वयन हेतु प्रथम पुरस्कार से सम्मानित किया गया। इसके अतिरिक्त, केरेउअवप्रसं, बहरमपुर में **"शहतूती रेशम का विकास – नयी तकनीकियों के साथ"** विषय पर आयोजित हिंदी संगोष्ठी में **"ड्रम किट ड्रिप और हाईड्रोजेल के साथ जल संरक्षण का भविष्यात्मक पहलू"** विषयक शोध-पत्र के पोस्टर प्रस्तुती हेतु तृतीय पुरस्कार प्राप्त हुआ।

- किसान अधिवेशन का आयोजनः काशीपुर में एक किसान अधिवेशन / रेशम कृषि मेला का आयोजन किया गया जिसमें कुल 94 कृषकों ने भाग लिया।

- बीज कोसा जनन कार्यक्रमः लाभार्थियों के स्तर पर 5,20,000 बीज कोसा उत्पादित कर पश्चिम बंगाल के बीजागार को रोमुच के उत्पादन हेतु रुपये 520/कि.ग्रा. की दर से आपूर्तित की गई।

- एचवाईवी के साथ शहतूत पौधरोपण का प्रसारः ओडिशा के रायगढ़ा जिले के अधीन काशीपुर ब्लॉक में एस-1635 समेत 5 एकड़ में नए शहतूत पौधरोपण किए गए।

क्षेरेउअके, जोरहाट

- आई. एस. ओ. 9001:2008 प्रमाणन जारी रखा गया।

- सहयोगी परियोजना एपीएस 3539 के अधीनः एनबीएसएस व एलयूपी समेत असम के गोलाघाट जिले के चयनित रेशम ग्रामों में पोषक प्रबंधन हेतु शहतूत वर्धन मृदा का लक्षण वर्णन कर कुल 43 मृदा स्वास्थ्य कार्ड कृषकों को संवितरित किया गया।

- 84 विस्तार संसूचना कार्यक्रमों यथा जागरुकता व श्रव्य-दृश्य कार्यक्रम, प्रदर्शनी, प्रक्षेत्र दिवस, समूह चर्चा, प्रौद्योगिकी का निदर्शन, रेशम कृषि मेला तथा क्षेरेउअके एवं इसके अधीनस्थ अविके में रेशम कृषि मेला [आरकेएम] एवं लघु रेशम कृषि मेला का आयोजन कर कुल 5047 हितधारक प्रशिक्षित किए गए।

- मानव संसाधन विकास कार्यक्रम के अधीन शहतूत एवं रेशमकीट रोगों व पीड़क प्रबंधन के नवीनतम प्रौद्योगिकियों पर प्रशिक्षु प्रशिक्षण - 5 रेशम निदेशालयों, गोलाघाट के कर्मचारी सदस्यों एवं 888 कृषक प्रशिक्षित किए गए। 980 लाभार्थी विभिन्न आवश्यकता आधारित कार्यक्रम आदि के अधीन पशिक्षित किए गए।

- विविध प्रौद्योगिक पहलुओं के क्रियान्वयन हेतु द्विप्रज क्लस्टर संवर्धन कार्यक्रम के अधीन कृषकों के आठ क्लस्टरों तथा इस क्षेत्र के टीओटी के अंतर्गत सात आदर्श रेशम ग्रामों का मॉनिटरिंग किया जा रहा है।

1a. EXECUTIVE SUMMARY

Central Sericultural Research and Training Institute, Berhampore along with its nested 03 Regional Sericultural Research Stations (RSRSs) and 15 Research Extension Centers (RECs) have made significant contributions for the development of sericulture industry in the Eastern and North Eastern regions. The Research & Development focus was mainly on prioritized need of regional requirements, extension and human resource development for benefiting the sericulture stakeholders in close coordination with Directorates of Sericulture / Industries in Eastern (5) and North Eastern (8) states. For long, West Bengal along with the Eastern part of the country were known as non-congenial zone for bivoltine sericulture due to climatic hazards but overcoming all those abiotic stress, bivoltine sericulture has gained momentum due to tireless efforts of research and extension machineries. During the period, 31 research projects and programmes (26 Projects and 5 Prog.) were continued for addressing problems in various aspects of sericulture industry. Moreover, during the year, a total of 14 projects, 1 pilot study and 2 programmes were initiated and 11 projects + 1 prog. were concluded. The major achievements made during the year 2016-17 are as follows:

MULBERRY IMPROVEMENT & PRODUCTIVITY

- Through **AICEM Phase-III**, 5 mulberry genotypes (3 entries *viz.* C-2038, G-4 and Suvarna-2 + 2 checks *viz.* Vishala and S-1635) were tested in 7 test centres of Eastern and North Eastern states. Among the test genotypes, C-2038 has emerged as the higher yielder in both irrigated and rainfed condition with leaf yield of 53.8 t/ha/yr and 17-21 t/ha/yr, respectively (21- 23 % higher than check S1635). Another test centre at RSRS, Kalimpong (hills of West Bengal) where 6 genotypes (4 entries *viz.* C-2038, G-4, Suvarna, and Tr-23 + 2 checks *viz.* Vishala and S-146) were tested; Tr-23 has been registered as the top yielder (10-12 t/ha/yr - 42% over check S-146).

- Under low input soil of irrigated condition**,** 07 test genotypes selected, of which, C-9 was recorded highest leaf yield of 52.81 t and 34.11 t/ha/yr in full recommended fertilizer dose (RFD) (N: P: K:: 336:180:112 kg/ha/yr) and 50% of RFD, respectively.

- 07 triploid genotypes were short-listed out of 15 and leaf yield of which ranged from 390.8- 433.4 g/plant/crop over check genotype (S-1635**:** 297.7 g/plant/crop).

- 224 genotypes were shortlisted as drought tolerant mulberry variety among 2190 progenies under limited irrigation. Progenies exhibited significant variation for leaf yield (136 to 512 g/ plant), chlorophyll content (5.7 - 42 μgcm^2), specific leaf area (107 -631 cm^2/g) and moisture content (35-92%).

- Survivability of Vishala (96.6%) & S1635 (96.32%) recorded & found at par. Palatability of leaf, growth and larval duration between S1635 & Vishala were found non-significant result.
- To check cattle menace, curtail maintenance expenditure, avoid grazing problems, and obtain optimum leaf yield in rainfed condition of Odisha, high bush and tree type mulberry plantation was established and showed highest leaf yield of 4.46, 3.3 and 2.12 t per ha/yr in S1635 under the spacing of 5' x 5', 6' x 6' and 8' x 8', respectively.

MULBERRY PROTECTION

- Through biotechnological approach, evaluated 8 powdery mildew (PM) resistant promising mulberry progenies under FYT, three of the lines exhibited 16% - 26% more leaf biomass yielding potential with significant disease resistance over ruling cultivar S-1635. Four of the putative PM responsive SCAR and SSR markers showed ≥76% correlation with the phenotypic disease reaction of the progenies.
- Under evaluation for bacterial leaf spot (BLS) resistance of developed progeny (F2) using identified SSRs to establish marker-trait link for MAS based utilization, identified BLS resistant lines, results showed significant variability of leaf biomass over the ruling cultivar S-1635 and pipe line cultivar C-2038 in two progeny lines.
- Under disease survey and surveillance of foliar mulberry diseases & pests in Eastern & NE region, developed one forewarning calendar with the help of forecasting models. This forewarning as well as remedial measure for foliar mulberry diseases & pests are extended through message *"m-kisan portal" for th*e direct benefit of the sericulture farmers.
- Developed and upgraded the integrated pest management modules for silkworm and mulberry pests of 13 Eastern and NE states of India. In the changing climatic scenario, weather based prediction / forecasting models are upgraded to avert crop losses.
- Under the study of root rot disease (*Fusarium solani)* of mulberry, the application of treatment 0.1%, 0.15%, and 0.20% of SAAF (Carbendazim 12% + Mancozeb, 63%) showed most effective growth inhibition of *Fusarium solani* at the rate of 84%, 88% and 94.4%, respectively. Application of bio-fungicide *Trichoderma viride* controls 66.22% growth inhibition.

SILKWORM IMPROVEMENT AND PRODUCTIVITY

- Seven multivoltine lines with high SR (> 17%) and high neatness (> 80 points) have been developed [M.Con.1x MH1 (M1) -White; M.Con.4 x MH1 (M2) – Yellow; Nistari x MH1 (M3) –Yellow; Gen3 x M.Con.4 (M4) –Yellow; (SK6xSK7) x M.Con.4 (M5) –Yellow; M6DPE x MH1 (M6) –Yellow and MH1 x BHB (M7) –White]. Besides, two Multi x Multi hybrids [*viz.* M4 x M.Con.4 and M1 x M9A] and two Multi x Bi hybrids [*viz.*M2 x B.Con.4 and M1 x MC4(O)] were also identified.

- Two six-way bivoltine converged gene pool for high shell weight and three multivoltine converged gene pool for high survival are developed.
- Five new oval and five new dumbbell shaped breeds are developed at six locations *viz.* CSRTI, Berhampore; RSRS, Kalimpong; RSRS, Koraput; RSRS, Jorhat; REC, Bhandra and REC, Shilong which have acquired better genetic plasticity through shuttle breeding approach.
- Under authorization trail, a total of 1,61,000 dfls were tested. In M6DPC x (SK6 x SK7), the production/100dfls was 47.56 kg against 44.85 kg in control [Nistari x (SK6 x SK7)]. In case of B.Con.1 x B.Con.4, the production/100dfls was 52.4 kg against 48.9 kg in control [SK6 x SK7].
- The breeds collected from different breeding centres were subjected for screening at high temperature ($35\pm1°C$) and high humidity ($85\pm5\%$). Based on overall performance with special emphasis on pupation rate, ten breeds were selected as breeding resource materials. 5 oval and 5 dumbbell shaped foundation crosses were raised and tested under high temperature ($35\pm1°C$) and high humidity condition. Using them as breeding material, 25 oval x dumbbell hybrids were short listed.

SILKWORM PROTECTION

- Silkworm diseases surveyed at REC Maheshpur Raj (Jharkhand), REC Kamnagar, Midnapore, REC Mothabari, Uttar Dinajpur, Dakshin Dinajpur and Birbhum of West Bengal and RSRS Ranchi (Jharkhand), RSRS Koraput (Orissa) and 6 centers in the NE states under RSRS Jorhat were reported: 3-25% grasserie; 0.5-5% flacherie; <1% muscardine; 1-17.2% Gattine and 0.5-1.5% pebrine along with suggested remedial measures.
- Haemolymph samples collected upon infecting the silkworm larvae and six proteins with molecular wt. 10, 15, 24, 40, 45 and 50 kDa elicited upon infecting the larvae with pathogenic bacteria were purified, sequenced and showed homology to antibacterial proteins for use as a source material for cloning.

COST REDUCTION

- **Plastic mountage folding device:** Designed for folding and packing the plastic mountages & its disinfection. Size of the device - 6 x 1 x 6" with 3 lockers with a capacity to fold/pack 10 plastic mountages at a time. It was made up of 0.6 cm diameter Iron rod with a cost of about Rs. 150.00. It has several advantages such as easy to handle, durable and cost effective.
- To reduce the mulberry foliage production cost and for sustained high productivity and quality mulberry leaves through **terrestrial carbon sequestration,** recommended moderate tillage with grass cover, FYM / rearing waste compost @ 20 t/ ha/ yr along with soil test-based NPK fertilizers under irrigated condition. **Benefit:** Leaf yield 38.7 t/ha/yr., Carbon Sequestration potential - 6.9 t/ha/yr with 40.1 Mg/ha/yr Soil Organic Carbon Stock (SOCS).

- Developed the **Reeliboost [**Surface Active Agent (SAA) & Wetting Agent (WA) in combination**]** for improvement in cocoon reelability and observed 5 -15% reelability improvement of cocoon as well as quality silk production with low investment. It has been <u>applied for patenting</u>.
- **''Drum Kit Drip Irrigation System''** has re-installed at the institute and RSRSs' for effective use of water source and reduce the cost effective of the mulberry cultivation.

TECHNOLOGY TRANSFER

- With an eye towards transfer of technology efficiently, 18 Seri Model Villages were identified and there upon implemented in Eastern and NE region of the country. Separate technology packages (Rainfed and Irrigated) were disseminated among 1800 beneficiaries at their filed level. During the period, the leaf yield recorded was 44.74 t / ha / yr under irrigated condition and 12.81 t / ha / yr under rainfed condition. A total of 3,20,825 dfls (MxB: 27,000 & BxB: 50,825) were reared by all the beneficiaries. The average cocoon yield (BxB) under rainfed condition was 41.89 kg per 100 dfls and for MxB it was 42.46 kg per 100 dfls. Under irrigated condition (M x B) average cocoon yield was 49.04 kg per 100 dfls.

*Popularization of technologies***:** Four technologies were popularized through demonstration in 685 farmers field.

- Application of *Thiamethoxam* (0.015%) for whitefly management covered 150 farmers' field, the results reflecting saving of leaf loss by 8.1- 13.8 %.
- *Yellow sticky traps* for the management of major mulberry pests covered 250 farmers' field which observed loss reduction by 6 – 10.6 % leaf yield loss.
- Application of soil test based Sulphur fertilizer in mulberry field for productivity and quality improvement, covered 185 farmers and observed yield gain range of 8.7-12.4 %.
- Foliar application of *1% Potassium Chloride (Jalsanjeevini)* in mulberry field under rainfed condition for moisture retention, covered 100 farmers and observed yield gain of 4.3-5.9 %.

*IT Initiatives: Development of data base and technology***:**

- A total of 3015 farmers' database created and 115 messages in different languages (*viz.* Bengali, Hindi, Oriya, Nepali, Khasi in English script) had been sent through the *m-Kisan* portal to forewarn and take preventive measures towards sericultural crop success during the year 2016-17.
- In "*Seri-5k*" Portal, a total of 6815 farmers were enrolled and up-loaded the crop-wise data.
- All the on-going and concluded research projects (45 Nos.) uploaded in the institute website (www.csrtiber.res.in) for *e-monitoring* of R&D activities.

- Three documentary films (15 min) were made on "**Kisan Nursery", "Nari Shakti in Sericulture"**and**"Bivoltine Sericulture"** for telecasting.
- 16 number of "Resham Katha" on sericulture improvement through All India radio has been broadcasted for dissemination of modern technologies for the farmers and 02 FM Broadcasting has been aired for sericulture development.
- All brochures/ pamphlets published recently in different vernaculars had been uploaded in the institute website *www.csrtiber.res.in*
- A well-established VC studio started functioning in this Institute from 14.02.2017.
- Efforts were made continuously for 100% coverage of DBT through PFMS portal.

EXTENSION COMMUNICATION PROGRAMMES (ECP):

- Different ECPs *viz.*, Awareness programmes, Audio-visual prog., Exhibition, Field Days etc. are being organized at the farmers' level with a multifold approach of dissemination of farmer friendly technologies, catering to the farmers' needs and also pre-warning the farmers of any upcoming field problem. A total of 16,375 stake holders were sensitized through 273 extension communication programmes [51- Awareness prog. (3294), 31Audio-visual prog. (1141), 44- exhibitions (3991), 39 - Field Days (1753), 59- Group Discussions (1827), 37 -Technology Demonstrations (1493) and 15 -Resham Krishi Melas / Mini RKMs/ Workshops (2876)]. In addition, 35- Farmers Training Prog. (2279) and 2 - Trainers Training Prog. (15) were organized.

BIVOLTINE CLUST*ER P*ROMOTION PROGRAMME

- Fifteen Bivoltine clusters at West Bengal (4), Odisha (2), Bihar (1), Assam (3), Manipur (2), Mizoram (1), Nagaland (1) and Tripura (1) have been successfully organized in 8 states under Eastern & NE zones. Against a total target of 29.45 lakh (Bv. 22.50 lakh & ICB 6.95 lakh) dfls, 48.534 lakh (Bi. 18.83 lakh; ICB 29.7 lakh) dfls were reared. Total cocoon production was 1816.3 t (Bv. 513.8 t; ICB 1302.5 t) and raw silk production was 203.7 t (Bv. 79.3 t; ICB 124.4 t) which was 21% higher over target of 168.3 t.

HUMAN RESOURCE DEVELOPMENT (HRD)

- Various human resource development programmes were organized for transfer of technology for sustainable development of sericulture in the regions.
- Under structured course, a total of 24 students (2015-16 batch) completed the PGDS course and 13 new students (2016-17 batch) were joined in the 15 months PGDS course affiliated to the University of Kalyani, Nadia (W.B.). Otherthan structured curriculum, a total of 264 farmers of West Bengal and Orissa have been trained on different training programme like Disease and Pest Management, Chawki Rearing, Late age rearing etc. The farmers were provided free boarding, lodging and wage compensation which was paid through **DBT**. A total of 94

Govt. officials both from State and Central related with sericulture were trained on different specialized training activities under the head of technology orientation program (TOP).

- A total of 1465 numbers of farmers from Bihar and U.P were trained on Mulberry Sericulture under need based taining programme.
- Established 3 Seri Resource Centre at Barbakpur (Nadia), Alinagar (Malda) and Bankipur (Murshidabad) and trained 609 farmers.
- A total of 107 farmers from NE states have visited the Institute under exposure visit on the mulberry sericulture practiced in and around West Bengal. Scientists and Technical staff of CSB are given practical knowledge on sericulture through refresher course. Officials and Registered Seed Producers (RSP) under DoS West Bengal were trained on microscopic moth examination and on handling of testing equipments. Scientists were deputed to train the officials of DoS, Nagaland and the farmers of Nagaland on Chawki Rearing.

SWACHHA RESHAM GRAM

- A total of 330 farm families practicing mulberry sericulture (with help of baseline data) as their major livelihood in Mallikpur-Diara village were adopted for implementing *Adarsh Swachha Resham Gram* programme.

PUBLICATIONS

- **Two News & Views,** a half-yearly Institute's R&D news bulletin were published.
- **Four Resham Krishi Barta,** a quarterly sericulture bulletin in Bengali, were published.
- 29 International & National research papers, 2 popular articles, 6 books/ book chapter and 27 extension literatures (like technical bulletins/ compendium/ brochures/ pamphlets/ extension manuals/ leaflets in local language) were published.

OFFICIAL LANGUAGE IMPLEMENTATION

- **दिनांक 11.11.2016** को गंगटोक [सिक्किम] में आयोजित **"भारत के पूर्व एवं पूर्वोत्तर राज्यों के क्षेत्रीय राजभाषा सम्मेलन"** में संस्थान को वर्ष **2015-16** के दौरान राजभाषा नीति के उत्कृष्ट कार्यान्वयन व अनुपालन हेतु समारोह के मुख्य अतिथि **माननीय गृह राज्य मंत्री, श्री किरण रिजुजु तथा सिक्किम के राज्यपाल, श्री श्रीनिवास दादासाहेब पाटिल महोदय** के कर-कमलों से **द्वितीय पुरस्कार** से सम्मानित किया गया।

- **दिनांक 20.01.2017** को **"शहतूती रेशम का विकास - नयी तकनीकियों के साथ"** विषयक एक दिवसीय राजभाषा संगोष्ठी का आयोजन इस संस्थान में किया गया। संगोष्ठी में रेशम उद्योग से जुड़े विविध विषयों पर **28 शोध-साराशों का एक प्रोसिडिंग** भी प्रकाशित किया गया। संगोष्ठी में केरेबो के विभिन्न केन्द्रों से **52 अधिकारियों/पदधारियों** समेत प्रगतिशील कृषकों ने भी भाग लिया।

- नगर राजभाषा कार्यान्वयन समिति, बहरमपुर [प.बं.] की **31वीं एवं 32वीं** बैठक संस्थान की निदेशक महोदया, डॉ. कणिका त्रिवेदी, की अध्यक्षता में क्रमशः दिनांक **29.04.2016 एवं 23.09.2016**

को अपराह्न **3.00** बजे केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर के बैठक कक्ष में संपन्न हुई। इस बैठक में राजभाषा विभाग से उपनिदेशक [कार्यान्वयन] भी उपस्थित थे जिन्होंने राजभाषा की दिशा में संस्थान तथा नराकास, बहरमपुर के सदस्य - कार्यालयों को बहुमूल्य सुझाव दिए।

COLLABORATIVE RESEARCH PROJECTS:

- A few number of collaborative research projects (10) were continued with the reputed Institutes / Organizations (*viz.*, APSSRDI, Hidupur, Andhra Pradesh; ISRO, NESAC, Meghalaya; NBAIR, ICAR, Bangalore; NBSS&LUP, ICAR, Jorhat; CSGRC, Hosur, Tamil Nadu and SBRL, Kodathi, NSSO, CSTRI, Bangalore) for the improvement of mulberry and silkworm productivity.

OTHER SIGNIFICANT ACHIEVEMENT

- During the year Surveillance audit has been conducted for accreditation of **ISO 9001:2015** certification.

REGIONAL SERICULTURAL RESEARCH STATION (RSRS)

RSRS, Kalimpong (West Bengal)

- Continued with ISO 9001: 2008 certification.
- Disease forecasting and forewarning systems were followed for management of mulberry foliar diseases and pests.
- Maintained 81 Bivoltine silkworm germplasm accessions.
- In the Seri Model Village, Kalimpong hills a total of 70 farmers were selected and observed average cocoon yield / 100 dfls of these farmers were 34.70 kg during autumn crop, 2016.
- Under technology disseminate prog., 819 farmers / seri-stakeholders were sensitized in 13 ECP programmes *viz.* Resham Krishi Mela, Awareness, Audio-visual programmes, Exhibition, Field day, Group discussion, Technology demonstration prog. etc.

RSRS, Koraput (Odisha)

- Continued with ISO 9001: 2008 certification.
- Survey and surveillance of mulberry foliar disease incidences at farmer's level and the Percentage Disease Index (PDI) of different foliar diseases were maintained below economic threshold level (ETL) by taking necessary precautionary control measures and adopting forewarning system.
- A new project on yield gap in mulberry leaf and cocoon production in Eastern ghat highland zones of Odisha (**MOE 3604**) has been initiated.
- Survey, Surveillance and monitoring of silkworm diseases in seed and commercial crops in Eastern and NE India recorded an average disease prevalence of Grasserie, Flacherie & Muscardine diseases and suggested remedial measures to reduce the crop loss.

- *Under Cluster promotion programme*, two clusters *viz*., Kashipur and Ghatgaon are being monitored and supervised in implementation of various technological aspects.
- Organized Trainers' Training Programme (TTP) at the premises of RSRS, Koraput to impart training to the 9 technical personnel of DOS, Odisha. Trained 36 farmers in three batches under Farmers' Training Programme (FTP) on latest technologies. Under farmers' field school, trained a total of 99 farmers with two lead farmers. Conducted 44 ECPs with participation of 2013 farmers and technical literature in the form of Pamphlets (12 nos.) & flexi banners (13nos.) in their vernacular language have been widely circulated among the farmers to bring awareness about the technologies.
- *Awards and Recognitions*: Received first prize in the National Level Krishimela conducted at Puri from 4-8th June, 2016. Also received first prize in the Implementation of Office Language Hindi in Koraput circle by "Nagar Raja Bhaasha Karyaanvayana Samiti" for 2016-17. In addition received third prize in poster presentation on "drum kit drip aur hydrogel ke saath jal sanrankshan ka bhavishya pahalu" during Hindi seminar "Sahatooti Resham Ka Vikash Nayee Takaneekiyon Ke Saath" at CSR&TI, Berhampore.
- *Organization of Kissan Meet*: Organized one Kissan meet/RKM in Kashipur with participation of 94 farmers.
- *Seed cocoon generation programme***:** Generated 5,20,000 bivoltine seed cocoons at beneficiary level and supplied to West Bengal grainages for production of dfls at the rate of Rs.520/ kg.
- *Expansion of mulberry plantation with HYV***:** 5 acres of new mulberry plantation with S1635 was raised in Kashipur Block under Rayagada district of Odisha.

RSRS, Jorhat (NE States)

- Continued with ISO 9001: 2008 certification.
- Under Collaborative project *APS 3539- "*characterization of mulberry growing soils for nutrient management in selected seri-villages of Golaghat district of Assam" with NBSS & LUP Jorhat a total of 43 soil health cards were distributed to the farmers.
- Conducted 84 Extension Communication Programmes like Awareness & Audio-visual programmes, Exhibition, Field day, Group discussion, Technology demonstration, Resham Krishi mela (RKM) and mini RKMs at RSRS and its nested RECs and 5047 stake holders were sensitized.
- Under HRD programme, like Trainers Training - Five DOS, Golaghat staff & 888 farmers were trained in latest technologies of mulberry and silkworm, disease and pest management. 980 beneficiaries trained under different need based programme etc.
- Farmers of eight clusters under Bivoltine Cluster Promotion Programme and seven Seri Model Village under ToT of this region are being monitored and supervised in implementation of various technological aspects.

2. INTRODUCTION

Central Sericultural Research Station at Berhampore established in 1943 has been certified as ISO 9001: 2015 Institute for rendering outstanding Research, Developmental, Technical, Technological, Extension and Service support to silk industry by developing package of practices for mulberry development, silkworm rearing, innovations, products, development of region specific breeds and processes suited to the Eastern and North Eastern regions comprising of 13 states, 5 in Eastern regions i.e., West Bengal, Odisha, Bihar, Jharkhand, Chhattisgarh and 8 in North Eastern regions like Assam, Manipur, Meghalaya, Mizoram, Nagaland, Arunachal Pradesh, Sikkim and Tripura.

The Institute is having 31 acres of mulberry plantation out of 63 acres of land, of which, it envisages its R&D and extension activities through seven major divisions namely Moriculture-I; Moriculture-II; Sericulture; Reeling & Spinning; Training; Project Monitoring, Coordination & Evaluation (PMCE) and Extension & Publicity comprising of eight research sections *viz.,* Mulberry Breeding & Genetics, Soil Science & Chemistry, Mulberry Pathology, Entomology, Silkworm Breeding & Genetics, Silkworm Physiology & Rearing Technology Innovations, Silkworm Pathology Biotechnology and Bivoltine cell besides Computer and Administration.

For dissemination of the developed technologies to the farmers and to get a regular feed back through its nested units, the Institute has an extension network of three Regional Sericultural Research Stations (RSRSs), 14 Research Extension Centres (RECs) located in 5 Eastern and 8 North-Eastern states.

VISION:

"To become Eastern and North Eastern states, a region for Centre of excellence in Sericulture and keeping it sustainable"

MISSION:

❖ Continuous R&D efforts and effective Transfer of Technology.
❖ Popularizing of HYV of mulberry suitable for different agro-climatic region.
❖ Popularizing region & season specific bivoltine hybrids combating high humidity and temperature.
❖ Popularization of improve package of practices.
❖ To create greater opportunities for gainful employment.

MANDATE:

At Research Institute
- ❖ 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 and 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 Stock.
- ❖ 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.
- ❖ Studies on techno-economic feasibility of sericulture technologies.
- ❖ Providing technical and consultancy services.

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

At RECs/Sub Units
- ❖ Front line demonstrations of technologies through selected farmers in coordination with DoS.
- ❖ Popularize the proven technologies through various extension methods through cluster area approach.
- ❖ Resource centre for critical inputs and seri appliances such as mulberry cuttings, silkworm seed, chemicals etc.
- ❖ Conduct farmers' training on various technological aspects.
- ❖ Conduct survey on crop yield, economics and disease and pest surveillance for forecasting/ forewarning.
- ❖ Coordination with Department of Sericulture and allied department in all extension activities.
- ❖ Conservation of ecoraces prevailing in the region.
- ❖ Collection of feedback on technologies / services, analysis and crop monitoring.

3a. ACHIEVEMENTS ON RESULTS FRAME WORK DOCUMENTS (RFD)

#	Objectives	Actions	Success Indicator	Target	Achievement	
1	Conduct scientific, technical and economic research to enhance production, productivity and quality of Indian silk.	Undertaking Research projects to enhance quality and productivity. (Research Projects-Coded by CO)	Total on- going Projects (No.)	16	36	225%
			Projects Concluded (No.)	10	11	110%
			New Projects taken up (No.)	10	17	170%
			New Projects taken up at RSRS's (No.)	5	2	40%
			Technologies / innovations developed /likely to be developed out of concluded projects. (No.)	1	2	200%
			New Technologies for field testing (No.)	1	1	100%
		Mechanization of sericulture industry	Equipment/ machines newly developed for sericulture mechanization (No.)	1	1	100%
			Machines / equipment absorbed in the field (No.)	1	1	100%
2	Commercialization of products and Technologies	Sericulture technologies including chemical taken up for commercialization /patenting	Technologies commercialized (No.)	1	1	100%
			Technologies applied for patenting (No.)	1	1	100%
3	IT Initiatives	Development of data base and technology under IT initiatives	No. of Farmers database created for m-Kisan Portal (No.)	1800	3015	168%
			No. of Messages up-loaded in m-Kisan Portal (No.)	70	115	164%
			Up-loading of data in " Seri-5k" Portal [Farmer (No.)]	2000	6815	341%
			No. of Research Projects uploaded for E-Monitoring (No.)	36	45	125%
			Digitization of Soil Health Records (Acres)	4800	43	-
		Implementation of DBT	% of implementation of Direct Benefit Transfer(DBT)	90	34	38%
			No of farmers covered under DBT (No.)	2000	680	34%

#	Objectives	Actions	Success Indicator	Target	Achievement	
4	Field level Interventions for Quality and productivity Improvement through Information, Education and Communication and Capacity Building	Interventions through main Institutes level	Number of Seri-model Village identified (No.)	10	18	180%
			No. of farmers adopted (No.)	1800	1905	106%
			Expected rawsilk Output (MT)	45.0	35.36	79%
		Large scale trial of L14 X S8 & other ICB breeds	No. of dfls proposed for large scale trial (Lakh Nos.)	0.45	1.74	387%
		Interventions through RSRS/ REC level	Number of Blocks/Districts adopted (No.)	15	15	100%
			No of farmers covered (No.)	3000	5731	191%
			Rawsilk Output (MT)	100	270.45	270%
		New plantation with improved varieties	Popularisation of ,C2028 , C2038 and S1635 varieties (acres)	90	90.12	100%
		Organization of Swachha Resham Gram	No of villages covered (No.)	1	1	100%
			Adoption of villages (%)	90	90	100%
		100 % Adoption of Technologies amongst different stake holders	Number of farmers covers under 100% adoption of technology (No.)	3800	4027	106%
		Extension communication programmes viz., Group discussion, Awareness programme, Field days, Krishi Melas etc.	No of programmes conducted (No.)	225	273	121%
			No of farmers covered (No.)	9000	16692	185%
			Post programme follow up (%)	90	98	109%
			Participation in Radio Programm (No.)	10	13	130%
			Participation in TV Programm (No.)	10	12	120%
			No of Seri Tourism corridor developed (No.)	1	1	100%
		Skill Development	Beneficiaries trained under structured programmes, need based programme etc. (No.)	400	1738	435%
5	Revenue Generation	Generation of funds as per XII Plan guidelines	Revenue generation through commercialisation of Technology (Rs. In lakh)	0.54	2.07	383%
			Revenue generation through other methods (Rs. In lakh)	20	23.84	119%

#	Objectives	Actions	Success Indicator	Target	Achievement	
6	Strengthening institutional framework to support ongoing research and related programmes	Utilization of existing land holdings	Effective utilization of cultivable land for assigned mandates (Acres)	31	31	100%
		Utilization of service buildings (laboratory, rearing house, grainages, staff quarters, hostels, guest house etc)	Extent of utilization of facilities for the core purpose of assigned mandates (%)	90	98	109%
		Optimum utilization of manpower	Utilization of scientific manpower for research activities (%)	90	98	109%
		Effective Monitoring of Civil Works	Monitoring of progress of construction works at Institute & sub-units (%)	90	98	109%
			Submission of UCs (%)	90	98	109%
		Utilization of Grants	Expenditure under Central Sector Schemes. (Rs. In Crore)	30.61	37.83	124%
7	Collaborative Research Programmes with other R&D organizations in India and abroad	Identifying potential R&D institutes in India and abroad and undertake collaborative research programmes for the benefit of both the countries.	Projects taken up for collaborative research (No.)	1	2	200%
8	Administrative Reform	Implement mitigating strategies for reducing potential risk of corruption	% of implementation	90	98	109%
		Swachha Bharat Abhiyan	% of implementation	90	98	109%
		Biometric Attendance	Units functioning under the Institute (No.)	17	17	100%
			Units covered under Biometric attendance (%)	90	100	111%

Overall RFD score = 93%

3b. ORGANIZATIONAL CHART

ORGANIZATIONAL SET UP OF CSR&TI, BERHAMPORE

Nested units under CSR&TI, Berhampore

RSRS Jorhat

RSRS Koraput

RSRS Kalimpong

RESEARCH EXTENSION CENTRES

Imphal (Manipur)
Shillong (Meghalaya)
Dimapur (Nagaland)
Aizawl (Mizoram)
Agartala (Tripura)
Mongoldai (Assam)
Balijan (Arunachal Pr.)

Dhenkikote (Odisha)

Rongpo (Sikkim)
Kamnagar (WB)
Mothabari (WB)
M.P. Raj (Jharkhand)
Bhandra (Jharkhand)

Involves 13 Eastern & NE states

4. HIGHLIGHTS OF OUTPUT FROM THE CONCLUDED PROJECTS

PROJECTS: 12 Nos.

1. **AICEM-III:** In AICEM Phase III, mulberry genotype C-2038 exhibited highest average annual leaf yield production (53.8 t /ha / yr in irrigated and 17.3 - 21.3 t/ha/yr in rainfed) and excelled the national check (S-1635) by 21% and 23% in irrigated and rainfed condition of Eastern and North Eastern regions. In hilly region of Kalimpong, Tr-23 appeared best performing genotype and showed 10-12 t/ha/yr - 42% higher leaf yield potential than zonal check S-146.

2. **PIB 3479:** Identified 24 promising genotypes with more leaf yield potential (range: 2.1 to 2.5 kg/plant/yr.) compared to check S-1635 (1.6 kg/plant/yr.) and may be evaluated further through yield trials for utilization. Utilizing the leads of the project a new project proposal entitled, "Preliminary evaluation of newly evolved mulberry genotypes for mulberry improvement" has initiated as a 2nd phase.

3. **PIB 3515:** Identified 7 genotypes were found to provide significantly higher leaf yield (21.9 to 46.8 %) over the ruling variety, S-1635. The selected genotypes were also found to be superior in their biochemical parameters and at par with the physiological traits like moisture content and moisture retention capacity with check variety S-1635. These, identified genotypes with leaf yield may be evaluated thoroughly under FYT for commercial exploitation.

4. **PPF 3532:** Determined the area under mulberry as per standing crop employing geospatial technique for major sericultural districts of WB. Estimated the correlation of OSAVI with leaf protein and moisture for predicting mulberry crop condition in large areas**.** Also developed the sample Mulberry Information System (MIS) of farmers' layers.

5. **PPS 3504:** Isolated and identified the organism causing root rot disease (*Fusarium solani*) of mulberry; the application of fungicide 0.1%, 0.15%, and 0.20% of SAAF (Carbendazim 12% + Mancozeb, 63%) showed most effective growth inhibition of *Fusarium solani* at the rate of 84%, 88% and 94.4%, respectively.

6. **CSS2107:** Updated the forewarning calendar through survey and surveillance data of foliar mulberry diseases using best prediction models.

7. **AIB 3501:** Seven multivoltine lines with high SR percentage (> 17%) and high neatness (> 80 points) have been developed [M.Con.1x MH1 (M1)-White; M.Con.4 x MH1 (M2) –Yellow; Nistari x MH1 (M3) –Yellow; M6DPE x MH1 (M6) –Yellow; MH1 x BHB (M7) –White; Gen3 x M.Con.4 (M4) –Yellow and SK6x7 x M.Con.4 (M5) –Yellow]. Besides, best two Multi x Multi [M4 x M.Con.4 & M1 x M9A] and two Multi x Bi [M2 x B.Con.4 & M1 x MC4(O)] hybrids are also identified.

8. **AIB 3480:** Raised six way cross bivoltine converged gene pool for high shell weight *viz*., (B.Con.4 x CSR-2) x (Dun-21 x KPG-A) x (RSJ-14 x APS-45) and two lines were isolated as Plain (*p*) and Marked (+*p*) larvae with faint constricted & white (*c*) coloured cocoon.

Raised six way cross multivoltine converged gene pool for high survival (horizontal tolerance) *viz.,* (Nistari+*p*) x Cambodge) x (M.Con.4 x PM) x (MH1 x Sarupat) and three lines were isolated *viz.,* Plain (*p*) larvae with yellow (*C*) & oval shaped cocoon; Plain (*p*) Larvae with white (*c*) & oval shaped cocoon and plain (*p*) larvae with light greenish (*Gr*) & oval shaped cocoon.

Further, using above lines, developed 2 multivoltine congenic lines (RBL1) with high shell weight (>0.24g) and 2 bivoltine congenic lines (RBL1) with high survival (>90%).

9. **AIB 3466:** Developed five new oval (BHP-1, BHP-2, BHP-3, BHP-4 and BHP-5), and five new dumbbell breeds (BHP-6, BHP-7, BHP-8, BHP-9 and BHP-10) at CSRTI, Berhampore, RSRS, Kalimpong, RSRS, Koraput, RSRS, Jorhat, REC, Bhandra and REC, Shillong, have acquired better genetic plasticity through shuttle breeding approach.

10. **ARP 3516:** Six probiotic bacteria namely *Bifidobacterium longum, Streptococcus faecalis*, *Lactobacillus* spp*., Lactobacillus rhamnosus*, *Lactobacillus sporogenes* and *Lactobacillus acidophilus* and one probiotic yeast species *Saccharomyces boulardii* of appropriate concentration were combined separately with prebiotic (Fructo Oligo Saccharides) to obtain seven synbiotic combinations. The efficacies of these synbiotics were tested in silkworm *Bombyx mori* L. Though, the synbiotic combinations tested in the present study were proved to be successful in humans and other systems, it could not generate the same effect in silkworm as the physiological, biochemical, immunological aspects and interaction of host native microbiota are different among different systems. The strain specificity of probiotic microbes also plays a significant role in producing the beneficial effect on the host.

11. **APS3539:** Generated the database of important fertility parameters of mulberry growing soils of Golaghat district of Assam. It has been revealed that available N, P and K fertility status in these soils ranges from low to medium, medium to high respectively. This study indicates that among the micronutrients, the deficiency of Zn and B is prevalent in these soils. The severity of B deficiency is much higher than Zn.

12. **IVLP (BMO-042):** Estimated the BCR (Benefit Cost Ratio) of cocoon production/ 100 dfls following the separate technology packages extended under irrigated and rainfed conditions during the implementation of IVLP. Under irrigated condition, it was observed that by spending one rupee a farmer got average of Rs. 1.83 per 100 dfls (ranging between 2.92 : 1 to 1.36 : 1), while, this was 1.65 : 1 under rainfed condition (ranging between 2.18 : 1 to 1.24 : 1).

5. AWARDS AND RECOGNITIONS

ISO 9001-2015 Standards: Continued at CSR&TI, Berhampore for the year 2016-17.

- ✓ Dr. Manjunatha, G. R, Scientist-B of this Institute has Awarded Ph.D. degree in **Agricultural Statistics** from Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal dt. 16.06.2016**.**
- ✓ Dr. R. Mahesh, Scientist-B of this Institute has Awarded Ph.D. degree from Tamil Nadu Agricultural University along with a GOLD medal for best Water management Ph.D. work in **Agronomy**.

RSRS, Jorhat, Asaam:

Nagar Rajbhasa Karyanayan Samiti, Jorhat (Bharat Sarkar, Griha Mantralaya, Rajbhasa Bibhag) awarded Shesjthata Puraskar for 2015-2016.

RSRS, Koraput, Odisha:

Bagged first prize in National level Exhibition held at Puri, Odisha during 04.06.2016 to 08.06.2016. The Ex. chief Minister Dr. Giridhari Gamanga and the ruling Member of Parliament Shri A.V.Swamy visited the stall and commended the presentation in the stall.

Dr. Bhagirathi Gamanga Ex Chief Minister, Odisha and Sri A.V.Swamy MP, Rajyasabha visited the stall at Puri, Odisha

6. TECHNOLOGIES TRANSFERRED DURING THE YEAR

TECHNOLOGY PACKAGES WERE EXTENDED FOR MULBERRY CULTIVATION AND SILKWORM REARING THROUGH SERI MODEL VILLAGE:

With regard to implementation of Seri Model Village with an eye towards transfer of technology, **18 Seri Model Villages** have been identified. Two seperate improved package of practices (**Rainfed and Irrigated**) were ddemonstrated among 1700 farmers at the concerned irrigated and rainfed zones.

#	Name of Centre	Name of village	Number of farmers
1.	CSRTI, Berhampore	1. Balashpur,	200
		2. Deshalpurr	150
		3. Sayedpur	200
2.	RSRS, Kalimpong	1.Mahakaldara	15
3.	RSRS, Koraput	1.Dhenkikote	50
4.	RSRS, Jorhat	1. Chapori	50
5.	REC, M.P.Raj	1.Amritpur	50
6.	REC, Kamnagar	1.Sahebnagar	200
7.	REC, Mothabari	1.Bangalgram	200
8.	REC (SU), Kalitha	1.Kanupur,	100
		2.Toilpara	100
9.	REC, Imphal	1.Yumnamkhunou	70
10.	REC, Aizawl	1. Saitual	60
11.	REC, Shillong	1.Ummulong	50
		2. Nahiajer	50
12	REC, Mongaldoi	1.Halda	60
		2.Rowmari	65
13	REC, Agartala	1.Chikancharra	30
	Total=	18 Nos.	1700 Nos.

Two seperate improved package of practices for **Rainfed and Irrigated** were dissminated:

Mulberry Cultivation	Silkworm Rearing
HYV - S1635 (Plains) BC259 (Hills)	Use of general disinfectants and bed disinfectants.
Spacing : 2 x 2 (Irrigated) ; 3 x 3 (Rainfed)	Productive silkworm hybrids : Multi x Bi / Bi x Bi
FYM : 20 mt/ha/yr (Irrigated) 10 mt/ha/yr (Rainfed)	Incubation of dfls.
Biofertilizers : Nitrofert: 20 kg/ha/yr (Rainfed: 10 kg/ha/yr) in 5 equal split doze. Phosphofert: 75 kg/ha/yr (Rainfed: 40 kg/ha/yr) once in 4 years.	Chawki Rearing

Reduced doze of chemical fertilizers: N:P:K =168:30:112 kg/ha/yr (Rainfed : 75:10:50 kg/ha/yr) (15 days after application of Biofertilizer)	Late age rearing
Irrigation: As and when required.	Timely mounting and harvesting
Pruning, inter cultivation & weeding : As per crop schedule	Integrated disease & pest management
Integrated pest & disease management	

6.1. EXTENSION ACTIVITIES OF RSRS, REC AND REC(SU)

FARMERS FIELD SCHOOL

Name of the centre	No. of Prog.	No. of Participant	Name of the centre	No. of Prog.	No. of Participant
Jorhat	8	232	**Deogarh**	2	22
Kalimpong	2	32	**Rangpo**	2	60
Koraput	8	20	**Aizwal**	8	215
Mothabari	11	408	**Imphal**	8	143
Kamnagar	10	390	**Dimapur**	7	81
M.P.Raj	4	199	**Shillong**	8	127
Dhenkikote	1	10	**Agartala**	8	194
Bhandra	7	247	**Mongoldoi**	8	185
Sub Total =	**51**	**1538**	**Sub Total =**	**51**	**1027**
Grand Total=				**102**	**2565**

CENTRE-WISE REARING PERFORMANCE REPORT FOR AUTHORIZATION TRIAL PROGRAMME(PHASE-II) FOR THE YEAR 2016-17

Centre	M6DPC x (SK6 x SK7)		N x (SK6 x SK7)		B.con1 x B.con 4		SK6 x SK7	
	Total Dfls	Av. Yield	Total Dfls	Av. Yield	Total Dfls	Av. Yield	Total Dfls	Av. Yield
*Kamnagar	5500	54.86	8300	53.22	8500	64.24	500	63.70
*Mothabari	6000	44.98	7800	41.83	8500	58.50	500	52.45
*Rajmohal	1550	45.79	1850	41.68	3400	57.06	200	52.00
*M P Raj	1350	42.23	950	41.88	900	50.25	100	48.60
ZSSO, Malda	10000	41.40	5800	42.60	10300	57.25	300	58.80
DoT(S), Mld	6000	40.82	7800	34.62				
DoT(S), Msd.	6000	46.95	2700	43.66				
DoT(S), Bir.	14000	33.48	2700	30.25				
DoT(S), Nadia	5500	46.93	1200	43.74				
*Bhandra	3800	40.88	-	-				
RSRS Jorhat					17700	40.41	500	40.25
*Agartala					8400	47.95	-	-
*Aizawal					8500	49.35	-	-
*Imphal					13300	48.25	500	45.20
*Dimapur					3000	44.85	200	43.33

*Shilong					9000	47.60	-	-
*Rongpo					5000	41.00	-	-
RSRS Koraput					1800	35.72	-	-
*Bademairnga					1000	30.45	-	-
*Deogharh					2600	40.83	-	-

- dfls not supplied and * RECs

ECP, HRD AND EXPANSION OF IMPROVED MULBERRY VARIETIES CONDUCTED BY CSR&TI, BERHAMPORE AND NESTED UNITS.

| Centre | Extension Communication Programme | | | | | | | HRD | New area covered | | |
	R.K.M/ (Mini*)/ W'-shop	Aw. prog.	Field day	Exi.-tion	A.V. Prog.	Gr. Dis.	Tech. Demo.	TTP/ FTP	No. of farmers	Area (Acre)	Vari-ety
CSRTI, B'pore	1 (1054)	3 (235)	2 (166)	7 (2048)	1 (65)	2 (49)	2 (205)	NA	NA	NA	NA
RSRS, Koraput	1 (174)	4 (169)	3 (105)	2 (65)	2 (82)	5 (177)	4 (128)	6 (113)	5	5.	S1635/C2038
RSRS, K'pong	1 (180)	2 (66)	2 (56)	3 (569)	1 (34)	6 (73)	3 (71)	3 (42)	10	2	BC259
RSRS, Jorhat	1+1* (250+101*)	3 (154)	2 (120)	2 (82)	3 (110)	3 (140)	2 (100)	2 (35)	5	2.	S-1635
REC, M'bari	-	11 (893)	4 (170)	4 (125)	3 (117)	5 (175)	4 (139)	5 (227)	22	12.	S-1635
REC, K'nagar	-	7 (469)	4 (208)	2 (201)	4 (192)	4 (122)	3 (157)	5 (223)	34	10	S-1635
REC, M.P.Raj	1 (75)*	2 (100)	3 (105)	3 (96)	2 (76)	3 (175)	2 (57)	3 (170)	20	2	S-1635
REC, Deogarh	-	1 (34)	1 (48)	1 (35)	-	1 (29)	1 (41)	1 (25)	5	5	S-1635
REC, D'kote	1 (153)*	2 (101)	2 (92)	2 (88)	2 (65)	3 (90)	1 (43)	4 (129)	5	5.	S1635/C2038
REC, Rangpo	1 (115)*	1 (39)	-	2 (115)	-	4 (178)	-	5 (208)	5	2.5	BC259
REC, Aizwal	1 (103)*	2 (156)	3 108	3 (118)	2 (70)	3 (89)	2 (74)	5 (163)	5	2.	S-1635
REC, Agartala	1 (102)*	3 (383)	3 (123)	3 (106)	2 (61)	3 (65)	2 (57)	5 (168)	5	2.	S-1635
REC, Shillong	1 (100)*	4 (251)	2 (100)	2 (72)	2 (55)	3 (85)	2 (65)	5 (154)	5	2.	S-1635
REC, Imphal	1 (87)*	1 (53)	1 (88)	1 (25)	1 (26)	2 (48)	2 (91)	5 (141)	5	2.	S-1635
REC, Dimapur	1 (108)*	2 (70)	3 (113)	2 (64)	2 (50)	4 (84)	3 (95)	5 (102)	5	2.	S-1635
REC, M'ldoi	1 (100)*	2 (101)	3 (111)	3 (106)	2 (41)	3 (87)	2 (97)	5 (129)	5	2.	S-1635
REC(SU) Bhandra	1 (174)	1 (20)	1 (40)	2 (76)	2 (97)	5 (159)	2 (73)	7 (265)	23	39	S-1635
TOTAL	15 (2876)	51 (3294)	39 1753	44 (3991)	31 (1141)	59 (1827)	37 (1493)	71 (2294)	164	102.4	

Figure in parentheses is the number of person sensitized.

DETAILS OF SUPPLY OF SAPLINGS AND INCOME GENERATION

#	Name of the Unit	Supply of saplings		Income generation (Lakh)	
		Target	Achievement	Target	Achievement
RSRSs					
1.	Kalimpong	10000[#]	10000	0.15	0.6653
2.	Koraput	10000	4000*	0.30	0.4424
3.	Jorhat	10000	10000	0.20	0.5481
RECs					
1.	Agartala	25000	25000	0.15	0.36207
2.	Dimapur	50000	25000	0.15	0.3250
3.	Imphal	5000	5000	0.15	0.2551
4.	Shillong	5000	5000	0.15	0.17218
5.	Mongoldoi	50000	50000	0.15	0.8181
6.	Kamnagar	40000	41000	0.30	0.82
7.	Bhandra	10000	5000*	0.10	0.0806
8.	Mothabari	-	-	0.10	0.09750
	Total	**215000**	**180000**	**1.90**	**4.58643**

* *Due to extreme draught, survival of saplings was poor.*

[#] *Supplied saplings of $BC_2 59$ otherwise S-1635.*

7. TECHNOLOGIES / PRODUCTS / PROCESSES RELEASED

#	Technology	Technology Details	Application Details	Stake holder (No.)	Expected Benefits
1.	Popularization of Thiamethoxam for whitefly management.	Spraying of Thiamethoxam on mulberry for management of whitefly.	Spray of Thiamethoxam @ 0.015% on mulberry leaf twice at 15 days interval, after 4pm.	150	8.1-13.8% leaf yield gain
2.	Popularization of yellow stick traps for the management of major mulberry pests	Fixing of yellow stick traps in the mulberry field.	Yellow polythene strips (2''x1') pasted with grease, @ 20 nos/bigha.	250	6.0-10.6 % leaf yield save
3.	Technology for the application of sulphur fertilizer in mulberry field.	Sulphur fertilizer in mulberry field in the form of ammonium sulphate.	Ammonium sulphate application @ 40 kg/ha/yr.	200	8.7-12.4 % leaf yield gain
4.	Technology for foliar application of KCl / Jalsanjeevini in mulberry field under rainfed conditions.	Application of KCl (1%) - as antitranspirant.	1st foliar application- 20days before brushing followed by 2nd application after 10days of 1st spray.	140	4.3 – 5.9% leaf yield gain
5.	Popularization of intercropping technology.	Intercropping in the mulberry field with short term crops.	Short duration crops-Ginger, chilly, cabbage and other vegetables.	75	Additional income generation

8. PATENTS GRANTED

GHAR SODHON - a fumigant room disinfectant for disinfection of rearing room and its appliances: It is commercialized and applied for patenting.

- It is a broad spectrum, cost effective, non-hazardous and user-friendly fumigant room disinfectant. Application method is very easy requiring no labourer, water or electricity
- **Yield Gain:** Average: 4 – 5 kg / 100 dfls.
- **Benefit Cost Ratio:** 5.19:1.
- Technology knowhow was released to two entrepreneurs **M/s Nabagram Resham Shilpa Unnayan Co-operative Society Ltd., Murshidabad** and **M/s Dariapur Rural Development Society, Kaliachak**, Malda, West Bengal vide training on the subject from 24.05.16 – 26.05.16. and same has informed to NRDC, New Delhi on 31.05.2016.

9. PATENTS APPLICATIONS FILED FOR PATENTING

REELIBOOST - cocoon reelability enhancer

- **Use of Surface Active Agent (SAA) & Wetting Agent (WA) in combination for improvement in cocoon reelability**.

- **Benefit:** 5 -15% reelability improvement of cocoon.

10. LIST OF RESEARCH PROJECTS AND PROGRAMMES

Institute/ RSRS	Ongoing			Concluded			Total
	Proj.	PS	Prog.	Proj.	PS	Prog.	
CSR&TI	25	01	4	10	-	01	45
RSRS	4	-	2	1	-	-	07
Total	29	01	6	11	-	01	48

10. A. Ongoing : 36 Nos. (29 Projects + 1 P.S. + 6 Prog.)

#	Code No.	Title	PI
I. ENVIRONMENTAL CHALLENGES & GLOBAL WARMING (8 Proj +1ps + 1prog)			
1.	PIB 3505	Development of drought tolerant mulberry variety for rainfed sericulture. (**Jan., 2014 to Dec., 2019)** [**Collaborative project with CSGRC, Hosur**]	Suresh, K., Sci-B
2.	PPS 3598	Arsenic contamination in mulberry sericulture of Bengal Plain and its alleviation through application of zinc in soil. **(Nov., 2016 to Oct., 2019)**	V.Vijay, Sci-B
3.	PPF 3585	Application of growing degree days as a model driver for developing mulberry yield weather model. **(Oct., 2016 to Dec., 2018)**	M. Chaudhuri, Sci-D
4.	AIB 3547	Development of high temperature and high humidity tolerant bivoltine breeds of silkworm (*Bombyx mori* L.) **(Jul., 2015 to Jun., 2017)**	N.Chandrakanth, Sci-B
5.	AIB 3602	Development of thermo tolerant bivoltine breeds / hybrids of silkworm, *Bombyx mori* though marker assisted selection. **(Nov., 2016 to April, 2021)**	N. Chandrakanth, Sci-B
6.	PPA 3560	Studies on high bush and tree type mulberry plantation under rainfed condition of Odisha. **(April, 2014 to March, 2019)**	S.K.Misro, Sci-C RSRS, KPT
7.	BPI (PS) 010	Identification of bio-chemical markers for thermo-tolerance in silkworm (*Bombyx mori* L.) **(Oct., 2016 to Sept., 2017)**	P. Makawana, Sci-B
8.	B-JRH (P) 040	Studies on mulberry germplasm in agro-climatic condition in North East States. **(April, 2015 to August, 2017)**	M.Pamehgam, Sci-C RSRS, JHT
II. INPUT COST REDUCTION (2 Proj)			
9.	PPS 3600	Soil health card preparation for mulberry growing soils in Eastern and North-Eastern India. **(Nov., 2016 to Oct., 2019)**	M. Chaudhuri, Sci-D

#	Code No.	Title	PI
10.	**PPA 3588**	Evaluation of low-cost drip fertigation systems on yield and quality of mulberry leaves. **(Oct., 2016 to March., 2019)**	R.Mahesh, Sci-B
III. ECO FRIENDLY & ORGANIC FARMING (3 Proj)			
11.	**PPS 3559**	Testing of carbon capturing potential in mulberry in different location. **(April, 2015 to March, 2018)**	R.Kar, Sci-D
12.	**PIN 3587**	Improvement of leaf quality and productivity through external application of seaweed extracts in mulberry (*Morus alba* L.) **(Oct., 2016 to Sept., 2017)**	Anil Pappachan, Sci-B
13.	**PPE 3517**	Population interaction of pest and natural enemies in mulberry ecosystem. **(Aug., 2014 to July, 2017) (Collaborative with NBAIR, Bangalore)**	S.Chanda, Sci-D (fr.22.11.16), D. Das, Sci-D (upto 21.11.16
IV. PRODUCTIVITY IMPROVEMENT (8 Proj)			
14.	**PIB 3481**	Evaluation of mulberry varieties suitable for low in put soil. **(Jan., 2013 to Dec., 2017)**	D. Chakravarty, Sci-D, (fr. 14. 07. 16)
15.	**PIB 3576**	Evaluation of new mulberry genotypes for improvement in productivity and quality. **(June, 2016 to July, 2020)**	Suresh K., Sci-B
16.	**PIC 3554**	Candidate gen based molecular marker (s) for screening promising recombinants in mulberry. **(Jan., 2016 to Dec., 2018)**	R.Banerjee,Sci-D
17.	**PPA 3499**	Evaluation of field level performance of Vishala mulberry variety in different locations under irrigated conditions in West Bengal. **(April, 2013 to Mar., 2018)**	G.C.Das, Sci-C
18.	**AIB 3577**	Evaluation of multivoltine germplasm to identify potential parents for developing cross breeds suitable for Southern and Eastern India. **(April, 2016 to March, 2019) [Collaborative with CSGRC, Hosur]**	N.Chandrakanth, Sci-B Z.Hossain, Sci-D
19.	**AIB 3578**	Evaluation of exotic bivoltine silkworm breeds to identify promising parental genetic resources. **(June, 2016 to September, 2019) [Collaborative with CSGRC, Hosur]**	A.K.Verma,Sci-D Z.Hossain,Sci-D

#	Code No.	Title	PI
20.	**AIB 3514**	Development of multivoltine based congenic /NIL breed of silkworm (*Bombyx mori* L.) through introgression of "*Id*" gene and its uses. **(July, 2014 to June, 2017)**	A.K.Verma,Sci-D
21.	**AIB 3545**	Authorization trial of silkworm hybrids in Eastern and North Eastern India. **(Aug., 15 to Jul., 17). [Collab. with NSSO, Bangalore and CSTRI, Bangalore]**	A.K.Verma,Sci-D
V. DISEASE AND PEST MANAGEMENT (7 Proj)			
22.	**PIB 3521**	Assessment of promising powdery mildew resistance lines for perspective commercial use. **(Jan., 2015 to Dec., 2017)**	S. Chattopadhyay, Sci-D
23.	**PIB 3548**	Evaluation of bacterial leaf spot resistant improved progenies of mulberry for field utilization. (**Jan., 2016 to Dec., 2018)**	R Banerjee, Sci-D
24.	**PRE 3589**	Assessment of designed antimicrobial peptides for mulberry protection against brown leaf spot and root rot: a biotechnological approach**. (Oct., 2016 to Sept., 2019)**	S.Chattopadhyay, Sci-D
25.	**ARP 3522**	Isolation, cloning and characterization of antibacterial protein(s) from *Bombyx mori* L. **(May, 2015 to April, 2018)** *(A collaborative project with SBRL, Kodathi, Bangalore)*	K.Rahul, Sci-B (fr.09.08.2016) & S. Chakrabarty, Sci-C (up to 02.07.16)
26.	**ARP 3590**	Studies on the efficacy of phototrophic bacterial extracts as feed supplement for management of diseases in silkworm, *Bombyx mori* L. **(Oct., 2016 to Sept., 2019)**	K.Rahul, Sci-B
27.	**PRE 3533**	Incidence of whitefly in mulberry germplasm accessions**. (July, 2015 to June, 2018)**	S.Chanda, Sci-D (fr. 22.11.16) & D. Das, Sci.-D (up to 21.11.16)
28.	**AIT 3557**	Multi-locational trial on transgenic Bm NPV resistant silkworm strains to establish their efficacy and generate data for their regulatory approval. **(Jan., 2016 to Aug., 2017) (Collaborative with APSSRDI, Hindupur, Andhra Pradesh)**	G.C.Das, Sc-D (fr. 01.03.17) & J. Sarkar, Sc-D (upto 28.02.17)

#	Code No.	Title	PI
VI. BRIDGING GAP IN TECHNOLOGY ADOPTION (3 Proj)			
29.	**MTS 3599**	Study on mulberry sericulture production in West Bengal: a statistical approach. **(Nov., 2016 to April, 2018)**	G.R Manjunatha, Sci-B
30.	**MOT 3601**	Skill gap analysis and capacity development of sericulture extension workers and farmers in traditional and non-traditional states. **(Nov., 2016 to April, 2018)**	Shafi Afroz, Sci-B
31	**MOE 3604**	Yield gap analysis in mulberry leaf and cocoon production - A study in Eastern ghat highland zones of Odisha. **(Dec., 2016 to Nov., 2018)**	K.C Brahma,Sci-C
VII. ROUTINE PROGRAMME (5 prog)			
32.	**BAI (RP) 021**	Silkworm disease monitoring of seed and commercial crop rearing of West Bengal (SDMSCC) [A collab. Prog. ZSSO, Malda & DoT (Seri), W.B.] **(April, 2016 to March, 2019)**	Z. Hossain, Sci-D (fr. 09.08.16); S. Chakrabarty, Sci-C (up to 02.07.16).
33.	**BPR (RP) 022**	Survey and surveillance of mulberry pest in Eastern and North-Eastern region of India. **(June, 2016 to May, 2021)**	S. Chanda (fr.22.11.16), D. Das (upto 21.11.16)
34.	**BPI (P) 025**	Maintenance of mulberry germplasm bank at CSR&TI, Berhampore (W.B). **(January, 2013 to December, 2018)**	Suresh, K Sci.-B
35.	**BAI (RP) 003**	Maintenance of Multivoltine and Bivoltine Germplasm. (Continuous)	V. Lakhsmanan, Sci.-D & A. K. Verma, Sci.-D
36.	**B-KPG (RP) 017**	Maintenance of Bivoltine silkworm Germ Plasm. **(April, 2015 to March, 2020)**	C. Maji (upto 10.06.16), S. Chatterjee (upto 30.11.16), R. Kar (fr. 13.07.16)

10. A.ONGOING RESEARCH PROJECTS & PROGRAMMES
10.A.I. ENVIRONMENTAL CHALLENGES & GLOBAL WARMING
10.A.I.1. MULBERRY BREEDING AND GENETICS SECTION

10.A.I.1.1. PIB 3505: Development of drought tolerant mulberry variety for rainfed sericulture**. (Jan., 2014 to Dec., 2019). [Collaborative project with CSGRC, Hosur]**

Suresh, K**.** (**PI-** fr.01.04.2016), M. K. Ghosh (**PI-**upto 31.03.2016), P.K. Ghosh, S.K. Dutta and K Jhansi Lakshmi and A. Sahay (fr. 01.04.2016) (CSGRC, Hosur).

Objective: Development of drought tolerant mulberry variety.

➢ *Hybridization, selection and preliminary screening of genotypes.*

After completion of hybridization programme at CSGRC, Hosur, Tamil Nadu, segregating progenies of crosses were established at this Institute. A total of 3189 progenies derived from 10 crosses (**Table 1**) were maintained in the nursery for one year providing life- saving irrigation and without application of chemical fertilizer.

Table 1. Progressive selection of progenies in different crosses of mulberry.

#	Crosses/population	Seedlings Raised (No.)	Seedling survived (No.)	Seedlings in PRT (No.)	Seedling shortlisted (No.)
1	MI-0437 (*M.indica*) × ME-0125 (*M. alba*)	265	218	193	23
2	MI-0437 (*M. indica*) × MI-0256 (*M. indica*)	551	471	340	41
3	MI-0685 (*M. alba*) × MI-0314 (*M. alba*)	352	250	213	6
4	MI-0685 (*M. alba*) × MI-0308 (*M.indica*)	160	150	131	4
5	MI-0828 (*M. alba*) × ME-0125 (*M. alba*)	367	230	277	14
6	MI-0827(*M. indica*) × MI-0012 (*M. indica*)	159	140	147	16
7	MI-0762 (*M. latifolia*) × ME-0065 (*M. alba*)	40	30	42	12
8	MI-0763 (*M.indica*) × MI-0012 (*M.indica*)	763	732	471	37
9	MI-0477 (*M. indica*) × ME-0016(*M.latifolia*)	47	40	51	9
10	MI-0437 (*M. indica*) × MI-0670(*M. indica*)	458	430	325	40
	Total=	**3189**	**2691**	**2190**	**202**

A total of 2190 seedling were visually selected in the nursery, based on stem growth and leaf characters and were transplanted in progeny row trial (PRT) plot along with parents and check C-2038.

Preliminary screening of genotypes for leaf yield and physiological parameters.

After establishment period of 6 months under PRT, genotypes are pruned and evaluated for leaf characters, growth traits and leaf yield under limited irrigation. The mean leaf yield data was analyzed for frequency distribution (**Table 2**). The analysis revealed that around 163 genotypes recorded leaf yield higher than mean +1 SD representing 7.5% of population. Fourteen genotypes recorded leaf yield more than 500 g/plant representing 0.64% of population.

Class	Range of leaf yield (g/plant)			Frequency
> (x+3s)	>501.02			14
(x+2s) to (x+3s)	469.94	to	601.02	33
(x+1s) to (x+2s)	338.85	to	469.94	116
(x) to (x+1s)	207.76	to	338.85	283
<x		<	207.76	674

The developed progenies exhibited significant variation for leaf yield (136 to 512 g per plant), chlorophyll content (5.7 - 42 μgcm^2), single leaf weight (0.52 - 5.81g), specific leaf area (107 -631 cm^2g^{-1}), moisture content (35-92%), shoots per plant (1-14) and plant height (52-156 cm) (**Table 3**). Based on high leaf yield and chlorophyll content, low specific leaf area and smooth leaf texture~ 202 genotypes are shortlisted for further evaluation to identifying drought tolerant genotypes.

Table 3. Evaluation of progenies for physiological and yield traits.

Para-meters	CC (μgcm^2)	SLW (g)	LA (cm^2)	SLA ($cm^2 g^{-1}$)	MC (%)	SN (No.)	PH (cm)	LYP (g/crop)
Mean	17.49	1.84	112.40	292.65	78.18	5.02	88.73	205.74
Minimum	5.69	0.52	27.17	106.97	35.01	1.00	52.00	29.30
Maximum	41.87	5.81	249.05	631.27	92.46	14.00	156.00	511.70
Std. Devi.	4.66	0.72	37.37	49.60	3.34	1.80	20.61	122.52
CD.@ 5%	0.87	0.13	7.00	9.29	0.62	0.31	3.54	21.05

CC -Chlorophyll content, SLW -Single leaf weight, LA -Leaf area), SLA -Specific leaf area), MC -moisture content), SN-shoot number, PH-plant height and LYP- Leaf yield per plant.

10.A.I.2. SOIL SCIENCE AND CHEMISTRY SECTION

10.A.I.2.1. PPS 3598: Arsenic contamination in mulberry sericulture of Bengal plain and its alleviation through application of zinc in soil. **(Nov., 2016 to Oct., 2019).**

V. Vijay (**PI**), R. Kar, R. Mahesh and G.C. Das.

Objectives:

1. To investigate the extent of arsenic load/accumulation in irrigation water-soil-mulberry plant-silkworm larva continuum under mulberry vegetation.
2. To formulate dose of zinc for alleviating arsenic pollution in mulberry sericulture by application of zinc in soil wherein it is deficient.
3. To validate the efficacy of laboratory findings by conducting the appropriate field trials.

Progress: Thirty three numbers of shallow tube well samples were collected from Debipur in Kaliachak-II (Malda). From the preliminary semi-quantitative arsenic analysis, it was found that arsenic load in the samples are in range of ±0.05 to ±1.00 ppm. Precise quantification of arsenic load in the samples will be done using ICP-MS.

10.A.I.3. AGRONOMY SECTION

10.A.I.3.1. PPF 3585: Application of growing degree days as a model driver for developing mulberry yield weather model. **(Oct., 2016 to Dec., 2018).**

M. Chaudhuri **(PI),** R. Mahesh, Manjunatha, G. R and Anil Pappachan

Objectives: To prepare a model driven by growing degree days towards forecasting growth and yield of instar specific mulberry leaves under the spell of daily accumulated heat and basic weather variables.

Progress: Pruned and biofixed the established mulberry plots. Recording of foliage yield temporal data on foliage yield vis-à-vis weather has been initiated. Recorded whitefly infestation above ETL during Oct., 2016 followed by containing using ppm. Recording of daily temporal weather data and foliage yield was initiated on decadal basis.

10.A.I.4.SILKWORM BREEDING AND GENETICS SECT

10.A.I.4.1. AIB 3547: Development of high temperature and high humidity tolerant bivoltine breeds of silkworm, *Bombyx mori* L **(July, 2015 to June, 2017).**

N. Chandrakanth, N.Suresh Kumar, V. Lakshmanan, A. K. Saha (upto 15.12.2015) and N. B. Kar.

Objectives:

1. To determine the LD50 in silkworm.
2. To develop a method of induction for thermal stress in silkworm.
3. To develop high temperature and high humidity tolerant breed & biochemical characterization in relation to high temperature and high humidity stress.

Progress: Five oval (HTH-1, HTH-2, HTH-3, HTH-4 and HTH-5) and five dumbbell (HTH-6, HTH-7, HTH-8, HTH-9 and HTH-10) lines were derived from the selected silkworm breeds. These oval and dumbbell lines were tested at high temperature (35±1°C) and high humidity (85±5%) conditions during two seasons. The data on survival rate at normal and high temperature is presented in **Table 4 & 5**. Among the oval lines, HTH-3 and HTH-4 showed high survival in both the seasons (>60%) at 35±1°C. Among the dumbbell lines, HTH-6 showed high survival in both the seasons (>60%) at 35±1°C.

In order to develop thermo tolerant bivoltine hybrids, all the possible twenty five oval x dumbbell combinations were raised from the oval and dumbbell lines. Testing and shortlisting of the bivoltine hybrids at high temperature and high humidity conditions is under progress.

Table 4. Survival rate of selected oval lines at high temperature and high humidity.

#	Breed	Mar-April		June-July	
Oval lines		**Survival rate (35±1°C & 85±5 % RH)**	**Survival rate (25±1°C & 65±5 % RH)**	**Survival rate (35±1°C & 85±5 % RH)**	**Survival rate (25±1°C & 65±5 % RH)**
1	HTH-1	50.5	85.8	47.5	90.2
2	HTH-2	65.4	89.4	45.2	92.2
3	HTH-3	67.4	90.4	60.2	87.4
4	HTH-4	60.2	90.1	65.5	91.6
5	HTH-5	50.0	90.5	64.3	92.5
t-stat		16.10**		13.24**	

*** significant at 1 % α*

Table 5. Survival rate of selected dumbbell lines at high temperature and high humidity.

#	Breed	March-April		June-July	
Dumbbell lines		**Survival rate (35±1°C & 85±5 % RH)**	**Survival rate (25±1°C & 65±5 % RH)**	**Survival rate (35±1°C & 85±5 % RH)**	**Survival rate (25±1°C & 65±5 % RH)**
1	HTH-6	62.7	90.1	61.6	90.1
2	HTH-7	65.7	88.7	43.3	88.2
3	HTH-8	62.7	86.5	48.8	88.5
4	HTH-9	60.8	85.3	35.7	86.5
5	HTH-10	55.4	80.4	37.4	84.2
t-stat		9.18**		9.71**	

*** significant at 1 % α*

10.A.I.4.2. AIB 3602: Development of thermotolerant bivoltine breeds / hybrids of silkworm, *Bombyx mori* through marker assisted selection. **(Nov., 2016 to April, 2021).**

N. Chandrakanth, A. K. Verma, V. Lakshmanan and N. B. Kar.

Objectives: Development of thermotolerant bivoltine silkworm breeds / hybrids through DNA marker assisted selection and their evaluation.

Progress:

Rearing of two thermotolerant (SK4C and BHR3) and two productive [(GEN3 and D (6) M)] bivoltine breeds was conducted in Feb.-March, 2017 season. Eight new F_1 combinations were prepared by using these breeds as parents. The breeding process will be continued as proposed in the project.

Table 6. Performance of selected breeds during Feb.-March, 2017 rearing.

#	Breed	Fec.	Yield / 10000 larvae by no.	Yield / 10000 larvae by wt. (kg)	Single cocoon wt.(g)	Single shell wt.(g)	Shell (%)
1	D6(M)	489	7050	9.370	1.342	0.226	16.83
2	BHR-3	498	8425	12.338	1.495	0.249	16.65
3	SK4C	505	8360	12.729	1.399	0.244	17.46
4	GEN-3	432	6350	10.650	1.660	0.339	20.40

10.A.I.5. BIOTECHNOLOGY SECTION

10.A.I.5.1. BPS (PS) 010: Identification of biochemical markers for thermotolerance in silkworm *Bombyx mori* L. **(Oct., 2016 to Sept., 2017).**

Pooja Makwana (**PI**) and S Chattopadhyay.

Objectives: Identification of biochemical markers associated with ROS defense in bivoltine silkworm under thermal stress.Establishment of correlation between ROS defense associated enzymes and yield parameters.

Progress:
Identification of biochemical markers associated with ROS defense in bivoltine silkworm under thermal stress:

In order to assess the thermal stress tolerance properties for breeding utilization, eleven bivoltine silkworm breeds (SK6, SK7, B.Con.1, B.Con.4, Gen3, SK4C, NB18, BHR2, BHR3, D6PN and CSR2) were reared in Oct.- Nov., 2017 and Feb.-March, 2017. Initially all 10 breeds were exposed to high temperature (35^0C and 40^0C) and 75-80±5% RH on first day of fifth instar. Control batches were reared

at 25^{0}C and 70±5% RH. All breeds were survived with different degrees of mortalities in thermal stress regime except CSR2. Protein was extracted from hemolymph, fat body, mid gut and silk gland samples. In the hemolymph protein, hydrogen peroxide, ascobate peroxidases (APOX) and catalases were assessed. Hydrogen peroxide levels were high in SK4C, SK7 and D6PN among the tested breeds while lowest in Gen3 (**data not shown**). APOX activity was high in all 10 breeds silkworm larvae exposed to elevated temperature of 35°C and 40°C (with specific RH of 75-80% in both the cases) compared to control (25°C and 70% RH) larvae (**Fig. 1**). APOX and catalase activities (**Table 7**) were high in SK7, BHR2, BHR3 and D6PN (range: APOX- 1.10 to 3.3 folds; CAT- 1.07 to 7.4 folds) over the respective controls.
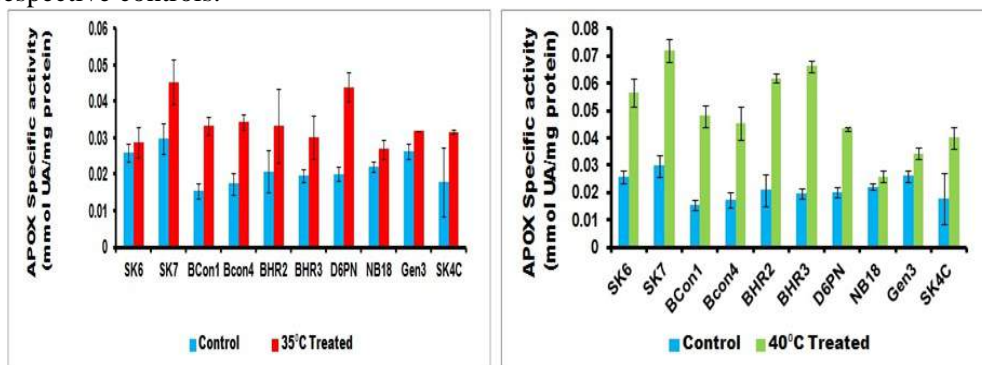
Fig. 1: *Assessment of ascorbate peroxidase activity in hemolymph proteins of different silkworm breeds at two different thermal stress conditions. [data are mean of five observations per season]*

Table 7. Assessment of catalase activity in hemolymph proteins of different silkworm breeds at two different thermal stress conditions.

Breed	Temperature (°C)		
	25°	35°	40°
SK6	0.42	0.46	1.41
SK7	0.41	1.71	1.73
BCon1	0.33	0.94	1.39
Bcon4	0.33	1.21	1.65
BHR2	0.48	1.37	1.98
BHR3	0.42	1.42	2.61
D6PN	0.32	1.66	2.39
NB18	0.35	1.30	1.38
Gen3	0.43	0.85	2.17
SK4C	0.33	1.09	2.04
LSD$_{(0.05)}$			
Temp. (T)	0.031		
Breed (B)	0.057		
T X B	0.099		

Note: Data are mean of five observations per season

10.A.I.6.RSRS. KORAPUT, ODISHA

10.A.I.6.1. PPA 3560: Studies on High Bush and Tree type mulberry plantation under rainfed condition of Odisha**. (April, 2014 to March, 2019).**

   N. R. Rao **(PI)** and S.K.Misro.

Objective: To develop a package of practice for High Bush and Tree type mulberry plantation to avoid grazing problems in state of Odisha.

Progress: After completion of the establishment period for 2 years the 1st leaf yield data has been recorded during the months of Sept., 2016 and March, 2017 are as follows:

Table 8. Leaf yield data for 2 years.

Variety/ Spacing	Leaf yield (kg /ha/ crop)			
	R1	**R2**	**R3**	**Mean**
Season - September, 2016				
S-1635				
150 ×150	2368	2222	2457	2349
180× 180	1851	1882	1929	1887
240× 240	1258	1197	1276	1244
C-1730				
150 ×150	2000	1928	2040	1989
180× 180	1811	1820	1882	1838
240× 240	1102	1111	1137	1116
Season - March, 2016				
S-1635				
150 ×150	2124	2080	2129	2111
180× 180	1404	1423	1385	1404
240× 240	875	873	866	871
C-1730				
150 ×150	1800	1774	1774	1783
180× 180	1216	1191	1163	1190
240× 240	866	852	840	853

10.A.I.7. RSRS, JORHAT, ASSAM

10.A.I.7.1. B-JRH(P)040: Studies on mulberry germplasm in agro-climatic conditions of North eastern states. **(April, 2015 to March, 2018).**

   M. Pamehgam (**PI**) and S. N. Gogoi.

Objective: To study and maintain mulberry germplasm in agro-climatic conditions of North eastern states.

Progress: All the plants (**23 accessions**) including new collections are being maintained with cultural operations and application of NPK & FYM.

Studies on growth and leaf yield of mulberry genetic resources:

Mulberry plant growth and leaf yield data was recorded on 23 mulberry accessions along with check variety (S1635) during the year / 3 crops in normal dose with at rained garden and showed higher leaf yield was recorded in the Accession no. MI-0349 (11.22 mt) followed by MI-0879 (10.85 mt/ha/yr) and MI-0884 (10.43 mt/hac/yr.) among the germplasms. Although, leaf moisture contents of 23 accessions were ranges from 68.12 % (MI-0090) -74.38 % (MI-0875). **(Table 9).**

Table 9. Average (3 crops) leaf yield (mt/ ha/yr.)

#	Acc ssion No.	Acc. Name	Leaf yield/ [mt/.ha/yr.]	Moisture Contents (%)
1	MI-088	-	10.43	72.65
2	MI-035	Dilma	8.12	73.35
3	MI-039	Tingari	7.29	72.54
4	MI-080	-	6.74	71.14
5	MI-015	Phyung Heigranmana	7.71	71.17
6	MI-035	Garbandha-3	3.31	72.44
7	MI-087	-	10.85	73.12
8	MI-087	-	8.70	74.38
9	MI-034	Moulai lobed-1	9.31	71.49
10	MI-0106	Heipai	8.11	72.25
11	MI-0344	Pangree local	7.82	72.26
12	MI-0358	Dilma-2	8.90	73.33
13	MI-0357	Garbandha-1	9.02	72.99
14	MI-0355	Umlong Local lobed	9.30	69.91
15	MI-0349	Garbandha-2	11.22	72.14
16	MI-0845	-	9.54	71.21
17	MI-0844	-	7.94	68.18
18	MI-0255	Nanabana centre	8.70	72.55
19	MI-0356	Chngapatgiri	8.57	72.26
20	MI-0877	-	7.94	69.87
21	MI-0346	Tingari local	7.57	72.11
22	MI-0873	-	7.94	69.12
23	MI-0090	Monla-1	7.61	68.22
Con.	MI-0173	S1635	**10.79**	73.28

Studies on disease and pests incidences of mulberry genetic resources:

During the year observations of diseases and pests were done among the 23 accessions, leaf rust disease was recorded higher in MI-0359 (0.7 PDI) followed by MI-0354 (0.6 PDI) and MI-0844 (0.5 PDI) and intensity of leaf spots (0.2 PDI) were negligible among the Germplasms.

Studies on the palatibality of mulberry silkworms on mulberry genetic resources:

Silkworm rearing was conducted during March, 2017 with B. Con 1 x B. Con. 4 to test 23 mulberry germplasms along with check variety (S 1635). The rearing parameter was recorded high in Accession No. ***MI-0349 , Garbandha-2*** [single cocoon wt.(1.75g), single shell wt (0.315 g) , SR% (18.11%) , ERR by no. (8748), ERR by wt. (15309 g) , yield / 100 dfls (61.24 kg)] followed by ***MI-0807*** [single cocoon wt.(1.71g), single shell wt (0.310 g) , SR% (18.10%) , ERR by no. (8852), ERR by wt. (15090 g) , yield / 100 dfls (60.36 kg)] , whereas low yield was recorded in Acc. No. MI-0357, Garbandha-1 (44.67 kg/ 100 dfls.). **(Table 10)**

Table 10. Rearing performance of 23 genetic resources during 2016-17

#	Accession No.	Acc. Name	Larvae Brushed (No.)	Cocoon harvtd.(No.)	SCW (g)
(1)	(	(3)	(4)	(5)	(6)
1	MI-0884	-	428	314	1.68
2	MI-0354	Dilma	426	365	1.57
3	MI-0395	Tingari	430	383	1.54
4	**MI-080**	-	43	386	1.71
5	MI-0151	Phyung Heigranmana	443	302	1.66
6	MI-0359	Garbandha-3	433	299	1.67
7	MI-0879	-	429	357	1.67
8	MI-0875	-	420	336	1.61
9	MI-0342	Moulai lobed-1	431	304	1.67
10	MI-0106	Heipai	432	354	1.63
11	MI-0344	Pangree local	431	373	1.64
12	MI-0358	Dilma-2	439	360	1.61
13	MI-0357	Garbandha-1	414	309	1.60
14	MI-0355	Umlong Local lobed	434	303	1.64
15	**MI-0349**	Garbandha-2		377	**1.75**
16	MI-0845	-	441	370	1.72
17	MI-0844	-	436	371	**1.78**
18	MI-0255	Nanabana centre	441	347	1.53
19	MI-0356	Chngapatgiri	425	351	1.60
20	MI-0877	-	423	349	1.56
21	MI-0346	Tingari local	430	329	1.62
22	MI-0873	-	426	315	1.58
23	MI-0090	Monla-1	431	332	1.54
Con	MI-0173	S1635	425	315	1.62

Table 10. (*Contd.*)

#	SSW(g)	SR%	ERR By No.	ERR By wt. (g)	Yield /100 dfls.(kg)
(1)	(	(8)	(9)	(10)	(11)
1	0.300	18.00	7342	12703	50.81
2	0.275	17.31	8561	13355	53.42
3	0.260	16.79	**8907**	13806	55.22
4	**0.310**	**18.10**	8852	**15090**	**60.36**
5	0.295	17.53	6848	11293	45.17
6	0.270	16.72	6904	11533	46.13
7	0.305	**18.58**	8301	13913	55.66
8	0.275	16.94	8000	12220	48.96
9	0.285	18.02	7054	11864	47.09
10	0.275	16.76	8195	13358	53.43
11	0.265	16.70	8653	14233	54.97
12	0.260	14.75	8207	13252	53.00
13	0.260	16.94	7002	11168	**44.67**
14	0.270	16.90	6989	11460	45.84
15	**0.315**	**18.11**	**8748**	**15309**	**61.24**
16	0.285	16.98	8388	14044	56.18
17	0.265	15.55	8499	14338	57.35
18	0.250	16.11	7858	11945	48.25
19	0.155	16.78	8254	13193	52.77
20	0.265	16.13	8247	13376	53.50
21	0.270	16.97	7651	12399	49.59
22	0.265	16.66	7403	11696	46.78
23	0.255	16.58	7705	11905	47.62
Con	0.270	16.54	7401	12002	47.97

10.A.II. INPUT COST REDUCTION

10.A.II.1. SOIL SCIENCE AND CHEMISTRY SECTION

10.A.II.1.1. PPS 3600: Soil health card preparation for mulberry growing soils in Eastern and North Eastern India. (**Nov., 2016 to Oct., 2019).**

K. Trivedy (**PI**), M. Chaudhuri, V. Vijay, R. Mahesh, A. Pappachan, R. Kar, S.K. Mishra, S. N. Gogoi, R. Luikham, U.C. Boruah, M. Pamehgam, L Somen Singh, S.T.Lepcha, S. Dey, G.S.Singh, B. K.Basumatary, Collins Z Renthlei, B.N.Choudhury, L.Pachuau, G.B.Singh and A. Borah.

Objectives: To analyze the soil parameters (pH, EC, OC, Available N,P,K,S, Zn, Fe, Cu, Mn & B) of Mulberry growing soils for preparation and distribution of soil health card (18,000) to the sericulture farmers in Eastern and North Eastern India.

Progress: 777 Soil samples were collected and analyses of 360 soil samples were completed.

10.A.II.2. FARM MANAGEMENT SECTION

10.A.II.2.1. PPA 3588: Evaluation of low cost drip fertigation systems on yield and quality of mulberry leaves. **(Oct., 2016 to Mar., 2019)**

R. Mahesh (**PI**), V. Vijay and Anil Pappachan.

Objectives:
1. To evaluate the comparative performance of drip tape fertigation system and drum kit fertigation system under both 2'×2' and 3'×3' spacing on yield and quality of mulberry leaves.
2. To optimize the fertigation schedule for higher mulberry leaf productivity.
3. To evaluate the drip tape fertigation system and drum kit fertigation system on water use efficiency and fertilizer use efficiency of mulberry leaves.
4. To compute the economics of drip tape fertigation and drum kit drip fertigation system in mulberry cultivation.

Progress:

Initial soil sample analysis was done in the experimental field (pH: 7.5 & 7.95, EC: 0.94 & 0.72 dS/m, Ava. N (354.67 & 336.00 kg/ha, P: 78.50 & 47.12 kg/ha, K: 660 & 760 kg/ha and Organic carbon: 0.83 & 0.79% respectively in 2 feet × 2 feet and 3 feet × 3 feet. Irrigation water analysis was done (pH: 6.8 and EC: 0.43 dS/m).

Fertilizer solubility test was done (Jar test was done to find out the solubility percentage of fertilizer Urea: 1070 g/lit, DAP 550 g/lit, 300 MOP g/lit). Installed water tank 5 feet above the ground. Constructed 1000 L capacity underground cement tank in the experimental field to store water for irrigation. Partial drip irrigation components were procured. Installed Solar Nano Pump also.

10.A.III. ECO-FRIENDLY & ORGANIC FARM

10.A.III.1. SOIL SCIENCE & CHEMISTRY SECTION

10.A.III.1.1. PPS 3559: Testing of carbon capturing potential in mulberry in different location**. (April, 2015 to March, 2018).**

R.Kar (**PI**), G.S. Singh, S. Chatterjee (upto 30.11.2016), S. K. Misro and S. N. Gogoi.

Objectives:
1. To assess carbon capturing efficiency of Mulberry growing under varying eco-geographical condition
2. To examine the validity of the technology for spraying of cationic micronutrients in mulberry garden at farmers level.

Results: Mulberry plots were culturally operated with recommended packages of practices and with light covering with grasses. Data shown in tables 11 to 13 showed leaf yield significantly higher in treated plots than untreated one.

Table 11. Yield and carbon capturing potential of mulberry growing under two different farming practices during different crop seasons in hills of Kalimpong.

Crop period	Shoot / Leaf	Leaf/ shoot yield (kg/ha)		C capturing potential (kg/ ha)	
		Moderate tillage with grass cover	Moderate tillage without grass cover	Moderate tillage with grass cover	Moderate tillage without grass cover
April, 2016	Leaf		5020	653	554
June, 2016	Shoot	6480	5980	920	820
Aug., 2016	Leaf		5320	710	609
Dec., 2016	Shoot	6030	5760	886	813

Table 12. Recording of Leaf Yield and shoot yield data in S 16335 during the year was taken up and the carbon capturing potential was assessed at RSRS, Koraput as per the following

Crop period	Shoot / Leaf	Treatment/ Control	Yield (t/ha)	Ccapturing potential (kg/ha)
June,2016	Shoot	Treat.	4.617	646.95
		Control	4.444	596.83
Sept., 2016	Leaf	Treat.	4.346	464.58
		Control	4.229	433.67
Nov., 2016	Leaf	Treat.	3.622	431.37
		Control	3.486	398.16
Jan., 2017	Shoot	Treat.	4.069	537.12
		Control	3.812	496.58
March, 2017	Leaf	Treat.	2.641	284.80
		Control	2.503	254.56

Table 13. Recording of Leaf Yield data during the year was taken up and the carbon capturing potential was assessed at RSRS, Jorhat as per the following

Crop period	Leaf yield kg/ crop/ha (mt) Moderate tillage with grass cover	Leaf yield kg/crop/ha (mt) Moderate tillage without grass cover	Moisture (%) Moderate tillage with grass cover	Moisture (%) Moderate tillage without grass cover
April, 2016	5885.71	5600	75.84	76.60
June, 2016	5942.85	5657.14	74.89	77.58
Sept., 2016	5675.14	5428.57	73.91	76.41

RSRS, JORHAT: Data on the growth attributing characters and leaf yield were recorded during April, June and September, 2016. Studies on the carbon

capturing potentials of mulberry revealed that the treated plot has got higher value than the control **(Table-13).**

10.A.III.2. MULBERRY PHYSIOLOGY SECTION (MORI-I)

10.A.III.2.1. PIN3587: Improvement of leaf quality and productivity through external application of seaweed extracts in mulberry. **(Oct., 2016 to Sep., 2017).**

Anil Pappachan (PI), R. Mahesh and N. Chandrakanth.

Objectives:
1. To determine the effect of application of seaweed extracts on growth and biomass in mulberry leaves.
2. To standardize the dosage and time interval for the application of seaweed extract. To determine the effect of application of seaweed extracts on foliar diseases of mulberry.
3. To perform bioassay on silkworm larvae fed with seaweed extract treated mulberry leaves.

Progress: Efficacy of two new formulations from *Ascophyllum nodosum* and *Kappaphycus alvarezii* and are under trial showed in Tables 14 -16.

Table 14. Effect of seaweed extracts on the yield of mulberry.

Treatment		Leaf yield per plant (g)	Shoot yield per plant (g)	Total shoot length per plant (cm)	Plant height (cm)	Internod al length (cm)	Number of shoots per plant
A. nodosum extract at 21 and 28 DAP	0.5 ml /L	152.22	67.78	425.60	54.00	3.86	15.56
	1.0 ml /L	135.00	52.22	407.16	55.72	4.81	13.33
	2.0ml /L	177.78	65.00	460.41	64.50	4.33	14.44
A. nodosum extract at 28 DAP	0.5 ml /L	159.50	52.72	471.77	55.06	4.11	15.00
	1.0 ml /L	135.72	58.17	432.84	54.15	4.12	15.33
	2.0 ml /L	120.00	48.33	346.77	56.06	4.04	11.11
K. alvarezii extract at 21 and 28 DAP	0.5 ml /L	146.67	62.22	486.56	54.89	4.01	16.56
	1.0 ml /L	141.66	58.00	426.02	60.06	4.45	12.1
	2.0 ml /L	119.44	39.33	360.94	49.61	3.75	13.11
K. alvarezii extract at 28 DAP	0.5 ml /L	118.89	39.50	400.91	51.83	4.20	14.11
	1.0 ml /L	119.17	43.61	445.38	44.78	3.57	17.89
	2.0 ml /L	98.89	36.11	338.93	55.50	3.84	12.00
Water Spray (Control)		76.11	32.78	300.0	51.10	4.39	10.67
SEm±		1.93	0.89	4.81	1.94	0.12	0.17
LSD at 5%		42.43	19.42	105.50	NS	NS	3.79

Table 15. Effect of seaweed extracts on the quality of mulberry leaves.

Treatment		Moisture Content (%)	Average SPAD units	Protein content (mg/g of FW)
A. nodosum extract at 21 and 28 DAP	0.5 ml /L	76.48	11.29	35.23
	1.0 ml /L	68.33	10.45	41.16
	2.0 ml /L	74.63	10.17	37.96
A. nodosum extract at 28 DAP	0.5 ml /L	75.80	12.42	43.65
	1.0 ml /L	76.26	11.30	41.16
	2.0 ml /L	76.89	14.84	32.62
K. alvarezii extract at 21 and 28 DAP	0.5 ml /L	71.00	13.87	38.55
	1.0 ml /L	73.50	10.67	37.88
	2.0 ml /L	71.68	11.81	31.73
K. alvarezii extract at 28 DAP	0.5 ml /L	72.92	12.84	30.13
	1.0 ml /L	70.86	13.06	40.57
	2.0 ml /L	70.93	11.81	28.22
Water Spray (Control)		69.52	12.66	35.74
SEm±		0.289	0.164	1.216
LSD at 5%		NS	NS	NS

Table 16. Effect of seaweed extracts on the disease and pest incidence.

Treatment		Powdery mildew incidence (PDI)	Leaf spot incidence (PDI)	Tukra incidence (%)
A. nodosum extract at 21 and 28 DAP	0.5 ml /L	2.50	2.53	2.32
	1.0 ml /L	2.36	2.26	2.83
	2.0 ml /L	2.50	2.35	1.04
A. nodosum extract at 28 DAP	0.5 ml /L	2.50	1.83	1.82
	1.0 ml /L	1.98	2.03	2.52
	2.0 ml /L	2.15	2.51	1.12
K. alvarezii extract at 21 and 28 DAP	0.5 ml /L	2.58	2.40	1.53
	1.0 ml /L	2.17	1.93	1.08
	2.0 ml /L	2.66	2.50	2.75
K. alvarezii extract at 28 DAP	0.5 ml /L	1.79	2.27	3.17
	1.0 ml /L	2.43	1.97	1.04
	2.0 ml /L	2.30	2.81	0.71
Water Spray (Control)		2.35	1.86	1.89
SEm±		0.047	0.037	0.089
LSD at 5%		NS	NS	NS

NS- Non Significant @ 5% α

Foliar application of *Ascophyllum nodosum* extract 2 ml/L at 21 and 28 DAP recorded highest leaf yield 177.78 g/ plant. The treatment was on par with the application of *Ascophyllum nodosum* extract 0.5 ml/L at 21 and 28 DAP (two time application) and 0.5 ml/L at 28 DAP (single application). Foliar application was also effective in enhancing total shoot length (cm) and number of shoots per plant. *Kappaphycus alvarezii* 0.5 ml/L and 1 ml/L at 21 and 28 DAP significantly increased the leaf yield, total shoot length and number of shoots per plant. Leaf quality parameters were not affected by the application of seaweed extracts. Similarly pest and disease incidence also did not show any significant change due to the application of seaweed extracts. Consistency of the field performance is under trial.

10.A.III.3. ENTOMLOGY SECTION

10.A.III.3.1. PPE 3517: Population interaction of pest and natural enemies in mulberry ecosystem [Collaborative with NBAIR*, Bangalore] **(August, 2014 to July, 2017).**

S.Chanda (**PI** fr.22.11.16), D. Das (PI fr.01.04.16 to 21.11.16 and CI – fr. 22.11.16 to 31.03.2017), U.C Boruah, S. Chatterjee(upto 30.11.16), R. Kar (fr. 01.12.16), Dr. Ankita Gupta* and Dr. Pratheepa.*

Objective:

1. To study the population interactions of host plant, major mulberry pests and their natural enemies and correlation with abiotic factors. `
2. Studies on the biological attributes of the parasitoids.

Progress:

Tri-trophic interactions between host plant, pests and natural enemy complex:

Survey was conducted at fortnightly for mulberry pest and natural enemies along with the alternate hosts in the mulberry ecosystem in 04 major districts *viz*. Murshidabad, Malda, Birbhum and Nadia of WB practicing sericulture to observe the tri-trophic interactions. The data on the seasonal incidence of major mulberry pests along with their natural enemies were collected. The host range of pests, their natural enemies and the migration behavior of both the pests and their natural enemies were observed for taking up suitable control measures.

The major pests on mulberry *i.e*. Thrips, White Fly and Mealy Bug along with the abiotic factors and the alternate hosts in the neighbouring tracts of mulberry gardens have been mentioned in **Table 17** and **Table 18**. Two species of whitefly, *Dialeuropora decempuncta* (Quaintance & Baker) and *Aleuroclava pentatuberculata* Sundarraj & David (Homoptera: Aleyrodidae) were recorded throughout the year. The whitefly nymphal population in banana leaf (**Table 18**) ranged from 4 to 149/leaf. Highest incidence of white fly on banana (plate1.1) and *Ixora* (3-45/leaf) were observed during Dec. The peak period of mealy bug colony on Papaya (12/shoot), Brinjal(29/ shoot) and *Hibiscus* (29/ shoot) was found during Nov. and on Chilli during Nov. thrips population was noted (6/leaf). Field data reveals that the mulberry plots adjacent to the banana plantations are more prone to the whitefly prevalence. A specific migration pattern of whiteflies were

noted from mulberry to banana plantation during the month of Nov. – May, while during Sept. incidence of white fly crossed the ETL level i.e. 28/leaf.

Bihar Hairy caterpillar, *Spilosoma obliqua* was recorded in mulberry plantations during *April to June.* In some cases it resulted in skeletonisation of the mulberry foliage and in extreme cases, defoliation.

In the mulberry ecosystem, the mealy bug complex observed were *Maconellicoccus hirsutus*, *Paracoccus marginatus*, *Phenococcus parvus* etc. Life stages of the mealy bugs were recorded on mulberry from Apr. to Nov. and the highest infestation (17/shhot) was recorded during Sept. **(Table 17),** China rose (*Hibiscus rosasinensis*) (plate1.2), leaves of papaya (plate 1.3) and Brinjal (plate 1.4) and Land Lily (plate 1.5).

Except January during all seasons native predators viz. *Micraspis discolor, Cryptolaemus montrouzieri Mulsant* and *M.crocea* , Anegleis cardoni (Weise), Coccinella transversalis Fabricius, Cheilomenes sexmaculata (Fabricius), Coelophora bissellata Mulsant, Illeis cincta (Fabricius), *Jauravia pallidula* Motschulsky etc. were found low ranging from 1-3/plant.

Infestation by aphid *Lipaphis erysimi* was recorded in all the districts on mustard adjacent to the mulberry plots. It has been observed that, as mustard is potential alternate hosts of many predators it may be beneficial for the mulberry ecosystem.

During the month of March attack by *Spodoptera litura* was recorded at low level. As per data recorded by RSRS, Kalimpong 3-19 root mealy bug/plant during July to August was seen with high ant population.

Data of RSRS, Jorhat reveals that incidence of thrips (3-4/leaf), white fly (5-16/leaf) and mealy bug (4-5/shoot) were observed from June to Oct.

This study will generate information on tritrophic interactions among mulberry eco-system, pests and predators/parasites that can be successfully utilized in modulating Integrated Pest Management for the major pests of mulberry.

Table 17. Month-wise incidence of Pests on mulberry with Abiotic factors.

Month	Temp. Max. (C)	Temp. Min.(C)	RH Max. (%)	RH Min. (%)	RF (mm)
(1)	( )	(3)	(4)	(5)	(6)
April, 2016	40.9	18.5	90.8	44.0	20.9
May, 2016	38.8	21.5	86.8	47.3	85.9
June, 2016	38.8	21.2	85.8	51.3	146.5
July, 2016	36.2	25.2	97.0	68.0	232.0
Aug., 2016	37.2	24.4	98.0	66.0	142.0
Sept., 2016	35.6	20.1	97.0	75.0	250.0
Oct., 2016	36.0	19.2	95.0	67.0	40.0
Nov., 2016	36.6	11.2	85.0	57.0	0.0
Dec., 2016	29.4	10.0	74.0	54.0	0.0
Jan., 2017	24.4	08.5	82.0	42.0	11.3
Feb., 2017	27.1	13.3	91.0	45.3	3.8
Mar., 2017	35.2	16.7	88.8	49.5	6.2
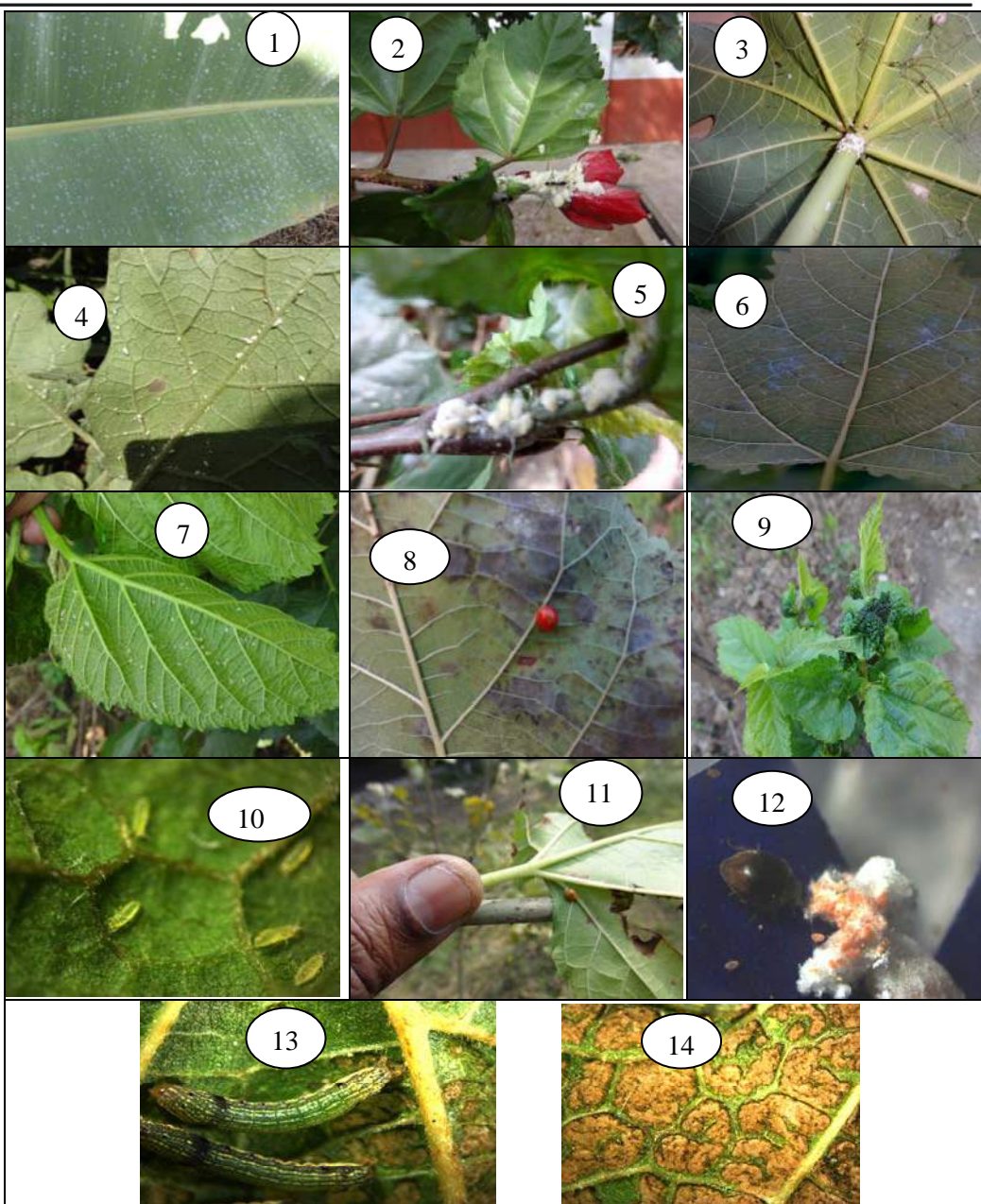
Plate 1. Alternate hosts of mulberry pests from adjoining tracts of mulberry gardens.
1. Whitefly nymphs on *banana leaf*, 2. Mealy bug complex on *Hibiscus*, 3. Mealy bug complex on *Papaya*, *4.* Mealy bug complex on Brinjal, 5. Mealy bug complex on Land lily 6.Whitefly nymphs under mulberry leaf, 7. Whitefly adults on *under mulberry leaf,* .8. Predator on white fly nymphs under mulberry leaf, 9. Tukra infested leaf, 10.Thrips under mulberry leaf, 11. Predator under mulberry leaf, 12. *Scymnus pallidicolli* eating eggs of mealy bug (under laboratory condition), 13. *Spodoptera litura* feeding on chlorophil of mulberry, 14. Photograph showing loss of chlorophyll after feeding of *Spodoptera litura*.

Table 17. (*Contd.*)

Month	Thrips	White fly	Mealy bug	Natural Enemies
(1)	(7)	(8)	(9)	(10)
April, 2016	19	3	10	3
May, 2016	22	1	12	3
June, 2016	8	4	13	2
July, 2016	3	5	9	2
Aug., 2016	3	7	4	2
Sept., 2016	0	28	17	1
Oct., 2016	1	12	9	1
Nov., 2016	0	9	11	1
Dec., 2016	0	0	0	2
Jan., 2017	2	2	0	0
Feb., 2017	8	0	0	3
Mar., 2017	50	7	0	3

Table 18. Population of of pests on adjacent plants of mulberry and natural predators for 2016-17.

Months	Mulberry Thrips	Mulberry White fly	Mulberry Mealy bug
(1)	(2)	(3)	(4)
April, 2016	19	3	10
May, 2016	22	1	12
June, 2016	8	4	13
July, 2016	3	5	9
Aug., 2016	3	7	4
Sept., 2016	0	28	17
Oct., 2016	1	12	9
Nov., 2016	0	9	11
Dec., 2016	0	0	0
Jan., 2017	2	2	0
Feb., 2017	8	0	0
Mar., 2017	50	7	0

Table 18. (*Contd.*)

Month	Pest Population (Adjacent plants)					
	Banana (WF) (No/leaf)	Ixora (WF) (No/leaf)	Papaya (MB) (No/Shoot)	Brinjal (MB) (No/shoot)	*Hibiscus* (MB) (No/shoot)	Chilli (TH)
(1)	(5)	(6)	(7)	(8)	(9)	(10)
April, 2016	10	0	4	0	2	0
May, 2016	15	0	4	0	1	0
June, 2016	0	0	7	3	14	0
July, 2016	4	4	4	7	7	2
Aug.,2016	4	3	2	3	3	2
Sept., 2016	9	14	1	7	7	1
Oct., 2016	13	5	0	3	3	1
Nov., 2016	30	28	12	29	29	6
Dec., 2016	149	45	0	15	15	0
Jan., 2017	65	0	7	0	0	0
Feb., 2017	21	0	0	3	5	0
Mar., 2017	33	0	0	3	11	0

10.A.IV. PRODUCTIVITY IMPROVEMENT

10.A.IV.1. MULBERRY BREEDING AND GENETICS SECTION

10.A.IV.1.1. PIB 3481: Evaluation of mulberry varieties suitable for low input soil. **(Jan., 2013 to Dec., 2017).**

M. K. Ghosh (**PI-** up to 31.03.16), D. Chakravarty (fr. 14.07.16), P.K. Ghosh, S.K.Dutta, S.Chanda, A.K.Verma, S.N. Gogoi (RSRS-Jorhat), S.K. Misro (RSRS-Koraput) and G. S. Singh (REC, Bhandra).

Objective: To evaluate newly evolved promising mulberry varieties suitable for low input soil.

Mulberry plant growth and leaf yield data were recorded on seven test genotypes along with check variety (S-1635) during 5 crops in normal dose and with 50% reduced dose of recommended fertilizer at irrigated garden during the year. (**Table 19**)

Results indicated that the test genotype C-9 exhibited maximum annual leaf yield i.e., 34,106 kg/ha/year and 52,816 kg/ha/year both under reduced dose of chemical fertilizer (N: P: K : :168:90:56 kg/ha/year) full dose of chemical fertilizer (N: P: K:: 336:180:112 kg/ha/year) under irrigated condition. Besides, C-2, C-3, C-5 & C-6 also performed well in compare to the check (S-1635), during the period under report.

Table 19. Seasonal mean leaf yield (kg/ha/crop) of test genotypes.

Test Genotypes	Average Leaf yield (kg/ha/crop)					
	May, 2016		July, 2016		Sept., 2016	
	Half Dose	Full Dose	Half Dose	Full Dose	Half Dose	Full Dose
(1)	(2)	(3)	(4)	(5)	(6)	(7)
C-1	5811	8078	6415	0682	6536	0888
C-2	6635	031	6772	834	6474	11279
C-3	6618	9531	6799	0535	6351	0841
C-4	6098	9000	5875	0903	6419	0310
C-5	6446	0200	6521	1204	6054	0608
C-6	6703	9031	6825	1253	6457	1559
C-9	6873	0563	6986	1567	6653	1873
S1635	5359	8407	5864	0625	5697	0590
LSD at 5%	450	88	84	62	435	620
CV%	4.07	4.25	5.13	3.49	3.92	0.90

Table 19. (*Contd.*)

Test Genotypes	Average Leaf yield (kg/ha/crop)			
	Nov., 2016		Feb., 2017	
	Half Dose	Full Dose	Half Dose	Full Dose
(1)	(8)	(9)	(10)	(11)
C-1	6848	9839	6748	7950
C-2	6733	10231	6733	7963
C-3	6662	9792	6909	8280
C-4	6746	9261	6613	7825
C-5	6387	9560	6809	8426
C-6	6749	10510	6596	7978
C-9	6964	10824	6630	7989
S1635	6019	9579	6529	7802
LSD at 5%	163	604	178	NS
CV%	1.40	3.47	1.52	4.17

10.A.IV.1.2. PIB 3576: Evaluation of new mulberry genotypes for improvement in productivity and quality. **(June, 2016 to July 2020).**

> **Coordinator** : R Banerjee

> Suresh, K**.** (**PI**- fr. 01.04.2016), M K Ghosh (**PI**- up to 31.03.2016), K.C.Brahma, S.N.Gogoi and G.S.Singh.

Objective: To evaluate high yielding mulberry genotypes with early sprouting behavior capable of producing sustainable leaf yield during winter months.

➤ *Multiplication of the newly evolved genotypes along with ruling check S-1635:*

Ten test genotypes along with check S-1635 have been established in nursery in two phases and a total of 8,000 saplings are generated for distribution to the component units during 2017.

10.A.IV.1.3. PIC 3554: Candidate gene based molecular marker(s) for screening promising recombinants in mulberry. **(Jan., 2016 to Dec., 2018).**

> R Banerjee, Suresh, K**.,** S Chattopadhyay**,** Pooja Makwana and V Vijay.

Objective: To develop candidate gene based molecular markers of nitrate reductase and chalcone synthase in mulberry.

Progress:

Establishment of progeny derived from cross of Kajli OPx V-1:Established clonal set of segregating population (~150 F-1 progenies) derived from the cross of Kajli OP x V-1 along with parents in ARBD during October, 2016 and being maintained with recommended cultural operations.

Isolation of total RNA

Total RNA from representative leaf samples (100mg) has been isolated using Hi Pur A^{TM} plant and fungal RNA miniprep purification kit (Hi-Media). RNA has been quantified using Nanodrop Spectrophotometer (Thermo Fisher) and resolved in 8% (w/v) agarose gel (1XTAE, Tris-acetate EDTA) with the yield range of 2.0-2.5 µg/µl.

10.A.IV.2. AGRONOMY SECTION

10.A.IV.2.1. PPA 3499: Evaluation of field level performance of Vishala mulberry variety in different locations under irrigated conditions in West Bengal. **(April, 2013 to March, 2018).**

G. C. Das **(PI)**, S. K. Mandal (upto 31.03.2015), S. Rajaram (upto 01.12.15), T. Datta (Biswas) and eight others from DoS and NSSO.

Objectives:
1. To find out the potentiality of Vishala mulberry variety under irrigated conditions in West Bengal.
2. Evaluation of field performance of Vishala mulberry variety in different locations under irrigated conditions in West Bengal.

Progress:

Selected farmers & plantation site in 23 different locations of W.B. Established Vishala mulberry plantations along with control variety (S1635) in all 23

Table 20. Summarized leaf yield and bioassay data in 23 locations.

Biomass Particulars \ Crops	Crop wise Leaf Yield [Ha^{-1} crop^{-1} (t)]					
	April-2016	June-July-2016	Sept-2016	Nov-2016	Feb-2017	Total yield
Vishala (t /ha)	5.725	8.276	9.898	7.249	5.015	36.163
S1635 (t/ha)	5.460	7.590	8.774	6.755	4.870	33.449
Improvement%	4.85	4.04	12.81	7.31	2.96	8.114
P value under t stat	0.43	.406	0.050*	0.23	0.53	0.15

Bioassay Particulars \Crops	Crop wise Cocoon Yield/100dfls					
	April-2016	June-July-2016	Sept-2016	Nov-2016	Feb-2017	Avg. yield
Vishala feed	44.30	35.20	27.30	46.30	52.70	41.16
S1635 feed	42.90	33.25	26.70	47.60	52.00	40.49
Improvement %	3.26	5.86	2.25	-2.73	1.35	1.65
P value under t stat	1.08 ^{ns}	1.66 ^{ns}	0.95 ^{ns}	-1.02 ^{ns}	0.67^{ns}	0.82 ^{ns}

*Note: ns - non significant & * - Significant at 5% α*

-locations covering 5 districts of West Bengal under irrigated condition in two phases. Raised plantations are maintaining effectively under proper agronomic as well as plant protection managements in the all 23 locations of the state. Data collection in respect of yield potentiality and bioassay study has been made in 23 locations during 2016-17.

The leaf cocoon conversion rate (ECI to cocoon %) observed higher in Vishala (8.98) in respect of S1635 (8.74). So, both the varieties are very good in respect of nutritional quality.

10.A.IV.2. SILKWORM BREEDING & GENETICS SECTION

10.A.IV.2. 1.**AIB-3577: E**valuation of multivoltine germplasm to identify potential parents for developing cross breeds suitable for Southern and Eastern India. **(April, 2016 to March, 2019).**

Zakir Hossain and N.Chandrakanth (From CSRTI, Berhampore) & N.Balachandran, M.Muthulakshmi, G.Thanavendan and S.Nivedita (From CSGRC, Hosur), K.K.Sharmila, Dayananda and Y.C. Radhalakshmi (From CSRTI, Mysuru).

Objectives: To evaluate multivoltine germplasm accessions for the identification of crossbreeds suitable for Southern and Eastern Zones.

Progress: The project is initiated in CSGRC, Hosur. The work which has been assigned to CSRTI, Berhampore, will be initiated from April-June, 2017.

10.A.IV.2.2. AIB 3578: Evaluation of exotic bivoltine silkworm breeds to identify promising parental genetic resources. **(June 2016 to Sept., 2019).**

A. K. Verma and Zakir Hossain (From CSRTI, Berhampore) & M.Muthulakshmi, Veeranna Gowda and Anuradha H. Jingade and S. Nivedita (From CSGRC, Hosur), C. M. Kishor Kumar and P. V. Soudaminy (From CSRTI, Mysuru), and, Babulal and D. Guruswamy (From CSRTI, Pampore)

Objectives: To evaluate multivoltine germplasm accessions for the identification of crossbreeds suitable for Southern and Eastern Zones.

Progress: The project is initiated in CSGRC, Hosur. The work which has been assigned to CSRTI, Berhampore, will be initiated from Oct.-Nov., 2016.

10.A.IV.2.3. AIB-3514: Development of multivoltine Congenic/NIL breed of silkworm (*Bombyx mori* L.) through introgression of '*Id*' gene**. (July, 2014 to June, 2017).**

A. K. Verma (**PI**), G. K. Chattopadhyay (upto 31.10.2014), A. K. Saha (upto 15.12.2015) N. B. Kar and S. Nirmal Kumar (upto July, 2015).

Objective: Development of multivoltine (V_3) based Congenic /NIL (Near Isogenic Line) / Breeds through introgression of homozygous dominant '*Id*' (Inhibitor of Diapause) gene for which acid treatment is not required during cross with bivoltine females and increase the egg production.

Progress:

By a complicated method of introgression, '*Id*' character carrier homozygous females and males were developed using Berhampore[Id] as diapause inhibitor pseudo pigmented homozygous *Id* character carrier breed as a resource material.

Table 21. Hatching Test of Bi x Multi [id] hybrids with extended duration of Black Boxing (October, 2016)

Hybrids' Name	No. of dfls kept	Duration of Black Boxing/ % Hatching			Remarks
		36h	60h	84h	
B.Con.1 x M.Con.4[Id]	150	90.2	3.5	00	-
B.Con.4 xM.Con.4[Id]	150	75.5	8.5	6.0	Same parentage
(B.Con.1xB.Con.4) x M.Con.4[Id]	150	92.5	2.5	00	-
(SK6xSK7) x M.Con.4[Id]	150	85.5	6.8	2.0	-

Table 22. Performance of Diapause Inhibitor (Id) Carrier Breeds (Oct.-Nov., 2016)

#	Breed	Eggs Character	Cocoon Colour & shape	Fec. (No.)	Hat %	ERR No.	Yield/ 10,000 (kg)	SCW (g)	SSW (g)	Shell %
1.	M.Con.4 [Id]	Non pigmented	G. Yellow (C). Oval	547		9100	15.27	1.692	0.294	17.40
2.	M.Con.4 [Id]	Pseudo pigmented	Butter Colour. Oval	466		9300	13.83	1.497	0.272	18.20
3.	M.Con.4 [Id]	do	G. Yellow (C). Oval	493		9000	12.27	1.474	0.259	17.60
4	M.Con.4 (Check)	Normal Multivoltine	G. Yellow (C). Oval	527		9100	14.47	1.565	0.250	15.97
5.	B.Con.4 [Id]	Pseudo pigmented	Butter Colour. Oval	554		8867	12.00	1.309	0.243	18.56
6	B.Con.4 (Check)	Diapausing like Bivoltine	White (w) Faint Dumbbell	546	95	9100	15.33	1.692	0.322	19.03
7.	BHB [Id]	Pseudo pigmented	White (w) Oval & Dumbbell	417		8967	11.67	1.312	0.253	19.30

-Two types of egg phenotypic expression *i.e.*, (i) Pseudo pigmented and (ii) Non pseudo pigmented were observed. Both are homozygous dominant for diapause inhibitor character over the obligatory sex linked maternal inherited character *i.e.,* voltinism in *Bombyx mori* L. On the basis of egg phenotype, cocoon colour and cocoon shape three *Id* character carrier breeds were raised among which non-pseudo diapause inhibitor breed was the first report in sericulture.

Table 23. Hatching Test of Bi x Multi ^{id} hybrids with extended duration of Black Boxing (Jan., 2017)

Hybrids' Name	No. of dfls kept	Duration of black boxing/hatching (%)			Yield/ 100 dfls (kg)	Remarks
		48h	72h	96h		
B.Con.1 x M.Con.4^{Id}	150	92	-	-	60.22	4 did not hatch
B.Con.4 xM.Con.4^{Id}	150	90	-	-	58.32	3 did not hatch
(B.Con.1xB.Con.4) x M.Con.4^{Id}	150	94	2	-	59.02	2 did not hatch
(SK6xSK7) x M.Con.4^{Id}	150	96		-	59.05	-

Table 24. Performance of Diapause Inhibitor(Id) Carrier Breeds (Jan.-Feb., 17)

#	Breed	Eggs Character	Cocoon Colour & shape	Fec. (No.)	Hat %	ERR No.	Yield/ 10,000 (kg)	SCW (g)	SSW (g)	Shell %
1.	M.Con.4 ^{Id}	Non pigmented	G. Yellow (C). Oval	555		9300	12.30	1.332	0.221	16.51
2.	M.Con.4 ^{Id}	Pseudo pigmented	Butter Colour. Oval	502		9367	11.80	1.271	0.221	17.38
3.	M.Con.4 ^{Id}	do	G. Yellow (C). Oval	577		9267	11.37	1.243	0.229	18.42
4	M.Con.4 (Check)	Normal Multivoltine	G. Yellow (C). Oval	498	96	9000	11.97	1.339	0.219	16.35
5.	B.Con.4 ^{Id}	Pseudo pigmented	Butter Colour. Oval	551	96	9500	11.03	1.272	0.234	18.39
6	B.Con.4 (Check)	Diapausing like Bivoltine	White (w) Faint Dumbbell	602	93	8833	12.40	1.417	0.269	18.98
7.	BHB ^{Id}	Pseudo pigmented	White (w) Oval & Dumbbell	429	94	9433	10.70	1.150	0.203	17.65

The homozygous *Id* character carrier either male or female have potentiality to break the diapause as *Id* character was found to be dominant over obligatory sex

linked maternal inherited character. As a result, females of pure bivoltine breed/ foundation cross of bi x bi can be used in grainage to produce bi x multi dfls by crossing with any *Id* character carrier. M.Con.4[Id] breeds developed for commercial use where acid treatment not required. The developed breed will save the paucity of multi x bi hybrid egg production in Eastern and North Eastern India during Oct. to March commercial rearing. The rearing performances of the developed lines along with controls are given in the **Tables 22 & 24.** Initially it was observed that the hatching in bi x multi[id] dfls requires more than 60hrs black boxing, but after 20-22 generations, more than 90% hatching observed in 36-48hrs black boxing **(Tables 21 & 23).**

10.A.IV.2.4. AIB 3545: Authorization Trial of Silkworm hybrids in Eastern and North Eastern India. [**Collab. with NSSO, Bangalore and CSTRI, Bangalore]. (Aug., 2015 to July, 2017).**

A. K. Verma **(PI)** and N. Suresh Kumar (up to 31.05.2016).

Objective:
1. To evaluate the newly developed, Multi x Bi and Bi x Bi hybrids at the farmers level in Eastern & North Eastern Zone.
2. To popularize the newly developed hybrids at the farmers level in Eastern & North Eastern Zone.
3. To analyze the data of the tested hybrids in Eastern & North Eastern Zone.
4. To identify the suitable hybrids for the Eastern & North Eastern Zone.
5. Recommendation of the hybrids for the Eastern and North Eastern zone for commercial exploitation.

Progress:

Table 25. Performance of multi x bi hybrids during Falguni/Spring crop, 2016

Centre	Hybrids			
	M6DPC x (SK6 x SK7)		Nistari x (SK6 x SK7)	
	Quantity	Yield/100 dfls	Quantity	Yield/100 dfls
REC, Kamnagar	0	0	2900	51.86
REC, Mothabari	2900	46.00	0	-
REC, Rajmahal	700	45.20	0	-
REC, M.P. Raj	0	-	700	46.07
DoT(Seri) Malda	2900	45.56	0	-
DoT(Seri),Birbhum	0	-	2900	36.00
DoT(Seri), MSD	0	-	2900	48.00
DoT(Seri), Nadia	0	-	700	42.05
ZSSO, Malda	2900	52.45	0	-
REC, Bhandra	700	52.87	0	-
REC, Gumla	700	41.27	0	-
Total/Average	**10800**	**47.66**	**10100**	**44.38**

Table 26. Performance of bi x bi hybrid in West Bengal, Jharkhand and Odisha during Falguni/Spring, 2016

Centre	B.Con.1 x B.Con.4	
	Quantity	Yield/100 dfls
REC, Kamnagar	4500	54.88
REC, Mothabari	4500	53.50
REC, Rajmahal	1800	54.18
REC, M.P. Raj	500	54.12
ZSSO, Malda	5300	54.45
RSRS, Koraput	900	39.00
REC, Deogargh	900	47.80
REC, Bademaringa	900	39.43
Total/Average	**19300**	**49.67**

Table 27. Performance bi x bi hybrids in North Eastern states during spring crop, 2016

Unit	Target	B.Con.1 x B.Con.4	
		Quantity	Yield/ 100 dfls (kg)
RSRS Jorhat	8500	9700	42.18
REC, Agartala	4200	5000	39.60
REC, Aizawl	4500	4500	48.70
REC, Imphal	6900	6900	47.80
REC, Dimapur	2200	1000	46.50
REC, Shillong	4500	4500	48.17
REC, Rangpo	2500	2500	44.00
Total/Avg.	33300	34100	46.56

Table 28. Performance of multi x bi hybrids during Baishaki crop, 2016

Centre	Hybrids			
	M6DPC x (SK6 x SK7)		Nistari x (SK6 x SK7)	
	Quantity	Yield/100 dfls	Quantity	Yield/100 dfls
REC, Kamnagar	1200	50.80	6800	50.10
REC, Mothabari	1000	41.04	7000	39.01
REC, Rajmahal	550	42.10	1450	40.20
REC, M.P. Raj	150	34.73	550	36.64
DoT(Seri) Malda	1000	40.82	7000	34.62
DoT(Seri), Birbhum	1000	32.48	1900	30.25
DoT(Seri) , MSD	1000	50.60	1900	46.00
DoT(Seri), Nadia	1000	36.58	500	33.22
ZSSO, Malda	1000	41.75	5000	41.00
Total/ Average	7900	41.22	30200	39.00

Table 29. Performance of bivoltine hybrids in North-Eastern states under Authorization Trial of silkworm hybrids (Autumn Crop, 2016)

Test centres	Target	Hybrid			
		B.Con.1 x B.Con.4		SK6 x SK7	
		Qty.	Yield/100 dfls (kg)	Qty.	Yield/100 dfls
RSRS Jorhat	8500	8000	38.82	500	40.25
REC, Agartala	4200	4200	40.90	-	-
REC, Aizawl	4500	4000	48.70	500	46.30
REC, Imphal	6900	6400	47.50	500	45.20
REC, Dimapur	2200	2000	43.56	200	43.33
REC, Shillong	4500	-		4500	45.50
REC, Rangpo	2500	-	-	2500	41.00
Total/Avg.	33300	24600	45.16	8700	43.59

Table 30. Performance of bivoltine hybrids in West Bengal and Jharkhand under Authorization Trial of silkworm hybrids (Autumn Crop, 16)

Unit	Target	B.Con.1 x B.Con.4	
		Quantity	Yield/100 dfls (kg)
REC, Mothabari	4500	4500	51.87
REC, Maheshpur Raj	500	500	47.93
REC, Kamnagar	4500	4500	65.05
REC, Rajmahal	1800	1800	51.31
ZSSO, Malda	5300	5300	58.68
Total/Avg.	16600	16600	54.97

Table 31. Performance of multivoltine x bivoltine hybrids in West Bengal and Jharkhand under Authorization Trial of silkworm hybrids (Autumn Crop, 16)

Centre	Hybrids			
	M6DPC x (SK6 x SK7)		Nistari x (SK6 x SK7)	
	Qty.	Yield/100 dfls (kg)	Qty.	Yield/100 dfls
REC,Kamnagar	2900	1800	58.07	1100
REC,Mothabari	2900	2500	45.70	400
REC, Rajmahal	700	500	46.94	200
REC, M.P. Raj	900	700	44.64	200
DoT(Seri) Malda	2900	2500	Not receid.	400
DoT(Seri),Birbhum	2900	2500	Not receid.	400
DoT(Seri) , MSD	2900	2500	46.00	400
DoT(Seri),Nadia	1500	1000	52.00	500
ZSSO, Malda	2900	2500	39.95	400
Total/Average	20400	16500	47.61	30200

A total quantity of 63,400 dfls of multi x bi and bivoltine hybrids have been supplied to farmers of all the test centres for Falguni/spring crop. The performance of the hybrids are presented in **Tables 25-31.**

During Baisakhi/April crop, a total quantity of 38,100 dfls of multi x bi hybrid has been supplied to farmers of West Bengal and Jharkhand. The performance of the hybrids are presented in **Table 28.**

A total quantity of 1,00,500 dfls of multi x bi and bivoltine hybrids have been supplied to farmers of all the test centres for Agrahayani/ autumn crop. The performance of the hybrids are presented in **Tables 29.**

10.A.V.DISEASE & PEST MANAGEMENT

10.A.V.1. BIOTECHNOLOGY SECTION

10.A.V.1.1. PIB 3521: Assessment of promising powdery mildew resistance lines for perspective commercial use. **(Jan., 2015 to Dec., 2017).**

S Chattopadhyay (**PI**), R Banerjee and A K Saha (upto 15.12.2015).

Objectives:
1. Evaluation of powdery mildew resistant promising lines for foliage biomass and associated ancillary traits.
2. Evaluation of silkworm rearing efficiency of the selected line(s) through bioassay. Development of segregating progeny using sib-mating from promising F_1 lines.
3. Assessment of powdery mildew responsiveness of developed progeny using identified markers for MAS based utilization.

Progress:

Evaluation of powdery mildew resistant promising lines for foliage biomass, morpho-biochemical traits and silkworm rearing performance:

Eight promising powdery mildew (PM) resistance F_1 (Pseudo F_2) progenies along with parental clones were established under RBD for thorough evaluation of disease responsiveness, foliage biomass along-with various ancillary traits (morphological and biochemical), and silkworm bioassay with selected promising traits.

During the year (2016-17), two rounds (altogether four rounds) of disease scoring were conducted with the onset of natural incidence of PM coincided with the commercial silkworm rearing seasons of Aghryani (Nov., 2016) and Falguni (Feb., 2017). Ten plants of each line were evaluated by visual inspection in percentage of leaf area covered by PM on 60d after ground-level pruning during peak growth phase of mulberry. The scale of disease score ranged from 0 (resistant plants) to 10 (susceptible plants) following logarithmic scale of Horsfall and Cowling. All the

selected eight progenies exhibited DSI values of 3.92 to 10.9 with three highly resistant and five moderately resistant progenies **(Table 32)**.

During the period, five rounds of leaf biomass with other associated traits were also evaluated after 65 ± 5 days after basal pruning. Significant variability was observed for foliage biomass (**Table 32**) and associated morphological traits like leaf area, shoot length and total number of shoot per plant (data not shown). Four promising lines confirmed the foliage biomass increment of ~5.8 to 29.6% over superior ruling cultivar S-1635.

For physiological and biochemical estimations, leaf samples from 5 plants of each progeny along with check were collected from fifth to seventh position from top leaf after 60d of basal pruning. **(Table 33).**

Table 32. Mean seasonal disease severity index (DSI) and leaf biomass of eight promising mulberry progenies along with parents under field environment of Berhampore.

Progeny /Parent	Disease Reaction (DSI)			Leaf biomass[#]	
	DSI[*]	Grade	<S-1(%)	(g. plant-1)	>S1635 (%)
PMY-1	3.92	HR	83.1	334.7	--
PMY-2	10.82	MR	53.0	396.1	19.7
PMY-3	5.83	HR	74.7	382.3	15.5
PMY-4	4.64	HR	79.9	299.5	--
PMY-5	6.18	MR	73.2	428.9	29.6
PMY-6	6.27	MR	72.8	316.8	--
PMY-7	6.12	MR	73.4	321.1	--
PMY-8	6.74	MR	73.4	350.2	5.8
Susceptible parent (S1)	23.07	HS	---	236.3	--
Ruling cultivar (S1635)	28.01	HS	---	330.9	--
Resistant parent (Vietnam-2)	0.62		---	---	
LSD(0.05)	0.55			6.21	

DSI=mean of four seasonal data; [#]Leaf biomass = mean of five harvest data during April2016 to February 2017; HR= highly resistance, MR=moderately resistance, HS= highly susceptible.

Significant improvement of SLA, TSS and TPP were observed in promising progeny PMY-2 and PMY-5 over the ruling cultivar S-1635 (**Table 33**). But variation of leaf pigment contents was less apparent in promising lines than the checks.

Rearing of silkworm hybrid B.Con.1 x B.Con.4 with three high foliage yielding promising genotypes indicated significant difference with the check (S-1635) for most of the larval, cocoon and yarn parameters except denier (**Table 34**). The recorded variation of cocoon yield between PMY-5 (most promising leaf biomass yielding progeny with significant resistance to PM) showed about, 7% single shell

weight (SSW), 4% of higher cocoon yield and 7% more filament length over the respective values of ruling cultivar S-1635.

Table 33. Mean seasonal performance of various physio-biochemical traits of eight promising mulberry progenies along with parents under field environment of Berhampore.

Genotype	SLA ($m^2 kg^{-1}$)	T Chl (mg g^{-1} FW)	Chl a/b	T Caro (mg g^{-1} FW)	TSP (mg g^{-1} FW)	TSS (mg g^{-1} FW)	TPP (mg g^{-1} DW)
PMY-1	24.8	0.59	1.1	.18	9.7	11.8	0.35
PMY-2	20.4	0.63	1.3	.18	8.5	13.4	0.33
PMY-3	23.1	0.67	1.0	.19	9.3	12.6	0.30
PMY-4	20.3	0.57	2.1	.19	8.0	15.2	0.28
PMY-5	19.8	0.90	1.0	0.20	12.3	13.6	0.28
PMY-6	20.3	0.67	1.2	.17	9.0	12.9	0.28
PMY-7	22.1	0.57	1.4	.18	8.7	12.2	0.28
PMY-8	29.2	0.71	1.3	0.19	11.9	16.0	0.23
S-1	24.5	0.60	1.2	.17	8.4	13.5	0.22
S-1635	20.9	0.69	1.9	0.19	11.0	15.1	0.29
LSD$_{(0.05)}$	0.77	0.007	---	0.005	0.45	0.57	0.015

Data are mean of two seasonal observations with three replications per season. SLA = Specific leaf area; TChl = Total chlorophyll, Chl a/b = Chloprophyll a/b ratio; Tcaro = Total carotenoids; TSP = Total soluble protein; TSS = Total soluble sugar and TPP = Total polyphenols

Table 34. Mean seasonal performance of larval, cocoon and yarn parameters of silkworm hybrid B. Con.1 x B. Con. 4 fed with three promising progenies and S-1635 leaves during favourable seasons.

Genotype	Larval duration (d)	Pupation (%)	SSW (g)	Cocoon yield (kg 100^{-1} dfls)	Filament length (m)	Denier
PMY-2	26 80	87.8	0.32	65.4	708.8	2.50
PMY-3	26 10	89.8	0.33	68.0	741.2	2.54
PMY-5	26 40	91.0	0.36	70.2	773.2	2.66
S-1635	26.80	89.5	0.34	68.0	726.2	2.50
LSD$_{(0.05)}$						
Genotype	.02	1.19	0.016	1.22	15.4	ns
Season	0.01	0.08	0.011	0.87	10.9	ns

Data are mean of two seasonal bioassays conducted during Oct.-Nov., 2016 and Jan.-Feb., 2017.

DNA profiling of promising lines with powdery mildew responsive markers:
DNA was extracted from leaf samples of parental as well as eight powdery mildew responsive promising lines and all progenies (~90nos) of advance breeding lines

derived from the cross of Vietnam-2 (PM resistant) x S-1 (commercial susceptible cultivar). Ten mulberry powdery mildew specific molecular markers (SCAR and SSRs) were tested on isolated DNA of promising PM resistant lines and 6 of the primers showed confirmatory result. In order to establish the segregation genetics of PM responsive markers on advance breeding lines, subsequently performances of 3 of total six better performing DNA markers were utilized and partial performances of two markers were presented in **Fig. 2a to 2d.**

Fig.2a

Fig.2b

Fig.2c

Fig.2d
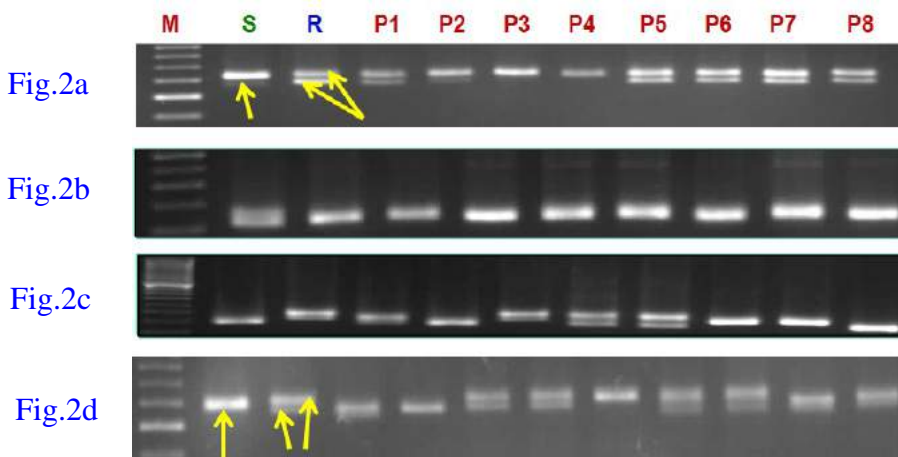
Fig. 2: *Amplification of powdery mildew resistance associated primer (PMP-2 PMP-4) on eight promising lines mulberry lines (a and b) and advance breeding lines (c and d) on 3% agarose gel. M= molecular marker of 50bp, V-2 = resistant parent; P-1 to P-8 = eight promising lines (a and b).*

Marker segregation was 1:1 for the marker PMP-2 and PMP-6; while in the ratio of 3:1 in the cases of PMP-4 and PMP-1 when tested on the advance breeding lines derived from the cross of Vietnam-2 x S-1 (***data not shown***).

*Crossing of promising F-1lines and development of powdery mildew specific F-2 to test the marker trait association***:**

Completed three round of crossing of identified PM resistance promising lines [pseudo F-2 (F-1)] and raised nursery of ~115 F-2 segregating progenies derived from the identified transgressive segregants (3-4 lines) for PM resistance with better foliage yield (S-1 x Vietnam-2) and susceptible (Philippines x Vietnam-2) lines. Genotyping of this trait refined lines with identified markers are under progress.

10.A.V.1.2. PIB-3548: Evaluation of bacterial leaf spot resistant improved progenies of mulberry for field utilization. **(Jan., 2016 to Dec., 2018).**

R Banerjee **(PI),** S Chattopadhyay and A K Saha (upto 15.12.2015).

Objectives:
1. Evaluation of bacterial leaf spot (BLS) resistant improved lines for foliage biomass and associated agronomic traits under RBD.
2. Silkworm bioassay of the promising lines for prospective commercial utilization. Trait refinement of promising lines through sib-mating and development of third generation (F_2).
3. Evaluation of bacterial leaf spot resistance of developed progeny (F_2) using identified SSRs to establish marker-trait link for MAS based utilization.

Progress:

Assessment of BLS disease reaction of test genotypes under field condition and inoculum:

In order to assess BLS disease reaction, the identified eight promising BLS resistant genotypes along with resistant and susceptible parental checks were evaluated symptomatically under field condition during July-August 2016 silkworm crop season . Besides, the durability of BLS resistance of the test genotypes was estimated in potted plant assay under artificial inoculums (dose: 10^8cfu/ml.) of *X. campestries* pv. *mori* local isolate based propagules during the natural onset of BLS in August 2016.

Table 35. Bacterial leaf spot disease severity of mulberry genotypes at field environment at Berhampore during Aug., 2016.

Genotype	DSI	Class	Variation(fold)
HY-1	10.3	MR	1.6
HY-2	10.9	MR	1.5
HY-3	10.1	MR	1.6
HY-4	10.6	MR	1.6
HY-5	3.3	R	4.9
HY-6	5.6	R	2.9
HY-7	10.2	MR	1.6
HY-8	9.5	MR	1.7
RP	2.6	R	
SP	16.4	S	
SP	19.7	S	
SP	25.5	S	

RP=resistant parent; SP=susceptible parent; DSI=disease severity index; R=resistant; MR=moderately resistant; S=susceptible

It was observed that BLS incidence and severity varied significantly across the test genotypes (**Table 35**).Two genotypes indicated BLS resistance (HY-5 and HY-6); while rest showed moderately resistant disease reaction with overall ~2 to 5 fold increment for resistance over the otherwise improved susceptible parent. Similarly, the inoculum based trial also indicated less disease progression in test genotypes (**Fig. 3A**). Moreover, highly significant correlation between the DSI values under field and inoculum based study suggested durability of BLS resistance in test genotypes (**Fig. 3B**).
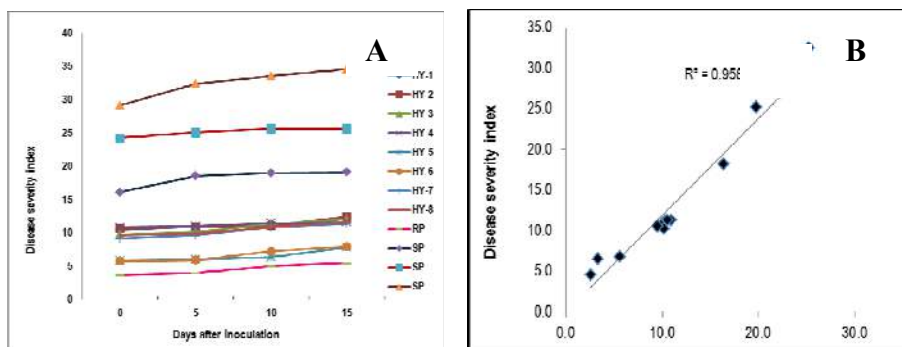
Fig. 3: *Mean seasonal disease severity index (DSI) of A) high yielding progeny, resistant parent and susceptible parent after inoculation and B) correlation of DSI values of field environment and inoculum based assessment.*

Evaluation of test genotypes for foliage yield and important agronomic traits:

Eight test genotypes along with parental clone of otherwise improved cultivar(S-1), ruling cultivar (S-1635) and most potential pipe line genotype C-2038 were established under RBD with three replication in 60 x 60cm spacing during June, 2016. Two rounds assessment of foliage yield and other important agronomic traits (**Feb.** and **April, 2017**) indicated significant variability of test genotypes for most of the traits (**Table 36**), It also revealed that three out of eight genotypes indicated more foliage yield than the checks.

Table 36. Mean seasonal values of growth parameters of mulberry test genotypes at CSR&TI Berhampore

Mulberry genotypes	Leaf length (cm)	Leaf width (cm)	Petiole length (cm)	Petiole width (cm)	Primary shoot length (cm)	Nodal distance (cm)
HY-1	16.67	12.58	2.71	0.26	104.33	2.96
HY-2	16.61	14.26	3.50	0.29	141.00	3.70
HY-3	18.06	14.21	3.39	0.29	130.11	3.13
HY-4	17.56	13.53	2.70	0.29	132.89	3.96
HY-5	18.17	16.50	3.22	0.31	149.33	3.82
HY-6	17.71	13.67	2.49	0.27	141.22	4.29
HY-7	20.89	15.37	3.64	0.33	128.78	3.76
HY-8	16.00	12.97	3.02	0.26	113.44	3.23
C-1	16.61	11.72	2.70	0.26	128.67	4.33
C-2	21.88	18.04	3.72	0.42	144.89	4.39
C-3	20.61	17.67	4.20	0.36	127.67	4.02
SEm±	0.35	0.37	0.13	0.09	2.33	0.09
LSD at 5%	0.70	0.85	0.58	0.25	4.94	0.35
CV%	10.93	14.43	21.28	17.16	10.21	14.4

Table 36 (*Contd.*)

Mulberry genotypes	Single leaf area (sq cm)	Shoot no	Leaf biomass (g.plant⁻¹)	MR%	MR
HY-1	126.35	8.78	316.27	79.06	60.77
HY-2	164.56	6.33	326.97	78.09	69.42
HY-3	166.26	7.89	422.03	77.95	63.30
HY-4	150.38	8.78	338.40	77.42	68.83
HY-5	221.57	7.56	436.60	75.89	66.71
HY-6	166.39	7.67	316.70	75.60	69.88
HY-7	192.62	9.33	449.43	78.67	69.88
HY-8	136.37	7.67	296.17	78.48	65.16
C-1	106.22	8.33	281.70	77.17	73.79
C-2	203.06	9.33	332.80	78.41	71.46
C-3	227.23	10.33	375.90	78.19	66.28
SEm±	7.22	0.22	10.41	0.29	1.53
LSD at 5%	26.20	1.08	30.54	NS	NS
CV%	24.53	15.35	16.90	2.11	12.96

Data are mean of two seasonal data. HY-1 to HY-8 = BLS responsive promising lines; C-1: S-1, C-2= S-1635 and C-3= C-2038

DNA profiling of BLS specific progeny with SSRs:

DNA analysis of parental clones (04) and progeny (80) was conducted with 06mulberry specific genic SSRs. Four primers indicated DNA polymorphism in the parental clones as well as in developed progenies at 200 to 150 bp **(Fig. 4)**
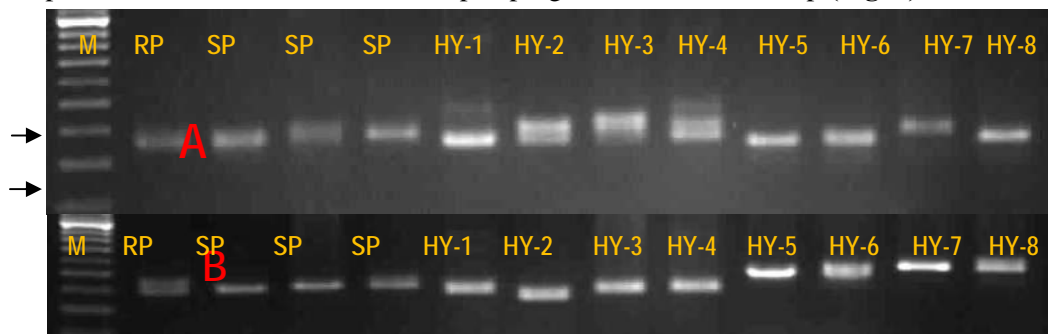
Fig. 4: *Polymorphism generated by the mulberry specific genic SSR: MUL-SSR-1 (A) and MUL-SSR-3 (B) on parent and progenies derived from the cross of M.multicaulis x KPG-1.*

Development of advanced breeding lines through controlled crossing:

Completed sib-mating among 05 developed progeny for generation of advanced breeding lines. Obtained seeds from the crossing were collected to establish in nursery.

10.A.V.1.3.PRE-3589: Assessment of designed antimicrobial peptides for mulberry protection against brown leaf spot and root rot: a biotechnological approach. **(Oct., 2016 to Sept., 2019).**

S Chattopadhyay **(PI),** R Banerjee and P Makwana.

Objectives:
1. Assessment of disease protection potential of synthetic antimicrobial peptides (AMPs) against *Myrothecium* leaf spot (MLS) and *Fusarium* root rot (FRR) of mulberry *in vitro.*
2. Assessment of disease protection potential of selected AMPs against MLS and FRR *ex-vivo.*
3. Determination of disease suppression ability of selected AMPs using quantitative PCR. Determination of the hemolytic activity of the selected AMPs against silkworm

Progress:

In order to assess the disease protection potential of AMPs against *Myrothecium* leaf spot (MLS) and soft rot pathogens *in vitro,* standardized the culture procedure of *M roridum* and *Fusarium solani*. The propagules of respective pathogens were collected from most frequently occurred local isolates in the mulberry fields of West Bengal. The propagules collection time was Oct., 2016 and Feb., 2017 (when propagules were in multiplying stages) for brown leaf spot and soft rot pathogens, respectively. The pathogen propagules were aseptically grown in half and full strengths of Potato dextrose and Czapex Dox agar media. It was observed that full strength potato dextrose agar was most consistent and produced prolific vegetative growth of *M roridum* and *F solani in vitro* (data not shown). Selection of 20 designed AMPs has been completed and in the 1st phase, process of synthesis of 08 of such peptides specific two diseases is in progress for testing.

10.A.V.2. SILWORM PATHOLOGY SECTION

10.A.V.2.1.ARP 3522: Isolation, cloning and characterization of antibacterial protein (s) from silkworm, *Bombyx mori* (*A collaborative project with SBRL, Kodathi, Bangalore*) (**May, 2015 to April, 2018**).

K.Rahul (**PI-** w.e.f. 09.08.2016), S. Chakrabarty (**PI** -up to 02.07.2016), Zakir Hossain (w.e.f. 09.08.2016), Shri Gourab Roy (JRF), CSSR&TI, Berhampore**,** G. Ravikumar, SBRL, Kodathi, Bangalore and).

Objectives: Isolation, purification and characterization of antibacterial protein fractions elicited against bacterial strain

Progress:

Haemolymph samples collected upon infecting the silkworm larvae with pathogenic bacteria were subjected to zone of inhibition assay (Fig.1) and SDS PAGE (Fig.2). Six proteins of Mol wt. 10, 15, 24, 40, 45 and 50 kDa elicited upon infecting the larvae with pathogenic bacteria were purified, sequenced and were showing homology to antibacterial proteins. These proteins will be used as source material for cloning.
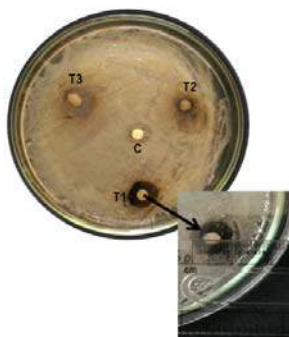
Fig.5. Zone of inhibition assay to determine the antibacterial activity in the haemolymph samples collected from silkworm larvae upon infection by pathogenic bacteria. **T1,T2,T3-** Haemolymph samples collected from *B.mori* upon infection with pathogenic bacteria. **C-**Haemolymph samples collected from control group of *B. mori*
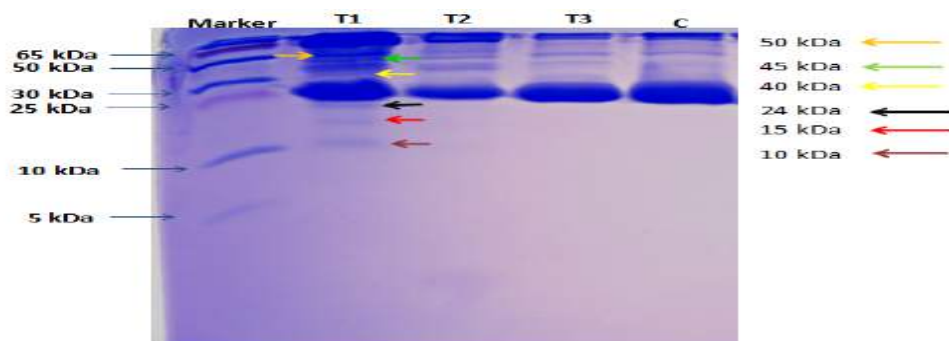
Fig.6. SDS-PAGE analysis of haemolymph samples collected from *B.mori* upon infection with pathogenic bacteria. **T1, T2, T3**- Haemolymph samples collected from *B.mori* upon infection with pathogenic bacteria. **C**- Haemolymph samples collected from control group of *B.mori*

10.A.V.2.2. ARP 3590: Studies on the efficacy of phototrophic bacterial extracts as feed supplement for management of diseases in silkworm, *Bombyx mori* L. **(Oct., 2016 to Sept., 2019).**

K.Rahul(**PI)** and Zakir Hossain.

Objectives: To screen the efficacy of phototrophic bacterial extracts as feed supplements for disease management in silkworm.

Progress: Illumination chamber required for culturing phototrophic bacteria in the culture room has been established. Culturing of Anoxygenic phototrophic purple bacteria has been initiated.

10.A.V.3. ENTOMOLOGY SECTION

10.A.V.3.1.PRE3533: Incidence of whitefly in mulberry germplasm accessions. **(July, 2015 to June., 2018).**

D. Das (**PI** - upto 21.11.16), S.Chanda (**PI** -fr.22.11.16) and S. Chattopadhyay.

Objectives:

1. Screening of mulberry germplasm for the selection of putative sources of resistance and susceptibility for whitefly infestation.
2. Evaluation of selected germplasm for white fly resistance using physiological and biochemical parameters.

Progress:

Preliminary screening of germplasm for resistant and susceptible cultivars in the field:

- Survey on the Mulberry germplasm accessions in the GPB plot is in progress.
- Screening of mulberry germplasm based on data of 2016-17 shows the following result:

Table 37. Accessions with lowest infestation of whiteflies

#	Name	Avg. infestation/ leaf
1.	Ichihei	0.19 - 0.78
2.	Rostely	0.17 - 1.50
3.	Kabul	0.33 - 1.50
4.	Chiana Black C	0.16 - 2.00
5.	Moretiana	0.33 - 2.17
6.	Ichinose	0.33 - 2.50
7.	Chiana Black B	0.17 - 2.83
8.	Leimoncina	0.17 -3.00
9.	Sen Matso	0.33 - 6.33
10.	Charitul	0.17 - 6.47

Table 38. Accessions with highest infestation of white flies

#	Name	Avg. infestation/ leaf
1.	Kosen	0.33 - 15.27
2.	Kirimoto	0.67-14.94
3.	Hungarian	0.67-12.18
4.	Okinowaso	0.83-11.52
5.	Kairo Akiata	0.50-10.43
6.	Seijuro	0.33- 8.33
7.	Sujanpur-5	0.16-7.51
8.	KPG-III	0.33-6.83
9.	*Morus nigra*	0.83-6.73
10.	Tomeiso	0.33 - 6.50

Preliminary survey on whitefly resistance of different germplasm reflects a pattern of *lower infestations* (0 to 3.00/ leaf) in the mulberry accessions namely Ichihei, Rostely, Kabul, Chiana Black C, Moretiana, Ichinose, Chiana Black B and

Leimoncina. The highest infestation of whitefly were observed (6.5 to 15.27/leaf) in the accessions namely Kosen, Kirimoto, Hungarian, Okinowaso, Kairo Akiata, Seijuro, Sujanpur-5, KPG-III, Morus nigra and Tomeiso.

10.A.V.4. SW PHYSIOLOGY & RTI SECTION

10.A.V.4.1 AIT 3557: Multi-locational trial on transgenic Bm NPV resistant silkworm strains to establish their efficacy and generate data for their regulatory approval. **(Jan., 2016 to Aug., 2017)** (**Collaboration with APSSRDI, Hindupur, Andhra Pradesh)**

Co-ordinator: Dr. Kanika Trivedi, Director, CSR&TI, Berhampore.

Gopal Chandra Das (**PI** fr. 01.03.2017), Jayeeta Sarkar (**PI** -upto 28.02.17) and S. Roy Chowdhury (upto 23.07.2016)

Objective: To conduct multilocational trials in contained facilities on GE BmNPV resistant *Bombyx mori* to establish their efficacy and generate data on parameters determining the resistance of transgenic lines against NPV for further steps in regulatory process.

Progress:

Transgenic silkworm hybrids were conducted at the two experimental site of West Bengal. 4 nos. trails conducted at CSR&TI, Berhampore, Murshidabad and 3 nos. trials conducted at the experimental site of REC, Mothabari, Malda during 2016-17. The 5th and final trial of transgenic silkworm hybrids rearing was conducted only at CSR&TI, Berhampore, Murshidabad during Feb.-March, 2017. As per the conditions stipulated by RCGM, all Trials conducted following the standard operating procedures (SOPs). The pooled mean data of experimental rearing in two experimental sites show no significant positive improvement of Transgenic hybrids except SR % and Denier at CSR&TI, Berhampore. The details of pooled mean value and season wise rearing performance data are given in the Table 39.

Table 39. Pooled Mean Value of rearing conducted in two experimental site of different seasons

Experimental site: CSR&TI, Berhampore

Hybrid	Fec.	Hatch. (%)	ERR		Yield/ 100 dfls	SCW (g)
			Nos.	wt (kg)		
Transgenic [N(T) x (Sk6 x SK7)]	324.9	4.53	7488	10.89	42.9	1.470
Non-Transgenic [N x (Sk6xSk7)]	345.6	5.57	7847	11.95	47.1	1.450
% improvement	-5.99	1.09	-4.57	-8.87	-8.92	1.36

Hybrid	SSW (g)	SR%	FL (m)	NBFL (m)	Denier	Raw silk %	Recovery %
Transgenic [N(T) x (Sk6 x SK7)]	0.2229	15.38	575.3	510	2.44	9.75	79.07
Non-Transgenic [N x (Sk6xSk7)]	0.2322	5.06	554.7	486	2.39	9.54	77.86
% improvement	-4.01	2.12	3.71	4.94	2.09	2.20	1.55

Experimental site: REC, Mothabari, Malda

Hybrid	Fec. (No.)	Hatch. (%)	ERR		Yield/ 100 dfls	SCW (g)
			Nos.	wt kg)		
Transgenic [N(T) X (Sk6XSK7)]	313.7	95.4	5052.0	7.2	28.8	1.40
Non-Transgenic [N x (Sk6xSk7)]	318.0	95.2	5443.3	7.6	30.3	1.40
% improvement	-1.35	.21	-7.19	-5.26	-4.95	0.00

Hybrid	SSW (g)	SR%	FL (m)	NBFL (m)	Denier	Raw silk%	Recovery %
Transgenic [N(T) X (Sk6XSK7)]	0.20	14.10	584.9	528.9	2.50	9.6	78.66
Non-Transgenic [N x (Sk6xSk7)]	0.20	17.30	515.8	496.3	2.20	8.6	69.38
% improvement	0.00	-18.5	13.40	6.57	13.64	11.63	13.38

10.A.VII. BRIDGING GAP IN TECHNOLOGY ADOPTION

10.A.VII.1. PMCE DIVISION

10.A.VII.1. 1. MTS 3599: Study on mulberry sericulture production in West Bengal: a statistical approach. **(Nov., 2016 to April, 2018)**

> G. R. Manjunatha (**PI**), Shafi Afroz, S. Chanda, D. Pandit and T. Datta Biswas.

Objectives:

1. To analyze the trends in mulberry cocoon production in West Bengal
2. To estimate costs and returns of mulberry cocoon production
3. To assess resource use pattern and resource use efficiency of sericulture farmers

Progress:

Trace of trends in mulberry cocoon production in West Bengal: The trend of mulberry acreage, cocoon production and rawsilk production were analyzed using time series data (1989-2016) in West Bengal which was collected from DoT (S), West

Bengal. In the study, result of trend analysis showed that mulberry acreage was best fitted with 3rd degree polynomial model ($y = 4.7314x^3 - 28433x^2 + 6E+07x - 4E+10$ & $R^2 = 0.7809$) whereas cocoon production ($y = 9E-17e^{0.0232x}$ & $R^2 = 0.8593$) and rawsilk production were best fitted with exponential models ($y = 2E-29e^{0.0365x}$ & $R^2 = 0.9543$). Mulberry acreage of WB is varied from 12374 ha to 21619 ha with an annual simple & compound growth rate of 0.02 % and -1.38 % respectively. Average mulberry acreage remained 16698.25 ha during the study. Similarly for Cocoon production (t) and rawsilk production (t) are given in the following **Table 40.**

Table 40. *Temporal* **performance of moriculture & sericulture in West Bengal during 1989-2016**

Particulars	Mulberry Area (ha)	Cocoon Production (t)	Rawsilk Production (t)
Minimum	12374	0780	829
Maximum	21619	3153	2450
Mean	16698.25	4951.43	1450.61
SE	587.53	605.59	84.00
CV (%)	3.52	4.05	5.79
Kurtosis	-1.40	0.52	-0.57
Skewness	0.33	0.98	0.59
SGR%	0.02	2.58	3.75
CGR%	-1.38**	.35**	3.72**

** indicates the 1% level of significance

10.A.VII.2. EXTENSION & PUBLICITY DIVISION

10.A.VII.2.1. MOT 3601: Skill Gap Analysis and Capacity Building of Sericulture Extension Workers and Farmers in Traditional and Non-Traditional States. (**Nov., 2016 to March, 2018**).

Shafi Afroz (**PI**), Manjunatha G.R., T. Dutta Biswas, D. Das, D. Pandit and B. C. Ray

Objectives:
1. To document job profile of the extension workers involved in sericulture activities and their engagement for each of the activity.
2. To identify the skill requirements for the extension workers and farmers for each activity.
3. To determine the skill gap of the extension workers and farmers involved in different sericulture activities.
4. To design capacity development programme to target the skill requirements of the extension workers and farmers.

Progress:

Schedules were prepared for job profile of extension workers and skills involved in mulberry cultivation as well as silkworm rearing. The information had been collected from the experts. The analysis will be done and studied to understand

the roles of extension workers for the development of sericulture and various skills required for improved sericulture practices.

10.A.VII.2.2 Seri Model Village

Objectives:

1. To bring about an improvement in the productivity and profitability in a sustained manner by adoption of the package of practices through technical guidance and providing of inputs by the institute, this will ultimately lead to economic upliftment of the stakeholders.
2. Future usage of the adopted village as a Technology Module to the general farmers to go for a technology change.

Table 41. Performance of cocoon production and cocoon productivity in different seri villages West Bengal during Autumn / Aghrayani crop

Name of the Centre/ Village	No. of farmers	Leaf Yield (t/ha/crop)		DFLs/ Comb.	Yield (kg)/100 dfls	
		Treat.	Cont.		Treat.	Cont.
CSR&TI, Berhampore, Balashpur	400	.9 (16.2%)	6.8	40000 N x (SK6xSK7)	52.6 (17.4%)	44.8
REC, Mothabari, Bangalgram	200	.1 (14.1 %)	7.1	30000 N x (SK6 x SK7)	53.3 (16.6%)	45.7
REC, Kamnagar, Sahebnagar	200	.5 (13.3 %)	7.5	30000 N x (SK6xSK7)	52.5 (15.4%)	45.5
REC(SU), Kalitha Kanupur Tailpara	100 100	7.8 (8.3 %)	7.2	20000 N x (SK6xSK7)	55.0 (20.1%)	45.8
CPP Nadia Barbakpur	150	8.4 (15.1 %)	7.3	15000 N x (SK6 x SK7)	49.0 (17.8%)	41.6
RSRS, Koraput Dhenkikota	50	3.8 (15.2 %)	3.3	5000 Nx(SK6xSK7)	49.0 (15.6%)	42.4
RSRS, Jorhat Chapori	50	4.1 (13.9 %)	3.6	2500 SK6xSK7	50.0 (17.1%)	42.7
RSRS, Kalimpong Mahakaldhara	15	4.2 (16.7 %)	3.6	1500 SK6xSK7	55.0 (12.5%)	48.9
REC, M.P.Raj Amritpur	50	6.6 (13.8 %)	5.8	7500 Nx(SK6xSK7)	49.3 (12.8%)	43.7
REC, Imphal Yumnamkhunou	70	4.2 (11.7 %)	3.6	7000 SK6xSK7	52.0 (14 %)	45.6
REC, Aizawl Saitual	60	4.2 (13.5 %)	3.7	6000 SK6 x SK7	52.5 (17.9%)	44.5
REC,Shillong Ummulong Wahiajer	50 50	3.9 (14.7 %)	3.4	4000 B.Con.1xB.Con.4	50.2 (14.6%)	43.8
REC,Agartala Chikancharra	30	4.2 (13.5 %)	3.7	3000 B.Con.1 x B.Con.4	48.5 (13.3%)	42.8
REC,Mongaldoi Halda Rowmari	60 65	4.8 (14.3%)	4.2	12500 SK6xSK7	51.3 (15.5%)	44.4

Falguni Crop						
CSR&TI, Berhampore Balashpur	200	.4 (13.8 %)	6.5	0000 N x (SK6 x SK7)	51.0 (13.8%)	44.8
RSRS, Koraput Dhenkikota	50	3.5 (9.3 %)	3.2	5000 N x (SK6 x SK7)	46.0 (12.1%)	41.0
REC, Mothabari Bangalgram	400	.0 (14.2 %)	7.0	4 000 N x (SK6 x SK7)	46.7 (15.3 %)	40.5
REC, Kamnagar Sahebnagar	200	.0 (11.1 %)	7.2	0000 N x (SK6 x SK7)	55.8 (19.4 %)	46.7
REC(SU), Kalitha Kanupur Tailpara	100 100	7.0 (12.9 %)	6.2	0000 10000 N x (SK6 x SK7)	51.6 (17.8 %)	43.8
CPP Nadia Barbakpur	150	8.2 (13.8 %)	7.2	5000 N x (SK6 x SK7)	52.5 (14.8 %)	45.7
REC, M.P.Raj Amritpur	50	6.1 (10.9 %)	5.5	7500 N x (SK6 x SK7)	44.0 (15.2 %)	38.2

N.B. In other stations no crop was conducted as per crop schedule.

10.A.VII.3. RSRS, KORAPUT, ODISHA

10.A.VII.3. MOE 3604: Yield gap analysis in mulberry leaf and cocoon production- A study in Eastern Ghat Highland zones of Odisha. **(Dec., 2016 to Nov., 2018)**

K.C. Brahma **(PI)**, S.K. Misro and S.B Dey.

Objective:
1. To assess the magnitude of 'Yield Gap' in respect of mulberry leaf and cocoon productivity at farmers' level.
2. To examine the nature of variation in 'Yield Gap', across different socio-economic strata of the sericultural farmers.
3. To identify factors influencing for 'Yield Gap'.

Observation: The secondary data on performance and productivity of various breeds / hybrids received from research institute level is as follows

Table 42.Performance and productivity of silkworm breeds / Hybrids

#	Breed/ Hybrid	Fec.	ERR No	ERR wt(kg)	SCW (g)	SSW (g)	Shell (%)	FL
1	SK6 x SK7	525	9050	13.6	1.450	0.282	19.45	800-850
2	B.Con.1xB.Con.4	584	9448	14.25	1.560	0.298	19.10	800-850
3	N X M12W	412	9150	8.33	1.125	0.180	15.19	300-350
4	N x(SK6xSK7)	456	9395	12.46	1.258	0.200	15.89	550-650
5	M.Con.1xB.Con.4	480	9255	13.14	1.420	0.250	17.60	700-775
6	M.Con.4xB.Con.4	465	9324	13.00	1.385	0.240	17.32	600-660

10. B.CONCLUDED RESEARCH PROJECTS (11 Projects & 1 prog.)

#	Code	Title	PI of the Proj/prog.
1.	**AICEM-III**	All India Coordinated Experimental Trail for Mulberry (AICEM)- Phase III, (A prog. of C.O., Bangalore) **(Aug., 2011 to Dec., 2016)**	M K Ghosh, Sci.-D (upto 31.03.16) & R Banerjee, Sci.-D (fr. 01.04.16)
2.	**PIB 3479**	Development of high yielding mulberry varieties using physiological growth parameters as markers for selection**. (Oct., 2012 to Sept., 2016)**	Jalaja S.Kumar, Sci.-D (upto May,16) Suresh K. (fr. June,16)
3.	**PIB 3515**	Evaluation of new developed triploid mulberry varieties for productivity and quality. **(Jun., 2014 to Mar., 2017)**	P.K. Ghosh, Sc-D
4.	**PPF 3532**	Assessment, Development and Management of area under mulberry in major sericulture districts of West Bengal. **(Feb., 2015 to Jan., 2017)**	M.Choudhuri, Sci.-D
5.	**PPS 3504**	Study on root rot disease of mulberry in the Gangetic plains of West Bengal and development of its control measures. **(April, 2014 to March, 2017)**	S .K. Dutta, Sc.-D
6.	**CSS-2107**	Forewarning of mulberry diseases of Eastern and North Eastern India**. (April, 2012 to March, 2017)**	S .K. Datta, Sci.-D
7.	**AIB 3501**	Development of multivoltine breeds of silkworm (*Bombyx mori* L.) with high shell percentage and high neatnes of silk filament. **(July, 2013 to June, 2016)**	A.K.Verma, Sci.-D
8.	**AIB 3480**	Development of silkworm Bombyx mori L. breeds from a gene pool with higher genetic plasticity. **(Sept., 2012 to Aug., 2016)**	A.K.Verma, Sci.-D
9.	**AIB 3466**	Development of region specific bivoltine breeds suitable for highly fluctuating and seasonally variable climatic conditions of Eastern and North-Eastern India**. (Aug., 2011 to Dec., 2016)**	N. Suresh Kumar, Sci.-D (upto 31.07.16) V.Lakshmanan, PI (fr. Aug., 16),

#	Code	Title	PI of the Proj/prog.
10.	**ARP 3516**	Studies on synbiotic (Combination of probiotic and pre biotic) induction for control of common disease of silkworm, *Bombyx mori* L. **(Oct., 2014 to Sept., 2016)**	K. Rahul, Sci-B, (fr. 09-08-2016); S. Chakrabarty, Sci-C, (upto 02.07.2016)
11.	**APS 3539**	Characterization of mulberry growing soils for nutrient management in selected Seri-villages of Golaghat district of Assam. **(April, 2015 to March, 2017) (Collaborative with NBSS&LUP, ICAR, Jorhat)**	S. N. Gogoi, Sc-D, RSRS, Jorhat
12	**BMO (P)-042**	Institute Village Linkage Programme **(Apr., 14 to Mar., 17)**	D. Das, Sc-D

10.B. I.MAIN INSTITUTE

10.B.I.1. MULBERRY BREEDING & GENETICS SECTION

10.B.I.1.1. AICEM-III: All India Coordinated Experimental Trial for mulberry-Phase-III **(Aug., 2011 to Dec., 2016)**

Zonal Coordinator : K Trivedy (fr. 02.11.2015), S. Nirmal Kumar (fr. 22.04. 2013 to 31.07.2015) and B. B. Bindroo (upto 22.04.2015).

Investigators : M.K. Ghosh (upto 31.03.16 at CSRTI), R Banerjee (fr. 01.04.016), Suresh K. (fr. 01.04.16), S. Chatterjee (upto 30.11.16), S. N. Gogoi, R. Sahu (upto 31.03.15), N. R. Rao (01.04.15 to 31.05.16), M. K. Ghosh (fr. 01.06.16 at Koraput)**,** G. S.Singh and L. S. Singh.

Test centres: Eastern zone

1. CSR&TI, Berhampore
2. RSRS, Koraput
3. RSRS, Jorhat
4. RSRS, Kalimpong
5. REC(SU), Bhandra
6. REC, Imphal
7. DoT(Seri), Boswa Composite unit , WB
8. DoT(Seri), Ambarifalakata Sericulture Project farm, WB

Objectives: To identify and authorize suitable mulberry variety for commercial use in different agro-climatic mulberry cultivation zone of India.

In the AICEM Phase III, trial has been conducted at 24 test centers including 8 centers under East zone as per decision of MVAC meeting held on 26.10.2010. Three new genotypes of mulberry were tested in one irrigated (CSR&TI, Berhampore) and six rainfed test centers of Eastern zone of India under the coordination of the Institute. In addition to above three genotypes, Tr-23 had also been tested in RSRS, Kalimpong (KPG) hills (**Table 43**).

Table 43. Test centers detail of AICEM phase III trials of East zone.

Test centers	State	DoT (Seri)	Test condition	Test genotype	Transplan tation (date)
CSR&TI, Berhampore	West Bengal	CSB	Irrigated	MV-1, MV-2, MV-3; Check: Vishala & S-1635	March, 2012
RSRS, Koraput (KPT)	Odisha	CSB	Rainfed	MV-1, MV-2, MV-3; Check: Vishala & S-1635	July, 2012
RSRS Jorhat (JRH)	*Assam*	*CSB*	*Rainfed*	MV-1, MV-2, MV-3; Check:Vishala & S-1635	January, 2012
REC, Bhandra (BND)	Jharkhand	CSB	Rainfed	MV-1, MV-2, MV-3; Check: Vishala & S-1635	August, 2012
REC Imphal (IMF)	Manipur	CSB	Rainfed	MV-1, MV-2, MV-3; Check: Vishala & S-1635	July, 2012
Boswa Composite Farm (BOS)	West Bengal	DoT (Seri)	Rainfed	MV-1, MV-2, MV-3; Check: Vishala & S-1635	October, 2012
Ambari-falakata Farm (AMF)	West Bengal	DoT (Seri)	Rainfed	MV-1, MV-2, MV-3; Check: Vishala & S-1635	March, 2012
RSRS Kalim-pong (KPG)	West Bengal	CSB	Rainfed	Hill- MV-1, MV-2, MV-3,MV-4; Check:Vishala&S-146	March , 2012

MV-1: C-2038, MV-2: G-4 (FYT/99), MV-3: Suvarna-2 and MV-4: Tr-23

Evaluation of mulberry genotypes under irrigated condition at CSR&TI-BHB:

The genotype C-2038 showed highest survival (79%) which was significantly better than Vishala (one of the checks) and at per with the zonal check S-1635 (**Table 44**).The genotype C-2038 also exhibited highest fresh shoot weight (28.57g /plant).

Table 44. Result of propagation parameters of test genotypes along with checks at CSR&TI Berhampore

Genotype	Cuttings survival (%)	Fresh shoot wt(g)	Fresh root wt(g)	Shoot/Root ratio
MV-1(C-2038)	78.50	28.57	3.23	8.99
MV-2(G-4)	77.17	17.95	2.43	7.43
MV-3(Suvarna-2)	54.00	19.81	3.03	6.83
MV-4(Vishala)*	76.83	19.24	3.07	6.36
MV-5(S-1635)*	78.50	25.50	3.15	8.25
LSD$_{(0.05)}$	2.20	2.43	0.44	1.49

*Check genotypes

C-2038 exhibited maximum leaf yield potential (range: 8.5 to 12.4 t ha^{-1} crop^{-1}) than others over all tested seasons (**Table 45**). Besides, the annual leaf yield of C-2038 showed 20% higher than the zonal check S-1635 and 24% over national check Vishala (**Table 46**).

Table 45. Mean seasonal leaf yield potential of test genotypes and checks at the field environment of CSR&TI Berhampore spanning over three years

Genotypes	Seasonal leaf yield (kg ha^{-1})				
	September	**November**	**February**	**April**	**July**
MV-1(C-2038)	11040.97	8502.50	9781.57	12020.87	12435.51
MV-2(G-4)	9330.55	7143.75	8049.33	9414.91	9882.62
MV-3(Suvarna-2)	8843.79	6605.60	7544.16	8840.88	9248.90
MV-4(Vishala)*	9195.70	7161.68	7917.33	9331.76	9814.39
MV-5(S-1635)*	9675.50	7052.14	8036.03	9784.58	10277.01
LSD$_{(0.05)}$	354.59	256.29	491.55	402.78	537.68

Check genotypes

Table 46. Annual leaf yield of test genotypes and checks at the field environment of CSR&TI Berhampore

Genotypes	Leaf yield (kg.ha^{-1})[**]			
	Year-1	**Year-2**	**Year-3**	**Mean**
MV-1(C-2038)	43654.15	56296.29	61393.81	53781.42
MV-2(G-4)	38976.65	45287.51	47199.29	43821.15
MV-3(Suvarna-2)	36814.89	42079.44	44355.63	41083.32
MV-4(Vishala)*	38515.99	44174.85	47571.76	43420.87
MV-5(S-1635)*	39239.10	46193.83	49042.83	44825.25
LSD$_{(0.05)}$	148.71	363.00	373.97	1597.54

*** Mean of sum of five seasonal observations; *Check genotypes*

The test genotype C-2038 also exhibited highest values for total shoot length (1198cm), number of leaves unit length of shoot (22no.m^{-1}), shoot yield (85.8 t.ha^{-1}), leaf shoot ratio (0.57), leaf moisture content (79.4%) and leaf moisture content after 6 h (77.9%) which were significantly higher than both the checks.

Similarly for number of days to sprouting efficiency of , C-2038 was found at per with S-1635 across the seasons and it varied significantly among the genotypes (range: 10.5 to 14.8; **Fig. 7**).
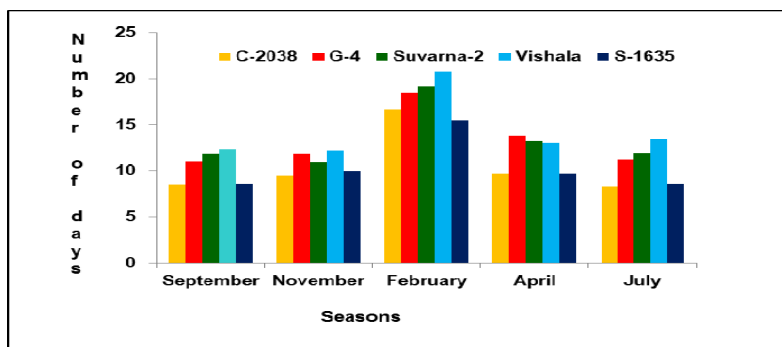
Fig. 7. Sprouting behaviour of tested genotypes of mulberry in different seasons at CSRTI Berhampore

Table 47. Mean Percent disease index (PDI) of foliar diseases and pests of mulberry at CSR&TI Berhampore

Genotypes	PDI(%)			
	MLS	PLS	BLS	Tukra
MV-1(C-2038)	2.2	1.3	2.4	21.5
MV-2(G-4)	3.5	2.6	2.5	14.2
MV-3(Suvarna-2)	2.2	2.8	2.0	11.0
MV-4(Vishala)*	2.3	2.4	2.9	16.5
MV-5(S-1635)*	3.4	4.1	5.2	21.5
LSD(0.05)	0.75	0.70	0.58	2.94

Rearing of silkworm breed B.Con.1 x B.Con.4 with the test genotypes indicated non-significant difference with the checks for most of the rearing parameters (**Table 48**).

Table 48. Rearing performances of silkworm breed B.Con.1x B.Con.4 fed by mulberry genotypes in two different seasons at CSRTI, Berhampore.

Season	Larval duration	Genotype	Yield/500 larvae		Cocoon wt(g)	Shell wt(g)
			By No.	wt. (kg)		
June-July, 2016	25 days	C-2038	483±1.8	0.73±0.005	1.373±0.02	0.251±0.01
		G-4	475±1.2	0.65±0.01	1.381±0.04	0.259±0.01
		Suvarna-2	484±2.1	0.73±0.01	1.426±0.02	0.254±0.01
		Vishala*	476±1.2	0.65±0.02	1.429±0.02	0.252±0.01
		S-1635*	478±1.4	0.70±0.01	1.392±0.01	0.255±0.01
		LSD (0.05)	4.1	0.02	NS	NS
Oct.-Nov., 2016	28 days	C-2038	480±4.1	0.85±0.01	1.556±0.01	0.284±0.003
		G-4	430±4.1	0.94±0.01	1.645±0.01	0.314±0.007
		Suvarna-2	464±8.0	0.91±0.02	1.648±0.04	0.296±0.010
		Vishala*	482±3.1	0.87±0.03	1.639±0.02	0.306±0.003
		S-1635*	463±5.6	0.91±0.01	1.658±0.02	0.300±0.005
		LSD (0.05)	NS	0.06	NS	NS

Check genotypes

Incidence of *Myrothecium* leaf spot (MLS), *Pseudocercospora* leaf spot(PLS) and bacterial leaf spot diseases were observed during June to September at CSR&TI Berhampore (**Table 47**). Disease severity (PDI) for MLS ranged from 2.2 to 3.5 among the test genotypes. C-2028 recorded minimum PDI for MLS (2.2) and PLS (1.3). It appears that BLS severity was less in three test genotypes (PDI<5) , but it was maximum in zonal check, S-1635 (5.2). Infestation of tukra was recorded during May-June and it ranged from 11 to 21.5 (per shoot).

Evaluation of mulberry genotypes under rainfed conditions:

Cutting survival and other propagation parameters were recorded after 90 days of plantation in all test centers. Significant variation has been observed for all the traits in all locations (data not shown) among the test genotype. Cutting survivality-wise C-2038 appeared most promising (survival range: 76.4% to 81.7%) in all six test centers with an average of ~79.2% which was at par with the check, S-1635 in the rainfed regions (**Table 49**).

Table 49. Cutting survival (%) of 3 test genotypes along with 2 checks at six test centers under rainfed condition

Genotypes	RSRS KPT	RSRS JRH	REC(SU) BND	REC IMF	AMF	BOS
C-2038	76.37	79.33	78.17	81.67	81.33	78.50
G-4	75.33	64.17	65.67	77.50	73.33	74.17
Suvarna-2	49.33	49.33	51.83	54.33	63.67	49.00
Vishala*	66.50	80.17	76.50	78.83	78.00	72.17
S-1635*	84.17	83.31	80.50	81.50	78.17	79.17
LSD(0.05)	8.00	4.00	2.90	4.40	3.30	3.90

*Check genotypes

Annual leaf yield potential of C-2038 was found maximum in all six rainfed centers with a variation of 21.3 t/ha at AMF to 17.3 t/ha at KPT (**Table 51**). Average leaf yield of C-2038 in six rainfed test centers was 19.2t ha^{-1} which significantly higher than two checks S-1635 and Vishala to the tune of 23%. Importantly, variations of leaf yield of two checks were non-significant in most of the centers.

Table 50. Pooled means values of leaf yield of test genotypes along with checks at six test centers under rainfed condition

Genotypes	Leaf yield (t. ha.$^{-1}$yr $^{-1}$)					
	RSRS Koraput	RSRS Jorhat	REC(SU) Bhandra	REC Imphal	DoT(S) A Falakata	DoT(S) Boswa
C-2038	17.33	18.64	18.38	18.68	21.27	20.78
G-4	12.41	16.27	16.35	14.51	14.70	16.48
Suvarna-2	15.74	15.03	16.31	13.76	17.08	15.66
Vishala*	13.42	17.06	15.64	15.69	16.23	15.58
S-1635*	12.88	17.09	15.75	13.88	17.37	16.56
SE±	0.59	0.33	0.28	0.52	0.43	0.59
LSD(0.05)	1.50	0.31	0.24	1.50	0.647	0.58
CV%	15.92	7.55	6.65	13.16	16.64	13.48

Data are mean of nine seasonal values for each test centers.

Center-wise variation of total shoot length was significant (range: 535cm to 1232cm).Maximum total shoot length (TSL) was recorded in C-2038(1232cm) at REC Imphal, but maximum variation between the shoot length of C-2038 and zonal check S-1635 was observed in REC (SU) Bhandra which was ~17% higher than the zonal check S-1635.

Incidence of major foliar diseases and pest under rainfed condition in different test centers are presented in Table 51, 52, 52a. Significant variation for *Myrothecium leaf spot*(MLS) severity among the test genotypes was observed (**Table 51**). Minimum PDI for MLS was recorded in C-2038 and it varied from 1.61 at KPT to 3.83 at AMF.

Table 51: Mean Percent disease index (PDI) of Myrothecium leaf spot under rainfed condition.

Genotypes	RSRS Koraput	PDI (%)	DoT(S) Boswa
		DoT(S) A Falakata	
C-2038	1.61	3.83	2.02
G-4	1.72	3.81	3.73
Suvarna-2	1.77	7.71	4.42
Vishala*	1.81	6.86	4.63
S-1635*	2.19	11.11	4.78
LSD(0.05)	0.19	1.42	0.68

* Check cultivars

C-2038 also recorded minimum powdery mildew severity and recorded 15%, 25% and 54% less PDI values over zonal check, S-1635 at KPT, BND and AMF (**Table 52**).

Table 52. Mean percent disease index (PDI) of powdery mildew under rainfed condition.

Genotypes	RSRS Koraput	PDI(%)	REC(SU)Bhandra
		DoT(S) A Falakata	
C-2038	1.23	2.22	2.11
G-4	1.42	2.71	2.83
Suvarna-2	1.30	3.28	3.35
Vishala*	1.42	3.82	3.63
S-1635*	1.44	4.86	2.83
LSD(0.05)	NS	1.03	0.57

* Check cultivars

Center-wise tukra infestation is presented in **Table 52a**. C-2038 recorded minimum infestation (2.87) among the test genotypes at BOS.

Rearing performances of bivoltine silkworm hybrid (SK-hybrid at AMF; BCon1 x BCon4 in all other test centers) indicated significant variability for most of the rearing parameters in all test centers (**Table 53: a-d**). In both the rearing seasons (spring and autumn of 2016), the genotype C-2038 fed silkworm showed maximum cocoon yield with the range of 432 to 486 (no/500larvae reared) during spring and 469 to 487 (no / 500 larvae reared) during autumn crops, respectively (**Table 53a**). The recorded variation of

cocoon yield (no/500larvae) between C-2038 and zonal check S-1635 was maximally 29% in BOS, followed by 23% in RSRS KPT during Spring 2016.

Table 52a. Mean Percent disease index (PDI) of tukra under rainfed condition.

Genotypes	RSRS Jorhat	PDI(%)	DoT(S) Boswa
		DoT(S) A Falakata	
C-2038	3.58	1.19	2.87
G-4	3.99	4.25	6.13
Suvarna-2	3.39	1.47	5.97
Vishala*	3.83	1.79	4.57
S-1635*	5.17	4.13	8.00
LSD(0.05)	NS	NS	1.35

* Check cultivars

Table 53a.   Performance of mean cocoon yield by no of Bi x Bi silkworm fed by mulberry genotypes in two different seasons at six test centers.

Season	Genotype	Yield/500 larvae by number					
		RSRS Koraput	RSRS Jorhat	REC (SU) Bhandra	REC Imphal	DoT(S) A. Falakata	DoT(S) Boswa
Mar-April, 2016	C-2038	462	472	432	461	449	486
	G-4	452	449	423	460	432	464
	Suvarna-2	453	441	428	446	437	461
	Vishala*	437	427	418	452	427	462
	S-1635*	431	426	419	441	434	376
	LSD (0.05)	**4.54**	**8.55**	**6.46**	**24.16**	**8.95**	**14.91**
Oct.-Nov., 2016	C-2038	487	480	474	469	477	485
	G-4	465	456	436	451	460	481
	Suvarna-2	464	452	425	453	459	476
	Vishala*	465	472	451	464	455	473
	S-1635*	398	462	458	466	446	470
	LSD (0.05)	**12.44**	**6.59**	**9.48**	**10.08**	**18.70**	**4.69**

*Check genotypes

The cocoon yield by weight was also recorded maximum in C-2038 in all test centers in both seasons (**Table 53b**). The observed variation between C-2038 and zonal check S-1635 was significantly higher (27%) during Autumn than the spring season rearing (11%).

Table 53b.   Performance of mean cocoon yield by weight of Bi x Bi silkworm fed by mulberry genotypes in two different seasons at six test centers.

Season	Genotype	Yield/500 larvae by weight(kg)					
		RSRS Koraput	RSRS Jorhat	REC (SU) Bhandra	REC Imphal	DoT(S) A Falakata	DoT(S) Boswa
Mar-April 2016	C-2038		0.758	0.608	0.799	0.735	0.809
	G-4	0.	0.696	0.537	0.769	0.629	0.790
	Suvarna-2	0.596	0.690	0.547	0.723	0.661	0.759

	Vishala*	0.566	0.656	0.564	0.716	0.621	0.712
	S-1635*		0.670	0.563	0.707	0.652	0.584
	LSD(0.05)		**0.023**	**0.026**	**0.027**	**0.021**	**0.018**
Oct-Nov 2016	C-2038		0.740	0.708	0.801	0.634	0.684
	G-4	0.	0.657	0.607	0.733	0.591	0.679
	Suvarna-2	0.714	0.691	0.590	0.757	0.566	0.695
	Vishala*	0.724	0.696	0.611	0.777	0.577	0.608
	S-1635*		0.676	0.647	0.779	0.571	0.630
	LSD(0.05)		**0.020**	**0.017**	**0.015**	**0.012**	**NS**

*Check genotypes

Maximum single cocoon weight was estimated in C-2038 with a variation of 1.3 fold in both the rearing seasons (**Table 53c**). C-2038 also exhibited maximum single shell weight in spring (0.310g) and autumn (0.332g) (**Table 53d**).

Table 53c. **Performance of mean single cocoon weight of Bi x Bi silkworm fed by mulberry genotypes in two different seasons at six test centers.**

	Genotype	Single cocoon weight(g)					
		RSRS Koraput	**RSRS Jorhat**	**REC (SU) Bhandra**	**REC Imphal**	**DoT(S) A Falakata**	**DoT(S) Boswa**
Mar-April 2016	C-2038	1.328	1.685	1.564	1.703	1.698	1.669
	G-4	1.312	1.627	1.442	1.668	1.545	1.715
	Suvarna-2	1.317	1.653	1.458	1.583	1.643	1.698
	Vishala*	1.298	1.621	1.451	1.643	1.512	1.623
	S-1635*	1.278	1.656	1.497	1.680	1.642	1.672
	LSD (0.05)	**0.016**	**0.037**	**0.047**	**0.052**	**0.026**	**0.019**
Oct-Nov 2016	C-2038	1.673	1.604	1.547	1.715	1.388	1.412
	G-4	1.592	1.513	1.425	1.580	1.377	1.410
	Suvarna-2	1.588	1.600	1.463	1.562	1.345	1.459
	Vishala*	1.611	1.540	1.424	1.600	1.352	1.286
	S-1635*	1.623	1.536	1.465	1.612	1.364	1.341
	LSD (0.05)	**0.045**	**0.033**	**0.024**	**0.030**	**0.005**	**NS**

*Check genotypes

Table 53d. **Performance of mean single shell weight of Bi x Bi silkworm fed by mulberry genotypes in two different seasons at six test centers.**

Season	**Genotype**	Single shell weight(g)					
		RSRS Koraput	**RSRS Jorhat**	**REC (SU) Bhandra**	**REC Imphal**	**DoT(S) A Falakata**	**DoT(S) Boswa**
Mar-April 2016	C-2038	0.241	0.294	0.285	0.310	0.273	0.304
	G-4	0.229	0.277	0.259	0.283	0.235	0.294
	Suvarna-2	0.233	0.282	0.265	0.277	0.247	0.291
	Vishala*	0.226	0.270	0.257	0.268	0.222	0.280
	S-1635*	0.218	0.283	0.270	0.272	0.257	0.290
	LSD (0.05)	**0.006**	**0.003**	**0.005**	**0.011**	**0.010**	**0.006**
Oct-Nov 2016	C-2038	0.332	0.305	0.284	0.315	0.234	0.239
	G-4	0.301	0.285	0.253	0.290	0.228	0.216

Suvarna-2	0.298	0.287	0.249	0.288	0.223	0.242
Vishala*	0.310	0.287	0.262	0.300	0.217	0.194
S-1635*	0.314	0.290	0.272	0.298	0.228	0.208
LSD (0.05)	**0.010**	**0.008**	**NS**	**0.010**	**0.003**	**0.035**

*Check genotypes

Evaluation of mulberry genotypes under hilly area at RSRS Kalimpong:

Cutting survival and other propagation parameters were recorded after 90 days of plantation. Significant variation has been observed for all four specified traits. Among the test genotype Tr-23 exhibited ~68% survival, followed by Suvarna-2 (67%), C-2038 (54%) and G4 (53%; **Table 54**).

Table 54. Result of propagation parameters of 4 test genotypes along with 2 checks at RSRS Kalimpong.

Genotypes	No of cuttings survived (%)	Fresh shoot wt (g)	Fresh root wt (g)	Shoot/ Root ratio
C-2038	54.40	42.85	2.81	15.38
G-4	53.60	51.38	4.18	12.23
Suvarna-2	67.20	32.07	4.06	7.93
Tr-23	68.60	42.65	3.89	11.06
Vishala*	61.60	26.33	1.45	20.02
S-146*	46.60	28.77	2.69	10.90
LSD$_{(0.05)}$	6.70	9.03	0.78	4.91

*Check genotypes

Assessment of leaf yield and ancillary traits indicated significant variability among the mulberry genotypes. Tr-23 recorded maximum leaf yield potential (11.4 t. ha^{-1}y^{-1}) and increased over Vishala (check) by 39% and S-146 (check) by 32% (Table 55). Tr-23 also showed maximum total shoot length (891cm), moisture percent (75.1%) and moisture retention after 6 fours (72.5%) **(Table 55).**

Table 55. Pooled Mean values of leaf yield and growth parameters of mulberry test genotypes evaluated during 2013 - 2016 at RSRS Kalimpong.

Genotypes	Leaf yield (t.ha^{-1}yr^{-1})	Total shoot length (cm)	Leaves per meter shoot (No)	Leaf moisture (%)	Leaf Moisture after 6hrs (%)
C-2038	9.30	756	22	73.43	71.09
G-4	7.23	619	21	73.52	70.97
Suvarna-2	8.57	771	19	74.14	72.14
Tr-23	11.38	891	22	75.10	72.95
Vishala*	8.21	712	19	74.17	72.02
S-146*	8.62	742	20	74.01	71.64
SE	0.61	29.41	0.48	0.27	0.40
LSD at 5%	0.51	25.33	1.01	0.41	0.36
CV%	26.49	16.66	9.83	1.56	2.39

*Check genotypes

Among the reported biotic agents, though the infestations of leaf webber and root mealy bug (per plant) were major, but found insignificant in Tr-23.

Silkworm (SK-hybrid) rearing was conducted twice (spring and autumn 2016) with the leaves of all four test genotypes with checks (**Table 56**). The genotype Tr-23 fed silkworm recorded maximum cocoon yield by number during spring (411) and autumn (277). The cocoon yield variation between Tr-23 and zonal check S-146 was 13% during spring and 10% during autumn, respectively. Tr-23 also recorded maximum single cocoon weight (1.585g) during spring and autumn (1.419g) with overall increment of 6.5% and 6% over two checks, S-146 and Vishala respectively.

Table 56. Rearing performances of SK hybrid fed mulberry genotypes in two different seasons at RSRS Kalimpong.

Season	Larval duration	Mulberry genotype	Yield/500 larvae		Cocoon wt(g)	Shell wt(g)
			By no.	By wt.(kg)		
April-May 2016	27 days	C-2038	381	0.549	1.511	0.244
		G-4	351	0.504	1.527	0.243
		Suvarna-2	349	0.500	1.522	0.232
		Tr-23	411	0.612	1.585	0.260
		Vishala*	365	0.507	1.483	0.234
		S-146*	393	0.542	1.489	0.241
		LSD(0.05)	25.45	0.032	0.063	0.011
Aug-Sept 2016	26 days	C-2038	280	0.377	1.403	0.227
		G-4	261	0.333	1.339	0.214
		Suvarna-2	277	0.345	1.351	0.223
		Vishala*	278	0.349	1.355	0.218
		Tr-23	277	0.371	1.419	0.239
		S-146*	266	0.337	1.332	0.213
		LSD(0.05)	**8.80**	**0.010**	**0.05**	**0.011**

*Check genotypes

Conclusion: Overall performances of genotype C-2038 indicated highest average annual leaf yield production   (53.8 t /ha / y in irrigated and 17.3 to 21.3 t /ha / y in rainfed) and excelled the check (S-1635) by 21% and 23% in irrigated and rainfed condition of eastern and northeastern regions. The genotype Tr-23 appeared best performing genotype in hilly region of Kalimpong and showed 42% higher leaf yield potential than zonal check S-146.

10.B.I.1.2. PIB 3479: Development of high yielding mulberry varieties using physiological growth parameters as markers for selection**. (Oct., 2012 to Sept., 2016).**

Jalaja S.Kumar (**PI -** up to 31.05.16), Suresh K. (**PI -** fr. 01.06.16) and P.K Ghosh.

Objective: To develop mulberry varieties with superior quality and with 10% higher leaf yield over the ruling variety.

Hybridization, preliminary screening and establishment of progenies.

Six female and eleven male mulberry resources selected from germplasm bank of CSR&TI Berhampore based on physiological traits and leaf yield were utilized in controlled crossing programme during Feb., 2013(**Table 57**). Obtained seeds from 57 combinations (full-sib/half-sib) were raised in seedling nursery. Afterwards ~1024 promising seedlings were identified on the basis of visual observation for leaf morphology, seedling growth and branching nature; and established in progeny row trial (PRT) plot along with check variety, S-1635 at spacing of 60×60 cm in Nov., 2013.

Table 57. List of mulberry resources used in hybridization programme

#	Name	Accession No.	Species/pedigree	Sex	Source
1	M. indica HP	MI-0099/ IC313827	*M. indica*	♀	India
2	China White	ME – 0042/ EC493799	*M. alba*	♀	China
3	Chinese F_1-10	-	OPH from China	♀	India
4	MS-30	MI-0103/IC313965	*M.indica*	♀	India
5	Multicaulis	ME – 0006/ EC493763	*M. multicaulis*	♀	Russia
6	Kajli OPH	-	OPH of Kajli	♀	India
7	V- 1	MI-0308/ IC313996	$S_{30} \times C776$	♂	India
8	ACC.No.1190	MI-0031/IC313687	*M.indica*	♂	India
9	Almora Local	MI – 0015/ IC313680	*M.indica*	♂	India
10	BerhamporeB	MI – 0627/ IC405775	*M.indica*	♂	India
11	Bishnupur-10	MI – 0117/ IC313831	*M.indica*	♂	India
12	C-776	MI-0158/ IC313917	English black x *M. ulticaulis*	♂	India
13	Charitul	MI – 0169/IC313833	*M.alba*	♂	India
14	English Black	ME – 0004/ EC493761	*M.latifolia*	♂	France
15	Kosen	ME – 0066/EC493823	*M.latifolia*	♂	Japan
16	KPG-1	MI – 0144/IC313766	*M.indica*	♂	India
17	MS-7	MI-0001/ IC313963	*M.indica*	♂	India
18	Nagaland	MI – 0167/ IC313961	*M.indica*	♂	India

Primary screening of genotypes through progeny row trial (PRT)

After establishment the progenies were pruned at ~30cm above ground. The growth and leaf yield data of 1024 genotypes along with the check S-1635 was recorded in April 2015, September 2015, November 2015, February 2016 and July 2016 following silkworm cocoon crop schedule. Frequency analysis of pooled data, revealed that 136 genotypes recorded leaf yield higher than mean + 1SD. While, in 43 genotypes leaf yield was higher than mean + 2SD representing. (**Table 58**) Moreover, 140 (13.70% of population) genotypes recorded significantly higher yield over the ruling check S-1635.

Table 58 Frequency analysis of annual leaf yield (kg/plant) of progenies

Classes	Range of leaf yield (kg/plant/y)			Frequency	% age
>(x+3s)	> 2.341			13	1.32
(x+2s) to (x+3s)	1.844	to	2.341	30	3.05
(x+1s) to (x+2s)	1.346	to	1.844	93	9.47
(x) to (x+1s)	0.849	to	1.346	282	28.72
<x		<	0.849	564	57.43

Studies on physiological growth parameters of shortlisted genotypes

Evaluation of 140 short-listed genotypes for physiological growth parameters indicated significant variability for total chlorophyll content (range:11 to 30 µg cm^{-2}), specific leaf area (range:185-372 cm^{2}g^{-1}), total leaf area(range:191to 475 m^2), absolute growth rate (range:18 to 34 g day^{-1}) , leaf area duration (range:2.9 to 7.3 m^{2}day^{-1}), leaf area ratio (range:13 to 28 m^{2}g^{-1}) and leaf weight ratio(range:0.42-0.57) (**Table 59**). Besides, genotypes with high values for the physiological growth parameters also exhibited high leaf yield potential.

Table 59. List of promising genotypes identified under PRT.

#	.N.	CSP	TCC	SLA	TLA	AGR	TSL	SNP	MC	IDL	LYP
1	350	79.80	14.10	223.55	472.27	33.91	1348	9	77.81	4.5	2.561
2	359	68.29	12.54	237.55	470.16	28.20	1410	11	78.10	5.0	2.559
3	319	64.42	16.93	254.75	474.68	32.42	1435	10	78.08	4.0	2.546
4	490	62.40	13.61	215.03	369.86	31.33	1845	12	76.74	5.5	2.538
5	986	79.60	11.49	272.28	419.53	27.37	1534	12	81.83	4.0	2.526
6	642	73.60	15.91	260.55	381.18	25.94	1322	9	78.85	4.0	2.518
7	362	81.20	17.76	228.10	314.48	22.60	1366	12	76.07	3.0	2.512
8	245	71.62	16.42	246.68	352.97	23.97	1566	11	78.39	4.5	2.504
9	838	66.70	30.43	185.30	211.71	22.53	1108	7	74.58	4.5	2.499
10	343	82.40	15.50	243.30	306.14	21.62	1176	9	78.68	3.5	2.425
11	570	74.24	17.34	270.74	306.42	23.85	1561	11	81.33	4.5	2.409
12	768	76.40	12.06	323.00	304.55	24.08	1425	10	79.85	4.5	2.389
13	400	72.10	17.34	270.00	400.68	25.95	1760	11	85.03	4.5	2.367
14	936	75.80	11.78	274.91	277.15	22.44	1386	11	81.44	4.5	2.325
15	52	79.60	17.24	226.52	202.05	18.15	957	8	75.57	5.0	2.318
16	616	58.40	16.93	200.23	227.13	23.70	1415	11	78.73	4.0	2.316
17	313	76.40	18.92	248.98	297.43	21.19	1107	9	76.84	4.5	2.315
18	836	78.64	16.52	372.13	388.73	21.70	1175	9	88.80	5.0	2.306
19	413	79.98	15.91	205.05	269.85	18.68	960	8	74.11	5.2	2.256
20	1016	78.20	11.11	279.14	349.28	20.31	1145	9	82.16	5.0	2.256
21	1019	52.60	13.22	233.35	278.42	22.44	1234	9	78.55	5.5	2.179
22	790	72.60	14.40	242.93	191.02	22.70	1345	9	78.40	3.5	2.171
23	716	69.40	23.75	217.93	205.57	22.45	1466	11	76.34	3.5	2.115
24	721	58.60	21.75	228.91	243.85	17.79	779	6	76.33	7.00	2.104
S-1635		76.80	17.1	254.4	203.4	18.24	1018	8	79.23	4.80	1.620
LSD@5%	1	53	2.1	60.1	191.0	11.9	68.4	1.04	4.56	0.24	0.143

CSP(cutting survival %), TCC(total chlorophyll content), SLA(specific leaf area), TLA(total leaf area), AGR(absolute growth rate), TSL(total shoot length), SNP(shoots per plant), MC(moisture content), IDL(inter nodal length) and LYP(leaf yield per plant).

Studies on propagation efficiency of the shortlisted genotypes

Propagation study of the selected genotypes indicated significant variability for survival (range: 53 to 82%), shoot length (range: 33 to 91 cm), shoot fresh weight (range:16.4 to 36 g) and root length (range 13.2 to 28 .2) (data not shown). The genotype number 343 recorded maximum survival (82.04%) and 19 other genotypes recorded significantly high mean values for propagation parameters over check S-1635.

Conclusion: Identified 24 promising genotypes with more leaf yield potential (range: 2.104 to 2.561 kg/plant/y compared to check S-1635 (1.620 kg/plant/y).

Future plan of work: The selected 24 genotypes may further be evaluated through yield trials (PYT/FYT) for mulberry improvement programme.

10.B.I.1.3. PIB 3515: Evaluation of new developed triploid mulberry varieties for productivity and quality. **(Jun., 2014 to Mar., 2017)**

P. K.Ghosh **(PI),** M. K. Ghosh (up to 31.3.016), Jalaja S. Kumar (up to 31.05.16), Suresh, K. (01.04.16), D. Chakravarty (w.e.f. 14.7.16), S. K. Dutta and N. Lalitha (up to 31.10.15).

Objective: Evaluation of newly developed triploid mulberry varieties under irrigated condition for better productivity and quality.

Evaluation of newly developed triploid mulberry genotypes for growth and leaf yield parameters

The growth and leaf yield characters of fifteen triploid test genotypes along with check S-1635 were recorded for 8 crops seasons after one year period of establishment during June 2014. Significant variation for all the parameters was observed among the genotypes **Table 60.** The range of number of shoots per plant was recorded from 10.45 cm (C-124) to 17.55 cm (C-135), total shoot length from 1169 (C-333) to 1747 (C-105), leaf fall at 65 days after pruning(DAP) from 11.7 (C-174) to 13.8 (C-47), longest shoot length from 153.8 cm (C-129) to 182.9 (C-252), inter-nodal distance from 4.2 cm (C-57) to 5.06 cm (C-116), leaf to shoot ratio from 0.37 (C-448) to 0.60 cm (C-252), dry leaf weight per plant and dry shoot weight per plant was 70.8-149.2 g and 134.8 -344.47 g. respectively.

Table 60. **Performance of triploid test genotypes for 8 different growth traits**

Geno-type	No. of shoots /plant	Total shoot length (cm)	Longest shoot length (cm)	Inter-nodal distance (cm)	Leaf fall at 65 Days after pruning	Leaf to shoot ratio	Leaf dry weight per plant(g)	Shoot dry weight per plant(g)
C-105		1747	179.2	4.54	11.9	0.59	149.20	290.42
C-252		1568	182.9	4.63	13.1	0.60	115.23	264.18
C-077		1621	159.2	4.96	13.1	0.52	100.41	173.38

C-135		1422	162.0	4.62	12.7	0.52	93.67	214.22
C-333		1169	155.3	4.92	13.1	0.55	106.28	160.60
C-047		1415	168.8	4.73	13.8	0.54	96.32	171.04
C-057		1462	170.9	4.20	13.6	0.58	110.74	136.81
C-109		1494	170.2	4.90	13.0	0.49	93.87	135.89
C-116		1308	170.7	5.06	13.4	0.57	70.85	140.32
C-124		1371	164.4	4.95	13.2	0.53	84.75	139.52
C-129		1450	153.8	4.83	12.7	0.56	85.17	134.80
C-131		1417	171.4	4.27	12.4	0.58	100.42	142.87
C-138		1348	171.8	4.40	12.4	0.41	95.53	164.29
C-174		1398	165.6	4.99	11.7	0.54	104.10	263.40
C-448		1411	179.3	4.83	13.7	0.37	115.31	344.47
S-1635		1083	146.9	4.42	24.9	0.50	86.98	198.47
CV	14.	9.37	5.06	5.72	4.82	12.19	17.55	35.14
LSD@5%		284.02	13.54	0.22	1.54	0.10	13.35	26.42

The mean performance of the test genotypes covering 8 crops spanning over two years indicated that C-105 recorded the maximum values for total shoot length, low leaf senescence, high leaf to shoot ratio, leaf and shoot dry weight per plant. Seven out of 15 test genotypes recorded high and significantly superior leaf yield over the ruling check S-1635. The leaf yield of seven promising genotypes ranged from 369.5 to 444.9 g/plant/crop compared to check S-1635(303g), the gain in leaf yield over check S-1635 was 21.9 to 46.89 %. **Table 61.**

Table 61. Seasonal leaf yield performance of 7 promising triploid mulberry genotypes

5	Sept 15	Nov 15	Feb 16	April 16	July 16	Sept 16	Nov 16	April 17	Pooled mean (g/crop)	% gain over S-1635
C-105	411.45	445.43	375.56	379.00	529.30	458.2	435.3	525.4	444.96	46.9
C-252	376.37	431.85	373.14	387.10	484.40	445.6	423.3	586.9	438.58	44.8
C-116	351.35	380.45	308.96	402.60	544.80	407.2	386.8	323.4	388.20	28.1
C-131	275.02	392.82	373.20	380.60	525.40	386.3	367.0	497.5	399.73	31.9
C-57	344.60	367.25	330.60	351.00	560.00	373.3	354.6	455.1	392.06	29.4
C-174	347.91	399.44	311.83	407.00	523.70	359.8	341.8	523.7	401.90	32.7
C-124	331.84	384.38	324.95	342.90	537.20	346.1	328.8	359.6	369.47	21.9
S-1635	259.92	317.97	295.98	345.1	376.1	250.7	238.2	339.8	302.97	
LSD @5%	74.11	81.13	63.22	35.16	95.76	48.99	46.54	58.64	23.4	

Studies on disease and pest incidence in triploid mulberry genotypes.

Study of disease and pest incidence revealed that bacterial leaf spot (July, September & November 15), *Pseudocercospora* leaf spot (July & November, 16) and *Myrothecium* leaf spot (July, September and November, 15) were found to affect the test genotypes. Thrips & white fly (April, July, September, & February, 2015-16), and tukra (April, July & September, 15) incidences were also noticed (data not shown). Both the disease and pest incidences were below the ETL level.

Studies on the Physio-biochemical assay of promising triploid genotypes

Physio-biochemical study of 15 promising triploid genotypes revealed that all the test genotypes exhibited significant variability for total chlorophyll content, chlorophyll a/b, total soluble protein and sugars except moisture content and moisture retention capacity after 6 hours (**Table 62**). The short-listed 07 test genotypes also recorded significantly higher total chlorophyll content, total soluble protein and sugars over the check S-1635. In the case of moisture content and moisture retention capacity after 6 hours all the test genotypes were at par with the check S-1635.

Table 62. Physio-biochemical parameters of 15 triploid test genotypes

Genotype	Moisture content (%)	Moisture retention capacity (%)	Total Chl (mg/g. fr.wt.)	Chl a/b	Total soluble protein (mg g^{-1} fr. wt)	Total soluble sugar (mg g^{-1} fr. wt)
C-105	79.51	81.03	1.83	1.80	29.53	39.66
C-252	87.92	73.86	2.10	1.80	27.34	53.09
C-077	77.70	87.00	1.23	1.56	45.61	39.50
C-135	78.92	82.20	1.25	1.60	35.18	40.99
C-333	74.9	77.71	1.21	1.50	36.20	43.79
C-047	76.33	90.06	1.39	1.64	31.64	33.06
C-057	81.19	75.25	1.57	1.42	21.77	48.02
C-109	85.75	71.12	2.08	1.30	34.70	44.60
C-116	78.54	75.56	1.64	1.81	33.31	38.65
C-124	84.04	76.89	1.57	1.70	35.34	33.97
C-129	79.30	79.45	1.49	1.42	20.62	43.38
C-131	79.12	72.95	1.83	1.65	15.46	40.33
C-138	80.73	71.73	1.94	1.69	13.34	45.50
C-174	80.11	69.46	1.59	3.95	24.23	45.40
C-448	79.01	94.26	1.23	1.88	30.73	44.66
S-1635	80.57	73.73	1.51	1.65	15.92	37.51
F-test	NS	NS	**	*	**	**
LSD@5%	1.75	1.43	0.21	0.79	2.72	4.45

Leaf palatability assay of triploid test genotypes by moulting test

All the 15 test genotypes recorded significantly high moultout percentage at second instar over the check variety S-1635 indicated the better feeding value. In respect of gain in weight of 2nd mould out larvae it was found the C-105 recorded the highest weight gain of 2.291 g/50 larvae which was significantly higher than rest of the others. Moreover, weight gain of silkworms fed with identified 7 test genotypes was significantly superior over the check variety, S-1635 which was 2.009 g/50 larvae.

Conclusion: From PYT evaluation, 7 genotypes were found to provide significantly higher leaf yield, ranging from 21.9 to 46.8 %, over the ruling variety, S-1635. The selected genotypes were also found to be superior in their biochemical parameters and at par with the physiological traits like moisture content and moisture retention capacity with check cultivar

S-1635.All the 15 new triploid genotypes were significantly better than the check variety, S-1635 in respect of feeding value as revealed from moulting test.

Future plan: Identified seven promising genotypes with leaf yield of > 21 % over the ruling variety S-1635 may be evaluated thoroughly under FYT for commercial exploitation.

10.B.I.2. AGRONOMY & FARM MANAGEMENT SECTION

10.B.I.2.1.PPF 3532: Assessment, Development and Management of area under mulberry in major sericulture districts of West Bengal. (**Feb., 2015 to Jan., 2017**)

M.Choudhuri (**PI**), CSR&TI, Berhampore and B.K. Handique (PI), NESAC

Objectives:

1. To estimate the current spatial extent of mulberry cultivation in seri blocks of 4 major Mulberry growing districts of West Bengal using Remote Sensing, Geographic Information System and Global Positioning Systems.
2. Leaf protein and moisture contents estimation using hyperspectral data and relation with the laboratory based analysis.
3. To develop block specific MIS which can be integrated with SILKS portal for dynamic rendering.
4. To estimate the current spatial extent of mulberry cultivation in selected blocks of 4 major Mulberry growing districts of West Bengal using Remote Sensing, Geographic Information System and Global Positioning Systems.

Methodology:

✓ The four major sericulture practicing districts Malda, Murshidabad. Birbhum and Nadia in West Bengal were selected.
✓ An integrated approach of combining RS, GIS and GPS-based ground survey. Multi temporal, LISS-III/LISS-IV images of IRS P6 (Resourcesat-2) satellite were used in this study.
✓ Collateral data pertaining to the district boundaries, block boundaries, village boundaries etc. were collected.
✓ Field information pertaining to mulberry variety, field crop area, farmers' crop calendar etc. were also acquired.
✓ Mulberry leaf protein and moisture were estimated using the protocol of Lowry *et al*. (1951) and by determining deference of fresh and dry weight per 100mg fresh weight.

Image classification Method: Maximum likelihood classifier (Flow Chart 1) was found to be accurate enough for classifying the study area for extraction of mulberry areas with clear differences from the neighboring features, mostly paddy and vegetables.

Methodology flow chart 1
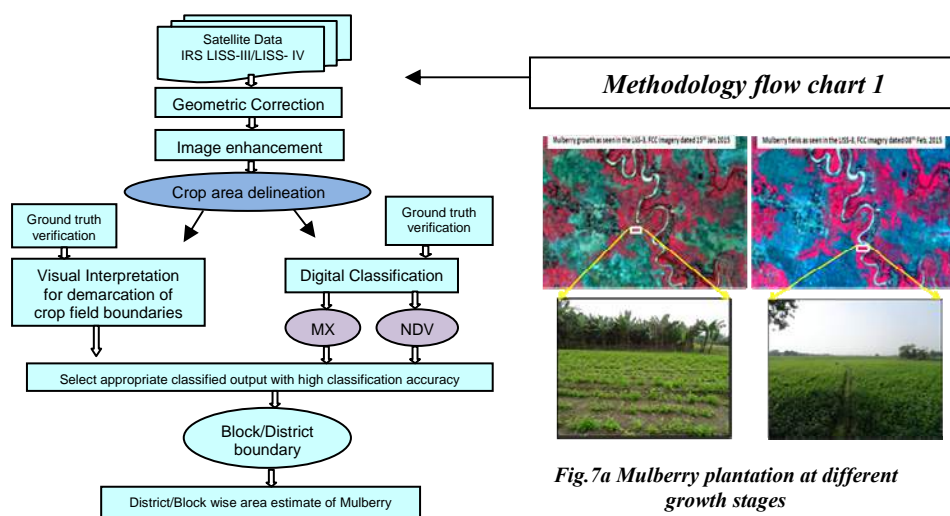
Fig.7a Mulberry plantation at different growth stages

Results:

Estimation of area under Mulberry:

Seri-districts	Malda	Murshidabad	Birbhum	Nadia
FCC images				
Classified images				
Mulberry area (ha)	6584.9	2242.5	1918.8	545.9

Fig. 7b: False Colour Composite and classified maps of Malda, Murshidabad, Birbhum and Nadia

✓ Mulberry leaf protein and moisture were estimated using the protocol of Lowry *et.al*. (1951) and by determining deference of fresh and dry weight per 100mg fresh weight.

✓ The field measurements were carried out using the HR-1024 portable spectroradiometer measuring over the visible to short-wave infrared wavelength range (350-2500nm). The observation window was through 'Freshly' calibrated reference panels strictly kept between 11:00 and 13:00h.

✓ Moisture and protein levels of mulberry foliage were discriminated by NDVI and OSAVI 1510 (Fig 7d). But OSAVI 1510 shows good correlation between mulberry leaf protein content.
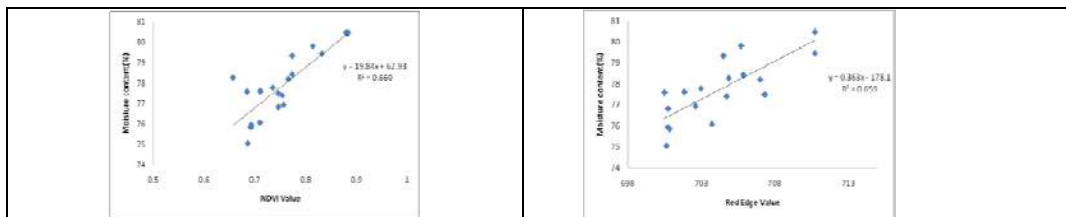
Fig 7j: NDVI vs Moisture content

Fig 7i : REP vs Moisture content
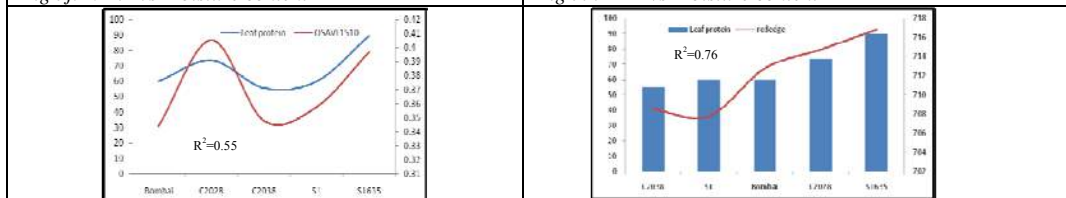
Fig 7c: Leaf protein, and OSAVI 1510 index value of leaf of all the mulberry varieties

Fig 7d: Leaf protein, and REP value of leaf of all the mulberry varieties

Mulberry Information System (MIS) is developed as shown in flowchart 2 and 3:
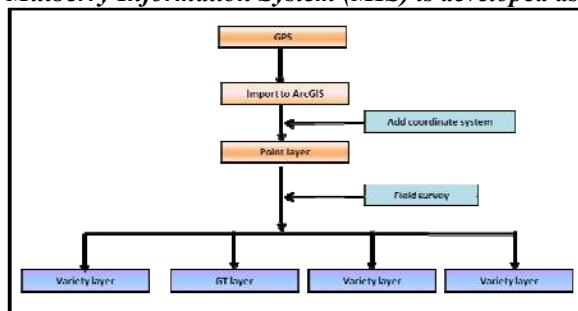
Flowchart 2: *Methodology for preparation of spatial layer*
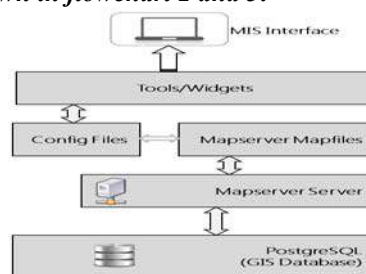
Flowchart 3 : *Methodology of MIS development*

MIS is developed for four villages namely Chandrghat, Barbakpur, Tailpara and Khanpara representing Murshidabad, Nadia, Birbhum and Malda districts of West Bengal respectively.

MIS layers contained the following:

Variety: In Chandraghat village S-1, S-1635 and local varieties are grown. Out of surveyed 628 farmer's field, maximum 410 fields are used for growing local variety and S1 variety is grown in 206 fields whereas S-1635 variety is grown in 7 fields. Both local and S1 varieties are grown in 5 fields.

- In Barbakpur, 252 fields were surveyed and it is found that in 246 fields, farmers grow S-1 variety where as only 6 fields are used for growing variety S-1635.
- In Tailpara 438 fields were surveyed where local variety is preferred more compared to variety S-1 and S-1635. Local variety is grown in 418 fields whereas only one farmer grows S-1635 and S-1 variety is grown in 19 fields.
- In Khanpara, 183 fields were survey and it is observed that farmers grow S-1, S-1635 and local varieties.In this village maximum farmers grow S-1 variety in 126 field. S-1635 variety

is grown in 54 fields where as only local variety is grown only in 2 fields and both S1 and S1635 variety is grown by only one farmer.

*Government schemes***:** In the study area more than 50% farmers is receiving aid from government through different schemes sponsored by Central Silk Board and Department of Sericulture, West Bengal (Fig.7e and 7f).

- In Chandrghat 4 other schemes namely 2' x 2' plantation, CDP (Rearing house), L.S.P (Grainage house) and L.S.P are operational (Fig 7g). In Barbakpur village 4 schemes namely CDP, CDP (Rearing house), Rearing house and Rearing house repairing are operational.
- Again in Khanpara 3 different schemes are operational. They are CDP, CDP (Rearing house) and CDP (Chawki Rearing house).
- In Tailpara CDP (Rearing house), Rearing house and Rearing house repairing scheme is operational.

| *Fig 7e: Location of fields with different variety* | *Fig 7f: Location of field with government aid* | *Fig 7g: Sponsors of Govt. schemes* | *Fig 7h: Other Schemes* |
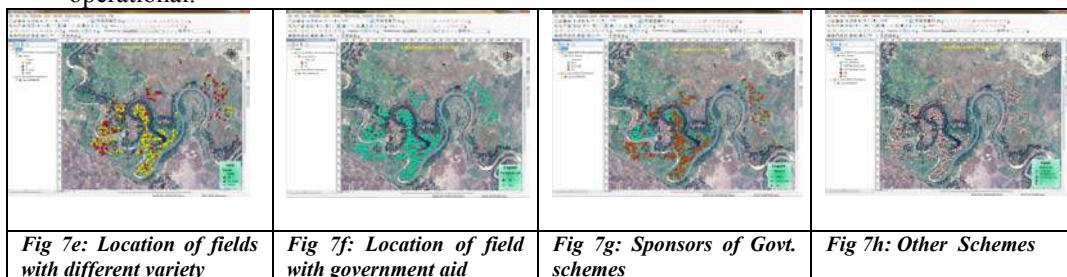
Sample MIS layers developed

Inference: The results of this state of the art first ever study in mulberry would serve as a crucially integral component of decision support system in mulberry farming with dynamism.

Future plan: Uploading the results in the SILKS PORTAL and regular updating.

10.B.I.3. MULBERRY PATHOLOGY SECTION

10.B.I.3.1.PPS 3504: Study on root rot disease of mulberry in the Gangetic plains of West Bengal and development of its control measures. **(April, 2014 to March, 2017)**

S. K. Dutta **(PI),** V. Vijay (from 01.12.15), A.K.Dutta (up to 30.11.15), P. K. Ghosh (from 01.12.15) and T. Dutta Biswas.

Objectives:

1. Survey and collection of root rot disease from the Gangetic plains of West Bengal.
2. Isolation and identification of the organism causing root rot disease of mulberry.
3. Recording of severity of root rot disease of mulberry in different locations of the Gangetic plains of West Bengal.
4. Isolation of fungicide as control measure (*In vitro*) for plant root protection method including bio control agents and chemical management.

Incidence of root rot disease caused by Fusarium solani was observed in Banjetia, Derul and Dangapara area of Murshidabad district. Rot is associated in > 10 years old plantation. In Malda Bangalgram area and REC Mothabari incidence of rot association was observed. Kalyanpur area of Birbhum and Gomakhali area of Nadia district association of rot was observed. In all the places rot was observed in >10 years old plantation. > 35% rot incidence was recorded in Malda area followed by Murshidabad area where incidence is 20%. Both in Birbhum and Nadia area above 14% incidence was recorded. Isolated fungus culture in PDA media was identified from IARI, New Delhi and NFCCI, Pune.

Growth of *Fusarium solani* covers 9cm. in 12 days in petriplates in vitro condition as control (*Fig.*8), but in 0.1%, 0.15%, and 0.20% SAAF (Carbendazim 12% + Mancozeb,63%) application shows 84%,88% and 94.4% growth inhibition respectively but 0.1%, 0.15%, and 0.20% BAVISTIN (Carbendazim 50%) application shows 87%,88% and 92% growth inhibition respectively. Moreover 0.1%, 0.15%, and 0.20% INDOFIL M-45 (Mancozeb 75%) application shows 85%, 88% and 88% growth inhibition respectively in vitro condition. Application of bio fungicide *Trichoderma viride* can control 66.22% growth *Fusarium solani* in comparison with control

As per survey report *Fusarium solani* as root rot fungus is predomination in the Gangetic plains of West Bengal. Specimen was also identified from IARI, New Delhi and NFCCI, Pune Application of SAAF (Carbendazim 12% + Mancozeb, 63%) at 0.20% concentration for control of *Fusarium solani* in the Gangetic plains of West Bengal is recommended.

Fig.8. Pure culture of *Fusarium solani*

10. B.I.3.2.CSS-2107: Forewarning of mulberry diseases of Eastern and North Eastern India**. (April, 2012 to March, 2017).**

S. K. Dutta(**PI**), V. Vijay, M. D. Maji (upto 30.05.2015), A.K.Dutta (up to 30.11.15) P. K. Ghosh (fr. 01.12.15), D. Pandit, S. T. Lepcha, S. K. Misro, M. Alam, M. Pamegam, A. Borah, G. B. Singh, B. N. Choudhuri , B.K.Basumatary and L. S. Singh.

Objectives:

1. Collection of disease incidence (in weekly interval) and meteorological data (day wise) from Eastern and North Eastern India.
2. Publicity and recommendation of package of forewarning system in different locations.
3. Development of long term and broad spectrum data base for disease and meteorology of Eastern and North Eastern India at the end of XII plan period.
4. Due to climatic change existing disease forecasting models to be fine-tuned at the end of XII plan and more models to be developed when severity of disease is > ETL.
5. Due to climatic change existing disease calendar (as developed in the XI plan period) to be fine-tuned at the end of XII plan.

CO-ORDINATING UNITS: (**1**) CSR&TI, Berhampore (Murshidabad), (**2**) REC, Bagmara (Malda), (3) RSRS, Kalimpong (West Bengal), (**4**) REC-Rangpo (Sikkim), (**5**) RSRS, Ranchi (Jharkhand), (**6**) REC, Maheshpur Raj (Jharkhand), (**7**) RSRS, Koraput (Odisha), (**8**) RSRS, Jorhat (Assam), (**9**) REC, Dimapur (Nagaland), (**10**) REC, Aizwal (Mizoram), (**11**) REC, Agartala (Tripura), (**12**) REC, Imphal (Manipur).(**13**) Shillong, (Meghalaya).

Correlation coefficient of different disease severity and meteorological variables.
(**1**) **Murshidabad (West Bengal**)

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
BLS	0.3	0.536*	0.239**	0.201**	0.400*
MLS	0.307*	0.340*	0.250*	0.017	-0.075
PLS	-0.026	-0.012	0.297*	0.138	0.039
PMLD	-0.414*	-0.578**	0.005	-0.099	- 0.294*
LR	-0.63	-0.743*	-0.030	-0.247*	-0.195**

* 1% evel of significance &** 5% level of significance; BLS= Bacterial leaf spot, PLS= Pseudocercospara leaf spot, MLS= Myrothecium Leaf Spot, LR = Leaf rust and PMLD = Powdery Mildew

Disease severity > ETL for BLS, PLS, MLS, LR and PMLD was observed.

REGRESSION EQUATION (For BLS)

Developed disease forecasting model for BLS (*Bacterial leaf spot disease*) disease for Murshidabad district with accuracy and dependability Validity of the model was tested. Predicted disease severity has been found closely associated with observed disease severity, when coefficient of determination $R^2 = 0.24$.

Y= -2.70 -0.03X1 + 0.08X2 + 0.20X3 - 0.13X4 + 0.02X5

Where, X1 = Mx Tm; X2 = Mn Tm; X3 = Mx RH; X4 = Mn RH and X5 = Rainfall
(When value of Y is >5, model is exploited)

REGRESSION EQUATION (For PLS)
$R^2 = 0.22$ & Y = 8.69 - 0.12X1 + 0.11X2 + 0.24X3 - 0.23X4 + 0.02X5

REGRESSION EQUATION (For PMLD)

$R^2 = 0.33 \& Y = 10.88 - 0.05X1 + 0.03X2 - 0.02X3 - 0.27X4 - 0.08X5$

REGRESSION EQUATION (For LR)

$R^2 = 0.18 \& Y = 1.895 + 0.06X1 - 0.04X2 - 0.16X3 + 0.10X4 - 0.01X5$

REGRESSION EQUATION (For MLS)

$R^2 = 0.78$ **& Y = 6.64 + 0.05X1 + 0.06X2 - 0.01X3 + 0.14X4 - 0.03X5**

(2) Malda (West Bengal)

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
BLS	0.146	0.038	0.024	0.102	-0.031
MLS	0.313*	0.293*	0.172	0.190**	-0.092
PLS	0.032	-0.037	-0.005	0.001	0.028
PMLD	0.036	0.098	0.041	-0.022	-0.056

* 1% level of significance &** 5% level of significance

Disease severity > ETL for MLS was observed.

REGRESSION EQUATION (For MLS)

Developed disease forecasting model for MLS (Myrothecium Leaf Spot) disease for Malda district with accuracy and validity of the model was tested. Predicted disease severity has been found closely associated with observed disease severity, when $R^2 = 0.24 \& Y = -5.152 + 0.02X1 + 0.02X2 + 0.08X3 + 0.01X4 - 0.07X5$

(3) Kalimpong (West Bengal)

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PMLD	-0.197**	-0.130	0.148	0.132	0.034
BLR	-0.112	-0.190**	0.089	0.044	-0.052
YLR	-0.264*	-0.269*	0.051	-0.077	-0.025

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PMLD and BLR was observed.

REGRESSION EQUATION (For BLR)

Developed disease forecasting model for LR (Brown Leaf rust) for Kalimpong of West Bengal with accuracy and validity of the model was tested. Predicted disease severity has been found closely associated with observed disease severity, when $R^2 = 0.136 \& Y = 2.486 – 0.091X1 + 0.062X2 + 0.038X3 – 0.077X4 – 0.023X5$

Similarly, regression analysis for PMLD (Powdery mildew)

$R^2 = 0.149 \& Y = 0.099 + 0.012X1 + 0.052X2 – 0.083X3 + 0.044 X4 + 0.025X5$

(4) Ranchi (Jharkhand)

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PMLD	0.312*	0.350*	-0.176	-0.228**	-0.077
LR	0.037	0.023	-0.121	-0.158	-0.059

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PMLD & LR was NIL.

(5) Aizawl (MIZORAM)

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PMLD	0.146	0.199**	0.153	0.160	0.078
LR	0.364*	0.267*	0.221**	0.218**	0.078

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PMLD was observed.

REGRESSION EQUATION (For PMLD)

$R^2 = 0.23$ & $Y = -2.79 + 0.10X1 + 0.09X2 – 0.09X3 + 0.02X4 + 0.01X5$

(6) Agartala (Tripura)

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PMLD	-0.066	0.049	-0.020	-0.219**	-0.042

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PMLD was observed.

REGRESSION EQUATION (For PMLD)

$R^2 = 0.27$ & $Y = 1.87 – 0.01X1 + 0.06X2 + 0.11X3 – 0.33X4 – 0.04X5$

(7) Dimapur (Nagaland):

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
LR	0.044	0.041	0.039	0.236**	-0.115

* 1% level of significance &** 5% level of significance

Disease severity >ETL for LR was observed.

REGRESSION EQUATION (For LR)

$R^2 = 0.20$ & $Y = 0.950 + 0.035 X1 – 0.063 X2 + 0.027 X3 +0.104 X4 - 0.094 X5$

(8) IMPHAL (Manipur):

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PMLD	-0.020	0.130	0.140	0.190**	-0.040
LR	-0.199**	-0.030	0.090	0.100	-0.050

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PMLD and LR was observed.

REGRESSION EQUATION (For PMLD)

$R^2 = 0.21$ & $Y = -0.968 + 0.011X1 + 0.013X2 - 0.026X3 + 0.035X4 – 0.027X5$

REGRESSION EQUATION (For LR)

$R^2 = 0.18$ & $Y = - 0.222 + 0.012X1 + 0.013X2 – 0.029X3 – 0.021X4 – 0.012X5$

(9) Jorhat (Assam):

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PMLD	-0.196**	-0.077	-0.050	0.090	-0.080
LR	0.104	-0.066	-0.031	-0.061	-0.077

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PMLD & LR was NIL.

(10) Koraput (Odisha):

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PMLD	-0.797*	-0.356*	0.095	-0.172	-0.080
LR	-0.047	0.064	-0.013	-0.016	0.035

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PMLD and LR was observed.

REGRESSION EQUATION (For PMLD)

$R^2 = 0.36$ & $Y = 0.095 – 0.172X1 – 0.079X2 -0.035X3 -0.035X4 – 0.097X5$

REGRESSION EQUATION (For LR)

$R^2 = 0.15$ & $Y = 3.480 – 0.018X1 - 0.011X2 – 0.038X3 + 0.058X4 + 0.014X5$

(11) M.P.Raj (Jharkhand):

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PLS	-0.076	-0.077	0.226**	-0.216**	-0.052
BLS	-0.047	0.194**	-0.013	-0.016	0.035

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PLS was NIL.

(12) Rangpoo (Sikkim):

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
LR	-0.265*	-0.221**	-0.065	0.022	0.017

* 1% level of significance &** 5% level of significance

Disease severity >ETL for LR was observed.

REGRESSION EQUATION (For LR)

Developed disease forecasting model for LR (Leaf rust)

$R^2 = 0.18$ & $Y = 2.459 – 0.021 X1 + 0.040 X2 + 0.012 X3 - 0.163 X4 - 0.008 X5$

(13) Shillong (Meghalaya):

DISEASE	MAX T.	MIN T.	MAX RH	MIN RH	RF
PMLD	0.061	0.057	0.233*	0.299**	-0.036
LR	0.251**	0.227**	0.077	0.113	-0.032

* 1% level of significance &** 5% level of significance

Disease severity >ETL for PMLD & LR was NIL.

10. B.I.4. SILKWORM BREEDING & GENETICS SECTION

10. B.I.3.1.AIB 3501: Development of multivoltine breeds of silkworm (*Bombyx mori* L.) with high shell percentage and high neatnes of silk filament. **(July, 2013 to June, 2016).**

A.K.Verma (**PI**), S.Mukherjee (upto 31.05.2013) N. Suresh Kumar (upto 31.05.2016) N.B.Kar, A.K.Saha (upto Dec., 2015) G.K.Chattopadhyay (upto 31.10.2014).

Objective: To develop multivoltine breeds with higher shell content (16-18%), high neatness (80-85points) and other reeling parameters to Suit the adverse climatic conditions of West Bengal.

BREEDING PLAN

CSRTI Breed   x   Collected breeds (With desired traits)
  (As a Recipient)   (As a Donor)

F1 X Recipient Breed

BC1 X Recipient Breed

BC2 X Recipient Breed

BC3 X Recipient Breed

BC4 X Recipient Breed

BC5 X Recipient Breed

Inbreeding under selection pressure for targeted character

F1

F2

F3

F4

F5-F10

Developed New Breed

Collection of breeding resource material

The following **31** promising multivoltine breeds **(Table 63)** with high shell% and high Neatness have been collected from different breeding/ germplasm Centres in India including 4 from CSRTI, Berhampore which have been used as recipient.

Evaluation of Breeding Resource materials

The breeds received from different centers are reared to evaluate the qualitative and quantitative characters with special reference to target characters to select one or two resource materials.

Table 63. List of the breeds selected from different centres

#	Bree s	#	Breeds	#	Breeds
CSGRC-Hosur: **High Shell % breeds**		**CSGRC-Hosur:** **High Neatness % breeds**		**CSRTI, Mysore**	
1	PM	1	Tamilnadu White	1	ND7
2	BL-43	2	Kolar Gold	2	NDV6
3	M2	3	Raj	3	BL67
4	MH	4	P2D1	4	L14
5	M6M81	5	MU1	**APSSRDI, Hindupur**	
6	M15	6	OS-616	1	APM1
7	APM-	7	Moria	2	APM3
8	M6DP(C	8	G	3	APDR15
9	MW-1	9	Mysore Princes	**CSRTI, Berhampore**	
10	Nistid(WB	10	MY 23	1	M6DPE
				2	M.Con.1
				3	M.Con.4
				4	M6M81

Table 64. Performance of Multivoltine Accession from CSGRC, Hosur (Oct.-Nov. 2013)

Breed	Fec.	Yield/ 10,000 larvae (kg.)	Yield/ 10,000 larvae (no.)	P.R.%	SCW (g)	SSW (g)	Shell %
BMI-023 (M2)	336	9.55	8221	79.19	1.240	0.154	12.45
BMI-069 (M15)	419	9.71	8963	86.58	1.158	0.145	12.50
BMI-70(M6DPC)		9.93	8989	85.66	1.152	0.146	12.71
BMI-72 (M6M81)	420	10.68	8817	82.27	1.271	0.154	12.10
BMI-74 (MH1)	496	12.82	8111	79.33	1.566	0.253	16.14
BMI-01 (PM)	400	9.78	8517	80.67	1.041	0.133	12.78
BMI-11 (P2D1)	404	9.07	9108	85.36	1.026	0.111	10.78
BMI-38 (MU1)	404	9.82	9411	90.00	1.103	0.106	9.63
BMI-16 (G)	451	8.37	7300	68.66	1.186	0.147	12.39
BMI-25	477	9.20	7989	76.66	1.17	0.142	12.10
BMI-27	468	9.81	9056	85.33	1.164	0.133	11.44
Leimarel (Manipur)	274	12.44	7865	74.13	1.572	0.176	11.19

Table 65. Performance of Multivoltine breeds from CSRTI, Berhampore (Oct.-Nov. 2013)

Breed	Fec	Yield/ 10,000 larvae (wt-kg.)	Yield/ 10,000 larvae (no.)	P.R.%	SCW (g)	SSW (g)	Shell %
M.Con.1	517	10.71	8678	82.00	1.245	0.185	14.83
M.Con.4	529	10.60	8700	85.67	1.489	0.239	16.07
M6DPE	461	14.38	8789	84.67	1.596	0.233	14.62

From the rearing result of both the breeds, i.e., outside resource and institute recipient breeds mentioned above, it is clear that only MH_1 is showing highest shell%, so only this breed is selected as donor.

Results:

1. Initiation of cross

The selected breeds had been crossed with the recipients from CSR&TI, Berhampore and were evaluated in all the seasons. Selection for neatness character was carried out from the early generation itself. Cross breeding techniques by utilizing multivoltine parent with high shell percentage (>17%) and high neatness (>80 P) were employed to incorporate the targeted trait shell percentage and neatness to the resultant breed followed by recurrent back crossing (BC1 to BC5) to enhance the scope for selection of the desirable trait. From F2 generation, directional selection for both the traits high shell percentage and high neatness was initiated. The cocoons were randomly picked from each sub-line and after assessing the shell percentage, the silk was subjected for assessment of neatness trait, the sub-line with both the high shell percentage and high neatness were selected for raising the next generation. Care also was taken for selection of uniform cocoon colour, egg colour along with other qualitative parameters. The same method was repeated from F_4 to F_9 generation till the fixation of the trait.

Table 66. Performance of Cross between Hosur and Berhampore breeds (Oct.-Nov., 2013)

Breed	Fec	Yield/ 10,000 larvae (wt-kg.)	Yield/ 10,000 larvae (no.)	P.R.%	SCW (g)	SSW (g)	Shell %
1. M.Con.1 x MH1	401	15.67	9667	95	1.651	0.282	17.05
2. M.Con.4 x MH1	563	12.5	8700	97	1.442	0.228	15.81
3. M.Con.1 x Lm	512	13.4	8895	99	1.542	0.225	14.60
4. M6DPE x MH1	421	12.52	8746	92	1.502	0.225	14.98
5. MH1 x MCon.1	554	12.43	9140	99	1.451	0.255	17.57
6. M.Con.4 x Lm	558	11.5	8991	95	1.294	0.174	13.45
7. N(M) x MH1	479	12.26	9481	99	1.252	0.181	14.46

2. Initial evaluation and selection

All the F_1s were reared and viable ones with better qualitative and quantitative characters including reeling parameters were selected.

3. Short listing of lines

Instead of continuing with all the lines promising lines were short listed.

4. Backcrossing and sib-mating

Five times backcrossing and seven times sib-mating was done. The performance of F6 and final generation along with reeling parameters only are depicted here.

Table 67. Performance of F_6 and their parents.

Breed/ Backcross	Fec.	Yield/ 10,000 larvae(no.)	Yield/ 10,000 larvae- wt. kg	SCW (g)	SSW (g)	Shell %	Neat- ness
MH1 (Donor)	457	9467	14.10	1.506	0.235	15.60	85
M.Con.1x MH1 -White	516	9467	12.23	1.294	0.224	17.31	88
M.Con.4 x MH1 - Yellow	555	94	14.23	1.502	0.260	17.31	88
M6DPE x MH1 -Yellow	511	9500	13.07	1.375	0.221	16.07	90
MH1 x BHB -White	530	8633	11.70	1.337	0.228	17.05	90
Gen3 x M.Con.4 - Yellow	538	93	12.93	1.347	0.236	17.52	89
SK6x7xM.Con.4 – Yellow	531	90	11.20	1.23	0.216	17.56	89

Table 68. Performance of developed lines and the donor parent.

Breed/ Backcross	Fec.	Yield/ 10,000 larvae (no.)	Yield/ 10,000 larvae- wt.kg	SCW (g)	SSW (g)	Shell %	Neat- ness
MH1 (Donor)	475	9133	12.69	1.506	0.235	15.60	83
M.Con.1x MH1 -White	511	8700	11.57	1.308	0.226	17.28	86
M.Con.4 x MH1 - Yellow	533	93	14.43	1.538	0.268	17.42	88
M6DPE x MH1 - Yellow	508	73	8.47	1.205	0.190	15.76	86
MH1 x BHB -White	513	7353	8.71	1.19	0.213	17.89	86
Gen3 x M.Con.4 - Yellow	522	80	10.27	1.24	0.211	17.02	86
SK6x7xM.Con.4 – Yellow	519	81	8.23	1.048	0.194	18.51	88
F - value	220.28[**]	1.85[**]	1.80[**]	28.65[**]	27.54[**]	171.71[**]	6.17[NS]

[*] $P < 0.001$; [**] $P < 0.0001$; [NS] *– Non Significant*

Table 69. Reeling performance of developed lines and the donor parent.

Breed/ Backcross	Fl. length (m)	Fl. size (d)	Reel- ability(%)	Raw silk %	Neatness	ness %	Degum- ing loss %
MH1 (Donor)	524	2.54	68.56	7.94	83	93	24.30
M.Con.1x MH1 -White	588	2	79.33	11.14	86	93	22.33
M.Con.4 x MH1 -Yellow	640	2	74.48	10.11	88	93	21.22
M6DPE x MH1 -Yellow	615	2	67.98	9.73	86	95	23.88

MH1 x BHB - White	608	2	80.14	11.14	86	94	20.33
Gen3 x M.Con.4 - Yellow	623	2	78.21	10.67	86	93	21.66
SK6x7xM.Con. 4 –Yellow	593	2	75.83	10.00	88	88	22.33
F - value	66.13[**]	19.11[*]	87.56[**]	22.38[**]	6.17[*]	29.26[**]	19.68[**]

[*] $P < 0.001$; [**] $P < 0.0001$; [NS] *– Non Significant*

After five backcrossing and seven sib-mating, six breeds are developed which are statistically better than donor and also fulfil the target of improvement particularly in respect of shell % and neatness. These breeds can be utilized to develop new improved multi x multi and multi x bi hybrids which is done as follows.

5. Hybrid evaluation: After fixation, hybrids have been prepared involving the institute lines both multivoltine during unfavourable and bivoltine during favourable seasons'. **P**romising hybrids are identified by using Evaluation Index method (Mano *et al.*, 1993).

Multi x Multi: The developed multivoltine lines are crossed with some viable multivoltine breeds to find out productive multi x multi hybrids

Table 70. Performance of Multi x Multi hybrid along with Evaluation Index (EI)

Multi x Multi	Fec.(No.)	S.C.W. (g)	S.S.W(g)	Shell %	ERR-no.	ERR-wt.	EI
19(M) x M6M81	499	1.624	0.289	17.80	9367	14.77	4
12(Y)xM6M81	410	1.464	0.227	15.51	7967	11.67	
8(W) xM6M81	377	1.657	0.285	17.20	9367	15.53	
21(Y) xM6M81	408	1.533	0.253	16.50	9433	14.43	
8(W) xM6DPE	386	1.633	0.284	17.39	9400	15.23	10
12(Y)xM6DPE	413	1.321	0.229	17.34	8400	10.97	
21(Y) xM6DPE	415	1.592	0.280	17.59	7554	12.23	
22(Y) xM6DPE	433	1.500	0.276	18.40	7960	12.08	
8(W) xOS616	359	1.754	0.309	17.62	8833	15.27	8
19(M) x OS616	497	1.727	0.293	16.97	9233	15.67	3
12(Y) xOS616	409	1.499	0.273	18.21	8135	12.06	
22(Y) xOS616	412	1.560	0.269	17.24	8767	13.37	
8(W) xM9A	410	1.851	0.340	18.37	9000	16.47	2
19(M) xM9A	534	1.640	0.293	17.87	7967	13.30	6
12(Y) xM9A	437	1.579	0.271	17.16	7480	11.42	
21(Y) xM9A	454	1.675	0.315	18.81	6863	11.47	
22(Y) xM9A	432	1.637	0.291	17.78	7880	12.76	
8(W) x G	384	1.687	0.292	17.31	7415	12.58	
19(M) x G	497	1.757	0.310	17.64	7500	13.54	7
21(Y) x G	391	1.708	0.290	16.98	7959	13.62	
22(Y) x G	412	1.483	0.257	17.33	7585	11.25	
15(Y) x M.con-4	455	1.335	0.220	16.48	8833	11.73	
16(W) x M.con-4	418	1.888	0.342	18.11	7641	14.26	5

Multi x Multi	Fec.(No.)	S.C.W. (g)	S.S.W(g)	Shell %	ERR-no.	ERR-wt.	EI
19(M) x M.con-4	536	1.914	0.356	18.60	7836	14.81	1
8(W) x CB5	430	1.686	0.289	17.14	7591	12.70	
21(Y) x CB5	384	1.878	0.317	16.88	6742	12.95	
19(M) x Sarupat	408	1.445	0.222	15.36	6767	9.57	
21(Y) x Sarupat	430	1.566	0.280	17.88	7400	11.40	
12(Y) x S2	501	1.748	0.304	17.39	6655	11.35	
19(M) x M15	508	1.615	0.271	16.78	9500	14.27	9
19(M) x N©	534	1.436	0.254	17.69	9300	13.50	
19(M) xN(M)	516	1.382	0.213	15.41	9367	12.87	
12(Y) x M15	528	1.567	0.257	16.40	8100	12.10	
21(Y) x M2	397	1.571	0.296	18.84	7279	12.65	
22(Y) x M2	412	1.551	0.254	16.38	7371	11.42	
13(W) x O	438	1.704	0.277	16.26	6955	11.73	
AVG.	**441**	**1.**	**0.280**	**17.295**	**8094**	**12.97**	
SD	**51.39**	**0.15**	**0.03**	**0.88**	**895.60**	**1.59**	

Multi x Bi:

The developed multivoltine lines are crossed with 10 nos. of hardy bivoltine breeds/foundation crosses to find out productive/ improved multi x bi hybrid.

Table 71. Performance of Multi x bi hybrid along with Evaluation Index

Particulars	Fec. (No.)	Hatc. (%)	SCW (g)	SSW (g)	Shell %	ERR (No.)	ERR (wt.)	E.I. Rank
M1xNB18	524	93.89	1.787	0.347	19.37	9178	16.18	5
M1xMC4(O)	491	96.92	1.698	0.334	19.67	8933	15.97	2
M1xBHR2	530	96.05	1.712	0.278	16.23	8956	14.94	
M1xSK3C	526	94.56	1.751	0.337	19.23	9378	16.04	4
M1xB.Con.4	501	96.61	1.781	0.346	19.43	8356	15.41	3
M1xB.Con.1	524	94.53	1.661	0.329	19.81	8988	14.94	
M1xSK6	510	95.71	1.769	0.349	19.73	8189	14.41	10
M1xSK7	499	96.03	1.547	0.289	18.66	9144	14.51	
M1xD6PN	490	95.35	1.535	0.271	17.65	9244	14.49	
M1xMJ2	505	96.50	1.617	0.301	18.63	8189	13.03	
M2xNB18	511	94.78	1.768	0.340	19.23	8667	13.77	
M2xMC4(O)	501	96.29	1.498	0.290	19.38	9244	14.05	
M2xBHR2	510	96.95	1.815	0.342	18.84	6911	12.14	
M2xSK3C	507	95.13	1.783	0.328	18.42	9133	16.62	
M2xB.Con.4	506	97.24	1.720	0.336	19.55	9244	15.78	1
M2xB.Con.1	465	95.47	1.741	0.346	19.87	5467	9.72	
M2xSK6	499	96.53	1.762	0.344	19.50	8022	14.35	
M2xSK7	490	95.65	1.594	0.292	18.32	9078	14.42	
M2xD6PN	487	97.10	1.705	0.321	18.85	7622	13.11	
M2xMJ2	516	95.09	1.618	0.303	18.73	8189	13.03	
M3xNB18	480	95.54	1.583	0.299	18.82	9089	13.89	
M3xMC4(O)	504	94.25	1.729	0.329	19.21	7822	13.44	
M3xBHR2	483	95.79	1.529	0.273	17.85	9300	14.57	
M3xSK3C	498	96.00	1.738	0.325	18.75	8800	15.64	
M3xB.Con.4	487	96.65	1.700	0.330	19.43	8956	15.19	

Particulars	Fec. (No.)	Hatc. (%)	SCW (g)	SSW (g)	Shell%	E (No.)	ERR (wt.)	E. I. Rank
M3xB.Con.1	495	95.43	1.605	0.327	20.38	9355	15.79	8
M3xSK6	472	95.77	1.792	0.350	19.51	9233	14.98	7
M3xSK7	513	94.41	1.744	0.331	18.98	9267	16.12	
M3xD6PN	496	96.64	1.736	0.334	19.26	9200	14.09	9
M3xMJ2	501	96.54	1.547	0.320	20.67	9367	14.80	6
M4xNB18	475	95.73	1.485	0.264	17.76	8822	13.11	
M4xMC4(O)	488	95.15	1.454	0.263	18.08	8989	9.79	
M4xBHR2	465	96.15	1.648	0.276	17.66	6222	10.43	
M4xSK3C	488	94.21	1.574	0.301	19.09	9011	14.43	
M4xB.Con.4	508	93.86	1.644	0.313	19.06	8878	14.98	
M4xB.Con.1	520	94.17	1.552	0.298	19.17	8978	16.09	
M4xSK6	502	95.15	1.488	0.278	18.68	9411	13.93	
M4xSK7	511	93.80	1.431	0.252	17.57	9389	13.13	
M4xD6PN	464	94.82	1.692	0.308	18.18	7644	12.01	
M4xMJ2	506	95.92	1.365	0.246	18.00	9367	12.93	
M5xNB18	519	95.37	1.511	0.282	18.68	9378	13.86	
M5xMC4(O)	475	94.10	1.567	0.323	20.61	8489	12.47	
M5xBHR2	385	93.34	1.629	0.288	17.68	8922	14.33	
M5xSK3C	399	93.16	1.521	0.301	19.77	8934	13.25	
M5xB.Con.4	494	95.81	1.646	0.321	19.52	9133	14.15	
M5xB.Con.1	490	93.88	1.412	0.272	19.28	9367	14.01	
M5xSK6	478	94.00	1.689	0.327	19.38	9389	15.41	
M5xSK7	479	96.27	1.580	0.303	19.18	9122	14.97	
M5xD6PN	467	94.07	1.689	0.337	19.97	9200	15.30	
M5xMJ2	472	95.48	1.353	0.256	18.94	9022	12.17	
Nx(SK6xSK7)-C	382	96.22	1.366	0.209	15.30	9324	12.29	
Average	**490**	**95.37**	**1.625**	**0.307**	**18.89**	**8775**	**14.09**	
SD	**30.70**	**1.060**	**0.124**	**0.032**	**0.984**	**811.27**	**1.56**	

6. Selection of hybrids : After evaluation, promising hybrids of both multi x multi and bi x bi have been selected.

Table 72. Performance of first ten Multi x Multi hybrid as per the Evaluation Index

Multi x Multi	Fec. (No.)	SCW (g)	SSW (g)	Shell%	ERR-no.	ERR-wt.	Neat-ness	E I. Rank
19(M) xM.con-4	536	1.914	0.356	18.60	7836	14.81	84	1
8(W) xM9A	410	1.851	0.340	18.37	9000	16.47	83	2
19(M) x OS616	497	1.727	0.293	16.97	9233	15.67	82	3
19(M)x M6M81	499	1.624	0.289	17.80	9367	14.77	80	4
16(W) xM.con-4	418	1.888	0.342	18.11	7641	14.26	80	5
19(M) xM9A	534	1.640	0.293	17.87	7967	13.30	83	6
19(M) xG	497	1.757	0.310	17.64	7500	13.54	80	7
8(W) x OS616	516	1.715	0.275	16.10	8900	14.87	83	8
19(M) xM15	508	1.615	0.271	16.78	9500	14.27	80	9
8(W) xM6DPE	386	1.633	0.284	17.39	9400	15.23	85	10

19(M) - MH1 x BHB[ld], 8(W) - M.Con.1 x MH1; 16(W)- N(M) x MH1

Table 73. Reeling Performance of Multi x Multi Hybrid

Multi x Multi	FL (m)	Filament size (d)	Reelability (%)	Raw silk%	Neatness	Renditta	Recovery %
19(M) x M. Con-4	573	2.46	74.66	9.56	84	10.46	78.94
8(W) x M9A	515	2.72	78.73	9.67	83	10.34	80.55
19(M) x OS616	541	2.73	75.51	10.00	82	10.00	81.08
19(M) x M6M81	560	2.70	77.67	10.19	80	9.81	80.00
16(W) x M.Con-4	646	2.52	78.41	11.00	80	9.09	82.50
19(M) xM9A	586	2.52	74.62	10.19	83	9.81	80.00
19(M) x G	594	2.82	76.36	9.67	80	10.34	80.55
8(W) x OS616	584	2.68	77.53	10.00	83	10.00	81.08
19(M) xM15	597	2.37	77.08	9.87	80	10.13	81.57
8(W) x M6DPE	539	2.74	79.41	11.00	85	9.09	82.50

19(M)- MH1 x BHB[ld]; 8(W)- M.Con.1 x MH1; 16(W)- N(M) x MH1

Table 74. Performance of first ten Multi x bi hybrid as per the Evaluation Index

Multi x Bi	Fec.	S.C.W. (g)	S.S.W (g)	Shell%	ERR-no.	ERR-wt	Neatness	E. I. Rank
M2x(B.Con.4x1)	506	1.720	0.336	19.55	9244	15.78	80	1
M1xMC4(O)	491	1.698	0.334	19.67	8933	15.97	85	2
M1x(B.Con.4x1)	501	1.781	0.346	19.43	8356	15.41	85	3
M1xSK3C	526	1.751	0.337	19.23	9378	16.04	80	4
M1xNB18	524	1.787	0.347	19.37	9178	16.18	78	5
M3xMJ2	501	1.547	0.320	20.67	9367	14.80	77	6
M3x(SK6x7)	472	1.792	0.350	19.51	9233	14.98	84	7
M3x(B.Con.1x4)	495	1.605	0.327	20.38	9355	15.79	75	8
M3xD6PN	496	1.736	0.334	19.26	9200	14.09	75	9
M1x(SK6x7)	510	1.769	0.349	19.73	8189	14.41	80	10

M1 = 8(W)- M.Con.1xMH1; M2 = 12(Y) - M.Con.4xMH1; M3 = 16(W)- N(M)xMH1
M4 = 21(Y)- Gen3xM.Con.4[ld]; M5 = 22(Y) – (SK6xSK7)xM.Con.4[ld]

Table 75. Reeling Performance of Multi x bi Hybrid.

MultixBi	FL (m)	F. size (d)	Reelab-ility(%)	Raw silk %	Neat-ness	Ren-ditta	Reco-very %	E. I. Rank
M2x (B.Con.4x1)	651	2.41	73.51	10.00	80	10.27	77.14	1
M1xMC4(O)	615	2.22	72.73	9.58	85	10.43	76.47	2
M1x (B.Con.4x1)	702	2.30	71.80	9.10	85	10.98	76.47	3
M1xSK3C	582	2.53	67.53	9.06	80	11.30	75.00	4
M1xNB18	587	2.51	73.06	9.80	78	10.20	77.78	5
M3xMJ2	615	2.23	69.43	9.10	77	10.98	76.47	6
M3x(SK6x7)	621	2.23	68.75	11.00	84	9.09	78.57	7
M3x (B.Con.1x4)	647	2.62	73.61	9.33	75	10.71	77.41	8
M3xD6PN	641	2.18	70.58	9.80	75	10.20	77.78	9
M1x(SK6x7)	576	2.49	44.38	9.56	80	10.46	76.92	10

M1 = 8(W)- M.Con.1xMH1, **M2** = 12(Y) - - M.Con.4xMH1
M3 = 16(W)- N(M)xMH1, **M4** = 21(Y) -- Gen3xM.Con.4[ld]
M5 = 22(Y) – (SK6xSK7) xM.Con.4[ld]

The following two each of multi x multi and multi x bi hybrids may be sent for on-farm trial (OFT):

Multi x Multi Hybrid

1. **M4 x M.Con.4**- SR%-18.60, ERR(No)- 7836 & ERR(Wt)- 14.81
2. **M1 x M9A**- SR%-18.37, ERR(No)- 9000 & ERR(Wt)- 16.47

Multi x Bi hybrid

1. **M2 x (B.Con.4x1)** - SR%-19.55, ERR(No)- 9244 & ERR(Wt)- 15.78
2. **M1 x MC4(O)-** SR%-19.67, ERR(No)- 8933 & ERR(Wt)- 15.97

Recommendations: Seven multivoltine lines with high SR% (more than 17%) and high neatness (more than 85 points) have been developed as follows:

1. M. Con.1x MH1 (M1)-White
2. M.Con.4 x MH1 (M2) –Yellow
3. Nistari x MH1 (M3) –Yellow
4. M6DPE x MH1 (M6) –Yellow
5. MH1 x BHB (M7) –White
6. Gen3 x M.Con.4 (M4) –Yellow and
7. SK6x7 x M.Con.4 (M5) –Yellow

By utilizing the above breeds as female parent, best two Multi x Multi and two Multi x Bi hybrids are also identified. These are:-

Multi x Multi Hybrid :

1. **M4 x M.Con.4**- SR%-18.60, ERR(No)- 7836 & ERR(Wt)- 14.81
2. **M1 x M9A**- SR%-18.37, ERR(No)- 9000 & ERR(Wt)- 16.47

Multi x Bi hybrid:

1. **M2 x (B.Con.4x1)** - SR%-19.55, ERR(No)- 9244 & ERR(wt)- 15.78
2. **M1 x MC4(O)-** SR%-19.67, ERR(No)- 8933 & ERR(Wt)- 15.97

These two each of **multi x multi** and **multi x bi hybrids** may be sent for on-farm trial (OFT).

10.B.I.4.2. AIB 3480: Development of silkworm Bombyx mori L. breeds from a gene pool with higher genetic plasticity. **(Sept., 2012 to Aug., 2016).**

A.K.Verma (**PI**), G.K.Chattopadhyay (up to 31.10.14), A.K.Saha (up to Dec, 2015), N. Suresh Kumar CI (upto31.05.16) and N.B.Kar.

Objective: To find out the genetic plasticity in the gene pool for the target traits after genetic assimilation among Bivoltine & Multivoltine breeds collected from different sericulture zones by raising converged gene pool.

Target trait: High Shell Weight in bivoltine and High Survival in multivoltine.

Progress: The work has been completed but it has taken more than 75% time of the project as development of converged geen pool after assimilation of different contrasting characters of 6 breeds in a single inbred line without any segregation was a tough and time consuming. So the objective No.2 has not been accomplished within the stipulated time.

Development of Congenic multivoltine breed from selected lines for high cocoon shell weight and bivoltine breed for horizontal tolerance.

Status: As per the methodology depicted in **Annexure-III** for development of congenic line, the work for development of RBL1 is in progress. As both the target characters i.e., shell weight and survival are multigenic so for congenic lines, work up to RBL4 has to be done for which as per the RAC decision a new project i.e., Phase II - to complete the remaining breeding work, will be submitted very soon.

Experiments:

E01: Raising of converged gene pool in search of genetic plasticity for survival and high cocoon shell weight.

E02: Development of congenic multivoltine (V_3) breed of high cocoon shell weight and bivoltine (V_2) breed for horizontal tolerance from selected line of V_2 and V_3.

Collection of Six Bivoltine and Six Multivoltine Breeds/ Strains from different geographical zones of India **(Annexure – I: Table- 76-a,b,c,d)** and convention silkworm rearing method will be followed for assessment of quantitative and qualitative characters in West Bengal climatic condition. Thereafter convergent breeding approach will be adopted to make broad genetic base to bring genetic plasticity in bivoltine for high cocoon shell weight and multivoltine for high survival- pupation percentage **(E01-Annexure-II).** Identified lines will be used as parents to develop productive and tolerant congenic silkworm breed **(E02-Annexure-III).**

Annexure-I

The following breeds have been considered for the proposed Project entitled "Development of Silkworm (*Bombyx mori* L) Breeds from a Gene pool with Higher Genetic Plasticity."

Table 76a. Bivoltine (V_2) breeds

#	Name	Zone / region
1	APS 45	APSSRDI(A.P)
2	B.Con.4	Berhampore (W.B)
3	RJS14	Pampur, J.K
4	DUN21	RSRS, Sahaspur
5	CSR2	MYSORE
6	KPGA	Kalimpong

Table 76b. Passport data of target trait in bivoltine (v₂) breeds

Breed's Name	Suitable for	Cocoon Shape	Cocoon Colour	Shell Wt (g)	Shell %	Pupation %
APS45	High Temp. & Low RH	Oval	White	0.378	19.43	93
B.Con.4	Highly Variable Climate	Oval (Slightly Constricted)	Off White	0.318	18.06	66 (Un- Fav.) 85 (Fav.)
CSR2	Congenial Climate	Oval	White	0.460	24.15	86
RSJ14	Low Temp. & Low RH	Oval	Off White	0.463	24.11	96
DUN21	Low Temp. & Low RH	Peanut Slightly Constricted	Off White	0.450	23.00	95
KPGA	Congen Climate	Oval	White	0.275	21.90	86

Avg. Shell wt. of all breeds = 0.391± 0.080

Table 76c. Multivoltine (V₃) breeds

#	Name	Zone / region
1.	Nistari +*p*	Berhampore (W.B)
2.	M.Con.4 (Congenic Breed)	Do
3.	Sarupat	Assam
4.	Cambodge(Exotic)	Karnataka
5.	Pure Mysore	Do
6.	MH1	APSSRDI

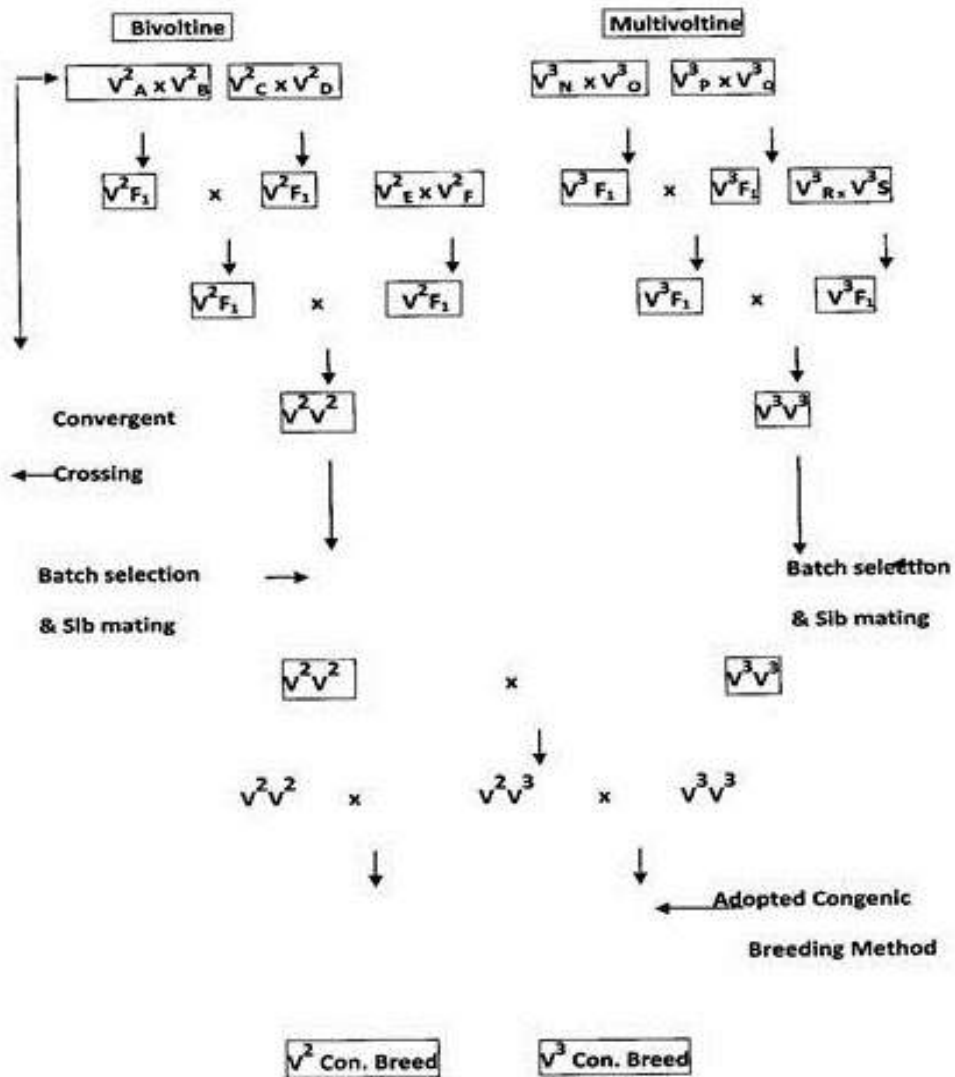**Table 76d.Passport data of target trait in multivoltine (v₃) strains/ breeds.**

Breed's Name	Suitable for	Cocoon Shape	Cocoon Colour	Shell Wt (g)	Shell %	Pupation%
M. Con. 4	Variable Climate	Oval	Yel	0.250 0.310	15.45 17.03	Un Fav-76. Fav-91
Nistari (+p)	Variable Climate	Spindle	Yellow	0.115 0.134	10.35 11.23	Un Fav-84 Fav-94
Sarupat	Temp. & High RH	Spindle		0.119 0.125	11.85 13.51	Un Fav-66 Fav-88
Cambodge	Exotic & Viral Resist.	Spindle	Yellow	0.140	14.20	Fav-91
Pure Mysore	Congenial Climate	Oval	L Greenish White	0.140	14.07	Fav-89
MH1	High Temp & Low RH	Spindle		0.198 0.245	13.93 14.65	Un Fav-82 Fav-93

BREEDING PLAN

E01-Annexure-II

Scheme for Development of a Line / Breed having Genetic Plasticity

Bivoltine

$V^2_A \times V^2_B$ $V^2_C \times V^2_D$

$V^2 F_1$ × $V^2 F_1$ $V^2_E \times V^2_F$

$V^2 F_1$ × $V^2 F_1$

Convergent

$V^2 V^2$

← Crossing

Batch selection →

& Sib mating

$V^2 V^2$ ×

$V^2 V^2$ × $V^2 V^3$ × $V^3 V^3$

V^2 Con. Breed

Multivoltine

$V^3_N \times V^3_O$ $V^3_P \times V^3_Q$

$V^3 F_1$ × $V^3 F_1$ V^3_R, V^3_S

$V^3 F_1$ × $V^3 F_1$

$V^3 V^3$

Batch selection

& Sib mating

$V^3 V^3$

← Adopted Congenic

Breeding Method

V^3 Con. Breed

Scheme for Development of Congenic Breed
(Dealing with Multigenic trait)
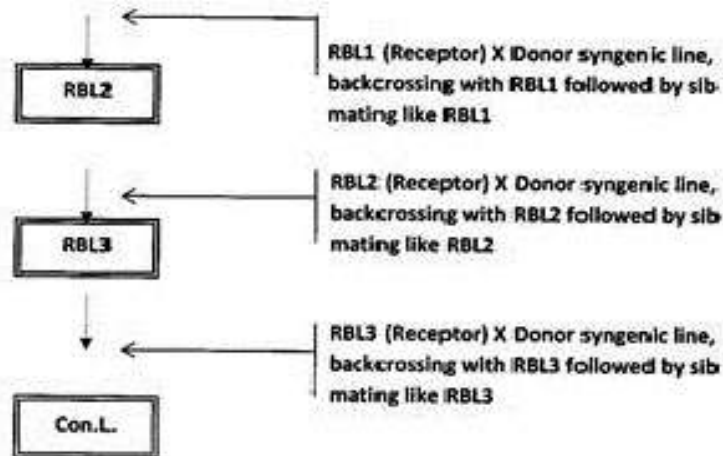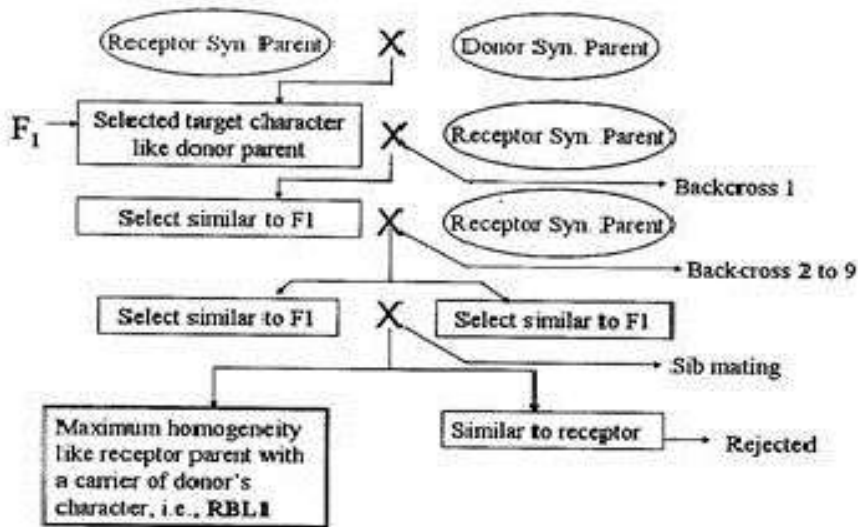
* Number of crossing with donor depends upon the transgression of target trait

• Chattopadhyay, G. K. *et al.*, 2001 a, b.

2. Evaluation of Breeding Resource materials

The breeds received from different centres are reared to evaluate the qualitative and quantitative characters with special reference to target characters to select one or two resource materials.

Table-76e.Rearing Performance of Bivoltine Parents: Congenial & Unfavourable Season-Temp. 25-32°C & RH: 74-93 %

Breed	Fec. (No.)	Hat. (No.)	Basic Larv (No.)	Good Cocn. (No.)	Pupation (%)	SCW (g)	SSW (g)	Shell (%)
B. Con.4	548 (469)	526 (408)	375 (210)	347 (181)	95 (64)	1.491 (1.375)	0.286 (0.245)	19.18 (17.81)
CSR-2	(565)	498 (523)	398 (199)	348 (161)	92 (56)	1.543 (1.367)	0.310 (0.246)	20.10 (17.99)
DUN-21	462 (521)	437 (490)	276 (176)	193 (115)	84 (34)	1.452 (1.325)	0.267 (0.234)	18.38 (17.66)
KPGA	(367)	398 (337)	297 (239)	195 (159)	95 (54)	1.226 (1.199)	0.219 (0.197)	17.86 (16.43)
APS-45	513 (498)	497 (459)	381 (226)	285 (157)	87 (54)	1.346 (1.143)	0.265 (0.205)	19. 68 (17.93)
RSJ-14	471 (459)	443 (335)	265 (276)	187 (125)	82 (47)	1.271 (1.250)	0.249 (0.221)	19.60 (17.68)

Parenthesis values indicates unfavorable season data

Table 76f. Rearing performance of multivoltine congenial & unfavourable Season –Temp. 25- 32°C & RH: 74-93 %

Breed	Fec. (No.)	Hat. (No.)	Basic Larv (No.)	Good Cocn. (No.)	Pupation (%)	SCW (g)	SSW (g)	Shell (%)
Nistari (+*p*)	412 (398)	408 (384)	357 (304)	325 (287)	97 (75)	1.042 (0.969)	0.126 (0.109)	12.09 (11.24)
Cambod (*p*)	422 (453)	408 (412)	281 (219)	259 (205)	96 (69)	1.049 (0.965)	0.140 (0.107)	13.20 (11.08)
Sarupat (*p*)	434 (398)	384 (387)	327 (254)	289 (198)	85 (51)	1.121 (0.981)	0.143 (0.114)	12.76 (11.62)
MH-1 (+*p*)	460 (499)	441 (471)	375 (375)	337 (303)	96 (74)	1.325 (1.212)	0.190 (0.167)	14.19 (13.77)
PM (*p*)	426 (356)	385 (328)	348 (279)	271 (211)	94 (64)	1.226 (0.998)	0.151 (0.113)	13.13 (11.32)
M.Con.4 (*p*)	543 (434)	527 (416)	397 (256)	361 (215)	95 (65)	1.442 (1.315)	0.232 (0.205)	16.08 (15.58)

Within Parenthesis: Unfavourable Season data

Result of both the breeds, i.e., bivoltine and multivoltine mentioned above, it is clear that in case of bivoltine, the maximum shell wt. obtained Is 0.310g in place of 0.463g as mentioned in passport data, whereas in multivoltine, survival percentage is more or less similar to passport data.

Results:
E01: Raising of converged gene pool in search of genetic plasticity for survival and high cocoon shell weight.

1. Initiati   of cross

The above mentioned 6 bivoltine and 6 multivoltine breeds were utilized to raise convergent lines of bivoltine with high survival and multivoltine with high survival as per the method given in **Annexure-II**. The resultant convergent lines after stabilization will be used for the development of congenic breeds. After initial crossing, it took 10-12 times sib-mating to fix the characters after 6-way cross. The rearing performance of F8, F9 and F10 generations have been given here.

Table 77a. Rearing Performance of (B.Con.4 x CSR-2) x (DUN21 x KPG-A) x (APS- 45 x RSJ-14)- Different rearing Schedule (Basic Larv.No.300)-2015

Character	Season	Fec. (No.)	Hat (%)	Yield/ 10000 lar. (no.)	Yield/ 10000 lar. (wt.kg.)	SCW (g)	SSW (g)	Shell (%)
Plain (*p*) Larvae, Faint Constricted, White (*c*) colour Cocoon	Jun-Jul,15 **F8**	554	92	8167	11.30	1.427	0.248	17.38
	Aug-Sept.,15 **F9**	524	93	8067	11.03	1.426	0.266	18.65
	NovDec.,15**F10**	532	93	9100	14.13	1.565	0.288	18.40
Marked (+p) Larvae, Faint Constricted, White (c) colour Cocoon	Jun-Jul,15 **F8** Aug-Sept,15 **F9**	559	91	8400	11.73	1.423	0.244	17.15
	Nov-Dec.,15 **F10**	528	92	8300	11.50	1.464	0.272	18.58
		542	93	9033	14.57	1.569	0.285	18.16

Table 77b. Rearing Performance of (Nistari+*p* x Cambd) x (M.Con.4 x M) x (Sarupat x MH1)- Different rearing Schedule (Basic Larv.No.300)

Character	Season	Fec. (No.)	Hat (%)	Yield/ 10000 lar. (no.)	Yield/ 10000 lar. (wt.kg.)	SCW (g)	SSW (g)	Shell (%)
Plain (*p*) Larvae, **Yellow (*C*), Oval Cocoon**	Jun-Jul,15 **F8**	532	94	9067	11.07	1.303	0.185	14.20
	Aug-Sept,15 **F9**	510	95	9054	11.22	1.304	0.185	14.19
	Nov-Dec15 **F10**	517	97	9433	12.03	1.306	0.208	15.92

Character	Season	Fec. (No.)	Hat (%)	Yield/ 10000 lar. (no.)	Yield/ 10000 lar. (wt.kg.)	SCW (g)	SSW (g)	Shell (%)
Plain (*p*) Larvae, **White (*c*), Oval Cocoon,**	Jun-Jul,15 **F8**	528	93	8833	11.60	1.304	0.171	13.11
	Aug-Spt,15 **F9**	507	93	9014	10.92	1.305	0.183	14.02
	Nov-Dec15 **F10**	502	97	9467	11.70	1.399	0.211	15.08
Plain (*p*) Larvae, Light **Greenish (*Gr*) Oval Cocoon**	Jun-Jul,15 **F8**	509	93	8967	10.97	1.274	0.187	14.68
	Aug-Spt,15 **F9**	532	95	9033	10.88	1.299	0.190	14.63
	Nov-Dec15 **F10**	525	95	9533	11.67	1.348	0.201	14.90

The above breeding approach was adopted to assimilate a number of favourable genes for a trait to bring genetic plasticity in the gene pool through aggregating the gene(s) from well-adapted different strains from different geographical zone of India and selection under adverse climate. So, there is a chance to bring capacity for adaptation caused by genetic changes *i.e.,* **Genetic plasticity.** Thereafter the above mentioned converged lines, by congenic breeding approach, will be utilized to develop tolerant bivoltine and productive multivoltine breed with quality silk respectively suitable for variable climatic situation.

Outcome from E01:
i. I **Bivoltine** six way cross *i.e.,*(B.Con.4 x CSR-2) x(Dun-21 x KPG-A) x (RSJ-14 x APS- 45)-raised as converged gene pool for high Shell weight and two lines were isolated as:
  1. P   *p*) and
  2. M   (+*p*) Larvae.
 ii.   **Multivoltine** six Way cross *i.e.,* (Nistari +*p*) x Cambodge) x (M.Con.4 x PM) x (MH1 x Sarupat) – raised as converged gene pool for horizontal tolerance (survival).

Three lines were isolated as:
  1. Plain yellow cocoon- To fix the yellow colour it took 12 times sib-mating with rigorous selection for cocoon colour, cocoon shape, larval marking, etc., whereas in other cases within 10 generation characters were fixed.
  2. Plain white (*c*) cocoon
  3. Plain light green (*Gr*) cocoon.

E02: Development of congenic multivoltine (V_3) breed for high cocoon shell weight and bivoltine (V_2) breed for horizontal tolerance from selected lines of V_2 and V_3.

In this experiment the multivoltine and bivoltine converged lines developed from E01 were utilized as parent for developing high shell weight multivoltine congenic lines and high survival bivoltine congenic lines as per the method shown in **Annexure-III**.

Table 77c. Rearing Performance of Receptor (Multivoltine 6-way cross) x Donor (Bivoltine 6-way cross)- F_1 & BC_1-BC_3 to develop white cocoon multivoltine Congenic line with High Shell Weight (Target character- Shell Weight).

Character		Fec. (No.)	Hat %	Yield/ 10000 lar.(no.)	Yield/ 10000 lar. wt. (kg.)	SCW (g)	SSW (g)	Shell (%)
Receptor x Donor (Multi-W x Bi)								
F1	Jan-Feb. 16	506	95.1	9600	15.33	1.630	**0.340**	20.85
Multi	Jan-F 16	501	97.5	9167	13.73	1.501	**0.241**	16.06
Bi	Jan-Feb. 16	526	90.9	9233	14.60	1.573	**0.312**	19.83
BC1	Apr May, 16	503	93.8	9422	14.54	1.578	**0.296**	18.75
BC2	June-July, 16	497	94.8	9433	14.37	1.525	**0.286**	18.80
BC3	Aug.- Sept.,16	453	95.6	9400	12.87	1.488	**0.264**	17.74

Table 77-d. Rearing Performance of Receptor (Bivoltine 6-way cross) x Donor (Multivoltine 6-way cross) - F_1 & BC_1-BC_3 to develop white bivoltine congenic line with high survival (Target character- Survival)

Character		Fec. (No.)	Hat %	Yield/ 10000 lar.(no.)	Yield/ 10000 lar. wt. (kg.)	SCW (g)	SSW (g)	Shell (%)
Receptor x Donor (Bi x Multi-W)								
F1	Jan-Feb., 16	511	94.9	**9845**	16.20	1.76	0.37	21.02
BC1	April-May, 16	542	94.6	**9300**	15.12	1.629	0.311	19.09
BC2	June-July, '16	518	92.9	**9233**	14.90	1.623	0.299	18.42
BC3	Aug.-Sept., 16	590	97.5	**9500**	13.53	1.500	0.288	19.20

The Congenic Breeding approach was adapted to introgress a target trait in multivoltine for high cocoon shell weight and the trait horizontal resistant in bivoltine. From the project it is expected that there is fair chance to get genetic plasticity in the gene pool for proposed target traits in the developed breeds.

Outcome from E02:

In silkworm for development of a congenic line with the introgression of a multigenic trait, 4(four) cycle (RBL4) of crossing, back crossing and selfing (total 11 generations) are required. At the end of this project period, the development of RBL1 stage of **two multivoltine congenic lines** with high shell weight, one **with white cocoons** and other with **yellow** and two **bivoltine congenic lines** with high survival both white cocoons is in progress. **RAC has suggested finishing the work with a new project as Phase-II.**

Conclusion: the following lines are developed:-

From EO.1. Bivoltine, Six way cross *i.e.,* (B.Con.4 x CSR-2) x (Dun-21 x KPG-A) x (RSJ-14 x APS-45)-raised as converged gene pool for high Shell weight and two lines were isolated as:

1. Plain (*p*) Larvae, Faint Constricted, White (*c*) colour Cocoon
2. Marked (+p) Larvae, Faint Constricted, White (c) colour Cocoon

Multivoltine

Six Way cross *i.e.,* (Nistari +*p*) xCambodge) x (M.Con.4 x PM) x (MH1 x Sarupat) – raised as converged gene pool for horizontal tolerance (survival) and Three lines were isolated as:

1. Plain (*p*) Larvae, Yellow (*C*), Oval shape Cocoon
2. Plain (*p*) Larvae, White (*c*), Oval shape Cocoon
3. Plain (*p*) Larvae, Light Greenish(*Gr*) Oval shape Cocoon

From EO2, The above lines have been used as parents to develop 2 multivoltine congenic lines with high shell weight (>0.24g) and 2 bivoltine congenic lines with high survival (>90%). The work is in progress.

As per the methodology as depicted in Annexure-III for development of congenic line, the work for development of RBL1 is in progress. As both the target characters i.e., shell weight and survival are multigenic so for congenic lines, work up to RBL4 has to be done for which as per the RAC decision a new project as Phase II i.e. to complete the remaining breeding work will be submitted very soon.

Recommendations: The developed convergent gene pool with high genetic plasticity will be utilized for the development of congenic lines which can be used without hybridization in the field with more production than any existing hybrid and also which can withstand a wide fluctuation in climatic condition.

10.B.I.3.3. AIB 3466: Development of region specific bivoltine breeds suitable for highly fluctuating and seasonally variable climatic conditions of Eastern and North-Eastern India**. (Aug., 2011 to Dec., 2016)**

V.Lakshmanan (**PI** Fr. Aug, 16), N. Suresh Kumar (**PI** Fr. Aug, 11 to May, 16), N.Chandrakanth, N.B.Kar,   A.K.Saha, (upto 15.12.15), S. Sreekumar, (Upto 15.12.15) and S. Chakraborthy (Upto May, 16) at CSR&TI, Berhampore; G. Singh, REC, Bhandra,U.C.Boruah, RSRS, Jorhat, K.C.Brahma, RSRS, Koraput, R. Kar, RSRS, Kalimpong and Collin, REC, Shillong.

Progress:

Five oval and five dumbbell breeds which were subjected for shuttle breeding in all six locations such as CSRTI, Berhampore, RSRS, Kalimpong, RSRS, Koraput,

RSRS, Jorhat, REC, Bhandara, REC, Shillong have completed F8 generation. Breeding process and fixation of lines was completed by F8 generation.

Table 78a. Performance of newly evolved breeds at CSRTI, Berhampore (F8 generation)

#	Bree	Fec. (No)	ERR (No)	ERR Wt (kgs)	SCW (g)	SSW (g)	Shell (%)
1	BHP-	433	8520	11.200	1.315	0.258	19.60
2	BHP-	543	9200	12.440	1.463	0.272	18.59
3	BHP-	580	9420	13.840	1.512	0.281	18.58
4	BHP-	518	9600	11.960	1.302	0.214	16.43
5	BHP-	573	9540	13.320	1.472	0.276	18.75
6	BHP-	540	8840	11.360	1.357	0.240	17.68
7	BHP-	516	8580	13.000	1.549	0.248	16.01
8	BHP-	486	8690	11.120	1.458	0.262	17.96
9	BHP-	513	9540	13.160	1.439	0.262	18.20
10	BHP-	461	9120	11.840	1.301	0.218	16.75
AVG		**516**	**9105**	**12.324**	**1.417**	**0.253**	**17.86**
LSD at 5%		**33**	**301**	**0.694**	**0.065**	**0.017**	**0.82**
CV%		**9.01**	**4.62**	**7.87**	**6.42**	**9.13**	**6.39**

Table 78b. Performance of newly evolved breeds at RSRS, Koraput (F8 generation)

#	Bree	Fec. (No)	ERR (No)	ERR Wt (kgs)	SCW (g)	SSW (g)	Shell (%)
1	Kora-1	541	9344	13.556	1.583	0.281	17.75
2	Kora-2	491	8744	14.722	1.633	0.295	18.06
3	Kora-3	545	9178	15.222	1.800	0.298	16.56
4	Kora-4	503	9389	13.111	1.565	0.262	16.74
5	Kora-5	545	9211	14.667	1.571	0.265	16.87
6	Kora-6	528	9067	14.444	1.613	0.281	17.42
7	Kora-7	499	9233	15.111	1.657	0.282	17.02
8	Kora-8	548	9200	14.889	1.768	0.290	16.40
9	Kora-9	552	9278	14.333	1.813	0.279	15.39
10	Kora-1	515	9278	13.778	1.611	0.299	18.56
AVG		**527**	**9192**	**14.383**	**1.661**	**0.283**	**17.08**
LSD 5%		**16**	**130**	**0.498**	**0.069**	**0.009**	**0.65**
CV%		**4.34**	**1.97**	**4.84**	**5.78**	**4.51**	**5.33**

Table 78c. Performance of newly evolved breeds at RSRS, Kalimpong (F8 generation)

#	Bree	Fec. (No)	ERR (No)	ERR Wt (kgs)	SCW (g)	SSW (g)	Shell (%)
1	KPG-	506	9267	12.767	1.511	0.282	18.68
2	KPG-	506	8078	11.533	1.569	0.280	17.87
3	KPG-	479	8156	11.789	1.553	0.285	18.35
4	KPG-	494	9689	13.756	1.478	0.275	18.58

#	Bree	Fec. (No)	ERR (No)	ERR Wt (kgs)	SCW (g)	SSW (g)	Shell (%)
5	KPG-	534	8100	11.333	1.488	0.264	17.79
6	KPG-	512	9367	14.411	1.609	0.299	18.59
7	KPG-	535	9344	15.667	1.661	0.307	18.48
8	KPG-	513	9267	14.611	1.631	0.294	18.01
9	KPG-	522	8844	13.578	1.600	0.295	18.42
10	KPG-	523	8989	13.000	1.510	0.280	18.52
	AVG	512	8910	13.244	1.561	0.286	18.33
	LSD 5%	12	426	1.025	0.045	0.009	0.22
	CV%	3.39	6.68	10.81	4.06	4.44	1.75

Table-78d. Performance of newly evolved breeds at RSRS, Jorhat (F8 generation)

#	Bree	Fec. (No)	ERR (No)	ERR Wt (kgs)	SCW (g)	SSW (g)	Shell (%)
1	Jor-1	405	9067	13.150	1.440	0.288	20.01
2	Jor-2	395	8700	12.350	1.430	0.286	20.01
3	Jor-3	410	8617	13.800	1.460	0.292	20.02
4	Jor-4	389	9067	13.250	1.407	0.286	20.38
5	Jor-5	390	9200	13.233	1.463	0.297	20.31
6	Jor-6	417	9133	13.350	1.500	0.302	20.17
7	Jor-7	400	8933	12.800	1.510	0.301	19.91
8	Jor-8	452	8917	12.933	1.438	0.290	20.17
9	Jor-9	483	9067	13.067	1.493	0.299	20.03
10	Jor-1	445	9350	13.367	1.447	0.292	20.17
	AVG	419	9005	13.130	1.459	0.293	20.12
	LSD 5%	22	159	0.276	0.024	0.004	0.11
	CV%	7.48	2.46	2.94	2.28	2.06	0.74

Table 78e. Performance of newly evolved breeds at REC, Bhandara(F8 generation)

#	Bree	Fec. (No)	ERR (No)	ERR Wt (kgs)	SCW (g)	SSW (g)	Shell (%)
1	Bhan-1	512	9564	12.780	1.426	0.225	15.78
2	Bhan-2	509	9458	12.455	1.413	0.234	16.56
3	Bhan-3	505	9512	12.451	1.428	0.234	16.39
4	Bhan-4	508	9425	11.564	1.303	0.222	17.04
5	Bhan-5	510	9421	12.568	1.430	0.233	16.29
6	Bhan-6	502	9447	12.884	1.341	0.223	16.63
7	Bhan-7	505	9412	12.658	1.328	0.214	16.11
8	Bhan-8	515	9418	12.365	1.374	0.219	15.94
9	Bhan-9	521	9354	12.165	1.309	0.215	16.42
10	Bhan-1	552	9387	11.956	1.386	0.237	17.10
	AVG	514	9440	12.385	1.374	0.226	16.43
	LSD 5%	10	43	0.285	0.036	0.006	0.31
	CV%	2.81	0.64	3.22	3.67	3.73	2.62

Table-78f. Performance of newly evolved breeds at REC, Shillong (F8 generation)

#	Bree	Fec (No)	ERR (No)	ERR Wt (Kgs)	SCW (g)	SSW (g)	Shell (%)
1	Shil-1	499	7800	13.026	1.670	0.320	19.16
2	Shil-2	501	9100	13.832	1.520	0.300	19.73
3	Shil-3	503	8500	15.130	1.780	0.320	17.87
4	Shil-4	500	8400	15.288	1.820	0.360	19.78
5	Shil-5	486	9000	16.920	1.880	0.360	19.14
6	Shil-6	488	8700	16.269	1.870	0.340	18.18
7	Shil-7	516	7800	13.962	1.790	0.310	17.31
8	Shil-8	512	8800	15.312	1.740	0.300	17.24
9	Shil-9	486	8200	14.760	1.800	0.340	18.88
10	Shil-1	489	8500	12.750	1.500	0.260	17.33
	AVG	498	8480	14.725	1.737	0.321	18.46
	LSD 5%	8	322	0.960	0.096	0.022	0.72
	CV%	2.15	5.30	9.11	7.71	9.57	5.42

Future course of action:

➢ The new bivoltine breeds developed at six different locations adopting shuttle breeding approach are expected to yield new bivoltine hybrid combinations with better genetic plasticity and therefore, will increase crop stability as well as productivity in their respective locations.

➢ Accordingly, a project on identification of new bivoltine hybrids suitable to all six locations has been proposed and the same has been approved by 45th RAC held on 17/18.01.2017.

➢ Therefore, a proposal entitled as "Identification of region specific bivoltine hybrids suitable for highly fluctuating and seasonally variable climatic conditions of Eastern and North-Eastern India" is being prepared as Phase –II of the project.

10.B.I.5. SILKWORM PATHOLOGY SECTION

10.B.I.5.1. ARP 3516: Studies on synbiotic (Combination of probiotic and pre biotic) induction for control of common disease of silkworm, *Bombyx mori* L. **(Oct., 2014 to Sept., 2016)**

K. Rahul (**PI** w.e.f. 09.08.2016) and S. Chakrabarty (**PI** upto 02.07.2016), K. Rahul (01.04.2016 to 08.08.2016) and Z. Hossain (w.e.f. 09.08.2016).

Objectives:
1. Application of synbiotics (combination of probiotics and prebiotics) for eco-friendly silkworm disease management.
2. Strengthen the immunity of silkworm to resist the microbial pathogenic attack.
3. To promote good cocoon yield.

Methodology: Probiotic bacteria and yeast species were procured and were maintained as per the standard conditions. The probiotics and prebiotics cultures used in the study are presented in **Table 79**. The probiotic cultures tested in the present study were *Bifidobacterium longum, Streptococcus faecalis, Lactobacillus* spp.*, Saccharomyces boulardii*, *Lactobacillus rhamnosus*, *Lactobacillus sporogenes* and *Lactobacillus acidophilus* in the concentration range of $1.5 - 3.5 \times 10^6$ c.f.u /ml. Fructo Oligo Saccharides was used as a prebiotic at a concentration100 mg per ml. The leaves of mulberry S-1635 variety were used. The synbiotic preparations were tested in silkworm hybrids MCon4 X BCon4 in three different seasons Aug-Sep 2015, Oct-Nov 2015, Jan-Feb 2016 and MCon4 X (SK6 X SK7) in Apr-May 2016. Successfully proved probiotic bacterial strains in humans, *Lactobacillus rhamnosus* ATCC 9595 and *Lactobacillus acidophilus* ATCC 4356 were procured from Himedia and synbiotic suspensions were prepared and tested in silkworm hybrid N x (SK6 x SK7) in Sept.-Oct., 2016. Mulberry leaves were fed to *Bombyx mori* L. larvae as per rearing methods suggested by Krishnaswami *et al*., 1978. Experimental as well control groups had 3 replications consisting of 100 larvae each. Experimental groups were fed (only once on the first day of IV Instar larvae) with mulberry leaves treated by dipping the leaves in the synbiotic suspensions and partially drying at room temperature. The control group of *B. mori* larvae was fed with mulberry leaves without treatment. Mulberry leaves dipped in pathogen suspension of standard doses as delineated in Sun *et al.*, 2016, Pachiappan *et al*., 2009 and Rajitha *et al*., 2014 were fed to the freshly moulted fifth instar larvae after two hour starvation and disease incidence was monitored. Parameters like ERR, mature larval weight, single cocoon weight (gm), shell weight (gm) and shell ratio (%) were recorded and data was analysed statistically to study the effect.

Table 79. Synbiotics (probiotics and prebiotic) used in the present study.

Treatment	Probiotics ($1.5 - 3.5 \times 10^6$ c.f.u /ml) used in the study
T-1	*Lactobacillus acidophilus*
T-2	*Lactobacillus sporogenes*
T-3	*Lactobacillus rhamnosus*
T-4	*Saccharomyces boulardii*
T-5	*Lactobacillus* spp.
T-6	*Streptococcus faecalis*
T-7	*Bifidobacterium longum*
Prebiotic	Fructo Oligo Saccharides 100 mg per ml

The performance of synbiotic preparations tested in the present study in silkworm hybrids M.Con.4 X B.Con.4 in three different seasons Aug.-Sept., 2015, Oct-

Nov.,2015, Jan.-Feb.,2016 and M.Con.4 x (SK6 x SK7) in April-May,2016 are depicted in **Tables 80 - 84**.

Table 80. Impact of synbiotics on various characteristics of silkworm *Bombyx mori* (M.Con.4 X B.Con.4) in Aug.-Sept., 2015.

#	Mature larval wt(g)	ERR (%)	SCW(g)	SSW(g)	SR%
SEASON: AUG – SEP 2015 [Hybrid: M.Con.4 X B.Con.4]
T1	3.139	64.0	1.38	0.217	15.7
T2	3.155	84.0	1.492	0.247	16.6
T3	3.161	65.0	1.378	0.214	15.5
T4	3.023	82.50	1.514	0.23	15.2
T5	3.313	84.0	1.52	0.225	14.8
T6	3.119	64.3	1.435	0.216	15.1
T7	3.137	64.0	1.39	0.214	15.4
Control(Infected)	**2.865**	**32.3**	**1.358**	**0.192**	**14.1**
Control(Healthy)	**3.175**	**64.0**	**1.49**	**0.21**	**14.2**
LSD @ 5%	**0.365**	**21.1**	**0.124**	**0.02**	**1.6**

Table 81. Impact of synbiotics on various characteristics of silkworm B*ombyx mori* (M.Con.4 X B.Con.4) in Oct.-Nov., 2015

#	Mature larval wt(g)	ERR(%)	SCW(g)	SSW(g)	SR%
SEASON: OCT-NOV 2015 [Hybrid : MCon4 X BCon4]
T1	3.086	66	1.543	0.269	17.4
T2	3.174	93.5	1.594	0.28	17.6
T3	2.966	72	1.534	0.273	17.8
T4	3.18	91.3	1.56	0.27	17.3
T5	3.21	89	1.543	0.281	18.2
T6	3.29	65.3	1.527	0.27	17.7
T7	3.232	72.5	1.528	0.271	17.8
T2+T4	3.317	97	1.535	0.287	18.6
T2+T4+T5	3.257	95	1.524	0.282	18.5
Control(Infected)	**2.104**	**45.5**	**1.241**	**0.171**	**13.8**
Control(Healthy)	**3.298**	**74.5**	**1.738**	**0.274**	**15.8**
LSD @ 5%	**0.178**	**13.9**	**0.125**	**0.018**	**1.6**

Table 82. Impact of synbiotics on various characteristics of silkworm *Bombyx mori* (M.Con.4 X B.Con.4) in Jan.-Feb., 2016

#	Mature larval wt(g)	ERR(%)	SCW(g)	SSW(g)	SR%
T1	3.536	84.8	1.258	0.221	17.5
T2	3.417	95.5	1.53	0.261	17
T3	3.524	83.8	1.326	0.222	16.9
T4	3.373	93	1.58	0.271	17.1
T5	3.359	93	1.56	0.265	17

#	Mature larval wt(g)	ERR(%)	SCW(g)	SSW(g)	SR%
T6	3.417	82.8	1.434	0.23	16.1
T7	3.365	85	1.355	0.216	16.1
T4+T5	3.575	93	1.373	0.253	18.8
T2+T4+T5	3.744	93.3	1.466	0.267	18.5
Control(Infected)	**2.536**	**55.3**	**1.238**	**0.193**	**15.7**
Control(Healthy)	**3.491**	**83**	**1.393**	**0.238**	**17.3**
LSD @ 5%	**0.764**	**11.4**	**0.218**	**0.035**	**3.149**

Table 83. Impact of synbiotics on various characteristics of silkworm *Bombyx mori* [MCon4 X (SK6 X SK7)] in Apr-May, 2016

#	Mature larval wt(g)	ERR(%)	SCW(g)	SSW(g)	SR%
T1	3.416	85.6	1.261	0.231	18.32
T2	3.214	90.2	1.532	0.252	16.45
T3	3.374	86.7	1.416	0.224	15.82
T4	3.271	91.8	1.47	0.267	18.16
T5	3.259	91.4	1.46	0.263	18.01
T6	3.527	82.1	1.534	0.228	14.86
T7	3.365	84.8	1.365	0.221	16.19
T4+T5	3.285	92.2	1.367	0.248	18.14
T2+T4+T5	3.524	92.7	1.366	0.256	18.74
Control (Infected)	**2.627**	**55.3**	**1.228**	**0.189**	**15.39**
Control (Healthy)	**3.292**	**84**	**1.293**	**0.248**	**19.18**
LSD @ 5%	**0.754**	**11.7**	**0.227**	**0.014**	**3.239**

The findings of the present study implies that synbiotics comprising of prebiotic (Fructo Oligo Saccharides) and probiotic bacteria (*Lactobacillus acidophilus*, *Lactobacillus rhamnosus*, *Streptococcus faecalis* and *Bifidobacterium longum*) were not showing significant differences with respect to ERR when compared with healthy control. The above treatments with respect to other parameters like mature larval weight, SCW, SSW and SR% was also not significant.

Table 84. Impact of probiotic bacteria *Lactobacillus rhamnosus* ATCC 9595 and *Lactobacillus acidophilus* ATCC 4356 on various characteristics of silkworm *Bombyx mori* [N X (SK6 X SK7)] in Sept.-Oct., 2016.

Treatment	Mature larval wt. (g)	ERR(%)	SCW(g)	SSW(g)	SR%
Lactobacillus rhamnosus ATCC 9595	3.02	91.67	0.99	0.14	14.14
Lactobacillus acidophilus ATCC 4356	3.44	81.67	0.98	0.15	15.30
Control	2.83	90.00	1.05	0.15	14.28
LSD @ 5%	0.43	NS	NS	NS	NS

Significant differences in respect to ERR were observed with the synbiotics comprising of prebiotic (Fructo Oligo Saccharides) and probiotic bacteria/yeast (*Lactobacillus sporogenes*, *Lactobacillus* spp., *Saccharomyces boulardii*) individually and in combination when compared with healthy control only in one season (Oct-Nov, 2015; Table-81). In season Jan-Feb, 2016 (Table 82), only *L. sporogenes and a* combination of *L. sporogenes*, *Lactobacillus* spp. and *Saccharomyces boulardii* showed significant differences in respect to ERR over healthy control. However, the result could not be replicated in other two seasons (Tables-80, 83).The above treatments with respect to other parameters like mature larval weight, SCW, SSW and SR% was not consistent in all the seasons.

Successfully proved probiotic bacterial strains in humans, *Lactobacillus rhamnosus* ATCC 9595 and *Lactobacillus acidophilus* ATCC 4356 (Vilela *et al*., 2015, Davis, 2014, Patent-EP 2229432 A1) were also not showing significant differences with respect to ERR, SCW, SSW and SR% when compared with healthy control (Table-84). Only significant increase in mature larval weight (3.44 gm) was observed from batch treated with *Lactobacillus acidophilus* ATCC 4356 when compared with control (2.83 gm).

Results: The information on the usage of synbiotics in sericulture is very limited. Bi and Bi, 2012 conducted studies on the efficacy of commercially available probiotic Darolac comprising *Lactobacillus acidophilus*, *Lactobacillus rhamnosus*, *Bifidobacterium longum, Saccharomyces boulardii* in combination with a neutraceutical agent Kids-pro and reported that it produced significant beneficial effect in the silkworm system. But *Lactobacillus acidophilus*, *Lactobacillus rhamnosus* and *Bifidobacterium longum* didn't produce any remarkable effect in the present study with respect to the characters tested and the possible reasons might be differences in the strains used (strain specificity). Though Anitha *et al.*, 2015 reported that Darolac had significant effect on the commercial characters of Eri silkworm but their reported results signified otherwise. The results in the present study are in accordance with the results reported by Anitha *et al*, 2015 where in Darolac has no significant influence with respect to characters tested in Eri silkworm. There is voluminous literature with respect to *Lactobacillus sporogenes*, *Lactobacillus* spp. and *Streptococcus faecalis* acting as probiotics and producing beneficial effects in humans but the same is not replicated in the present study in silkworm.

Recommendations: The synbiotics tested in the present study were not showing profound influence on the characteristics tested in silkworm. The probiotic microbes tested in the present study were proved to be successful in humans but it could not produce the same effect in silkworm system as the physiological, biochemical, immunological aspects and interaction of host native microbiota are

different among both the systems. The strain specificity of probiotic microbes also plays a significant role in producing the beneficial effect on the host.

11.B.II.RSRS, JORHAT, ASSAM

11.B.II.1.APS 3539: Characterization of mulberry growing soils for nutrient management in selected Seri-villages of Golaghat district of Assam. **(April, 2015 to March, 2017) (Collaborative with NBSS&LUP, ICAR, Jorhat)**

S. N. Gogoi (**PI**) and Prasenjit Roy, Co-PI, NBSS & LUP, Jorhat.

Objectives:
1. To characterize and classify the mulberry growing soils and prepare a data bank.
2. To prepare soil test-based fertilizer recommendation chart for the mulberry growing soils.
3. To popularize the soil test-based fertilizer application among farmers as per the fertility rating chart developed.

Achievements: To characterize and classify the mulberry growing soils and prepare a data bank. In total, twenty five villages from six (6) blocks namely, Kakodonga, Dergaon, Bokakhat, Sarupathar, Podumoni and Kathalguri of Golaghat district of Assam have been selected for the study. Selection of 100 farmers has been completed. Total, 200 geo-referenced composite soil samples were collected from two different depths namely, 0-20 and 20-50 cm (100 surface soil samples and 100 sub-surface soil samples). Important properties of Soil samples namely pH, electrical conductivity (EC), organic carbon (O.C.), available N, P, K, S, Zn, Cu, Fe, Mn and B have been analyzed. Block wise nutrient status of soils are given in Table 85.

Table 85. Soil fertility parameters of mulberry growing soils of different blocks of Golaghat district

Block/ Parameters		Dergaon	donga	Kathal guri	Podumoni	Sarupa-thar	Boka-khat
pH	(0-20 cm)	4.31-5.80 (5.04)	5.21-7.60 (6.48)	4.40-6.40 (5.09)	5.14-7.00 (5.95)	5.00-6.80 (5.95)	4.84-7.29 (6.05)
	(20-50 cm)	4.40-6.30 (5.39)	5.81-7.60 (6.88)	4.50-6.60 (5.31)	5.65-7.33 (6.32)	5.20-7.10 (6.15)	4.92-7.39 (6.20)
O.C. (%)	(0-20 cm)	0.14-1.79 (0.88)	0.05-1.90 (0.67)	0.35-1.20 (0.76)	0.26-1.29 (0.78)	0.35-1.60 (0.79)	0.26-1.42 (0.73)
	(20-50 cm)	0.02-0.73 (0.39)	0.04-1.47 (0.30)	0.20-0.80 (0.47)	0.18-1.06 (0.57)	0.24-1.10 (0.54)	0.15-1.06 (0.43)
E.C. (dSm^{-1})	(0-20 cm)	0.01-0.05 (0.02)	0.02-0.13 (0.04)	0.01-0.10 (0.04)	0.02-0.10 (0.04)	0.02-0.12 (0.06)	0.01-0.10 (0.05)
	(20-50 cm)	0.01-0.03 (0.02)	0.01-0.06 (0.02)	0.01-0.06 (0.03)	0.01-0.04 (0.03)	0.01-0.07 (0.03)	0.02-0.10 (0.03)

Block/ Parameters		Dergaon	donga	Kathal guri	Podumoni	Sarupa-thar	Boka-khat
N (kg/ha)	(0-20 cm)	180-480 (370)	47.5-398 (291)	175-486 (343)	341-490 (428)	250-495 (359)	123-469 (301)
	(20-50 cm)	66.5-389 (239)	47.5-379 (202)	106-401 (277)	287-387 (346)	165-390 (283)	104-359 (233)
P_2O_5 (kg/ha)	(0-20 cm)	47-84 (58)	37.5-87.2 (58.5)	35.8-85.4 (51.6)	40.8-56.4 (50.2)	37.2-81.5 (56.4)	31.2-85.8 (55.5)
	(20-50 cm)	40.3-77.7 (51.2)	34.3-80.4 (45.2)	31.9-61.2 (42.3)	35.8-48.6 (43.3)	29.2-68.9 (48.2)	21.7-63.2 (46.0)
K_2O (kg/ha)	(0-20 cm)	141-479 (317)	100-357 (265)	100-420 (297)	161-389 (332)	114-416 (301)	161-356 (265)
	(20-50 cm)	114-347 (234)	67.2-315 (204)	60.5-377 (255)	114-301 (256)	89.0-396 (275)	101-333 (211)
S mg/kg)	(0-20 cm)	12.6-17.2 (15.1)	10.4-17.0 (13.8)	14.7-21.0 (17.6)	17.2-23.0 (20.5)	16.3-22.2 (18.7)	12.0-22.0 (15.4)
	(20-50 cm)	10.7-16.9 (13.1)	9.20-13.2 (11.2)	13.9-18.3 (15.8)	12.2-19.8 (16.5)	14.8-19.0 (16.5)	9.56-20.4 (13.1)
Zn (mg/kg)	(0-20 cm)	0.21-3.70 (2.24)	0.23-3.00 (1.13)	0.98-3.47 (1.90)	0.75-3.70 (2.54)	0.80-2.04 (1.14)	0.40-3.44 (1.66)
	(20-50 cm)	0.14-2.50 (1.15)	0.16-1.70 (0.56)	0.49-2.76 (1.20)	0.59-2.70 (1.52)	0.41-1.30 (0.65)	0.20-2.58 (0.86)
Cu (mg/kg)	(0-20 cm)	1.53-3.78 (2.67)	1.81-4.80 (3.49)	0.90-3.10 (1.93)	1.65-3.00 (2.42)	1.30-3.20 (2.15)	0.83-4.56 (2.61)
	(20-50 cm)	0.79-2.20 (1.59)	0.72-3.34 (2.34)	0.40-2.30 (1.37)	0.90-2.36 (1.90)	0.90-2.40 (1.54)	0.35-2.90 (1.94)
Fe (mg/kg)	(0-20 cm)	38.5-163(104)	17.8-126 (72.7)	63.2-120 (97.5)	58.5-155 (110)	41.6-98.3 (63.4)	10.2-138 (83.1)
	(20-50 cm)	17.6-126 (61.3)	11.8-80.0 (37.1)	32.5-115 (77.2)	45.5-121 (83.1)	30.9-75.3 (49.4)	9.20-137 (58.5)
Mn (mg/kg)	(0-20 cm)	2.10-41.0 (20.0)	2.57-35.4 (12.4)	5.70-41.5 (22.1)	34.4-79.0 (59.0)	12.2-26.1 (22.3)	3.60-51.2 (18.7)
	(20-50 cm)	1.44-29.7 (12.1)	2.10-19.4 (8.27)	4.30-33.6 (14.8)	28.8-59.8 (45.6)	9.80-20.9 (17.6)	2.40-37.2 (12.7)
B (mg/kg)	(0-20 cm)	0.41-0.83 (0.55)	0.48-0.75 (0.58)	0.32-0.46 (0.36)	0.36-0.50 (0.42)	0.33-0.47 (0.37)	0.38-0.69 (0.49)
	(20-50 cm)	0.32-0.65 (0.49)	0.42-0.65 (0.54)	0.29-0.39 (0.34)	0.25-0.45 (0.39)	0.29-0.39 (0.33)	0.31-0.64 (0.45)

Figures in parentheses indicate the mean values. (0-20 cm) indicates surface soil and (20-50 cm) indicates sub-surface soil.

Major findings indicated that the status of available N, P and K in these soils ranges from low to medium, medium to high and medium to high, respectively (**Table 86**). Among the micronutrients, deficiency of Zn and B is prevalent in these soils (**Table 87**). The severity of B deficiency (44 to 100%) is much higher than that of Zn.

Table 86. Fertility status of NPK in mulberry growing soils of different blocks of Golaghat district

Blocks	Fertility status*	N	P (as P_2O_5)	K (as K_2O)
Kakodonga	Low	50	--	6.0
	Medium	50	75	75
	High	--	25	19
Dergaon	Low	9.0	9.0	9.0
	Medium	91	73	46
	High	--	18	45
Bokakhat	Low	45	6.0	--
	Medium	55	83	61
	High	--	11	39
Kathalguri	Low	30	--	6.0
	Medium	70	88	59
	High	--	12	35
Podumoni	Low	--	--	--
	Medium	100	100	22
	High	--	--	78
Sarupather	Low	12	--	18
	Medium	88	82	47
	High	--	18	35

Low, medium and high fertility status are expressed in % of the total samples analyzed

Table 87. Fertility status of Zn and B in mulberry growing soils of different blocks of Golaghat district.

Blocks	Fertility status*	Zinc (Zn)	Boron (B)
Kakodonga	Deficient	44	44
	Sufficient	56	56
Dergaon	Deficient	18	55
	Sufficient	82	45
Bokakhat	Deficient	22	83
	Sufficient	78	17
Kathalguri	Deficient	--	100
	Sufficient	100	--
Podumoni	Deficient	--	100
	Sufficient	100	--
Sarupather	Deficient	--	100
	Sufficient	100	--

**Deficient and sufficient status are expressed in % of the total samples analyzed.*

A. To prepare soil test-based fertilizer recommendation for the mulberry growing soils :

In order to optimize fertilizer (NPK) requirement of mulberry, a field experiment was conducted. The effect of state level recommended dosage of fertilizers

(150:50:50 kg ha^{-1}) for mulberry cultivation under rainfed condition in Assam on mulberry leaf yield was compared with that of NPK dosage based on ready reckoner soil test value (65:24:60 kg ha^{-1}). Results indicated that the crop responded positively to the application of higher dosage of fertilizers (150:50:50 kg ha^{-1}) as evidenced from the leaf yield (**Table 88**). Results further indicated that to obtain the targeted leaf yield of 18 t ha^{-1} yr^{-1} (in case of S1635 variety), application of fertilizer dosage based on ready reckoner soil test value (65:24:60 kg ha^{-1}) was not sufficient. This indicates that there is a need to revise the ready reckoner (based on STCR approach) for calculation of required amount of fertilizers for a targeted yield on the basis of soil test value under rainfed condition in Assam. As expected, it was found in the present investigation that application of fertilizer dosage at the rate of 150:50:50 kg ha^{-1} resulted in higher leaf yield as compared to that obtained in case of 65:24:60 kg ha^{-1}. Besides, the leaf yield (4302 kg/ ha/ crop cutting equivalent to 17.2 t ha^{-1} yr^{-1}) as obtained with the application of NPK fertilizers at the rate of 150:50:50 kg ha^{-1} along with boron containing fertilizer, lime and FYM was comparable with the targeted yield of 18 t ha^{-1} yr^{-1}.

Hence in the soil test based fertilizer recommendation chart (Soil Health Card), the recommended dosage of fertilizers (N: P$_2$O$_5$: K$_2$O) for mulberry cultivation under rainfed condition in this region has been validated as 150:50:50 kg ha^{-1} over the ready reckoner based NPK. In the same experiment, it was also observed that combined application of NPK fertilizers and boron containing fertilizer (boric acid) produced higher leaf yield as compared to that obtained with the NPK fertilizer alone.

Table 88. Leaf yield and yield attribute of mulberry as affected by nutrient management

Treatment	Leaf yield/ha/crop (kg)	Avg. branch height (m)
T1	3814[a]	1.80
T2	4135[d]	1.78
T3	4074[d]	2.00
T4	**4302[e]**	**2.05**
T5	3888[abc]	1.80
T6	3938[bc]	1.84
T7	3956[c]	1.89

Values followed by common letters are not significantly different at P ≤ 0.05.

T1- Control

T2- N: P2O5:K2O (150:50:50 kg ha^{-1}) + FYM (10 t ha^{-1})

T3- N: P2O5:K2O (150:50:50 kg ha^{-1}) + FYM (10 t ha^{-1}) + lime (based on lime requirement)

T4- N: P2O5:K2O (150:50:50 kg ha^{-1}) + FYM (10 t ha^{-1}) + lime (based on lime requirement) + Micronutrient (foliar application of boric acid solution @ 0.1%)

T5- NPK based on ready reckoner soil test value (65:24:60 kg ha^{-1}) + FYM (10 t ha^{-1})

T6- NPK based on ready reckoner soil test value (65:24:60 kg ha^{-1}) + FYM (10 t ha^{-1}) + lime (based on lime requirement)

T7- NPK based on ready reckoner soil test value (65:24:60 kg ha^{-1}) + FYM (10 t ha^{-1}) + lime (based on lime requirement) + Micronutrient (foliar application of boric acid solution @ 0.1%)

B.   To popularize the soil test-based fertilizer application among farmers as per the fertility rating chart developed :

In order to popularize soil test based fertilizer application among mulberry growing farmers, the following action was taken.

(i) Soil Health Cards were distributed to them considering the initial soil fertility status of the mulberry fields. Depending on actual soil fertility status of NPK (low/medium/high), the fertilizer dosage was calculated based on the validated recommended dosage of NPK.

(ii) Depending on the status of micronutrients (deficient/sufficient) in soil, micronutrient fertilizer was also recommended in soil health cards.

Future plan work:
- Completion of analysis of the leftover soil samples for important   properties.
- Completion of the field experiment at RSRS, Jorhat.
- Generation of fertilizer recommendation chart for the mulberry growing soils.

11. C. **Research Programme**
11. C.1.EXTENSION & PUBLICITY DIVISION

11. C.1.1. BMO (P) 42: Institute Village Linkage Programme (IVLP) - 2014 to 2017
D. Das (PI)

Institute Village Linkage Programme   (2014-17) was implemented in the mulberry sericulture belts of the Eastern and North-eastern states by CSR&TI Berhampore and the RSRSs and the nested units under its control, in a cluster mode through 8 clusters viz. 4 each under irrigated (*Berhampore, Khargram, Kaliachak, Bangalgram*) and rainfed (*Kalimpong, Ranchi, Koraput, Jorhat* zones).

Separate *Technology Packages* were extended for mulberry cultivation and silkworm rearing. As per schedule, inputs were provided and crop wise data was collected and compiled. Strict compliance through intensive monitoring was executed for maintenance of standard.

Table 89. Technology Packages were extended for Mulberry cultivation and Silkworm Rearing

Mulberry cultivation	Silkworm Rearing
HYV - S1635 (Hills : BC259)	Use of general disinfectants and bed disinfectants.
Spacing : 2 x 2 (Irrigated) ; 3 x 3 (Rainfed)	Productive silkworm hybrids : MxB / BxB
FYM : 20 mt/ha/yr (Irrigated) 10 mt/ha/yr (Rainfed)	Incubation of dfls.
Biofertilizers : Nitrofert : 20 kg/ha/yr (Rainfed : 10 kg/ha/yr) in 5 equal split doze. Phosphofert: 75 kg/ha/yr (Rainfed: 40 kg/ha/yr) once in 4 years.	Chawki Rearing
Reduced doze of chemical fertilizers N:P:K =168:30:112 kg/ha/yr (Rainfed : 75:10:50 kg/ha/yr) (15 days after application of Biofertilizer)	Late age rearing
Irrigation: As and when required.	Timely mounting and harvesting
Pruning, inter cultivation & weeding : As per crop schedule	Integrated disease & pest management
Integrated pest & disease management	

Table 89. Overall observations (*2014-17*)

#	Name of the Cluster	Dfls Utilised		Leaf Yield		Cocoon Yield			
		MxB	B	IVLP	Non IVLP	M x B		B x B	
						IVLP	Non IVLP	IVLP	Non IVLP
	Irrigated								
1.	Berhampore	155500		42.79	33.53	42.99	33.60	-	-
2.	Khargram	180000		43.88	33.92	46.53	34.82	-	-
3.	Kaliachak	148000		42.88	34.69	42.71	34.11	-	-
4.	Bangalgram	181500		40.76	33.67	43.88	33.80	-	-
Total/Avg.		**665000**		**42.58**	**33.95**	**44.03**	**34.08**		
Rainfed									
5.	Kalimpong	-	20105	12.21	9.41	-	-	47.6	34.86
6.	Koraput	54260	6500	11.33	9.23	42.47	36.00	44.60	35.15
7.	Ranchi	9700	-	11.64	9.59	41.99	32.02	-	-
8.	Jorhat	77000	176000	12.37	9.90	44.06	32.98	44.94	35.85
Total/Avg.		**140960**	**2**	**11.89**	**9.53**	**42.84**	**33.67**	**45.71**	**35.28**

While observing and thereupon analysing the outcomes as a whole during the period from *2014-17*, the following points were projected

Irrigated conditions:

- The average leaf yield noted at the IVLP farmers' level was 42.58 mt/ha/yr against 33.95 mt, the increase being 25.4 %.

- The total (*2014-17*) dfls reared were 665000 and exclusively MxB.

- The cocoon yield was 44.03 kg/100 dfls against 34.08 kg, the yield enhancement being 29.2 %.

- Among the 4 clusters, the highest leaf yield was noted in the Khargram cluster, 43.88 mt/ha/yr.
- In line with the leaf yield achievement, the maximum cocoon yield was also achieved by this cluster (46.53 kg/100 dfls).

Rainfed conditions:

- The average leaf yield noted at the IVLP farmers' level was 11.89 mt/ha/yr against 9.53 mt with the non SMV farmers, the increase being 25.4 %.
- The total BxB dfls reared (*2014-17*) were 202605 and the cocoon yield achieved was 45.71 kg/100 dfls with the IVLP farmers' against 35.28 kg with the non SMV farmers, the augmentation being 29.6%).
- The overall MxB dfls reared (*2014-17*) were 140960 and the cocoon yield noted was 42.84 kg/100 dfls against 33.67 kg, the yield enhancement being 27.2 %.
- Among the 4 clusters, the highest leaf yield was noted in the Jorhat cluster, 12.37 mt/ha/yr, followed by the Kalimpong cluster, 12.21 mt.
- The maximum cocoon yield for M x B was achieved by the Jorhat cluster (44.06 kg/100 dfls).
- With regard to BxB however, the highest yield was achieved by Kalimpong (47.60 kg/100 dfls).

Table 90. Overall Impact of technology packages on mulberry cultivation and silkworm rearing under Irrigated Zones

#	Particulars	Initial status	Present Status	Improvement (%)
1.	Mulberry leaf yield (mt/ha/yr)	30.00 (27-32)	42.58 (36 - 52)	41.9
2.	Average rearing capacity (dfls / farmer / crop)	100 (70-200)	150 (100 – 300)	50.0
3.	Yield/100dfls (kg)			
	M x B	35 (30 - 38)	44.03 (39 – 54)	25.8

Table 91. Overall Impact of technology packages on mulberry cultivation and silkworm rearing under Rainfed Zones

#	Particulars	Initial status	Present Status	Improvement(%)
1.	Mulberry leaf yield (mt/ha/yr)	9.5 (7 - 12)	11.89 (10.2 – 14.8)	25.2
2.	Average rearing capacity (dfls / farmer / crop)	50 (30-75)	100 (75 – 150)	100
3.	Yield/100dfls (kg)			
	M x B	34 (30 - 40)	42.84 (37 – 50)	26
	B x B	37 (34 - 43)	45.71 (40 - 54)	23.5

BENEFIT COST RATIO (BCR)

The economics of cocoon production (per 100 dfls) following the separate technology packages extended under irrigated and rainfed conditions during the implementation of IVLP projected the following observations. Under irrigated condition, it was observed that by spending one rupee a farmer got average of Rs. 1.83 per 100 dfls i.e. Benefit and Cost ratio was 1.83 : 1 ranging between 2.92 : 1 to 1.36 : 1, while, this was 1.65 : 1 under rainfed condition ranging between 2.18 : 1 to 1.24 : 1.

Table 92. Economics of cocoon production (per 100 dfls)

Irrigated	BCR	Range
	1.83 : 1	2.92 : 1 - 1.36 : 1
Rainfed	1.65 : 1	2.18 : 1 - 1.24 : 1

BENEFITS ACQUIRED

➢ Sustained crop success.
➢ Poverty alleviation and livelihood security through enhanced income.
➢ Improvement in the quality of life of the stakeholders of the *Seri Model Village* by increasing the productivity and enhancement in the profitability in a sustained manner.
➢ Profitability and viability helped in overall development of regional sericulture industry.
➢ *SMV* could effectively act as an advertiser to the general farmers, inducing them to go for advanced-proven technologies along with exclusive rearing of MxB and BxB hybrids.
➢ Ultimately, it was scientific sericulture, with advanced farmer – friendly technologies, which could prosper in the eastern and north eastern region of the country.

FUTURISTIC OUTLOOK:

❖ Continuation of programmes like SMV will help in furthering of adoption of the advanced Technology Packages amongst the general sericulture farmers of the eastern and north eastern regions of the country.

❖ Intricate monitoring and immediate action through effective level of communication, in case of exigencies at the farmers' level, either directly from the Main Institute/ RSRSs/ RECs or through the Lead Farmers of the cluster, have added a higher level of stability to the programme and can continue to do so in future, thus acting as a confidence building measure among the farmers to be adopted in future under SMV which has a great role to play in the success of any such programme.

❖ As this programme have attained stability, implementation of such programmes in future can be more effectively monitored with the precautionary measures already taken against the areas/steps where faltering /obstructions have been observed in the past.

❖ Such programmes being very positive from the sericulture farmers' point of view should continue in the long run for the benefit of the sericultural fraternity.

11. LIST OF ALL INDIA COORDINATED RESEARCH PROJECTS HIGHLIGHTS / AUTHORIZATION PROJECTS HIGHLIGHTS

11.1.1. AICEM: All India Coordinated Experimental Trial for mulberry -Phase-III **(August, 2011 to December, 2016)**

Highlight:

In **AICEM Phase III**, 4 new mulberry genotypes were evaluated in 8 test centers of Eastern and NE states over 3 years. In irrigated condition of CSR&TI, Berhampore, C-2038 appeared superior to other with the mean seasonal leaf yield of 10.80 t /crop and total yield potential of 53.80 t /ha/yr.

Pooled information from six rainfed test centers (three in WB and one each from Manipur, Jharkhand and Odisha) also showed the superiority of C-2038 over all other test genotypes in respect of leaf yield (23% over check cultivar S-1635), ancillary traits like total shoot length (11% over S-1635) and leaf numbers per meter length (11% over S-1635).

In the hilly area of RSRS Kalimpong, Tr-23 appeared best performer in respect of leaf yield (32% over zonal check S-146) and other foliage biomass attributing traits like total shoot length (20% over S-146) and leaves per meter length (10% over S-146).

Overall performances of genotype C-2038 indicated highest average annual leaf yield production (53.80 t /ha / yr in irrigated and 17.3 to 21.3 t /ha / y in rainfed) and excelled the check (S-1635) by 21% and 23% in irrigated and rainfed condition of Eastern and NE regions. The genotype Tr-23 appeared best performing genotype in hilly region of Kalimpong and showed 42% higher leaf yield potential than zonal check S-146.

11.1.2. AIB 3545: Authorization trial of silkworm hybrids in Eastern and North-Eastern India. **(August, 2015 to July, 2017).**

Highlight:

Falguni/spring crop, 2016: A total quantity of **63,400 dfls** of multi x bi and bivoltine hybrids has been supplied to farmers of all the test centers. Average yield of cocoon recorded in M6DPC x (SK6 x SK7) was 47.8 kg/ 100 dfls and in Nistari x (SK6 x SK7), it was 44.4 kg/ 100 dfls. Whereas in bi x bi hybrid (B.Con.1 x B. Con.4), the yield was 49.4kg/ 100 dfls in West Bengal, Jharkhand and Odisha and in NE states it was 46.6 kg/ 100dfls.

Baisakhi crop, 2016: A total quantity of **38,100 dfls** of multi x bi hybrid has been supplied to farmers of West Bengal and Jharkhand. The average yield/ 100 dfls was recorded in M6DPC x (SK6 x SK7) 41.22 kg and in Nistari x (SK6 x SK7) 39 kg.

Autumn crop, 2016: A total quantity of **1,00,500 dfls** of multi x bi and bi hybrids have been supplied to farmers of all the test centres. The average cocoon yield/ 100 dfls was recorded 45.2 kg in B.Con.1 x B.Con.4 and 43.6 kg in SK6 x SK7 in NE states where as in West Bengal and Jharkhand, B.Con.1 x B.Con.4 was supplied and yield recorded 54.9 kg/ 100dfls. In West Bengal and Jharkhand multi x bi hybrids (M6DPC x (SK6 x SK7) supplied and yield reported 47.6 kg/ 100dfls and in Nistari x (SK6 x SK7), it was 47.61 kg/ 100 dfls.

12.A.CENTRAL COLLABORATIVE PROGRAMME: BIVOLTINE CLUSTER PROMOTION PROGRAMME IN EASTERN & NORTH-EASTERN ZONE

Zonal co-ordinator: Dr. Kanika Trivedy, Director, CSR&TI, Berhampore
Zonal Nodal Officer: G. C. Das, Scientist-C, CSR&TI, Berhampore

During XII five year plan period (2013-2018), 15(Fifteen) BV clusters have been developed in the Eastern & North Eastern zone covering eight state viz. West Bengal (4), Odisha (2), Bihar (1), Assam (3), Manipur (2), Mizoram (1), Nagaland (1) and Tripura (1) with the active support of the respective DOSs for promotion of bivoltine silk production. The Bivoltine Cluster promotion programme is successfully completed with notable increment in bivoltine raw silk production than its initial years. All clusters of Eastern and NE zones are sucessfully functioning with increased intake of dfls, cocoons and raw silk production since implementation of the BV CPP.

The Bivoltine Cluster promotion programme was successfully completed the tenure of its XII five years plan with notable increment in bivoltine raw silk production than its initial years. During year 2016-17 achivements made againest the targets were: Total **44.49** lakhs Dfls (BV 15.695 lakh & ICB 28.701 lakh) were reared againest **29.45** lakh (BV 22.50 lakh & ICB 6.95 lakh) dfls with 151.07% achievment (but BV needs still achievement of 69.75% against the target). Raw silk production was 210.916 mt (BV 85.08 mt & ICB 125.836 mt) with 125.35% achivement againest a target of 168.26 mt (BV 140.66 mt & ICB 27.60 mt) and cocoon yield kg/100 dfls was 44.50 kg in Bivltine & 43.82 kg in ICB. On the whole, Eastern zone cluters are always achivening thier targets successfully (except Odisha clusters) as compare to NE zone clusters..

For effective monitoring of the clusters, JCPCs meeting were conducted every month to review the progress and chalk out the future plan of action. Zonal Programme Review Committee meetings were held quarterly to review the progress of the clusters. The Competent Authority has decided to continue the Cluster Promotion Programme for the next 3 years (2017-2020).

Table 93. Organization of ECP Target vs Achievement

State	Clusters	ECP			Farmers sensitized
		Target	Achiev.	% Achiev.	
West Bengal	Malda	14	14	100.00	754
	Murshidabad	15	17	113.33	1360
	Birbhum	13	13	100.00	562
	Nadia	14	14	100.00	872
Odisha	Keonjar/Ghatgaon	14	06	100.00	377
	Kashipur	14	08	100.00	305
Bihar	Kishanganj	14	16	114.29	465
Total Eastern Zone A		98	88	089.80	4695
Assam	Darrang	14	14	100.00	512
	Jorhat	14	14	100.00	525

BTC	Udalguri	14	14	100.00	425
Mizoram	Aizawl	14	14	100.00	495
Nagaland	Peren	14	22	157.14	250
Manipur	Churach'pur	14	14	100.00	628
	Ukhrul	14	14	100.00	576
Tripura	West Tripura	14	14	100.00	370
Total of NE Zone B		112	120	107.14	3781
Grand Total		**210**	**208**	**99.05**	**8476**
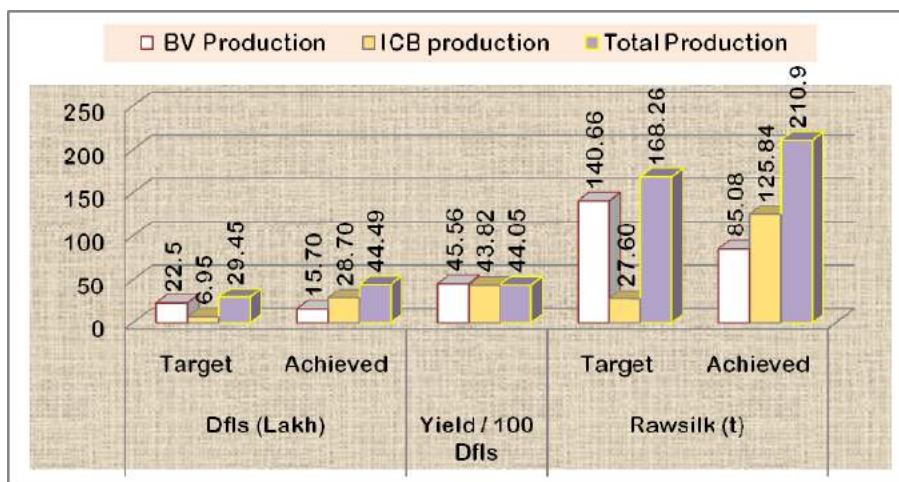
Fig. 9: Production at a glance 2016-2017
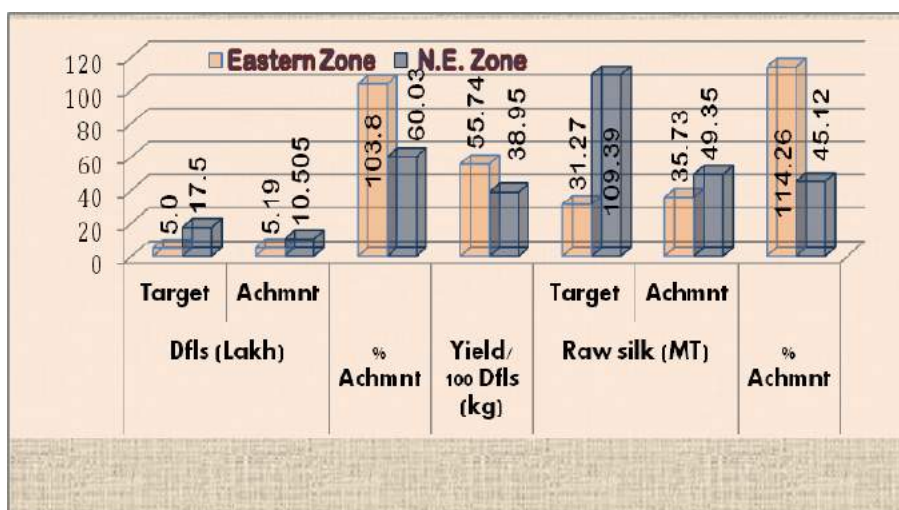
Fig. 10: BV Production in Eastern & N.E. zone during 2016-17
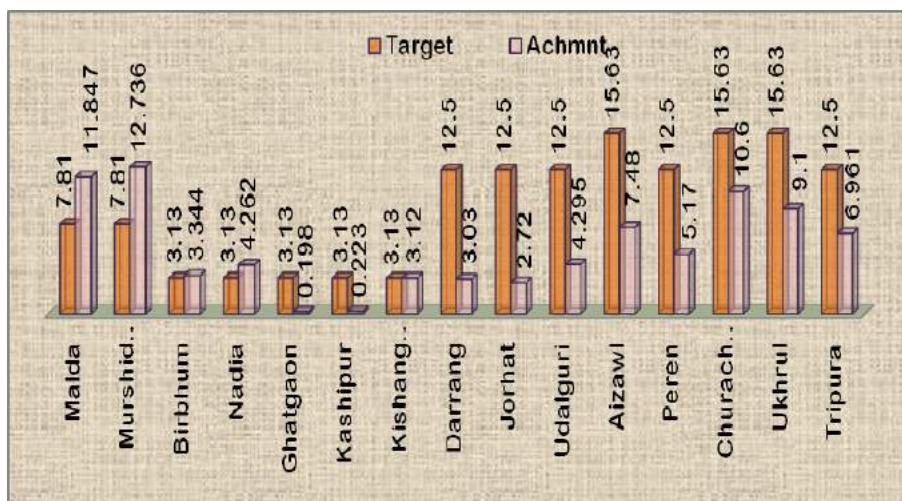
Fig.11: Cluster wise Bv Silk production during 2016-17
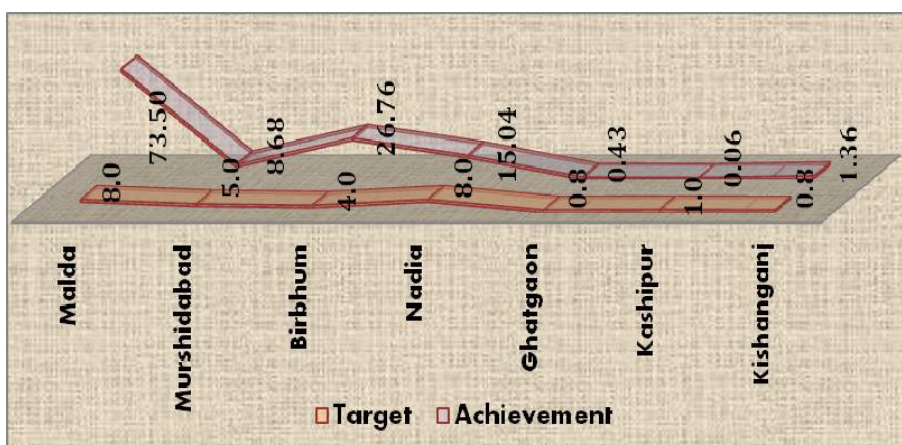
Fig.12: Cluster wise ICB silk production in Eastern zone during 2016-17

Table 94a. CPP production at a glance: target vs production **2016-2017**

Particulars	Dfls (Lakh)		% Achmnt	Actual cocoon yield (t)	Yield/ 100 dfls (kg)	Raw silk (t)		% Achmnt
	Target	Achmnt				Target	Achmnt	
BV production Eastern Zone	5.0	5.190	103.8	289.28	55.74	31.27	35.73	114.26
BV Production of NE Zone	17.5	10.505	60.03	409.13	38.95	109.39	49.35	45.12
Total BV Production	22.5	15.695	69.75	698.41	44.50	140.66	85.08	60.49
ICB production	6.95	28.701	412.96	1257.89	43.82	27.60	125.836	455.93
Grand Total	**29.45**	**44.49**	**151.07**	**1959.89**	**44.05**	**168.26**	**210.916**	**125.35**

Table 94b. ICB production under CPP (Easter zone) during 2016-17

#	Cluster	Dfls (Lakh)		% Achive.	Total cocoon yield (t)	Yield/ 100 Dfls (kg)	Raw silk (t)		% Achive.
		Tar.	Achi.				Tar.	Achi.	
West Bengal									
1	Malda	2.00	16.56	828.1	735.03	44.38	8.0	73.503	918.79
2	Murshidabad	1.25	1.73	138.4	86.81	50.18	5.0	8.681	173.62
3	Birbhum	1.00	6.79	678.9	267.60	39.42	4.0	26.764	669.10
4	Nadia	2.00	3.13	156.4	150.39	48.09	8.0	15.043	188.04
	Total	**6.25**	**28.21**	**451.3**	**1239.83**	**43.95**	**25.0**	**123.991**	**495.96**
Odisha									
1	Ghatgaon	0.25	0.131	52.4	3.85	29.38	0.80	0.425	53.13
2	Kashipur	0.25	0.033	13.2	0.63	18.94	1.00	0.062	6.20
	Total	**0.50**	**0.164**	**32.8**	**4.47**	**27.28**	**1.80**	**0.487**	**27.06**
Bihar									
1	Kishanganj	**0.20**	**0.330**	**165.0**	**13.59**	**41.18**	**0.80**	**1.358**	**169.75**
Grand Total of ICB Production		**6.95**	**28.701**	**412.96**	**1257.89**	**43.83**	**27.60**	**125.836**	**455.93**

Table 94c. BV production under 15 CPP (E & NE Zone) during 2016-17

#	Cluster	Dfls (Lakh)		% Achive.	Actual cocoon yield (t)	Yield/ 100 Dfls kg	Raw silk (MT)		% Achive.
		Tar.	Achive.				Tar.	Achive.	
West Bengal									
1	Malda	1.25	1.613	129.04	94.787	58.76	7.81	11.847	151.69
2	Murshidaba	1.25	1.720	137.60	105.262	61.20	7.81	12.736	163.07
3	Birbhum	0.50	0.560	112.00	26.75	47.77	3.13	3.344	106.84
4	Nadia	0.50	0.645	129.00	34.107	52.88	3.13	4.262	136.17
	Total	**3.50**	**4.538**	**129.66**	**260.906**	**57.49**	**21.88**	**32.189**	**147.12**
Odisha									
1	Ghatgao	0.50	0.090	18.00	1.591	17.68	3.13	0.198	6.33
2	Kashipur	0.50	0.062	12.40	1.790	28.87	3.13	0.223	7.12
	Total	**1.00**	**0.152**	**15.20**	**3.381**	**22.24**	**6.26**	**0.421**	**6.73**
Bihar									
1	Kishanganj	0.50	0.50	100.0	24.992	**49.98**	3.13	3.12	99.68
Total of Eastern Zone		**5.0**	**5.19**	**103.8**	**289.28**	**55.74**	**31.27**	**35.73**	**114.26**
Assam & BTC									
1	Darran	2.0	1.35	67.5	24.25	17.96	12.5	3.030	24.24
2	Jorhat	2.0	0.79	39.5	21.75	27.53	12.5	2.720	21.76
3	Udalguri	2.0	0.90	45.18	34.32	37.99	12.5	4.295	38.72
	Total	**6.0**	**3.04**	**44.67**	**80.32**	**29.97**	**37.5**	**10.05**	**26.79**
Mizoram									
1	Aizawl	2.5	1.30	52.00	61.87	47.59	15.63	7.48	47.86
Nagaland									
1	Peren	2.0	1.20	60.00	44.04	36.70	12.50	5.17	41.36
Manipur									
1	Churach'pu	2.5	1.80	72.00	85.59	47.55	15.63	10.60	67.82
2	Ukhrul	2.5	1.50	60.00	72.77	48.51	15.63	9.10	58.20
	Total	**5.0**	**3.30**	**66.00**	**158.36**	**47.99**	**31.26**	**19.70**	**63.01**

Tripura									
1	West Tripura	2.0	1.66	83.05	64.54	38.86	12.5	6.961	55.69
Total of NE Zone		**17.5**	**10.46**	**57.95**	**409.13**	**40.34**	**109.39**	**49.35**	**45.12**
Grand Total		**22.5**	**15.65**	**68.14**	**698.41**	**45.56**	**140.66**	**85.08**	**60.49**

Table 95. Clusterwise CDF (CSB & DoS) entrusted for CPP activity:

State	Cluster	Cluster Development Facilitator	
		CSB Representative	**DOS Representative**
West Bengal	**Malda**	Shri Kajol Ray, TA, REC, Mothabari, Malda	Shri Manoj Baidya, Dy. Director DoT (Seri), Malda.
	Murshidabad	Dr. T Dutta (Biswas), Sci-D, REC, Kamnagar, Murshidabad	Shri A. K. Pani, Dy. Director, DoT (Seri), Berhampore, Murshidabad.
	Birbhum	Shri S. Mukherjee, TA, REC(SU), Kalitha, Birbhum	Sri. S. K. Das, Dy. Director, DoT(Seri), Suri, Birbhum
	Nadia	Shri G. C. Das, Sci-C, CSR&TI, Berhampore, Murshidabad	Shri Anath Nath Mondal, JD & DD (I/C), DoT(Seri), Krishnagar, Nadia
Odisha	**Ghatgaon**	Shri Satyabrata Dey, Sci-C, REC, Dhenkikota, Keonjhar,	Shri R.C. Mahapatra, Asstt. Director (Seri), DoS, Keonjhar, Odhisha
	Kashipur	Dr. K. C. Brahma, Sci-C, RSRS, Koraput, Odhisha	Shri Bijaya Kumar Mishra, Asst. Director, DoS, Koraput, Odhisha
Manipur	**Churach- andpur**	Dr. L. Somen Singh, Sci-D, REC, Imphal, Manipur	Shri G. Vunglian, Asst. Director, DoS, Manipur
	Ukhrul	Dr. L. Somen Singh, Sci-D, REC, Imphal, Manipur	Shri John Lakshang, Asst. Director, DoS, Manipur
Mizoram	**Aizawl**	Shri B. N. Choudhury, Sci-D, REC, Aizawl, Mizoram	Shri Lalremsiama, Asst. Director, DoS, Mizoram
Nagaland	**Peren**	Dr. Anukul Borah**,** Sci-D, REC, Dimapur, Nagaland	Shri Yashimeren, District Sericulture Officer, DoS, Nagaland
Assam	**Darrang**	Dr. S.N. Gogoi**,** Sci-D, RSRS, Jorhat, Assam	Shri H.S. Dewan, Asst. Director (Seri), DoS, Darrang, Assam
	Jorhat	Smt. Mina Pamehgam, Sci-C, RSRS, Jorhat	Shri Gobin Kolitha, Extension Officer, DoS, Assam
	Udalguri, BTC	Shri. U. C. Boruah**,** Sci-D, RSRS, Jorha	Sri H. K. Hazarika, Asst. Director, DoS, Udalguri, BTC
Tripura	**Champak- nagar**	Dr. G. B. Singh, Sci-D, REC, Agartala,. Tripura	Shri Shakti Pada Bhowmik, Supdt. of Seri., DoS, Tripura
Bihar	**Kishanganj**	Shri Bimal Ch. Ray, Sci-D, MSEDP, Kishanganj, Bihar	Shri N. P. Verma, Asstt. Director, DoS, Purnea, Bihar.

View of the Zonal Bv-CPP meeting held on 19.07.2016 & 17.012017

12. B. LIST OF INTER-INSTITUTIONAL COLLABORATING PROJECTS – (along with the name of Coordinator and the investigators from each of the collaborating institute)

12. B. Projects: 10 Nos (Main Institute -9 Nos. + Nested Unit - 1 No.)

1. **AIB 3577.** Evaluation of multivoltine germplasm to identify potential parents for developing cross breeds for Southern & Eastern India. **(June, 2016 to Sept., 2019).** (**Collaborative with CSGRC, Hosur).**

   Investigators: Zakir Hossain and N. Chandrakanth (CSRTI, Berhampore) & N. Balachandran, M. Muthulakshmi, G. Thanavendan and S. Nivedita (From CSGRC, Hosur), K. K. Sharmila, Dayananda and Y.C. Radhalakshmi (Fr. CSRTI, Mysuru).

2. **AIB 3578.** Evaluation of exotic bivoltine silkworm breeds to identify promising parental genetic resources. **(June, 2016 to Sept., 2019).** (**Collaborative with CSGRC, Hosur).**

   Investigators: A. K. Verma and Zakir Hossain (fr. CSRTI, Berhampore) & M. Muthulakshmi, Veeranna Gowda and Anuradha H. Jingade and S. Nivedita (Fr. CSGRC, Hosur), C. M. Kishor Kumar and P. V. Soudaminy (Fr. CSRTI, Mysuru), and, Babulal and D. Guruswamy (Fr. CSRTI, Pampore).

3. **PPF 3532.** Assessment, development and management of area under mulberry in major sericulture districts of West Bengal using geo-spatial technique. **(Feb., 2015 to Jan., 2017). (Collaborative with ISRO, NESAC, Meghalaya).**

   Investigators: Monica Chaudhuri   (Fr. CSR&TI, Berhampore) and B.K. Handique, North East Space Application Centre, Dept. of Space, Govt. of India, Meghalaya.

4. **PIB 3505.** Development of drought tolerant mulberry variety for rainfed sericulture. (**Jan., 2014 to Dec., 2019). (Collaborative with CSGRC, Hosur).**

   Investigators: M.K. Ghosh (Upto 31.03.2016), K. Suresh (Fr.01.04.2016), P.K. Ghosh, S.K. Dutta, [CSR&TI, Berhampore] and K. Jhansi Lakshmi and M.M. Borpuzari [CSGRC, Hosur].

5. **PPE 3517.** Population Interaction of Pest and natural enemies in mulberry ecosystem. **(Aug., 2014 to July, 2017) [*Collaborative with National Bureau of Agricultural Insect Resources, ICAR, Bangalore].**

   Investigators: S. Chanda (Fr. 22.11.16), D. Das (upto 21.11.16 and CI fr. 22.11.16), U.C Boruah, Sudeb Chatterjee (Upto 30.11.16), Ranjit Kar (Fr. 01.12.16), Dr. Ankita Gupta* and Dr. Pratheepa*.

6. **ARP 3522.** Isolation, Cloning and characterization of antibacterial protein(s) from silkworm (*Bombyx mori* L.) **(April, 2015 to March, 2018).** (**Collaborative with SBRL, Kodathi, Bangalore)**

   Coordinator: Dr. K.Trivedi, Director, CSR&TI, Berhampore and Director (I/C) SBRL, Kodathi, Bangalore.
   Investigators: Satadal Chakrabarty (Upto 02.07.16) and K. Rahul (Fr. 09.08.2016), Zakir Hossain, Sci-D (Fr. 09.08.2016) and Gourab Roy, JRF and Dr. G. Ravikumar, Sci-D, SBRL, Kodathi, Bangalore.

7. **AIB 3545.** Authorization Trial of Silkworm hybrids in Eastern and North Eastern India. **(August, 2015 to July, 2017). [Collaborative with NSSO, Bangalore and CSTRI, Bangalore**].

   Coordinators: Dr. K.Trivedi, Director, CSR&TI, Berhampore and Director, NSSO, Bangalore and CSTRI, Bangalore.
   Investigators: A. K. Verma, N. Suresh Kumar (Upto 31.05.2016) and V. Lakshman (Fr. 06.08.16)

8. **AIT 3557.** Multi-locational trial on transgenic Bm NPV resistant silkworm strains to establish their efficacy and generate data for their regulatory approval. **(Jan., 2016 to Aug., 2017)** (**Collaboration with APSSRDI, Hindupur, Andhra Pradesh).**

   Coordinators: Dr. K.Trivedi, Director, CSR&TI, Berhampore and Director, APSSRDI, Hyderabad, Andhra Pradesh.
   Investigators: Gopal Chandra Das (Fr. 01.03.2017), Jayeeta Sarkar (Upto 28.02.17) and S. Roy Chowdhury (Upto 23.07.2016)

9. **AICEM-III.** All India Coordinated Experimental Trail for Mulberry (AICEM) - Phase III. (**A prog. of C.O., Bangalore**) (**August, 2011 to December, 2016).**

   Zonal Coordinator: K.Trivedy, Director, CSR&TI, Berhampore
   Team Leader: R. Banerjee, Sci-D
   Investigators: S.N. Gogoi, G.S. Singh, K.C.Brahma, Ranjit kar and L. S. Singh.

NESTED UNITS: 1 No.

10. **APS 3539.** Characterization of mulberry growing soils for nutrient management in selected seri-villages of Golaghat districts of Assam. **(April, 2015 to March, 2017). (Collaborative with NBSS&LUP, ICAR, Jorhat**)

    Coordinators: Dr. K.Trivedi, Director, CSR&TI, Berhampore and Director, NBSS & LUP, ICAR, Jorhat.
    Investigators: S. N. Gogoi, RSRS, Jorhat and Prasenjit Roy, NBSS & LUP, Jorhat.

13. CONTINUOUS / ROUTINE PROGRAMME

13.1. MULBERRY BREEDING AND GENETICS SECTION

13.1.1. BPI(P)025: Maintenance of mulberry Germplasm Bank at CSR&TI, Berhampore (W.B.). **(Jan., 2013 to Dec., 2018).**

K. Suresh (**PI**- fr.01.04.2016), M K Ghosh (**PI**- up to 31.03.2016), R Banerjee (from 1.4.2016), S K Dutta and Raghavendra K.V.(upto 19.08.2016).

Objective: Maintenance of mulberry germplasm bank for using them in breeding programme.

A total of 301 mulberry germplasm collections comprising of 12 *Morus* species are maintained in the gene bank in subtropical sericulture region of Berhampore, West Bengal following recommended cultural practices.

Periodical evaluation for incidence/infestation of diseases and pests indicated infestations of thrips and mealy bug during April to June 2016 and was in the range of 1.0 to 10.44 and 11.61 to 70 no per plant respectively. Various degrees of whiteflies infestations (range: 3.3 to 17.7 no per plant) was observed during July. *Myrothecium* leaf spot (MLS) and powdery mildew (PMLD) were predominant during October-November 2016. Disease severity varied from 3.5% (Rohachi) to 30.8% (Australia) for MLS; while in PMLD severity ranged from 1.3% (Shukakuichi) to 16.9% (*M. tiliafolia*).

13.2. SILKWORM BREEDING AND GENETICS SECTION

13.2.1. BAI(RP) 003: Maintenance of bivoltine and multivoltine germplasm (Continuous)

V. Lakshmanan, A. K. Verma and N. Chandrakanth.

Objective: To maintain the silkworm breeds confirming to their original breed characteristics.

A total of 50 bivoltine and 31 multivoltine silkworm breeds/ strains were maintained as stock lots conforming to their original breed characteristics. Multivoltine breeds are reared 5 to 6 times in a year whereas bivoltine 2 times. List of the bivoltine and multivoltine germplasm are given below.

Table 96a. List of the bivoltine germplasm

#	Name	#	Name	#	Name
BIVOLTINE - OVAL					
01	KPGA	09	SK3C	17	SP2
02	KPGB	10	SK3N	18	KSO1
03	KPG11	11	YB	19	GEN3
04	SK3	12	NBO1	20	BHR2
05	MC4 (E)	13	NBO2	21	BG(W)

06	MC4 (O)	14	NBO3	22	SH6
07	MC2	15	NBO4		
08	CSN	16	CSR47		
BIVOLTINE - DUMBBELL					
23	SK6	33	Chinese Pea nut	43	MJ$_2$
24	SK7	34	NBP$_4$	44	RSJ1
25	NB18	35	NP2	45	DUN22
26	P5	36	D6(M)	46	JPN
27	B.Con.1	37	BHR1	47	J112
28	B.Con.4	38	BHR3	48	SK6 (SL)
29	D6PN	39	SK4	49	SK7 (SL)
30	SK4C	40	D5	50	NB4D2 (SL)
31	D6(P)	41	SK4N		
32	NB4D2	42	MJ$_1$		

Table 96b. List of the multivoltine germplasm

#	Name	#	Name	#	Name
MULTIVOLTINE : ELLIPTICAL / SPINDLE					
51	M. Con.4	60	M$_2$B	69	M12(W) (SL)
52	M. Con.1	61	Pure Mysore	70	M12(W) (SL)
53	M15	62	Sarupat	71	MH1
54	M6DPC(lm)E	63	Nistari Plain	72	BL67
55	M6DPC (Gc)	64	Nistari Marked	73	ND7
56	M6DPC	65	Nistari Debra	74	Nistari Chalsa
57	M6M81	66	Nistari White	75	M.Con 4^{Id} (NP)
58	M12(W)	67	M.Con 4^{id} (P)		
59	Cambodge	68	Nistari (Sl)		
MULTIVOLTINE - OVAL					
76	M9A	78	O (Oval)	80	G
77	CB5	79	M2	81	OS616

13.3. SILKWORM PATHOLOGY SECTION

13.3.1.BAR (RP)021: Survey, surveillance and monitoring of silkworm diseases in seed and commercial crops in Eastern and North Eastern India *(In collaboration with RSRSs, RECs, DOS and NSSO).* **(April, 2016 to March, 2019)**

Chief Executive Autority: Dr. K. Trivedy, Director, CSRTI, Berhampore.

Co-Ordinators: Director, DoT (Seri), Govt. of West Bengal, Odisha, Jharkhand and Assam and Scientist-D, NSSO, West Bengal, Odisha, Jharkhand and Assam.
Zakir Hossain (**PI** w.e.f. 09.08.16),   S. Chakrabarty (**PI**- up to 02.07.16), V.Lakshmanan, C. Maji, S. Chanda, D. Pandit, D.Chakrabarty, G.C Das, S. Sarkar, K. Rahul, K.C.Brahma, S.K.Misro, S.N.Gogoi, and all In-Charge of RECs of Eastern & NE region, In-chrges of NSSO offices & DOT (Seri),W.B.

Objectives:

1. To identify the disease responsible for crop loss at DOT (Seri), NSSO and farmers' field during seed and commercial crops.
2. To suggest effective remedial measures to farmers/farms to prevent /management of the diseases and forewarn the farmers' for ensuing seed and commercial crops.
3. To collect the meteorological and crop yield data for analysis.

Progress:

A. West Bengal :

i) Commercial crops (565 samples) **(Fig.13)**

1. *Baisakhi (April):* From 208 samples collected from 37 villages 19.55% pebrine was detected. 1.45% flacherie, 2% grasserie, 0.33% muscardine and 11.97% gattine was also detected.
2. *Shravani (May-June)*: Overall disease incidence was low; Incidence of 6.67% gattine from 30 samples collected from 5 villages was detected.
3. *Bhaduri (August)*: During this season also disease incidence was comparatively low. Incidences of 0.21% flacherie, 2.67% grasserie, 0.2% muscardine and 2.5% gattine was detected from 86 samples collected from 12 villages.
4. *Aswina (September)*: 0.65% pebrine, 0.47% flacherie, 10.16% grasserie and 12.13% gattine was detected in 82 samples collected from 13 villages.
5. *Aghrayani (November)*: 159 samples collected from 26 villages revealed very low incidence of diseases: 1.56% grasserie, 0.39% muscardine, 0.76% gattine. Pebrine was reported from only 1out of 159 samples.
6. *Falguni (February)*: 120 samples collected from 12 villages revealed 1.83% grasserie, 0.9% muscardine and 0.1% flacherie.

ii) Seed Crops **(Fig.14)**

1. 972 samples collected from 48 villages/DoS farms revealed avg. incidences of 0.2% flacherie, 2.76 % grasserie, 0.23% gattine, 0.13% muscardine and 0.3% pebrine.

B. Jharkhand (Fig.15)

An average incidence of 2.22 % flacherie, 4.82 % grasserie and 3.07 % gattine from samples collected from 66 farmers.

C. Odisha (Fig.16)

Avg. incidence of 5.28 % grasserie, 6.13 % flacherie and 1.5 % muscardine was reported from 36 samples collected from rearings conducted in two crops i.e. Sept-Oct and Oct-Nov.

D. *NE Region* (Fig.17-19)

During the period 191 samples collected from 161 farmers from 75 villages of 7 states (Assam, Manipur, Nagaland, Tripura, Mizoram, Meghalaya and Sikkim) of the NE region revealed that:

1. In the *April crop* avg. incidence of Grasserie ranged from 1.6 – 12%; that of flacherie, 0.6 – 4.6%.

3. In the *September crop*, Grasserie ranged from 2.64 -14% and Flacherie 0.53 – 3%. In this crop Muscardine (7.91%) from Shillong and Gattine (0.1%) from Rangpo was also recorded.
4. In the *October/November* crop Grasserie was recorded in the range of 2.2 – 4% and Flacherie, 0 – 5.2%.

Preventive/remedial measures to minimize/control the crop loss due to diseases are regularly being advised to the stakeholders during the time of visit. Meteorological data is also regularly being collected and updated and the same will be correlated with silkworm disease incidence at the time of conclusion of the programme.
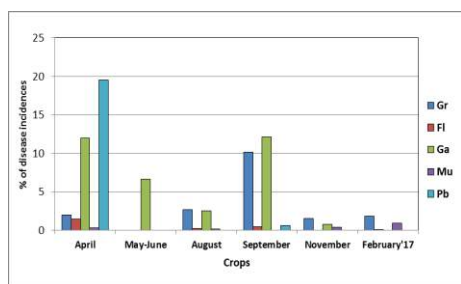
Fig.13 Avg. incidences (%) of silkworm diseases during commercial crops in West Bengal
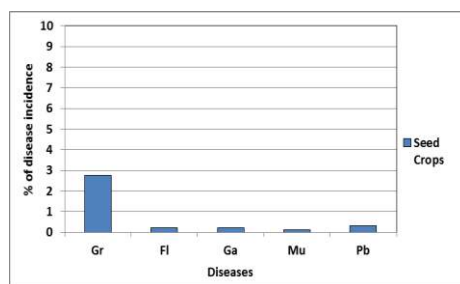
Fig.14 Avg. incidences (%) of silkworm diseases during seed crops in West Bengal
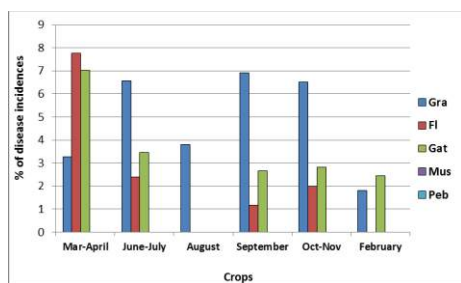
Fig.15 Avg. incidences (%) of silkworm diseases in Jharkhand
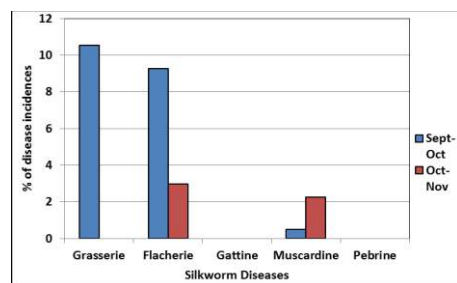
Fig.16 Avg. incidences (%) of silkworm diseases in Odisha
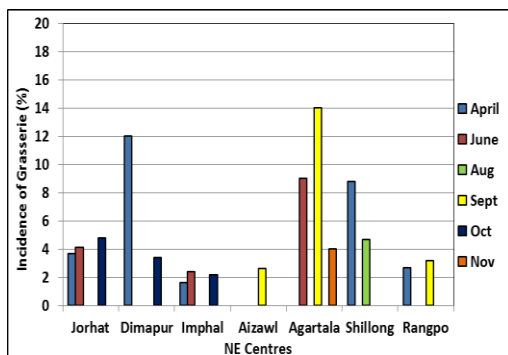
Fig.17. Avg. incidence (%) of Grasserie disease during different crops in NE region
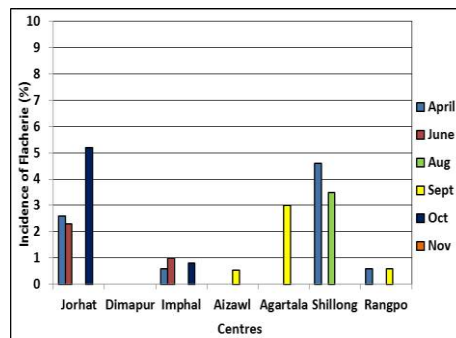
Fig.18. Avg. incidence (%) of Flacherie disease during different crops in NE region
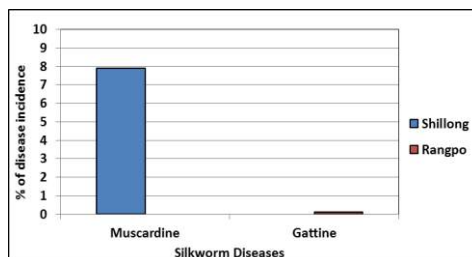
Fig.19. Avg. incidence (%) of Muscardine & Gattine during September crop in NE region (Shillong & Rangpo)

13.4. ENTOMOLOGY SECTION

13.4.1. BAR(RP) 022. Survey and surveillance of mulberry pests in the eastern and north eastern regions of India. **(June, 2016 to May, 2021)**
S. Chanda (**PI**- from 22.11.16), D. Das (**PI** upto 21.11.16), Manjunatha, G. R and in-charges of all RSRSs and RECs.

Objectives:
1. To generate and widen the database on pest incidence and climatic factors of the different agro-eco zones of the Eastern and North Eastern India.
2. To establish correlation between weather factors and pest incidence.
3. To develop weather based forecasting models for the major mulberry pests.

EO1. Survey on incidence of major pests on mulberry.
EO2. Correlation between weather factors and pest incidence.
EO3. Forecasting models for the major mulberry pests in eastern and north eastern regions of India.

Table 97. Incidence of pests on mulberry for 2016-17

#	Area covered	Pest population		
		Thrips (No./leaf)	Whiteflies (No./leaf)	Mealy bugs (No./shoot)
1.	Institute S-1 S-1635	0-1 0-2	1-8 1-17	0-3 0-11
2.	Murshidabad	0-3	0-12	0-9
3.	Malda	0-2	0-15	0-18
4.	Birbhum	0-5	0-10	-
5.	Nadia	0-4	0-12	0-10
6.	Kalimpong & Rangpo	-	-	1-6
7.	Koraput	0-5	0-4	0-5
8.	North Eastern region	3-5	3-17	3-5

13.5. RSRS, KALIMPONG

13.5.1. B-KPG (P) 017. Maintenance of bivoltine silkworm germplasm. **(April, 2015 to March, 2020).**

C. Maji(**PI** upto 10.06.2016),S. Chatterjee (upto 30.11.2016) and R. Kar (from 13.07.2016).

Objective: To maintain the bivoltine silkworm breeds true to their original racial characters and to study their qualitative and quantitative traits

Progress:

A total of 39 Bivoltine breeds are being maintained in the Bivoltine Germplasm Bank as Stock lot at RSRS Kalimpong. Rearing of the same was conducted during spring crop (April-May) 2016 and Autumn crop (August-September) 2016. Dfls of each breed were kept under aestivation. The rearing performances of the breeds are presented below in Table – 98 & 99.

Table 98. Rearing Performance of Bivoltine Silkworm Germplasm Breeds in spring, 2016

#	Breed	Fec. (No.)	ERR		SCW (g)	SSW (g)	Shell %
			No.	Wt.			
1	B. Con. 1	511	8833	14.70	1.60	0.305	19.00
	Bench Mark	550	9500	15.25	1.80	0.360	20.00
2	B. Con. 4	491	9167	16.06	1.58	0.301	19.04
	Bench Mark	550	9000	15.10	1.85	0.380	20.50
3	BHR1	504	8533	12.06	1.45	0.264	18.16
	Bench Mark	550	9250	16.10	1.85	0.380	20.50
4	BHR 2	460	7700	12.00	1.63	0.303	18.53
	Bench Mark	550	9500	16.10	1.85	0.370	20.00
5	BHR 3	540	9300	14.76	1.71	0.309	18.06
	Bench Mark	550	9350	16.10	1.90	0.390	20.50
6	BL1	550	6633	11.53	1.49	0.284	19.03
	Bench Mark	550	9500	16.25	1.85	0.360	19.50

#	Breed	Fecundity (No.)	ERR		SCW (g)	SSW (g)	Shell %
			No.	Wt.			
7	BP (Ch)	515	8267	13.33	1.58	0.266	16.81
	Bench Mark	450	9450	14.50	1.65	0.280	17.00
8	BP (Bl)	524	6533	8.36	1.45	0.234	16.13
	Bench Mark	450	9450	14.50	1.65	0.300	18.20
9	CSR 5	447	6600	10.13	1.59	0.295	18.45
	Bench Mark	550	9250	16.50	1.85	0.430	23.20
10	CSR 18	449	6233	10.00	1.40	0.259	18.49
	Bench Mark	600	9500	16.10	2.15	0.450	20.90
11	CSR 19	497	7167	10.36	1.39	0.253	18.10
	Bench Mark	550	9550	15.20	1.81	0.380	21.00
12	CSR 46	520	8333	11.33	1.55	0.299	19.27
	Bench Mark	550	9450	15.85	1.85	0.410	22.20
13	CSR 47	492	1533	2.40	1.50	0.250	17.22
	Bench Mark	550	9250	16.20	1.85	0.420	22.70
14	CSR 50	475	6433	8.70	1.42	0.286	20.03
	Bench Mark	550	9600	16.20	1.85	0.420	22.70
15	CSR 51	526	1733	2.50	1.32	0.210	15.97
	Bench Mark	550	9250	16.50	1.85	0.420	22.70
16	CSR 52	473	4900	6.20	1.35	0.230	17.05
	Bench Mark	600	9550	16.20	1.95	0.450	23.10
17	CSR 53	463	3733	4.80	1.33	0.220	16.58
	Bench Mark	600	9550	16.25	1.85	0.410	22.20
18	Changnang	464	8300	12.96	1.67	0.309	18.46
	Bench Mark	550	9500	15.50	1.75	0.350	20.00
19	D4	521	8100	12.56	1.62	0.309	18.97
	Bench Mark	550	9250	16.10	1.85	0.380	20.50
20	D6M	480	9133	14.33	1.64	0.321	19.53
	Bench Mark	550	9500	16.10	1.85	0.370	20.00
21	D6(P)	506	8167	12.53	1.43	0.270	18.85
	Bench Mark	550	9100	16.10	1.90	0.380	20.00
22	JD 6	535	9167	14.23	1.73	0.302	17.46
	Bench Mark	550	9500	16.25	1.75	0.360	20.60
23	J 122	539	9467	13.93	1.50	0.267	17.75
	Bench Mark	550	9500	15.25	1.80	0.370	20.60
24	KPG-A	562	8100	13.30	1.68	0.305	18.11
	Bench Mark	600	9250	15.85	1.84	0.370	20.10
25	KPG- B	528	8800	11.76	1.50	0.277	18.45
	Bench Mark	575	9500	15.25	1.75	0.350	20.00
26	KPG-7	535	5367	8.33	1.42	0.246	17.31
	Bench Mark	550	9550	15.25	1.80	0.370	20.60
27	MC1	491	8800	12.63	1.50	0.263	17.46
	Bench Mark	550	9500	15.25	1.80	0.36	20.00
28	MC2	525	6800	10.20	1.42	0.261	18.34
	Bench Mark	550	9300	15.20	1.80	0.360	20.00
29	MJ 1	507	8867	11.68	1.46	0.266	18.14
	Bench Mark	550	9500	16.20	1.75	0.360	20.60
30	MJ 2	470	6300	10.26	1.55	0.284	18.32
	Bench Mark	550	9450	15.85	1.85	0.370	20.00
31	NB4D2	517	9400	13.50	1.39	0.236	16.95
	Bench Mark	550	9500	16.50	1.90	0.390	20.50

#	Breed	Fec. (No.)	ERR No.	ERR Wt.	SCW (g)	SSW (g)	Shell %
32	NB 18	531	7867	12.76	1.60	0.311	19.39
	Bench Mark	500	9500	16.20	1.85	0.370	20.00
33	P5	519	8367	11.06	1.59	0.297	18.61
	Bench Mark	550	9200	16.15	1.80	0.360	20.00
34	Pam 105	535	5700	7.73	1.59	0.269	16.82
	Bench Mark	550	9500	15.25	1.85	0.370	20.00
35	SF19	537	7633	9.36	1.45	0.278	19.17
	Bench Mark	550	9250	15.65	1.85	0.380	20.50
36	SH-6	570	6733	9.93	1.57	0.300	19.10
	Bench Mark	550	9250	15.25	1.85	0.370	20.00
37	SK4 (II)	584	5600	8.96	1.53	0.296	19.35
	Bench Mark	550	9200	16.25	1.85	0.380	20.50
38	SK6	537	9067	13.46	1.56	0.285	18.27
	Bench Mark	550	9450	16.20	1.85	0.360	19.50
39	SK7	538	8000	12.66	1.53	0.286	18.60
	Bench Mark	550	9550	15.35	1.85	0.380	20.50

Table 100. Rearing Performance of Bivoltine Silkworm Germplasm Breeds in Autumn, 2016

#	Breed	Fec. (No.)	ERR No.	ERR Wt.	SCW (g)	SSW (g)	Shell %
1	B. Con. 1	531	8760	12.68	1.57	0.301	19.12
	Bench Mark	550	9500	15.25	1.80	0.360	20.00
2	B. Con. 4	473	7960	11.80	1.51	0.256	16.91
	Bench Mark	550	9000	15.10	1.85	0.380	20.50
3	BHR1	523	8720	13.24	1.63	0.311	19.02
	Bench Mark	550	9250	16.10	1.85	0.380	20.50
4	BHR 2	480	7720	11.80	1.62	0.297	18.27
	Bench Mark	550	9500	16.10	1.85	0.370	20.00
5	BHR 3	497	6760	09.92	1.6	0.299	18.37
	Bench Mark	550	9350	16.10	1.90	0.390	20.50
6	BL1	448	7520	11.24	1.76	0.335	18.99
	Bench Mark	550	9500	16.25	1.85	0.360	19.50
7	BP (Ch)	521	8800	12.08	1.41	0.205	14.51
	Bench Mark	450	9450	14.50	1.65	0.280	17.00
8	BP (Bl)	519	9600	13.24	1.48	0.195	13.16
	Bench Mark	450	9450	14.50	1.65	0.300	18.20
9	CSR 5	463	8200	11.08	1.48	0.268	18.01
	Bench Mark	550	9250	16.50	1.85	0.430	23.20
10	CSR 18	447	3920	05.44	1.45	0.256	17.62
	Bench Mark	600	9500	16.10	2.15	0.450	20.90
11	CSR 19	550	5480	07.24	1.42	0.259	18.20
	Bench Mark	550	9550	15.20	1.81	0.380	21.00
12	CSR 46	492	6040	08.08	1.51	0.273	18.08
	Bench Mark	550	9450	15.85	1.85	0.410	22.20
13	CSR 47	535	3040	03.84	1.51	0.258	17.03
	Bench Mark	550	9250	16.20	1.85	0.420	22.70
14	CSR 50	520	1880	02.20	1.45	0.252	17.31
	Bench Mark	550	9600	16.20	1.85	0.420	22.70

#	Breed	Fec. (No.)	ERR		SCW (g)	SSW (g)	Shell %
			No.	Wt.			
15	CSR 51	562	3200	3.960	1.53	0.261	17.00
	Bench Mark	550	9250	16.50	1.85	0.420	22.70
16	CSR 52	540	3120	4.040	1.51	0.260	17.14
	Bench Mark	600	9550	16.20	1.95	0.450	23.10
17	CSR 53	470	3200	03.76	1.52	0.270	17.67
	Bench Mark	600	9550	16.25	1.85	0.410	22.20
18	Changnang	526	7120	11.12	1.52	0.276	18.16
	Bench Mark	550	9500	15.50	1.75	0.350	20.00
19	D4	460	7200	10.00	1.47	0.230	15.65
	Bench Mark	550	9250	16.10	1.85	0.380	20.50
20	D6M	535	9560	14.36	1.40	0.229	16.31
	Bench Mark	550	9500	16.10	1.85	0.370	20.00
21	D6(P)	507	9440	11.40	1.67	0.325	19.38
	Bench Mark	550	9100	16.10	1.90	0.380	20.00
22	JD 6	504	8320	12.28	1.56	0.268	17.18
	Bench Mark	550	9500	16.25	1.75	0.360	20.60
23	J 122	525	7080	09.76	1.62	0.296	18.23
	Bench Mark	550	9500	15.25	1.80	0.370	20.60
24	KPG-A	537	8640	12.52	1.50	0.279	18.53
	Bench Mark	600	9250	15.85	1.84	0.370	20.10
25	KPG- B	538	6000	9.88	1.47	0.252	17.08
	Bench Mark	575	9500	15.25	1.75	0.350	20.00
26	KPG-7	535	6920	11.88	1.90	0.370	19.47
	Bench Mark	550	9550	15.25	1.80	0.370	20.60
27	MC1	539	5680	09.64	1.61	0.306	18.98
	Bench Mark	550	9500	15.25	1.80	0.360	20.00
28	MC2	511	5680	08.64	1.76	0.330	18.72
	Bench Mark	550	9300	15.20	1.80	0.360	20.00
29	MJ 1	584	9160	12.88	1.49	0.264	17.65
	Bench Mark	550	9500	16.20	1.75	0.360	20.60
30	MJ 2	570	9000	13.20	1.51	0.264	17.43
	Bench Mark	550	9450	15.85	1.85	0.370	20.00
31	NB4D2	491	9520	13.00	1.44	0.268	18.60
	Bench Mark	550	9500	16.50	1.90	0.390	20.50
32	NB 18	464	6240	11.20	1.70	0.312	18.35
	Bench Mark	500	9500	16.20	1.85	0.370	20.00
33	P5	528	7320	10.28	1.77	0.348	19.56
	Bench Mark	550	9200	16.15	1.80	0.360	20.00
34	Pam 105	491	7440	10.48	1.63	0.268	16.44
	Bench Mark	550	9500	15.25	1.85	0.370	20.00
35	SF19	469	7320	11.68	1.68	0.315	18.75
	Bench Mark	550	9250	15.65	1.85	0.380	20.50
36	SH-6	438	7840	12.40	1.74	0.348	19.99
	Bench Mark	550	9250	15.25	1.85	0.370	20.00
37	SK4 (II)	515	5280	08.68	1.72	0.338	19.58
	Bench Mark	550	9200	16.25	1.85	0.380	20.50
38	SK6	524	9760	14.00	1.46	0.264	18.02
	Bench Mark	550	9450	16.20	1.85	0.360	19.50
39	SK7	438	9400	13.20	1.42	0.259	18.24
	Bench Mark	550	9550	15.35	1.85	0.380	20.50

14. TRAINING PROGRAMMES CONDUCTED
14. A.MAIN INSTITUTE
14. A.1. STRUCTURED TRAINING COURSE
A.1. Post Graduate Diploma in Sericulture (Mulberry):

Duration: 15 months.

Scientists Associated: Chandana Maji, Sci-D, (Fr. 13.06.2016), Sukhabrata Sarkar, Sci-C (Fr. 05.07.2016), Zakir Hossain, Sci-D, (Upto 14.06.2016), Debashis Chakravarty, Sci-D (Upto 14.06.2016) and Jalaja S. Kumar, Sci-D, (Upto 31.05.2016).

Objective: To generate a steady stream of professionally competent Human Resources from the fresh candidates / deputed by different state Governments/ NGOs in both pre and post cocoon sectors for meeting the manpower requirement by the sericulture industries at various levels**.**

A batch comprising of 24 students of the session 2015-16 have successfully completed PGDS course by 30th September, 2016 and the next batch of 13 students of the session 2016-17 are undergoing training. The course is affiliated under the University of Kalyani (Table 101).

Table 101. Details of Post Graduate Diploma in Sericulture (Mulberry):

#	Sponsoring Agencies	No. of candidates	
		Course completed by 30.09.2016	Course started by 01.07.2016
1	Govt. of Manipur	08	05
2	Govt. of Nagaland	06	03
3	Govt. of Assam	06	-
4	Govt. of Mizoram	03	02
5	Govt. of Arunachal Pradesh	-	03
6	Direct admission (Maharashtra)	01	-
	Total:	**24**	**13**

Practical exam. of the PGDS students in 1st semester

Practical class on Post Cocoon Technology

PGDS students in "Clean India Campaign" on 26th Jan., 15 at CSB, Bengaluru

14.A.2. NON-STRUCTURED TRAINING COURSE
14.A.2.1. Farmers Skill Training Programme:

Duration: 5 – 10 days.

Scientists Associated: Chandana Maji, Sci-D (Fr. 13.06.2016), Sukhabrata Sarkar, Sci-C (Fr. 05.07.2016), Zakir Hossain, Sci-D (Upto 14.06.2016), Debashis Chakravarty, Sci-D (Upto 14.06.2016) and Jalaja S. Kumar, Sci-D (Upto 31.05.2016).

Objective: To upgrade the knowledge of sericulture farmers through theoretical and practical training for overall achievement in increase of their income levels from sericulture.

A total of 264 farmers were trained under this programme (Table 101).

Table 102. Details of the farmers training

Name of the course	Duration (Days)	Persons trained (No.)
Chawki Silkworm Rearing	10	91
Late Age Silkworm Rearing	10	36
Mulberry cultivation	5	56
Integrated disease & pest management	5	81
Total:	**-**	**264**

| Practical demonstration to the trainees under SUP | Theory class on pest management | Trainee is awarded certificate |

14.A.2.2. Technology Orientation Programme:

Duration: 3 days

Scientists Associated: Chandana Maji, Sci-D (Fr. 13.06.2016), Sukhabrata Sarkar, Sci-C (Fr. 05.07.2016), Zakir Hossain, Sci-D (Upto 14.06.2016), Debashis Chakravarty, Sci-D (Upto 14.06.2016) and Jalaja S. Kumar, Sci-D (Upto 31.05.2016).

Objective: To upgrade the knowledge of officers / officials both CSB and DoS in respect to technologies developed by this Institute for its effective translation in the farmers' field of their respective states for promotion of enterprise to achieve the target.

A total of 94 officers and staff of different sister units under CSB were trained in this training programme.

#	Duration (Days)	Sponsoring authority	Persons trained
1	3	Central Silk Board	50
2	1	--do--	43
3	1	--do--	01
		Total:	**94**

14.A.2.3. Need based training programme conducted on the request of different agencies:

> **Scientists Associated:** Chandana Maji, Sci-D (Fr. 13.06.2016), Sukhabrata Sarkar, Sci-C (Fr. 05.07.2016), Zakir Hossain, Sci-D (Upto 14.06.2016), Debashis Chakravarty, Sci-D (Upto 14.06.2016) and Jalaja S. Kumar, Sci-D (Upto 31.05.2016).

Table 103. Details of Adhoc training programmes conducted

#	Course	Duration (Days)	Sponsoring authority	Person trained	Objective
1	Beneficiary Empowerment Programme for Farmers	3-10	oS,Assam DoS,Meghalaya & DoS, Nagaland	134	To impart basic knowledge on sericulture and for exposure on latest technologies developed by the Institute to the farmers and officials of concerned state.
2	Orientation Training Programme for in service candidates	5	Ce tral Silk Board	08	To impart training on latest technologies developed to the in service candidates who joined this Institute from other units.
3	Training on microsco pic examination of silkworm disease	3	DoS, W. B.	81	To impart training on identification of different diseases of mother moths.
4	Training Progm. on "soil testing"	1	Ce tral Silk Board	27	Digitalization of soil health card
5	Training Progm. on "Establishment rule"	1	Ce tral Silk Board	01	To update knowledge on different establishment rules & regulation.
6	Awareness Training Programme for Jeevika Bihar	10 -30	DoS, Bihar	66	To impart training on latest technologies developed by the Institute to the officers & officials of DoS, Bihar.
7	On job Training Programme	3-9	K. N.college Berhampore & B.C.K.V,	30	To impart training on latest technologies of sericulture to the college students.

8	Awareness Training Programme for farmers of Uttar Pradesh	03	DoS, UP	518	To impart basic training on different aspects of sericulture and technologies developed by this Institute for the region.
9	Seri Resource Centre	1	DOS, W.B.	600	It is a **"Learning Centre"** in the farmers' field and technology transfer is made through the concept of **"Seeing is believing"** and **"Learning by Doing".**
	Total:	**-**	**-**	**1465**	-

Practical class of the trainees on vermicomposting

Chairman CSB visiting Library of CSR&TI,Ber

Distribution of certificate to the trainee after training

Inauguration of SRC, Barbakpur, Nadia by Hon'ble Director on 23.02.17

Training Programme held on 17.03.17 and 21.03.2017at SRC, Barbakpur

Distribution of SRC Materials at CSR&TI, Berhampore

Visit of students from universities/colleges/schools/ organizations and farmers for an exposure to mulberry sericulture:

A total of 449 students and 477 farmers along with escorts were exposed to modern technologies concerning sericulture activities during 2016-17 at this Institute.

Table 104. Visit of students

#	Date	Sponsored by	Persons (No.)
1.	05/04/2016	PGDS, CTR&TI, Ranchi, Jharkhand	13
2.	12/04/2016	K.N.College (Seri.), Berhampore, W.B.	37
3.	04/06/2016	Girls College, Berhampore, W.B.	44
4.	08/06/2016	K.N.College (Seri.), Berhampore, W.B.	21
5.	23/06/2016	Don Bosco School, Berhampore, W.B.	49
6.	25/04/2016	Sri Shikshayatan School, Kolkata	54

7.	07/12/2016	South City International School, Kolkata	40
8.	23/12/2016	Dukhulal Nibaran Chandra College, Murshidabad, W.B.	34
9.	27/02/2017	West Bengal State University, Barasat, W.B.	30
10.	28/02/2017	K.N.College (Seri.), Berhampore, W.B.	67
11.	01/03/2017	K.N.College (Seri.), Berhampore, W.B.	60
		Total :	**449**

Table 105. Visit of farmers

	Date	Sponsored by	Persons (No.)
1.	26/04/2016	ATMA, Gazole, Malda, W.B.	10
2.	29/06/2016	ATMA, Rampurhat, Birbhum, W.B.	30
3.	30/06/2016	ATMA, Bolpur, Birbhum, W.B.	63
4.	11/07/2016	ATMA, Karimpur, Nadia, W.B.	45
5.	12/07/2016	T.S.C., Mothabari, Malda,W.B.	11
6.	10/09/2016	ATMA, Nabadwip, Nadia, W.B.	07
7.	15/09/2016	Dy. Director (Seri), Malda, W.B.	10
8.	16/09/2016	ATMA, Kaliganj, Nadia, W.B.	09
9.	28/09/2016	ATMA, Chapra, Nadia, W.B.	08
10.	22/10/2016	ATMA, Khajure, Medinipur, W.B.	26
11.	07/02/2017	Asst. Director, Agriculture, Malda, W.B.	30
12.	15/02/2017	ATMA, Nabadwip, Nadia, W.B.	12
13.	23/03/2017	ATMA, 24 Paraganas, W.B.	37
14.	30/03/2017	ATMA, Md. Bazar, Birbhum, W.B.	179
		Total :	**477**

College students are in practical class

Meeting on Implementation of Official Language

One of the trainees is awarded certificate after completion of training

14.B. NESTED UNIT

14.B.1.RSRS,KALIMPONG

14.B.1.1. Trainers Training Programme (TTP):

One day Trainers' Training Programme (TTP) was conducted by RSRS, CSB, Kalimpong at SSDF, Nimbong, DoT (Seri), West Bengal with 07 trainees on 28.03.2017. The trainees were imparted training with different aspects of rearing of bivoltine silkworm, especially precautionary measures of silkworm diseases, handling and care of chawki worms, bed spacing etc.

Name of the Course	Duration (Days)	Persons trained (Nos.)
Trainers Training Programme	01	07

14.B.1.2. Farmers Training Programme (FTP):

RSRS, CSB, Kalimpong conducted one day Farmers Training Programme (FTP) each at Changdung village, Gitdubling , Kalimpong on 30.12.2016, at RSRS, Kalimpong on 30.01.2017 and 02.02.2017 with a view to enhance the knowledge level of the seri-farmers of Kalimpong area on different aspects of silkworm rearing and mulberry plantation.

Name of the Course	Date	Persons trained (Nos.)
Farmers Training Programme	1) 30.12.2016 2) 30.01.2017 3) 02.02.2017	12 15 15
Total	03 nos. programme	42

14.B.2. RSRS, KORAPUT

14.B.2.1. Trainers' Training Programme (TTP):

One Trainers' Training Programme was organized at the premises of RSRS, Koraput on 28th December 2017 to impart training to the technical personnel of DOS, Odisha on the following topics: -

- Soil Testing & its reclamation.
- Integrated Package of Practices for Mulberry cultivation.
- Disinfectants and disinfection procedure for a successful rearing. New Technologies of Silkworm rearing & management.

14. B.2.2. Farmers' Training Programme (FTP):

A total of 36 farmers were trained in three Farmers Training Programmes at the premises of RSRS, Koraput from different areas of the state

Batch No	Date	No of farmers	Area
1	10.08.2016	11	Kashipur Block
2	16.12.2016	13	Lamtaput Block
3	8.02.2017	12	Kashipur Block
Total		**36**	**2 Blocks**

14. B.2.3. Farmers Field School (FFS):

With two lead farmers Sri Bibhishan Kumbhar , village Kumbharashila and Sri Rabindra Gouda, Bhagamunda village in Kashipur Block, Rayagada district (Odisha) 8 sittings have been conducted and total of 99 farmers were attended.

14.B.3. RSRS, JORHAT

14.B.4.1. Trainers' Training Programme

Under Human Resources Development Programme, 5 days training programme was conducted at RSRS, Jorhat during the year. A total of 5 nos. of DOS officials of Golaghat district were trained in various aspects like Mulberry plantation,

silkworm rearing, Chawki rearing, disinfection of rearing room, black boxing, disease & pest management etc. The detailed is presented below:

Sponsoring Agency	Target	Apr - Sept	Oct - March	Achievement
DOS, Assam	1	--	1 (5)	1(5)

14. B.4.2. Farmers Training Programme:

Under Human Resources Development Programme, Farmers training programme was conducted at RSRS, Jorhat and its 6 nested unit during the year. A total of 888 nos. of mulberry farmers of N.E. states were trained in various aspects like Mulberry plantation, silkworm rearing, Chawki rearing, disinfection of rearing room, black boxing, disease & pest management etc. The detailed is presented below:

Name of Units	Target	Apr - Sept	Oct - March	Achievement
RSRS, Jorhat No. of beneficiary	03 programme	--	3	3 (90)
REC, Agartala No. of beneficiary	03 programme	--	5	5 (168)
REC, Aizawl No. of beneficiary	03 programme	2	3	5 (163)
REC, Dimapur No. of beneficiary	03 programme	2	3	5 (102)
REC, Imphal No. of beneficiary	03 programme	--	5	5 (141)
REC, Shillong No. of beneficiary	03 programme	3	2	5 (154)
REC, Mangaldoi No. of beneficiary	03 programme	--	5	5 (129)

CAPACITY BUILDING FOR SERICULTURE SECTOR:

Developing Community Based Organizations (CBOs) /Confidence building Training (CBT) under SRC:

1. Seri Resource Centre, Barbakpur, Karimpur II, Nadia: A total of 206 farmers of SRC, under Bivoltine CPP Cell Berhampore.
2. Seri Resource Centre, Mothabari, Malda: A total of 200 farmers of SRC, under REC, Mothabari were trained in 10 batches with 20 members of farmers each.
3. Seri Resource Centre, Kamnagar, Murshidabad: A total of 200 farmers of SRC, under REC, Kamnagar were trained in 10 batches with 20 members of farmers each.

Seri Resource Centre (SRC) is a new innovative concept / platform of **"Learning Centre"** in the farmers' field and technology transfer is made through the concept of **"Seeing is believing"** and **"Learning by doing"**. It is a farmer to farmer's extension teaching method and helps the farmers who cannot undergo training at Research Institute (CSRTI, Berhampore). The demonstration and teaching are being conducted at the lead progressive farmers' garden / rearing house in the village and

facilitate all the nearby farmers to participate in the event. Extension workers and subject matter specialists will teach the participants about the sericulture technologies. The main objectives of SRC were to empower the farmers with knowledge and skills and to make them experts in their own field.

"**Faculty development programme:**

CSR&TI, Berhampore has organized a **Five Days** training on "**Faculty development programme**" from 14th to 18th Feb., 2017 at this institute with active support of CBT, CSB, Bengaluru and a total of 25 scientists of this institute participated actively in the programme. During the programme few eminent resource persons were invited to impart the training. The basic objective of organising such programme was to develop the faculty for structured and non-structured courses conducted by this institute.

The Institute deputed scientists for various training programmes:

1 **Dr. (Mrs.) Subhra Chanda**, Scientist-D, participated in 5 days training programme on **"Navigating ICTs for Agricultural Extension"** held during 8-12 August, 2016 organized by National Institute of Agricultural Extension Management (MANAGE), Hyderabad at UAS Bengaluru, Karnataka.

2 **Mr. K. Suresh,** Scientist-B, participated in ten days training programme on "**Bioinformatics tools and techniques in Agriculture"** at ICAR-NAARM, Hyderabad, Telangana during 1st to 10th November, 2016.

3 **Dr. Dipesh Pandit**, Scientist-D, participated in10 days training programme on **"Innovative approaches to technology enhanced learning"** held during 17th to 26th November, 2016 organized by National Academy of Agricultural Research Management (NAARM), Hyderabad, Telangana.

4 **Dr. N. Chandrakanth,** Scientist-B, participated in three days training programme in "**Quarantine procedures under CSB Act, 2006"**, held at SSPC, Bangalore during 4th to 6th January, 2017.

5 **Dr. V.Vijay,** Scientist-B, participated in three days Training programme on "**Quarantine procedures under CSB Act, 2006"**, held at SSPC, Bangalore during 4th to 6th January, 2017.

6 **Ms. Pooja Makwana**, Scientist-B, participated in 3 days training on "**Quarantine procedures under CSB Act, 2006"**, held at SSPC, Bangalore during 4th to 6th January, 2017.

15. Important Delegation leaded or participated:

Ms. Arunima Das, WBCS (Executive), Managing Director, Paschim Banga Resham Shilpi Samabaya Mahasangha Ltd., West Bengal visited the Institute on 09.05.2016. Dr. Kanika Trivedy, Director welcomed her with a flower bouquet and she visited the museum of the Institute and Reeling & Spinning section. She was highly impressed to see the handicraft made from the cocoon by the institute.

Shri. Abhijit Mukherjee, Hon'ble Member of Parliament, Jangipur constituiency visited the Institute on 09.06.2016. He was welcomed by Dr. Kanika Trivedy, Director of the Institute. He had interacted with the scientists on finding the avenues for development of Mallickpur-Diara village, the Adarsha Resham Gram adopted by the institute. He visited the museum and field to observe the research activities. He highly appreciated the R&D activities, maintenance of the museum and breeding materials.

The Hon'ble **Chairman, CSB, Shri. Hanumanrtharayappa** visited reeling, spun mills, rearers' farms, cocoon market, registered seed producers (RSPs) at Malda and Uttar Dinajpur districts of West Bengal state on 23.03.2017 He expressed his happiness that these resource poor farmers are producing good returns in-spite of limitations and also suggested further improvements taking help from state and CSB units.

A meeting was conducted with the Commissioner Ms. Madhumita Choudhury, DoT (Seri), Govt. of West Bengal on 24th March, 2017 and discussed about the various issues relating to the development of sericulture in the state which was observed during his visit.

16. RESEARCH PUBLICATIONS

#	Particulars	Total
1.	Research papers:	
	A. International journals	*11*
	B. National journals	*18*
2.	Popular articles	02
3.	Book/ Book Chapter	07
4.	Pamphlets	27
5.	Magazine	02

I. Research papers: 29 Nos.

International: 11 Nos.

1. Banerjee, R., Chattopadhyay, S., Saha, A.K. (2016). Genetic diversity and relationship of mulberry genotypes revealed by RAPD and ISSR Markers. *Journal of Crop Improvement,* 30(**4**): 478-492 [Taylor & Francis, UK].

2. Chandrakanth, N., Moorthy, S.M., Rekha, M. and Sivaprasad, V. (2016). Stability and path analysis for yield and related traits in silkworm, (*Bombyx mori* L.) reared under stress conditions- Genetika**, 48 (1)**: 271-284.

3. Gupta, S.K., Hossain, Z., Madana Mohanan N. and Mondal K. (2016). Impact of microsporidian infection on growth and development of silkworm *Bombyx mori* L. (Lepidoptera: Bombycidae). *Agriculture and Natural Resources.* **50:** 388-395.

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3. Sahatuut Kishan Nurery: Ek Lavjanak Kadam (2017). Chakravarty, D., Suresh, K., Banerjee, R. and Ghosh, P. K.

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6. Mulberry varieties suitable for different agro-climatic zones of West Bengal (2017). Suresh, K., Banerjee, R., Chakravarty, D., Ghosh, P. K. and Trivedy, K.
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V. *Magazine: 2 Nos.*

1. Resham Krishi Barta – Quarterly (Bengali)
2. News & Views- Halfyearly (English) [Vol.10 No.1 and No.2]

17. PAPER PRESENTED IN CONFERENCES/MEETINGS/SEMINARS /SYMPOSIA etc.

International: 1 No.

Proceedings of the 24th International Congress on Sericulture and Silk Industry held during 10th -14th August, 2016 at Bangkok, Thailand.

1. Moorthy, S. M., Chandrakanth, N., Sivaprasad, V., Mal Reddy, N. and Ashwath, S. K. (2016). Evolution of thermo-tolerant suitable bivoltine silkworm breeds for tropics employing marker-assisted selection. Abs. p. 45.

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Proceedings of the National Conference on Mulberry Seri-biodiversity – Challenges and future perspectives for sustainable conservation and utilization held on 8th September, 2016 at CSGRC Hosur, Tamilnadu.

1. Moorthy, S.M., Sivaprasad, V. and Chandrakanth, N. (2016). Genetic relatedness between Nistari and Pure Mysuru through microsatellite markers. *p.* 49.
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Proceedings of the XIII Agricultural Science Congress, 2017 (Climate Smart Agriculture) held during 21st -24th February, 2017 at UAS, Bengaluru.

1. Kar, R. and K. Trivedi (2017). Assessment of carbon capturing potential of mulberry and soil organic carbon stock under different farming practices. *Abs.C095, pp. 494.*
2. Mahesh, R., Meitei, H. P., Chaudhuri, M. and Tirivedy, K. (2017). Effect of fertilizer dose and split application of fertilizer on nutrient use efficiency in mulberry.

Proceedings of the Rajbhasha Sangosthi on "Shehtuti Resham Ka Vikas – Nayi Taknikyon Ke Saath" held on 20th January, 2017, Central Sericultural Research & Training Institute, Central Silk Board, Berhampore, West Bengal.

1. Banerjee, R., Chattopadhyay, S., Makwana, P., Rao, A.B., Agarwal, R. K. and Nirmal Kumar, S. (2017). Nimna aur ucchha upaj clone ke sankaran se Sahatut *(Morus* sp.) geneprarup ka bisheshikaran. (Abs. No. PP-02, P.13)

2. Biswas. T. D., Joyshree Devi. T., Afroz. S and Kanika. T. (2017). Kishan star par kosa utpadan ke gunatmak aaur matratmak sudhar par chaki-palit resham kit ka prabhav. (Abs. No. OP-14, P.25)

3. Chakravarty, D. Ghosh, M. K., Suresh, K., Ghosh, P. K., Banerjee, R., Nirmal Kumar, S. and Trivedy, K. (2017). Khad ke dose 50% tak kam kar gangeya jalorh mrieda se upayukta geneprarup ke chayan par adhyan. (Abs. No. PP-03, P.14)

4. Chattopadhyay, G.K., Verma, A.K., Chadrakanta, N., Nirmal Kumar, S. and Trivedy, K. (2017). Sankaran ke bina banijyik keetpalan hetu congenic nasl ka pratyakshya upayog. (Abs. No. OP-12, P.23).

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7. Dasari. J. R. (2017). Resham Krishi – Ajibika ke samvardan hetu gramin udhyam ka ek Kendra. (Abs. No. OP-04, P.5).

8. Dey. S. B., Das Mahapatra. D. P and Ghosh. M.K. (2017). Sahatoot ke liya upayukt mrida , mrida ke namune ikkate karna avan parikshan. (Abs. No. PP-07, P.18).

9. Ghosh, M. K., Mishra, S, K., Brahma, K, C., Dey, S, B. and Das Mahapatra, D, P. (2017). Odisha may sahatoot resham utpadan ka ek sambhavit drishya. (Abs. No. OP-01, P.2).

10. Ghosh, P. K., Chakravarty, D., Ghosh, M. K., Suresh, K., Nirmal Kumar, S. and Trivedy, K. (2017). Sahatut ki utpadakata aur gunabatta bikash ke liye trigunita generup ka parikshwan. (Abs. No. PP-04, P.15)

11. Gupta, S.K, Hossain, Z., and Madan Mohanan, N. (2017). Reshamkeet (*Bombyx mori* L.) mein sankraman karnewali kayee microsporidian isolates ke ragjanakta, tulnatmak anishtkarta aur bahulikaran dar ka adhyyan. (Abs. No. OP-16, P.27.)

12. Lakshmanan, V., Suresh Kumar, N., Chadrakanta, N., Verma, A.K., Nirmal Kumar, and Trivedy, K. (2017). Purbi tatha uttar purbi khetro ke paribartanshil jalabayu abastha ke adhin shuttle prajanan taknik ke dwara *Bombyx mori* L. ke naya dwipraja sankar ka bikash . (Abs. No. OP-11, P.22)

13. Maji, C., Sarkar S., Zakir Hossain, Chakraborty, D., and Trivedy, K. (2017). Resham Utpadan Ke Bhivinna Bishaya Mei Prashikshan Karyokram Ka Mulyankan. (Abs. No. PP-01, P.6)

14. Maji. M. D and Maji. C. (2017). Paschim Bangal ke maidani elakon avan Darjeeling pahadi Kshetra ke sahtoot roog ke mausam aadharit purvanuman avan purvasuchana. (Abs. No.PP-10, P.21)

15. Mishra. S. K., Ghosh. M. K., Brahma. K. C., Dey. S. B and Das Mahapatra. D.P. (2017). " Drum kit drip aur highdojel" – bhavishya may jal sanrakshan hetu ek aashajanak padwati. (Abs. No. PP-08, P.19)

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17. Mukhopadhyay, S. K., Manjunatha, G.R., Shanthakumar, M.V, Lalitha, N. and Trivedy, K.(2017). Murshidabad mein mousam maapdand adharit khet makshi apatan haitu poorvaanumaan model ka vikaas (Abs. No. OP-09, P.11)

18. Nirmal Kumar, S. (2017). Reshamkit anusandhan ke kshetra may ubharta sambhavana aaur chunoutia. (Abs. No. A, P.1).

19. Pandit, D., Manjunatha, G.R. and Trivedy, K. (2017). Shauatooti resham krishako ki samaajik-artik stithi: Maheshpur Raj Pakur Jharkhand mein ek adhyaan (Abs. No. OP-03, P.4)

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21. Ponnuwel K. M., Gupta.T and Mishra R. K. (2017). Reshamkit Bombyx mori mein densovirus sankraman aaur isme roogpratirodh ki veavastha. (Abs. No. OP-15, P.26)

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23. Saini. P. and Chauhan. S. S. (2017). Jammu va Kashmir rajya ki sitoshna jalvaiyu may nispatron hetu sahatoot anuvansik sansadhano may anuvanshik vividhata ka adhyayan.(Abs.No. OP-05, P-7

24. Singh, G. B and Trivedy K. (2017). Tripura rajya may kosa utpadan par mausam ka prabhav, (Abs. No. OP-02, P.3)

25. Singhal. B., Bindru. B. B and Khan. M.A. (2017). Upa – usnakatibandhiea Bharat may sahatoot purna avan shakaon se audiogic utpad.(Abs. No. OP – 10, P.12)

26. Suresh, K., Ghosh, M. K., Banerjee, R., Ghosh, P. K., Chakravarty, D., Nirmal Kumar, S. and Trivedy, K. (2017). Sahatut me physio-morphological traits ka parna upaj se sambandha par ek akalan. (Abs. No. PP-05, P.16).

27. Suresh, K., Ruhiya, S., Chakravarty, D., Banerjee, R. and Trivedy, K. (2017). Kissan nursery ke liye sahatut paudhe utpadan ke bibhinna tariko ka akalan aur inka arthik bosleshan. (Abs. No. OP-07, P.9)

28. Verma, A.K., Chattopadhyay, S., Chadrakanta, N., Nirmal Kumar, and Trivedy, K. (2017). Amliya upachar ke bina Bahu x Dwi romuch -a upayog. (Abs. No. OP-13, P.24).

18. CONSULTATION & OTHER SERVICES RENDERED
- NIL -

19. KEY SCIENTIFIC RECOMMENDATIONS MADE BY THE RAC, RC RRAC AND EOM

Place	Events	Time Schedule
CSR&TI, Berhampore	RAC	20th July, 2016; 18 &19th, January, 2017
	RC	13th April, 2016; 25th & 26th Nov., 2016
	EOM & CPP	19th July, 2016; 17th January, 2017
RSRS, Kalimpong	RRAC	8th June, 2016 ; 17th December, 2016
RSRS, Koraput		27th June, 2016; 8th December, 2016
RSRS, Jorhat		13th June, 2016; 20th December, 2016

Major Recommendations:

A. Research Advisory Committee:

1. 44th meeting held on 20th July, 2016.

- Use of organic formulations and pheromone trap for management of mulberry pests and diseases.
- Increase the profitability and sustainability of sericulture through mechanization and drudgery reduction.
- Joint supervision of DoS and CSB in respect of management of pest and diseases, CRC and seed certification to the farmers to ensure production of quality dfls.
- Necessity of development of season /region-specific silkworm breeds/ hybrids and drought-tolerant mulberry variety for rain-fed regions.
- Transfer of technology programmes should be strengthened.
- Reduction of existing yield gap in both mulberry and silkworm through timely technological interventions.
- Orientation and placement of new scientists stressing more on strengthening their capacity building.

2. 45th meeting held on 18 &19th, January, 2017

- Scientists should visit the fields regularly and notice the problems of the stakeholders and formulate projects to tackle them.
- The extension functionaries should take special care in respect of disinfection procedures at the farmers' level and the farmers must be educated about the technological advancements in the reeling sector and technologies to be adopted for rearing in different seasons.
- The reeling machines should be popularised as the farmers are still practising the traditional ways of reeling and reeling clusters can be formed in different districts for the benefit of the farmers.
- Emphasis on the industry-based extension activities and also advised to follow a strategic plan to double the farmers' income in a year.
- Assess the impact of the technologies disseminated and find out the possibility of setting up a farmer's producer organization (FPO) with the help of NABARD.

- Put stress on organic farming practices, marketing strategies, while cautioning about the pests and the predators.
- Projects on agronomical practices have to be taken up and encourage the intercropping system.
- Take up more projects on mechanization and participate in more research-oriented training and communication programmes in allied disciplines in order to get acquainted with the research advancements which can be replicated in Sericulture.
- Explore the possibility of the implementation of soil-health card project in collaboration with the soil science subject-matter experts from NBSS & LUP, Jorhat, Assam.

B. Research Council:

1. 44th meeting held on 13th April, 2016

- Recording of data and monitoring of mulberry and silkworm pest and disease incidences in all states under Eastern & North-Eastern should be continued as routine programme.
- REC, Rangpo with DoS, Sikkim will conduct an experiment on nutrient uptake for sustaining organic mulberry farming in Sikkim in the farmer's field.
- At least 20 farmers from tarai region of North Bengal should be covered for digitalization of soil health and validate the results obtained at Kalimpong hills.
- Scientists of main Institute and RSRSs should formulate the need based projects/ prog and identify the new potential areas for the benefit of the sericulture industry in the Eastern & North-Eastern regions.

2. 45th meeting held on 25th & 26th November, 2016

- Maintenance of proper record of progress reports and expenditure incurred the project.
- Status of patenting and commercialization of the technology emanated from concluded projects to be recorded and concluded project report should invariably have a clear cut plan for utilization of the outcome.
- Quality of the different bed disinfectants which have been commercialized through the institute and available commercially at market to be analyzed periodically for maintaining its optimum quality.

C. Regional Research Advisory Committee (RRAC):

(a). RSRS, KALIMPONG:

1. 5th Meeting held on 8th June, 2016

- Preparation of farmers' Directory with complete address and phone number of the farmers pertaining to the region.
- Installation of 'Drum Kit Drip Irrigation System' at RSRS, Kalimpong campus.
- Testing of new hybrid in Kalimpong other than the ruling SK6 x SK7.

- Possibilities may be explored with a condition that the cocoons produced out of those new hybrids will be purchased by CSB from the rearers as per the rate of the seed coccons being provided by the DoT(Seri), Kalimpong.
- Preparation of Documentary film of success story to encourage the farmers of Kalimpong and Sikkim.
- Sending of messages in regional language (Nepali) on forewarning of weather and disease with precautionary measures and sent to the mobile numbers of all rearers through M- Kishan portal.
- Ensure supply of good quality of hybrid dfls to DOS, Sikkim.
- Rearers may be motivated for developing mulberry saplings by Kishan Nursery.

2. 6th Meeting held on 17th December, 2016

- Technical leaflet to be circulated among the participants while organizing extension communication programmes.
- Orient the demonstration programmes mostly around practical aspects of sericulture.
- REC, Rangpo was advised to try hard to achieve more than target with respect to expansion of new mulberry areas.
- Target of extension communication programmes to be achieved within the stipulated period.
- Detail of Direct Benefit Transfer (DBT) in Sikkim to be effeted.
- Advised DOT (Seri), Kalimpong to take up rearing of BCon1 x BCon4 at farmers level on sample basis involving just one or two progressive farmers.
- Speed up of preparation of soil health card
- Exposure visit of farmers of Sikkim to Kalimpong to gather know-how of the sericulture technologies prevailing in this hilly region.
- Seed cocoon producers of this region should be registered.
- Prepare a short term programme for improvement of sericultural productivity at seri-model village (Mahakaldara) of Kalimpong through providing live saving irrigation for mulberry during dry period and adopting appropriate soil nutrient management based on soil health card.

(b). RSRS, KORAPUT:

1. 20th Meeting held on 27th June, 2016

- Explore the possibilities of intercropping with mulberry.
- Ensure the supply of chawki worm to the farmers.
- Supply of improved Charkha & Spinning unit under Central Sector Scheme as per indent received from concern states.
- Dfls intake capacity of the farmers should be improved to its thresh hold levels.
- A model demonstration plot is to be maintained in the farm.

- Provide inputs to the farmers for disinfection of the rearing houses under prophylactic measures.
- Prepare a project **Adarshagram** on sericulture.

2. 21st Meeting held on 8th December, 2017

- Suggested to use POSHAN/ Seri boost a patented preparation of the CSR&TI, Mysore in the package of practices in Odisha.
- Mulberry disease monitoring study may be restricted to Rayagada and Koraput and with the collaboration with State government officials.
- Analyse pest and disease incidences correlating with the weather factors to develop forewarning systems.
- Gear up the preparation of soil health card for mulberry farmers with available data base.
- ECP programme will be organized for sericulture and also other farmers to motivate them for mulberry sericulture.
- Quiz programme may be conducted during ECPs and prizes to be awarded to the farmers in the form of tools, chemical and inputs.
- Studies may be taken up for multi -dimensional aspects combining different intercropping possibilities like mango with mulberry and vice versa.
- Chawki certificates are to be issued before distribution of the Chawki worms.
- Chawki rearers are to be trained from the state of Odisha.
- Publish research articles / papers in reputed journals.
- Formulate project for development/ evaluation of silkworm races/ hybrids performing best in Odisha climate.
- Propagate the drip irrigation system through drum kit to avoid water loss.

(c) RSRS, JORHAT:

1. 21st Meeting held on 13th June, 2016

- Reeling machines, one cocoon drying machine may be supplied at Jorhat district under central sector scheme.
- DoS, Assam is requested to submit proposal to establish CSB sponsored Cocoon bank to solve the problems of mulberry cocoon marketing and fixation of price an earliest.
- DoS, Assam is requested to submit complete proposal along with farmers profile indicating number of farmers, economic condition, area of plantation, dfls consumption, cocoon yield, CRC, reeling unit, incubation facilities, etc. for the development of mulberry sericulture in upland areas of Majuli.
- In-charges of all RECs was advised to develop tiger trench plantation system in hilly areas, tree type plantation, water harvesting technology concept in some selected villages.

- Green manure, vermicompost etc. should be popularized through training and demonstration in association with DOS of NE states. The resource persons from the AAU and other institutes having expertise should be invited and involved.
- As many of the silkworm indigenous races are in the verge of extinction but having enormous breeding values, RSRS in collaboration with CSR&TI, Berhampore should take up appropriate steps to collect and maintain these races in their germplasm bank for future breeding utilisation.
- Training on chawki rearing in association with DOS of NE states should be given priority to enhance cocoon yield.
- Raise plantation / Kishan nursery / CRC garden with recommended variety in Hilly and plain/ valley areas with proper spacing to increase productivity of mulberry leaf biomass.

2.   22ⁿᵈ Meeting held on 20ᵗʰ December, 2016

- Supply of improved Charkha & Spinning unit under Central Sector Scheme as per indent received from concern states.
- Initiate to establish mulberry cocoon bank for the farmers of Assam to get good cocoon price and DoS Assam should fix the cocoon price. The cocoon marketing should be conducted by DoS, Assam through co-operative society of states.
- The rearing of DUN6 x DUN22 and SH6 x NB4D2 during the Autumn Crop could not be conducted in some REC due to non receipt of dflss. However, the House advised to submit performance of the breeds in different altitudes of the region.
- Submit status report with complete farmers profile of Majuli and 5-10 Borpat dfls to CSR&TI, Berhampore during Spring Crop, 2017.
- At REC, Aizwal, Mizoram and REC, Imphal, Manipur, CxJ Hybrid (in Manipur), J112 (in Mizoram) gave good yield performance. Hence, these two hybrids to be tested under the Race Authorization programme.
- Tiger trench system & plantation practiced by REC, Dimapur to be stressed in other hills of RECs. The House advised to submit the details report on **"Tiger Trench"** system in hill areas in next meeting.
- Soil Health Card will be issued to farmers as per mandate.The local language invariably should be used in the soil health card. Benefit cost ratio should be worked out.
- The Pass port data should be worked out for comparing the data
- Collect the data under IBSDP e.g. numbers of farmers, total land area, total dfls consumed yearly and for NERTPS to collect details report of total number of farmers, training schedule, etc.
- Entire Seed development programme should be taken care of the respective state governments. Director, NSSO and Director, CSR&TI, Berhampore should be connected for discussion to chalk out programme for developing seed zone in each North Eastern states.

- In Assam, Bivoltine Seed Zone needs to be developed in the two hill districts of Karbi Aonglong and Dima Hasau due to suitable climatic and land conditions.
- State Sericulture Department should arrange special trainings for the unorganized weavers and reelers in Regional Silk Technological Research Station, Khanapara or in the local areas.

D. EXTENSION OFFICERS' MEETING (MAIN INSTITUTE):

1st Meeting held on 19th July, 2016.

- Install **'Drum Kit Drip Irrigation System'** at RSRS, Kalimpong and Jorhat.
- Supply of rotary mountages from CSR&TI, Mysore.
- Nodal Officers is directed to update "**Farmers Directory**" in hard and soft copy.
- Submit the proposal for condemnation of vehicles with full justification.
- Digitalization of land record should be done.
- Implement one **Seri Resource Centre** at Kamnagar, Murshidabad and Malda.
- All units should send messages in M-kissan portal in local languages.

2nd Meeting held on 17th January, 2017.

- Supply of rotary mountages will be pursued to Central Office Bangalore.
- Drum kit irrigation system to be shifted from RSRS, Ranchi to REC, Bhandra.
- Nodal Officer, Birbhum to be prepared "**Farmers Directory**" as soon as possible.
- Explore the feasibility of **"Tiger Trenching"** system for rain water harvest.
- Proposal for opening one **Seri Resource Centre** at Mallickpur village to be sent to Central Office, Bangalore.
- Land based units should establish Kissan Nursery and Vermicompost pit.
- Mandates/ goals of multitasking REC to be set to achieve the targets.

20. RESHAM KRISHI MELA, WORKSHOP, SEMINER AND FARMERS DAY ORGANIZED:

20. A. FOUNDATION DAY:
Venue: CSR&TI, Berhampore
Date: 15.10.2016

73rd Foundation Day of the Institute was celebrated gorgeously. It was inaugurated by the Chief Guest, Dr. Gurudas Gupta, Director, MDI, Murshidabad, Guest of Honour, Prof. Abhijit Biswas, Principal, Govt. College of Engineering & Textile Technology, Berhampore. A total no. of 241 participants with 15 guests & 12 media persons were registered on this important day. Media has covered the programme and broadcasted in TV Channels.

20. B. RESHAM KRISHI MELAS:

20. B.0 Resham Krishi Mela
Venue: CSR&TI, Berhampore
Date: 04.01.2017

A Resham Krishi Mela was organized at the Institute. A total of 1045 farmers of Malda, Nadia, Birbhum and Murshidbad districts and officials of DOS, WB were participated in the RKM. An Exhibition was also organized. **The Chairman, Central Silk Board, Bangalore was attended the programme as Chief Guest.** On the occasion 8 farmers from different district of West Bengal were awarded for their outstanding achievements. One farmer of Kalimpong, WB was awarded cash prize for his innovative idea of **preparing low cost mountages**. Awareness on Cashless Payment System in India - Unified Payment Interface (UPI) was also discoursed in the mela.

20. B.1 Resham Krishi Mela
Venue: REC, Bhandra
Date: 03.12.2016

A RKM with an exhibition on recent technologies of sericulture was organized at Lohardaga by REC, Bhandra and participated 162 farmers. The District Magistrate, Lohardaga was the chief guest. Director, CSR&TI, Berhampore presided over the function.

20. B.2 Resham Krishi Mela
Venue: RSRS, Kalimpong
Date: 16.12.2016

RSRS, Kalimpong organized RKM, 2016-17 at its office premises to aware the seri- farmers of Kalimpong hills about the technological interventions in sericultural activities and also to obtain farmers' views on adopting the same. Smt. Sarita Rai, MLA, Kalimpong was invited as the Chief Guest. '**Directory of Seri –Farmers in Kalimpong Hill**' has been released in this occasion by the dignitaries. During mela a total of 180 farmers were participated.

20. B.3 Resham Krishi Mela
Venue: RSRS, Koraput
Date: 07.12.2016

A Resham Krishi Mela was organized by RSRS, Koraput Odisha. The DM and Collector of Koraput District Shri. Jaya Kumar. V., IAS have conveyed his best wishes to all the participants. An exhibition was arranged to explain the farmers about the new technologies and innovations in the mulberry sericulture industry. A total of 178 farmers and dignitaries participated from the states of Odisha and Chhattisgarh. Four pamphlets in Odia language have been released during the Mela. Six (6) successful farmers 3 each from Odisha and Chhattisgarh were felicitated on the occasion.

20. B.4 Resham Krishi Mela
Venue: RSRS, Jorhat, Assam
Date: 22.12.2016

A Resham Krishi Mela was organized at Majuli college auditorium by RSRS, Jorhat, Assam with the gracious presence of Shri Ranjit Dutta, Hon'able Minister of Irrigation, small scale industries and sericulture, Dr. S. N. Saikia, ACS, Director, DoS, Assam, Mr. Jha, IAS, DC, Majuli, Dr. Debojit Saikia, Principal Majuli College, and Dr. K. Trivedy, Director, CSRTI, Berhampore and Dr. S. N. Gogoi, Sc-D, RSRS, JRH in the dais with a capacity audience of ~250 farmers, many dignitaries and students. Also organized an awareness programme on Cashless Payment System in India - Unified Payment Interface (UPI) to stakeholders in the mela.

Besides RKM, ten no. of mini RKMs were organized at different units of CSRTI, Berhampore for seri farmers of their respective region *viz*. REC, Dhenkikote, Odisha (05.12.2016); REC Rangpo, Sikkim (15.12.16); REC, MP Raj, Mahespur, Jharkhand (27.12.2016); REC, Agartala, Tripura (25.01.2017); Pasighat, Arunachal Pradesh (04.2.2017); REC Dimapur , Nagaland (10.02.17); REC Shillong, Meghalaya (06.2.2017); REC-Imphal (08.2.17); REC-Aizwal (12.2.17) and REC-Mongoldai (13.2.17).

20.C. SEMINAR/ WORKSHOP
Venue: RSRS, Kalimpong, West Bengal
Date: 21-23.02.2017 & 04.03.2017

Attended in the workshop on "**Technology Week and Rabi Krishi Mela**" was organized by Darjeeling Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Kalimpong, and Regional Research Station, IARI, Kalimpong at UBKV Hill Campus during 21-23 February, 2017.

A seminar was organized on "**Problems and Prospects of Mulberry Sericulture in Kalimpong Hills**" on 4th March, 2017 at Worship Centre, 9th Mile, Kalimpong, West Bengal for benefit of the seri-farmers of this region.

A Seminar on "**Problems & Prospects of Mulberry sericulture in the region**" was organized at **RSRS, Jorhat on 07.03.2017**. In the Seminar 2 no. of research papers were submitted by the Scientist of CSB and State officials. The Scientists of nested units, State officials, mulberry rearer & reelers were attended the Seminar.

20.D. HINDI SEMINAR WAS ORGANIZED BY CSR&TI, BERHAMPORE AT INSTITUTE PREMISES, BERHAMPORE, MURSHIDABAD

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर (प.बं.) में **दिनांक 20.01.2017 को "शहतूती रेशम का विकास - नयी तकनीकियों के साथ"** विषयक एक दिवसीय राजभाषा संगोष्ठी का आयोजन किया गया। संगोष्ठी का परम उद्देश्य रेशम उद्योग से जुड़े वैज्ञानिकों, कार्मिकों, प्रगतिशील कृषकों तथा रेशम पर्णधारियों समेत शहतूती रेशम पर पठन-पाठन तथा तद्विषयक शोध कार्य आदि में रत वैज्ञानिकों/पदधारियों व शोधार्थियों को मूल रुप से हिंदी में लेखन हेतु

प्रेरित एवं प्रोत्साहित कर राजभाषा प्रावधानों के सम्यक कार्यान्वयन व अनुपालन और इसके प्रसार-प्रचार को और भी गतिशील बनाना था। संगोष्ठी की अध्यक्षता संस्थान की निदेशक महोदया डॉ. कणिका त्रिवेदी द्वारा किया गया। संगोष्ठी के दौरान डॉ. एम. वी. सैमसन, निदेशक [सेवानिवृत], केरेबो, श्री राजेश बघेल, संयुक्त निदेशक, रेशम निदेशालय, बिलासपुर तथा डॉ. एम. डी. माजि, वैज्ञानिक-सी [सेवानिवृत], केरेबो क्रमशः सामान्य रेशम उत्पादन सत्र, रेशम संवर्धन सत्र एवं शहतूत संवर्धन सत्र के अध्यक्ष के तौर पर इस संगोष्ठी में विराजमान थे।

संगोष्ठी का आयोजन तीन सत्रों अर्थात् **"सामान्य रेशम उत्पादन सत्र"**, **"रेशम संवर्धन"** तथा **"शहतूत संवर्धन"** में किया गया। संगोष्ठी के दौरान संस्थान तथा केन्द्रीय रेशम बोर्ड के अन्य संस्थानों से पधारे वैज्ञानिकों द्वारा रेशम उद्योग से जुड़े काफी सूचनापरक एवं लाभप्रद कुल **23 शोध-सारांश** [13 मौखिक एवं 10 पोस्टर] प्रस्तुत किए गए। इस दौरान सर्वश्रेष्ठ मौखिक एवं पोस्टर शोध-प्रबंध व आलेख प्रस्तुत करने वाले वैज्ञानिकों को पुरस्कृत करते हुए संगोष्ठी का समापन किया गया।

20. E. SERI RESOURCE CENTRES

Director, CSR&TI, Berhampore inaugurated CSB sponsored three (3) **Seri Resource Centres** (SRCs) at Alinagar, Malad (18.2.2017), Bakipur, Murshidabad (21.2.2017) and Barbakpur, Nadia (23.2.2017) with the objectives of imparting training to the sericulture farmers' time-to-time for updating their knowledge and skills on improved sericultural activities/technologies throughout year.

<u>राजभाषा अनुभाग की उपलब्धियाँ (वर्ष 2016- 2017)</u>

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर (प.बं.) में वर्ष 2016-17 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। फलस्वरूप, दिनांक 11नवम्बर, 2016 को "भारत के पूर्वी तथा पूर्वोत्तर राज्यों" के लिए गंगटोक, सिक्किम में आयोजित क्षेत्रीय राजभाषा सम्मेलन के दौरान समारोह के मुख्य अतिथि माननीय गृह राज्य मंत्री, श्री किरण रिजुजु तथा सिक्किम के राज्यपाल, श्री श्रीनिवास दादासाहेब पाटिल महोदय के कर-कमलों द्वारा वर्ष 2015-16 के दौरान राजभाषा नीति के कार्यान्वयन में उत्कृष्ट योगदान के लिए राजभाषा शील्ड अर्थात् द्वितीय पुरस्कार से सम्मानित होने का सुअवसर इस संस्थान को प्राप्त हुआ।

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

1. धारा-3(3) का अनुपालन:

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

2. हिन्दी पत्राचार:

वर्ष के दौरान 'क', एवं 'ख' क्षेत्र में स्थित केन्द्र/ राज्य सरकार को क्रमशः 89.20%, 100% तथा 'ग' क्षेत्र में स्थित केन्द्रीय सरकार के कार्यालयों को 80.81% 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। इस दौरान संस्थान के कुल 07 पदधारी हिंदी प्रशिक्षण हेतु विविध पाठ्यक्रम [प्रबोध-01, प्रवीण-05 एवं प्राज्ञ -01] के अंतर्गत नामित किए गए। अब तक संस्थान के कुल 91.73% 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 2016-17 के अंतर्गत राजभाषा कार्यान्वयन समिति की चार बैठकों का नियमित आयोजन क्रमश: दिनांक 15.04.2016, 16.07.2016, 20.10.2016 एवं 30.01.2017 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 23.05.2016, 26.09.2016, 26.12.2016 एवं 24.03.2017 को हिंदी कार्यशाला आयोजित कर संस्थान के कुल 78 पदधारीगण [अधिकारी -11 एवं पदधारी - 67] राजभाषा हिन्दी में प्रशिक्षित किए गए तथा आगे भी यह क्रम जारी है। साथ ही, संस्थान तथा इसके अधीनस्थ केन्द्रों में कार्यरत अधिकारियों/पदधारियों को मौलिक रुप से हिंदी में तकनीकी विषयक आलेख, शोध प्रबंध आदि के लेखन हेतु प्रोत्साहित करने की दृष्टि से संस्थान में दिनांक 20.01.2017 को **"शहतूती रेशम का विकास - नयी तकनीकियों के साथ"** विषयक एक दिवसीय राजभाषा संगोष्ठी का आयोजन किया गया। इस अवसर पर 28 शोध-सारांशों से परिपूर्ण **"शहतूती रेशम का विकास - नयी तकनीकियों के साथ"** विषयक एक 'प्रोसिडिंग' का विमोचन भी संस्थान की डॉ. कणिका त्रिवेदी, निदेशक व अध्यक्ष, नराकास, बहरमपुर, डॉ. एम. वी. सैमसन, निदेशक [सेवानिवृत], केरेबो, श्री राजेश

बघेल, संयुक्त निदेशक, रेशम निदेशालय, बिलासपुर तथा डॉ. एम. डी. माजि, वैज्ञानिक-सी [सेवानिवृत], केरेबो के कर-कमलों द्वारा किया गया।

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 10 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 अभिरुचि जगाने हेतु समय-समय पर विभिन्न राजभाषा कार्यक्रम/प्रतियोगिता का आयोजन किया जाता है। इन कार्यक्रमों द्वारा कर्मचारियों को प्रोत्साहित/पुरस्कृत करने के अलावा हिन्दी में मूल रूप से टिप्पण-आलेखन करने वाले अधिकारियों/कर्मचारियों के लिए केन्द्रीय रेशम बोर्ड की उदारीकृत प्रोत्साहन योजना को भी लागू किया गया है जिसके अन्तर्गत निर्धारित शब्द संख्या हिन्दी में लिखने पर अनुपातत: नगद प्रोत्साहन राशि (महत्तम रू 2000.00) प्रदान की जाती है। हिन्दी दिवस/पखवाड़ा, 2016 के अवसर पर वर्ष 2015-16 के दौरान मूल रूप से हिन्दी में कामकाज करने हेतु कुल 09 पद धारियों को पुरस्कृत किया गया।

8. हिन्दी पुस्तक/ पुस्तिकाओं का प्रकाशन:

संघ की राजभाषा नीति के अनुसार संस्थान में अंग्रेजी प्रकाशनों के अनुरूप वैज्ञानिक एवं तकनीकी/प्रशासनिक प्रकाशनों का हिन्दी रूपांतरण तथा मूल रुप से हिंदी में लिखित पुस्तकें आवश्यकतानुसार प्रकाशित की जाती है। वर्तमान वर्ष के अंतर्गत संस्थान की वार्षिक वैज्ञानिक एवं प्रशासनिक रिपोर्ट वर्ष 2015-16 का सारांश हिंदी में प्रकाशित करने के अतिरिक्त आलोच्य अवधि के दौरान रेशम कृषि मेला के अवसर पर **"केंचुआ खाद, किसान नर्सरी: एक लाभजनक कदम एवं कीटनाशक या कवकनाशक छिड़काव करने के समय आवश्यक सावधानियाँ"** शीर्षक से तीन लीफ्लेट हिंदी भाषा में प्रकाशित की गई।

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

वर्ष 1997-98 के शुरूआत में ही राजभाषा विभाग, भारत सरकार, नई दिल्ली द्वारा संस्थान के निदेशक की अध्यक्षता में नगर राजभाषा कार्यान्वयन समिति के गठन, बैठकों के नियमित आयोजन तथा बहरमपुर नगर स्थित केन्द्रीय सरकार के कार्यालयों/बैंकों/निगमों/उपक्रमों/संगठनों आदि में संघ की राजभाषा नीति के सफल

कार्यान्वयन का अतिरिक्त दायित्व निहित किया गया। वर्ष के दौरान समिति की 31वीं बैठक दिनांक **29.04.2016** तथा दिनांक **23.09.2016** को 32वीं बैठक संपन्न की गई। समिति के प्रयास से नगर स्थित केन्द्रीय सरकार के कार्यालयों/ बैंकों/निगमों/ उपक्रमों/ संगठनों आदि में भी राजभाषा गतिविधियां बढ़ी है। इसके अतिरिक्त, नगर के सदस्य कार्यालय अपने-अपने कार्यालयो में हिन्दी दिवस, प्रतियोगिता, संगोष्ठी कार्यशाला एवं बैठकों का आयोजन कर रहे है। समिति की उक्त गतिविधियों के संचालन से संस्थान में राजभाषा कार्यान्वयन संबंधी कार्यमात्रा में भी अत्याधिक वृद्धि हुई है।

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

संस्थान के संबद्ध / अधीनस्थ केन्द्रों में कार्यरत 80% कर्मचारियों को हिन्दी प्रशिक्षण दिलाने के पश्चात ऐसे कार्यालयों को मंत्रालय द्वारा राजभाषा नियम-10(4) के अधीन अधिसूचित करने की कार्रवाई की जाती है। इस क्रम में संस्थान के 13 संबद्ध कार्यालयों को अधिसूचित कराया जा चुका है।

11. हिन्दी प्रतियोगिता का आयोजन:

वर्ष 2016-17 के दौरान दिनांक 01.09.16 से 14.09.16 तक आयोजित हिन्दी पखवाड़ा के अन्तर्गत विभिन्न हिन्दी प्रतियोगिता का आयोजन किया गया। इन प्रतियोगिता में संस्थान के अधिकारियों/ कर्मचारियों ने उत्साह से भाग लिया। इस दौरान कुल 10 हिन्दी प्रतियोगिताओं क्रमशः हिंदी टिप्पण व आलेखन 01/09/16, सुलेख एवं शब्दावली 02/09/16, निबन्ध 03/09/16, वाद विवाद 05/09/16, श्रुतलेख 06/09/16, राजभाषा प्रश्नोत्तरी 07/09/16, स्मृति परीक्षण एवं हिंदी टंकण 08/09/16, तात्क्षणिक भाषण 09/09/16 का आयोजन किया गया। प्रत्येक प्रतियोगिता के सर्वश्रेष्ठ प्रतिभागियों को प्रथम, द्वितीय, तृतीय एवं सांत्वना पुरस्कार से पुरस्कृत किए गए।

12. कंप्यूटर पर हिन्दी में कार्य:

राजभाषा अधिनियम-1963 की धारा 3(3) का अनुपालन, फार्म/प्रपत्र का द्विभाषीकरण, संबद्ध/ अधीनस्थ केन्द्रों की तिमाही रिपोर्ट का समेकीकरण एवं अनुभागीय प्रगति रिपोर्ट के तुलनात्मक विवरण आदि के संकलन एवं पत्रिका के प्रकाशन/संपादन का कार्य तथा नगर राजभाषा कार्यान्वयन समिति की गतिविधियों संबंधी कार्य को कंप्यूटर पर सुचारू रूप से किया जा रहा है। राजभाषा कार्यान्वयन के विभिन्न पहलुओं में कंप्यूटर के प्रयोग की शुरूआत से राजभाषा कार्यान्वयन के कार्य में गति आई है साथ ही साथ संस्थान की राजभाषा कार्यान्वयन समिति की बैठको में हिन्दी प्रगति से संबंधित आकड़ों का प्रस्तुतीकरण पावर-प्वाइंट के जरिये किया जा रहा है। ज्ञातव्य है कि संस्थान में

बहुभाषी पैकेज "यूनिकोड" का संस्थापन कंप्यूटर पर किया गया है जिससे शब्द प्रक्रमण के अलावा आंकड़ों के प्रक्रमण, आरेखीय निरूपण, आंकड़ों के समेकीकरण में सहूलियत एवं गति आई है।

क्षेरेउअके, कलिम्पोंगः

- वर्ष 2016-17 के दौरान क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र, कलिम्पोंग की राजभाषा कार्यान्वयन समिति की बैठकें क्रमशः दिनांक 24.06.2016, 29.09.2016,26.12.2016 एवं 25.03.2017 को केन्द्र के वैज्ञानिक-डी की अध्यक्षता में संपन्न की गई।

- वर्ष 2016-17 के दौरान क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र, कलिम्पोंग के परिसर में नगर राजभाषा कार्यान्वयन समिति, कलिम्पोंग की बैठकें क्रमशः दिनांक 29.06.2016, एवं 25.01.2017 को केन्द्र के वैज्ञानिक-डी की अध्यक्षता में संपन्न की गई।

- केन्द्र में दिनांक 14.09.2016 से 29.09.2016 तक हिंदी पखवाड़ा का आयोजन किया गया।

- क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र, कलिम्पोंग में दिनांक 29.06.2016 को क्षेरेउअके, कलिम्पोंग एवं नराकास सदस्यों के पदधारियों के लिए एक हिंदी कार्यशाला का आयोजन किया गया।

क्षेरेउअके, कोरापुटः

- वर्ष 2016-17 के दौरान क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र, कोरापुट की राजभाषा कार्यान्वयन समिति की बैठकें क्रमशः दिनांक 30.06.2016, 30.09.2016, 31.12.2016 एवं 31.03.2017 को केन्द्र के वैज्ञानिक-डी की अध्यक्षता में संपन्न की गई।

- केन्द्र में दिनांक 14.09.2016 से 28.09.2016 तक हिंदी पखवाड़ा का आयोजन किया गया।

- क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र, कोरापुट में दिनांक 28.09.2016 को केन्द्र के सभी अधिकारियों एवं पदधारियों के लिए एक हिंदी कार्यशाला का आयोजन किया गया।

क्षेरेउअके, जोरहाट : खेत्रिय रेशम अनुसंधान केन्द्र , जोरहाट(असम) में वर्ष 2016-17 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 ! राजभाषा हिन्दी के अन्य महत्वापूर्ण कार्यान्वयन बिन्दुओ/

प्रावधानों पर भी कार्रवाई की गई ! केन्द्र में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन राजभाषा प्रगति/ कमियों की समय-समय पर समीक्षा, हिन्दी कार्यशाला का आयोजन, हिन्दी दिवस/पखवाडा का आयोजन एवं प्रोत्साहन योजनाओं का कार्यान्वयन किया गया !

केन्द्र द्वारा वर्ष के दौरान विभिन्न कार्यान्वयन बिन्दुओं पर की गई कार्रवाई का ब्योरा निम्नवत है :

- **धारा 3(3) का अनुपालन** : राजभाषा अधिनियम की धारा -3(3) के अंतर्गत आने वाले सभी कागजात यथा सामान्य आदेश, निविदा, नियम , सूचना, अधिसूचना एवं करार, विज्ञप्ति तथा प्रशासनिक एवं अन्य रिपोर्ट आदि द्विभाषी, हिन्दी-अंग्रेजी रुप में जरी किए गए !

- **हिन्दी पत्राचार** : वर्ष के दौरान ' क ' ' ख ' क्षेत्र में स्थित केन्द्र / राज्य सरकार को 100% तथा ' ग ' क्षेत्र में स्थित केन्द्रीय सरकार के कार्यालयों को 78% पत्र हिन्दी में भेजे गए ! इस प्रकार पत्राचार के मद में लक्ष्य से अधिक पत्राचार किया गया !

- **हिन्दी प्रशिक्षण** : आलोच्य अवधि के दौरान अधिकारियों / कर्मचारियों को हिन्दी शिक्षण योजना के अधीन प्रशिक्षण कार्य जारी किया गया तथा 100% अधिकारी/कर्मचारी इस योजना के अंतर्गत प्रशिक्षित हो चुके है !

- **राजभाषा कार्यान्यन समिति की बैठक का आयोजन** : राजभाषा नियम /अधिनियम के प्रावधानों के सम्यक अनुपालन एवं समय -समय पर राजभाषा कार्यों की प्रगरि/ कमियों की समीक्षा हेतु केन्द्र में प्रत्येक तिमाही के दौरान राजभाषा कार्यान्यन समिति की बैठक का आयोजन कर कार्यान्यन की दिशा में आने वाली कठिनाईयों का निदान किया जाता है ! कार्यान्ययन समिति की चार बैठकों का नियमित रुप से आयोजन क्रमश: दिनांक 28.06.2016, 20.08.2016, 26.12.2016 एवं 10.03.2017 को किया गया ! बैठक में लिए गए निर्णयों पर अनुवर्ती कार्रवाई भी पूरी की गई !

- **हिन्दी कार्यशाला का आयोजन** : केन्द्र में कार्यरत अधिकारियों / कर्मचारियों को हिन्दी में काम - काज करने में मदद करने हेतु प्रत्येक तिमाही के दौरान एकदिवसीय हिन्दी कार्यशाला का आयोजन क्रमश: दिनांक 28.06.2016, 23.08.2016, 26.12.2016 एवं 10.03.2017 को किया गया !

- **राजभाषा प्रोत्साहन योजना का कार्यान्यन** : केन्द्र में कार्यरत अधिकारियों / कर्मचारियों में राजाभाषा हिन्दी के प्रति अभरुचि जगाने हेतु प्रतियोगिता क अयोजन किया जाता है! हिन्दी में मूल रुप से टिप्पण - आलेखन करने वाले अधिकारियों/कर्मचारियोंके

लिएअ केन्द्रीय रेशम बोर्ड की उदारीकृत राजभाषा प्रोत्साहन योजना को भी लागू किया गया है जिसके अंतर्गत निर्धारित शब्द संख्या हिन्दी में लिखने पर अनुपातत: नगद प्रोत्साहन राशि (महत्तम राशि रु.2000/-) प्रदान की जाती है! हिन्दी दिवस/पखवारा, 2016 के अवसर पर वर्ष 2015-116 के दौरान मूल रुप से हिन्दी में काम काज करने हेतु 7 अधिकारियों/ कर्मचारियों को पुरस्कृत किया गया !

- **हिन्दी दिवस/पखवारा का आयोजन** : दिनांक 01.09.2016 से 14.09.2016 तक हिन्दी पखवारा का आयोजन किया गया ! इस अवसर पर विभिन्न हिन्दी प्रतियोगिताओं का आयोजन किया गया! इन प्रतियोगिताओं में केन्द्र के अधिकारियों/ कर्मचारियों ने उत्साह से भाग लिया! इस दौरान कुल 05 हिन्दी प्रतियोगिताओं क्रमश: टिप्पण - आलेखन एवं शब्दावली अनुवाद 09.09.2016, कविता पठन, तत्काल भाषण एवं हिंदी गान - 14.09.2016 का आयोजन किया गया! प्रत्येक प्रतियोगिता के प्रथम, द्वितीय, एवं तृतीय प्रतिभागियों को नगद पुरस्कार प्रदान किया गया !

- **कम्प्यूटर पर हिन्दी में कार्य** : केन्द्र में राजभाषा अधिनियम - 1963 के धारा 3(3) का अनुपालन फार्म / प्रपत्र का द्विभाषीकरण अनुभागीय तिमाही प्रगति रिपोर्ट के तुलनात्मक विवरण, हिंदी पत्राचार, राजभाषा कार्यान्यन समिति की गतिविधियों संबन्धी कार्य को कम्प्यूटर पर सुचारु रुप से किया जा रहा है ! केन्द्र के कम्प्यूटरों पर "योनिकोड" संस्थापित किया गया है जिससे शब्द प्रक्रमण के अलावा आंकडो के प्रक्रमण में सहुलियत प्राप्त हुई है !

- **पुरस्कार प्राप्त** : इस केंद्र को जोरहाट सद्स्य कार्यालयों में उल्लखनीय राजभाषा हिंदी कार्यावयन के लिए नगर राजभाषा कार्यांव्यन समिति जोरहाट (भारत सरकार, गृह मंत्रालय, राजभाषा विभाग) द्वारा वर्ष 2015-16 का श्रेष्ठता पुरस्कार प्राप्त किया है ।

22. IMPLEMENTATION OF RIGHT TO INFORMATION ACT (RTI, 2005)

#	Applicant and address	Requested to and Date of Request	Details of compliance/ rejection of request		Relevant RTI section, if request rejected	Amount of Charges collected (in Rs.)
			Office order No.	Date		
1	Shri Santosh Kumar Saxena Advocate, Chamber No.42 Civil Court, Aligarh-202001 Uttar Pradesh	12.04.2016	No.CSB/CSRTI/Estt. RTI/15-16/Circular/757	19.04.2016	--	--
2	Smt. Susmita Mukherjee C/o, Smt. Minati Nandy Loke Nath Sarani, Arrah, Kalinagar Post-Arrah, Durgapur-713212 Dist.- Burdwan	The Director CSRTI, Berhampore dt. 05.12.2016 (Received on 17.12.2016)	No. CSB/PMCE/R-38/2016-17/12818	05.01.2017	--	10/- (Court fee)
3	Dr. G.B.Singh, Sci-D GPRA, Type IV No.5 Gandhigram, Agartala-799012 Tripura	The Director CSRTI, Berhampore dt. 30.12.2016 (Received on 06.12.2016)	No. CSB/PMCE/R-38/2016-17/ 13210	16.01.2017	--	50/- (IPO No. 91G 151114)

23. A. DISTINGUISHED VISITORS: MI

FOLLOWING DISTINGUISHED PERSONNEL VISITED THIS INSTITUTE DURING THE PERIOD.

#	Name	Designation	Date
1.	Ms. Arunima Das, WBCS (Exe.)	Managing Director, Paschim Banga Resham Shilpi Samabaya Mahasangha Limited Ltd., West Bengal	09.05.2016
2.	Dr. Kulandaivel, IFS	Deputy Conservator of Forest, Govt. of West Bengal	06.06.2016
3.	Shri Abhijit Mukherjee, Member of Parliament	Jangipur Constituency, West Bengal	09.06.2016
4.	Shri B.S. Chhabra, DDG	NSSO, FOD	23.06.2016
5.	Shri Sayantan Chatterjee	Secretary General , Brace Foundation, C-17, SDA, Commercial Complex, New Delhi	16.08.2016
6.	Prof. Gurudas Gupta	Director, MDI, Murshidabad	17.08.2016
7.	Elizabeth Light, Tourist from Abroad	New Zealand, Auckland	07.12.2016
8.	Shri K. M. Hanumanatharayappa,	Chairman, Central Silk Board, Bengaluru	3&4.01.2017
9.	Shri Gururaj Katti	ICAR, Indian Institute of Rice Reseach, Hyderabad	19.03.2017

Ms. Arunima Das, WBCS (Exe.)   Dr. Kulandaivel, IFS   Shri Abhijit Mukherjee, MP

Shri K. M. Hanumanatharayappa, Chairman, Central Silk Board, Bengaluru visited this institute on 3rd January 2017 and interacted with scientists, officers and other staff on research development as well as other aspects of the Institute. The Hon'ble Chairman was also attended the programme RKM of the institute as Chief Guest on 4th January 2017 and interacted with sericultural farmers on seri industry development.

A team of **Review Committee on Genetic Manipulation (RCGM), Department of Biotechnology** visited on 19.03.2017 during 5th Trail of Transgenic hybrids rearing in the collaborative project AIT-3557 with APSSR &DI, Hindupur, Andra Pradesh at CSR&TI, Berhampore (W.B.)

23. B. DISTINGUISHED VISITORS: NESTED UNITS
23.B.1.RSRS, KALIMPONG:

Shri K. M. Hanumanatharayappa, Chairman, Central Silk Board, Bengaluru, visited RSRS, Kalimpong and Sikkim State Seri- farm w.e.f. 15.03.2017 to 18.03.2017. He visited Mahakaldara and Echhey Seri-villages of Kalimpong hills on 19th March, 2017. He conducted meeting at RSRS, Kalimpong with staff members and at Mahakaldara & Echhey with seri-farmers. The Hon'ble Chairman shared his views with the seri-farmers of this region pertains to improvement of their socioeconomic condition through appropriate adoption of seri-technologies.

Visit of Chairman to DoS (Seri) Farm, Sikkim

24. A. RESEARCH ADVISORY COMMITTEE (RAC)

Chairman			
Dr. Saroj Kumar Sanyal, Ex- *Vice-Chancellor,* Saptaparni , Flat A1 (Ground Floor), 58/3, Ballygunge Circular Road, **Kolkata-700 019,** West Bengal			
#	**Members, RAC**		
1.	Prof. Kanchan Baral, Dept. of Plant Protection, Palli Siksha Bhavan, **Sriniketan – 723 326,** Dist. Birbhum, West Bengal	2.	Prof. Sunirmal Maity, Department of Agronomy B-2/221, **Kalyani-741 235** Dist- Nadia, West Bengal
3.	Dr. Rajeev Kumar Varshney, Director, Centre of Excellence in Genomics (CEG), Applied Genomics Laboratory, **Patancheru – 502 324,** AP	4.	Dr. S. Senthil Vinayagam, Professor & Principal Scientist (Agriculture Extension) ICAR-NAARM, Rajendranagar, **Hyderabad–500030**, AP
5.	Dr. M. V. Samson, Former Director (CSB), 13, Parama Street, **Nagercoil- 629001,** K.K.District,Tamil Nadu	6.	Director (Tech.), Central Silk Board, P.O. Madiwala, BTM Layout, **Bangalore – 560 068**
7.	Director (NSSO), Central Silk Board, Madiwala, BTM Layout, **Bangalore – 560 068**	8.	Director, CSTRI, Central Silk Board, Madiwala, BTM Layout, **Bangalore – 560 068**
9.	Dr. Kanika Trivedy, Director & Member Convenor, CSR&TI, **Berhampore – 742 101** Murshidabad, West Bengal	10.	Smt. Soma Bhattacharya, Commissioner, Director of Textiles, Govt. of West Bengal, 45 G.C. Avenue, **Kolkata -700013,** W.B.
11.	Director of Textiles & Handloom Govt. of Orissa, Sahidnagar, **Bhubaneswar - 751 007**, Odisha	12.	Director of Sericulture, Govt. of Chhattisgarh, Resham Sanchanalaya Kanij Bhawan, Ring Road, Telibandh **Raipur- 492 06,** Chhattisgarh
13.	Director of Sericulture & Weaving Govt. of Meghalaya, 3rd Sectt. (Nongkrek building), 2ndPhase,2ndFloor,Lower lachumiere, **Shillong – 793 001**, Meghalaya	14.	Director (Hand & Seri.), Dept. of Industries, Govt. of Bihar, Vikas Sachivalaya, **Patna- 800 015**, Bihar
15.	Director of Sericulture, Govt. of Nagaland, **Kohima – 797 001**, Nagaland	16.	Director of Sericulture, Govt. of Mizoram, **Aizawl – 796 001**, Mizoram

17	Director of Handlooms, Handicrafts & Sericulture, Govt. of Tripura, Pandit Jawaharlal Nehru Complex, Gorkha Basti, **Agartala – 799 006**, Tripura	18.	Director of Industries, Govt. of Jharkhand, III Floor, Nepal House, Doranda, **Ranchi - 834 002**, Jharkhand
19.	Director of Sericulture, Govt. of Manipur, P.O. Lamphelpat, **Imphal –795 004,** Manipur	20.	Director of Sericulture, Govt. of Assam (Near Research Gate), P.O. Khanapara, **Guwahati-781 022**, Assam
21.	Addl. Director of Sericulture, Deptt. of Forest & Environment, Govt. of Sikkim, Deorali, **Gangtok, Sikkim**	22	Md. Sufian Ali, Rearers Representative, S/o- Sher Mahammad, Vill. & P.O. Alinagar, P.S. Kaliachak, **Dist. Malda**, West Bengal
23	Shri Prafulla Kumar Mondal, Reelers Representative, Vill & P.O. Madhughat, PS. Kaliachak, **Dist. Malda**, West Bengal		

24. B. REGIONAL RESEARCH ADVISORY COMMITTEE (RRAC)

24. B. I. RSRS, KALIMPONG, WEST BENGAL:

#	Name	Position
1.	Prof. B. N. Chakraborty, Dept. of Botany, NBU, Siliguri, West Bengal	Chairman
2.	Dr. Kanika Trivedy, Director, CSR&TI, Berhampore , West Bengal	Vice-Chairman
3.	Dr. Ranjit Kar, Scientist-D & In-charge, RSRS, Kalimpong, West Bengal	Convener
4.	Prof. Ananda Mukhopadhya, North Bengal University, Siliguri	Member
5.	Dr. Prabhat Kr. Pal, Extension Education, UBKV, Cooch Behar	Member
6.	Shri R.P.Rai, Assistant Director, DOS, Sikkim	Member
7.	Shri N.K.Rizal, Assistant Director, DOT (Seri), Kalimpong	Member
8	Dr. P. K. Mukherjee, Dept.of Agronomy, UBKV, Coochbehar, West Bengal	Member
9.	Dr.K.Sathyanarayan, Scientist-D, Central Silk Board, Bangalore	Member
10.	Joint Secretary (Tech), R.O, CSB, Kolkata, West Bengal	Member
11.	Smt. Ongmu Sherpa, Farmer, Mahakaldara, Kalimpong, West Bengal	Member
12.	Shri Rafiq Ali, Malda Reeler's representative, Malda, West Bengal	Member

24. B.II. RSRS, KORAPUT, ODISHA

#	Name	Position
1.	Dr. M. Madhu, Head, Central Soil and Water Conservation Research & Trg. Institution, ICAR, Sunabeda, Koraput, Odisha.	Chairman
2.	Dr. Kanika Trivedy, Director, CSR&TI, Central Silk Board, Berhampore, West Bengal.	Vice–Chairman
3.	Scientist-D (I/C), RSRS, Central Silk Board, Koraput, Odisha.	Member Convener
4.	Smt. Pravamayee Acharjya, Extension Scientist, Project Co-ordinater, Govt. of Odisha, Semiliguda, Koraput	Member
5.	Dr. P.P. Adhikary, Soil Scientist (Agronomy), Central Soil and Water Conservation Research & Training Institution, ICAR, Sunabeda, Koraput, Odisha.	Member
6.	Dr. Karan Chanda Hembram, Higher Altitude Research Station. Pottangi, Koraput, Odisha.	Member
7.	Shri G.C.Roy, Deputy Secretary (Tech), Regional Office, CSB, Bhubaneswar, Odisha.	Member
8.	Shri Bijoy Kumar Misra, Assistant Director of Sericulture, Govt. of Odisha, Koraput, Odisha.	Member
9.	Shri Binda Muduli, Majhiguda, Dasamanthpur, Koraput, Odisha.	Rearer's rep.
10.	Ms.Gitanjali Sahu, Silk Reeler, Mahendragarh, Gajapati, Odisha.	Reeler's rep.
11.	Shri R.C.Das, Asst. Secretary (Tech.). CO,, Bangalore	Member

24. B.III. RSRS, JORHAT, ASSAM

#	Name	Position
1.	Dr. Pranab Talukdar, Sr. Professor & Head, Dept. of Breeding and Genetics, AAU, Jorhat, Assam	Chairman
2.	Dr.Kanika Trivedy Director, CSR&TI, Berhampore, West Bengal	Vice-Chairman
3.	Dr. S. N. Gogoi, Scientist-D & In-charge, RSRS, Jorhat, Assam	Member Convener
4.	Dr. Kalyan Pathak,Sr. Scientist, AAU, Jorhat, Assam	
5.	Dr. Badal Bhattacharya, Sr. Scientist, Dept of Entomology, AAU, Jorhat, Assam	Member
6.	Dr. Utpal Barman, Associate Professor, Dept of Extension Education, AAU, Jorhat, Assam.	Member
7.	Shri Sarat Deori, Joint Secretary (Tech), Regional Office, CSB, Guwahati, Assam.	Member
8.	Shri Moncy Issac, Deputy Secretary (Tech), Central Silk Board, Bangalore.	Member
9.	Shri Ranjit Doley, Baphala, Jorhat, Assam	Member
10.	Smt Anju Pegu, Baphala, Jorhat, Assam	Member

25. SCIENTIFIC & ADMINISTRATIVE PERSONNEL OF CSR&TI AND ITS CONSTITUENT UNITS

Dr. (Mrs.) Kanika Trivedy, Director

Dr. N. Suresh Kumar, Sci.-D (Upto 31.05.16) Dr. A.K.Verma, Sci-D (Fr.01.06.16-05.08.16) Dr. V. Lakshmanan, Sci.-D (Fr. 06.08.16).	**Divisional Head, Sericulture**
Dr. S. K. Dutta, Sci.-D (Upto 08.09.16) Dr. (Mrs) M. Chaudhuri, Sci.-D (Fr. 09.08.16)	**Divisional Head, Moriculture-I**
Dr. S. K. Dutta, Sci.-D (Fr. 09.08.16)	**Divisional Head, Moriculture-II**
Dr. S. Roy Choudhary, Sci- D (Upto 22.07.16) Dr.U.K.Bandopadhyay, Sci-D (23.07.16 - 30.11.16) Dr. Dipesh Pandit, Sci-D (Fr. 01.12.16)	**Divisional Head, PMCE**
Dr. (Mrs) S. Chanda, Sci-D (Upto 21.11.16) Shri D. Das, Sci-D (Fr. 22.11.16 - 30.11.16) Dr. (Mrs) T. Dutta (Biswas), Sci.-D (Fr. 01.12.16)	**Divisional Head, Extension & Publicity**
Dr. (Mrs.) Jalaja S. Kumar, Sci-D (Upto 31.05.16) Smt.Chandana Maji, Sci-D (Fr. 13. 06. 16)	**Divisional Head, Training**
Shri N. B. Kar, Sci.-D	**Divisional Head, Reeling & Spinning**

SERICULTURE DIVISION	
Silkworm Breeding & Genetics : Dr. V. Lakshmanan, Sci.-D (Fr. 06.08.16) Dr. A.K.Verma, Sci-D. Shri N. Chadrakanth, Sci-B	**SW Physiology & RTI and BV-Cell:** Dr. J. Sarkar, Sci.- D (Upto 28.02.17) Shri G. C. Das, Sci-D (Fr. 01.03.17) Dr. Manjunatha G.R.,Sci-B(Upto 19.06.16 BvCell)
Silkworm Pathology Section: Dr. S. Chakravarty, Sci.-C (Upto 02.07.16) Shri Zakir Hossain, Sci-D (Fr. 02.07.16) Shri K. Rahul, , Sci- B	**Entomology Section:** Shri D.Das, Sci.-D (Upto 21.11.16) Dr. (Mrs.) S Chanda, Sci-D (Fr. 22.11.16) Mr. Raghavendra, K.V., Sci-B (Upto 17.12.16)
	Biotechnology Section: Dr. S Chattopadhyay, Sci.-D Ms. Pooja Makhwana, Sci-B
MORICULTURE DIVISION (I)	**MORICULTURE DIVISION (II)**
Agro-Physio-Farm: Dr. Monica Chaudhuri, Sci.-D Dr. R. Mahesh, Sci.-B Shri A. Pappachan, Sci- B **Soil Science and Chemistry:** Dr. R. Kar, Sci-D (Upto 13.06.16) Dr. V.Vijay, Sci.-B (Fr. 14.06.16)	**Mulberry Breeding & Genetics:** Dr. Rita Banerjee, Sci.-D (Fr. 01.04.16) Dr. P.K.Ghosh, Sci-D Shri D. Chakravarty, Sci.-D (Fr.14.07.16) Shri K. Suresh, Sci-B **Mulberry Pathology :** Dr. S. K. Dutta, Sci -D Dr. V.Vijay, Sci-B (upto 13.06.16) Shri A. Pappachan, Sci- B (Fr. 14.06.16)

TRAINING DIVISION	PMCE DIVISION
Smt. Chandana Maji, Sci-D (Fr.13.06.16)	Dr. S. Roy Choudhary, Sci- D (Upto 22.07.16)
Shri Zakir Hossain, Sci-D (Upto 01.07.16)	Dr.U.K.Bandopadhyay,Sci-D(23.07.16 - 30.11.16)
Shri D. Chakravarty, Sci-D (Upto 14.07.16)	Dr. D. Pandit, Sci-D (Fr.05.07.16)
Dr. S. Sarker, Sci-C, (Fr. 05.07.16)	Dr. Manjunatha G.R., Sci-B
Shri T.N. Sreekantha,AD (Stat) (Upto 14.07.16)	Shri T.N. Sreekantha, AD (Stat) (fr. 15.07.16-04.11.16)

EXTENSION DIVISION	COMPUTETR
Shri Debijit Das, Sci-D (Fr. 22.11.16)	Shri P.K.Mahapatra, (Comp) (Upto 10.08.16)
Shri Safi Afroj, Sci-B (Fr. 04.10.16)	Shri P. K. Prasad, A.D.(Comp) (Fr.10.08.16)

ADMINISTRATION	OFFICIAL LANGUAGE
Shri Manas Roy, A.D. (A & A)	Shri Ram Briksh Choudhary, A.D.(OL)
Shri Biswajit Halder, A. D. (A & A)	
Shri Shyamal Kr. Saha,A.D.(A&A)(Upto 31.01.17)	
Shri Sanatan Tiadi, A. D. (A & A) (Fr.10.08.16)	
Shri G.R.V. Reddy, Asst. Eng.	

REGIONAL SERICULTURAL RESEARCH STATION:

RSRS, Kalimpong (West Bengal)	RSRS, Jorhat (Assam)
Smt. C. Maji, Sci. – D (Upto 12.06.16)	Dr. S. N. Gogoi, Sci. - D
Shri S. Chatterjee, Sci. - D (Upto 30.11.16)	Dr. Y. Debaraj, Sci. – D (Upto 12.06.16)
Shri Ram L. Ram, Sci. – C (Upto 31.05.16)	Dr. U.C. Barua, Sci -D
Dr. R. Kar, Sci-D (Fr. 02.07.16)	Smt. M. Pamehgam, Sci. - C

RSRS, Koraput (Odisha)	
Dr. M.K.Ghosh Scientist-D (Upto 03.01.17)	
Dr. N. R. Rao, Sci.- C (Upto 31.05.16)	
Dr. K. C. Brahma, Sci.- D (Upto 10.07.17)	
Shri S. K. Misro, Sci.- C	

RESEARCH EXTENSION CENTRES:

REC, Mothabari (West Bengal)	REC, Mangaldoi, BTC, Assam
Shri Kajol Roy, T.A.	Dr. B. K. Basumatary, Sci-C
	REC, Imphal (Manipur)
REC, Kamnagar (West Bengal)	Dr. L. Somen Singh, Sci. – D
Dr. Tapati Dutta (Biswas), Sci. - D	REC, Shillong (Meghalaya)
	Dr. Collin Z. Renthlei, Sci-C
REC, M.P. Raj (Jharkhand)	REC, Aizawl (Mizoram)
Dr. D. Pandit, Sci.– D (Upto 04.07.16)	Shri B. N.Chowdhury, Sci. – D
	Dr. Lalthlamuana Pachuau, Sci. - C
REC, Bhandra (Jharkhand)	REC, Dimapur (Nagaland)
Dr. G. S. Singh, Sci.-D	Dr. A. K. Borah, Sci. – D
	REC, Agartala (Tripura)
REC, Dhenkikote (Odisha)	Dr. G. B. Singh, Sci. - D
Shri Satyabrata Dey, Sci. – C	REC, Rongpo (Sikkim)
	Shri S.T. Lepcha, Sci. – D
REC, Deogarh (Odisha)	
Dr. D. P. Dasmahapatra,Sci–C	

26. SPECIAL ACTIVITIES ON WOMEN EMPOWERMENT, DEVELOPMENT OF SC/ST OR PEOPLE BELOW POVERTY LINE

The following human resource development programme were conducted for empowerment and strengthening of the weaker section of the society.

26.A. MAIN INSITUTE

26.A.1. Details of SC/ST candidates who participated in various training prog. during 2016-17.

Details of SC/ST candidates who participated in various training prog. during 2016-17 are as follows:

#	Category										Grand Total
	Male					Female					
	Gen.	SC	ST	OBC	Total	Gen.	SC	ST	OBC	Total	
1	**Post Graduate Diploma in Sericulture (15 months)**										
2015-16	4	1	5	1	11	4	0	9	0	13	24
2016-17	2	1	0	0	3	0	0	10	0	10	13
2.	**Farmers Skill Training (5-10 days)**										
	95	72	12	50	229	16	4	1	4	25	254
3.	**Technology Orientation Programme**										
	47	9	9	8	73	15	4	1	1	21	94
4.	**Orientation Programme for newly joined Sc-B (5 days)**										
	3	3	0	1	7	0	0	0	1	1	08
5.	**Training on Microscopic Exam of SW diseases (3 days)**										
	33	24	1	21	79	0	0	0	2	2	81
6.	**Awareness Training Programme for farmers from U.P. (3 days)**										
	76	82	78	275	511	0	3	0	4	7	518
7.	**Awareness Training Programme for Jeevika Bihar (30 days)**										
	10	10	0	42	62	1	0	0	3	4	66
8.	**On job Training Programme for B.Sc. students (9 days)**										
	12	5	0	4	21	5	1	0	3	9	30
9.	**Training Programme on "soil testing" (1 day)**										
	13	2	3	7	25	0	0	1	1	2	27
10.	**Training Programme on "Establishment Rule" (1 day)**										
	01	0	0	0	01	0	0	0	0	0	1
11.	**Beneficiary Empowerment Programme for farmers of NE Region (5 days)**										
	05	0	79	0	84	03	0	47	0	50	134
12.	**Seri Resource Centre (1 day)**										
	238	27	0	63	328	242	07	0	23	272	600
Total	539	36	187	472	**1434**	286	19	69	42	**416**	**1850**

26.B. NESTED UNITS

26.B.1. Special activities on Women Empowerment, development of SC/ST or people of BPL at RSRS, Jorhat:

1.   Women play a vital role in the development of mulberry sericulture industry. To increase their income, their development & their empowerment, RSRS, Jorhat and its RECs have conducted training programs for women (80 – 90%) especially for SC/ST/below poverty line under Chawki rearing training & farmers training programmes in NE states. They were trained in latest technologies of chawki silkworm rearing.

2.   In all the North Eastern states, almost all the beneficiaries (90-95%) are tribal women below poverty line. The extension communication programme helps them to take up one more rearing during the year with Bivoltine hybrid rearing and enhancing their annual income up to 10 %.

3.   Under BV CPP 99% of the beneficiaries are belonged to ST/SC in Manipur, Nagaland, Mizoram and BTC (Assam). Out of that, 95% of them are women beneficiaries of below poverty line group.

27. MISCELLANEOUS EVENTS/ACTIVITIES IF ANY:

Radio and Television programmes attended / sponsored by Central Sericultural Research & Training Institute, Berhampore (WB) **during the year 2016-17**

#	Radio/TV/FM/ Cable Prog. (specific slot/channel name)	Date and Time	Dura-tion (Min)	Topic Discussed	Name and Designation of the Scientist(s)/ official(s) attended the prog.	Sponsored/ invited
1.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	14/07/2016 08:15 PM "Resham Katha"	15	Introductory lecture on Mulberry sericulture & technologies developed at CSR&TI, Ber, its prospects	Dr. Kanika Trivedy, Director, CSR&TI, Ber	Sponsored
2.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	21/07/2016 08:15 PM "Resham Katha"	15	1. Disinfection of rearing rooms and appliances 2. Diseases and pests of silkworm	Dr. Satadal Chakarvarty, Scientist D, Silkworm Pathology section CSR&TI, Ber	Sponsored
3.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	28/07/2016 08:15 PM "Resham Katha"	15	Importance of Soil testing	Dr. Ranjit Kar, Scientist D, Soil Science & Chemistry section CSR&TI, Ber	Sponsored
4.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	04/08/2016 08:15 PM "Resham Katha"	15	Major 4 pests infestation of Mulberry and its control measures	Dr. Debojit Das, Scientist D, Entomology section CSR&TI, Ber	Sponsored
5.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	11/08/2016 08:15 PM "Resham Katha"	15	Kisan Nursery and improved technology for Mulberry plantation	Dr. Rita Banerjee, Scientist D, Mulberry Breeding Genetics section CSR&TI, Ber	Sponsored
6.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	18/08/2016 08:15 PM "Resham Katha"	15	Major Mulberry diseases and its control	Dr. Sandip Dutta, Scientist D, Moriculture-II CSR&TI, Ber	Sponsored
7.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	25/08/2016 08:15 PM "Resham Katha"	15	Method of Soil Sampling and Fertilizer Application	Dr. Ranjit Kar, Scientist D, S. Sc. & Chemistry CSR&TI, Ber	Sponsored

#	R dio/TV/FM/ Cable Prog. (specific slot/channel name)	Date and Time	Dura-tion (Min)	Topic Discussed	Name and Designation of the Scientist(s)/ official(s) attended the prog.	Sponsored/ invited
8.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	01/09/16 08:15 PM "Resham Katha"	15	Different varieties of mulberry plants, region specific mulberry varieties, package of practices for mulberry cultivation, utilization of feritlizers in mulberry field.	Dr. Rita Banerjee, Scientist D, MBG, CSR&TI, Ber	Sponsored
9.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	08/09/16 08:15 PM "Resham Katha"	15	Vermicomposting	Dr. Monika Chowdhury, Scientist D, Mori-I CSR&TI, Ber	Sponsored
10.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	15/09/16 08:15 PM "Resham Katha"	15	Incubation of Dfls and Chawki rearing	Dr. A. K. Verma, Scientist D, SBG, CSR&TI, Ber	Sponsored
11.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	22/09/16 08:15 PM "Resham Katha"	15	Different season and region specific breeds and hybrids	Dr. A. K. Verma, Scientist D, SBG, CSR&TI, Ber	Sponsored
12.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	29/09/16 08:15 PM "Resham Katha"	15	Late age rearing	Dr. A. K. Verma, Scientist D, SBG, CSR&TI, Ber	Sponsored
13.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	06/10/16 08:15 PM "Resham Katha"	15	By-product from Sericulture	N. B Kar, Scientist D, R & S section CSR&TI, Ber	Sponsored
14.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	13/10/16 08:15 PM "Resham Katha"	15	Post-cocoon Technologies- An Overview	Mr. N. B Kar, Scientist D, R & S section CSR&TI, Ber	Sponsored
15.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	20/10/20 16 08:15 PM "Resham Katha"	15	Marketing of Cocoon	Mr. N. B Kar, Scientist D, R & S section CSR&TI, Ber	Sponsored
16.	All India Radio (AIR)- Murshidabad (FM-102.2 MHz)	27/10/20 16 08:15 PM "Resham Katha"	15	Role of Women in Sericulture	Mr. Subhra Chanda, Scientist D, Extension & Publicity section CSR&TI, Ber	Sponsored

Sadbhavana Diwas:

CSR&TI, Berhampore organized "**Sadbhavana Diwas**" on 20th August, 2016 at the Institute on the eve of 72nd Birth Anniversary of Late Prime Minister Rajib Gandhi to maintain the harmony in the society. Director read out the pledge to the staff and officers of the Institute and asked to work for harmony to all the people regardless of caste, creed, religion, region and language.

Vigilance Awareness Week:

RSRS, Jorhat has observed vigilance awareness week from 31.10.16 to 05.11.16 to bring awareness against corruption in public life and ways and means to eradicate the same to make the country corruption free. On 31.10.16 at 11 AM, Dr. S.N. Gogoi, Sci-D administered oath to the office staff both in Hindi and English.

Swachha Bharat Mission:

RSRS, Jorhat has observed Swacha Bharat Mission on 02.10.2016 on Gandhi Jayanti. The employees of this station are cleaning the sourrending of this office

and weeding and cutting of grass both side of approach road of the station. 3 nos. ornamental plants have been planting on the occasion by the staff of RSRS, Jorhat, Assam.

Campaign on Colour of Independence Day:

The programme was celebrated during the period during 09.08.2016 to 15.08.2016 at Gangtok, Sikkim and Aizwal, Mizoram. At Mizoram, it was organized by REC, Aizwal at different places of Aizwal town viz. i) Near Directorate of Sericulture office, ii) Treasurey square, iii) Millenium centres, and iv) Pachhunga University College. At Gangtok, Sikkim, it was organized by REC, Rangpo at different places like i) Gangtok M.G. Marg, East Sikkim ii) Singtom Bazar, East Sikkim iii) Rangpo Bazar, East Sikkim, iv) Nandi Bazar, South Sikkim and v) Jorethang Bazar, South Sikkim.

World Environment Day:

On **6th June 2016**, the **CSR&TI, Berhampore** organized the World Environment Day. The scientist, technical & administrative officers and staff, TSFW's & SFW's were assembled at the labour shed for mahogany planting by individually. Deputy conservator of forest, Dr. S. Kulandaivel, IFS, Govt. of West Bengal was the Chief Guest. The first mahogany sapling was planted by Dr. Kulandaivel, IFS for inaugurating the event followed by Dr. Kanika Trivedy, Director, CSR&TI, Berhampore. A total 250 no's mahogany saplings was planted by all the staff members and students of our institute during the programme. Besides, all the saplings were individually tagged with number and the name of the person's name entered in the register.

The World Environment Day was observed by **RSRS, Jorhat** on 5th June 2016. All the Scientists, staff members and farm workers of the station including that of SSPC, CSB, Jorhat were participated in the programme.

The theme of world environment day was "**fight against the illegal trade in wildlife for life"** focusing on save the life of wild animals. This year's slogan is "**Go Wild for Life"** to raise the voice against wildlife crime and damages caused by it and take actions to prevent it. The most important purpose of this year celebration is to take strong actions to restrict illegal trade of wildlife which is putting the biodiversity of this planet into danger.

World Environment day was observed by **RSRS, Koraput** on **5th June, 2016** at its premises. D.r M. K. Ghosh, Sci-D addressed the staff explaining the importance of the day.

International Yoga Day:

CSR&TI, Berhampore organized the yoga day on **21st June, 2016** in the Auditorium Hall and renowned yoga guru Shri Sagar Ghosh was the chief Guest to demonstrate yoga for the benefit of staff and students. Director urged that everybody should practice yoga and it should a part of our life, beyond the boundary of caste, religion and politics, yoga has found its place not only in our country but also in the world for sustainability of outer and inner beings of human body, which is evident from the acceptance and

participation of people around the world in the international day of yoga.

Yoga guru demonstrated a variety of yoga techniques which were simple yet effective for the benefit of staff and students. Around 230 people including staff, students and farmers who came for the training attended the practicing of yoga.

UNIFIED PAYMENT INTERFACE (UPI):

Organized Seminar on 29.11.2016 at this institute on UPI that powers multiple bank accounts (of participating banks), several banking services features like fund transfer, purchasing any articles, etc.. Asst. Manager, SBI, Berhampore branch, unveiled the new mode of payment, a step towards the formation of cashless society. Moreover, CSR&TI, Berhampore has also organised awareness programmes on **Unified Payment Interface** (UPI) at different locations of Eastern & NE region and covered of **3694 stakeholders** of silk industry to adopt cashless transaction.

Swacchh Bharat:

CSRTI, Berhampore has organized special campaign on **"Swacchha Bharat",** programme on Mallickpur Primary School under Khargram block of Murshidabad District on 2nd Oct., 2016. All Scientists & officials of CSR&TI, Berhampore reached the primary school along with reporters of Akashwani, the Statesman and Local TV channels. The programme initiated with the laying of *Foundation Stone,* followed *by* garlanding the photo of the Father of the Nation thereafter watering of the mulberry plant with spiritual music playing in the background. The villagers promised about extending of full effort and co-operation about maintaining cleanliness of the village including schools, ponds and roads, emphasizing on no open defecation. It was assured that by 2020, **Mallickpur - Diara** will be developed into a *Clean Silk Village*. On the occasion, two big dustbins and 10 L Phenyl were handed over to school authority. Speaking on the occasion, Mr

Hatimul Islam, reporter of Murshidabad district for "All India Radio" appealed to the villagers to listen to the Prime Minister's "**Maan Ki Baat**" and "**Resham Katha**" sponsored by CSR&TI, Central Silk Board, Berhampore on FM 102.22 MHz at 8.15 pm, every Thursday. As a very special initiative, Transistor Radios for men (67 nos) and Sarees for women (75 nos) were distributed among the villagers of 60 years and above (senior citizens).

GUEST LECTURES: During the year the following Guest Lecture were arranged

- **Health & Hygine** – Dr. Rajib Kr. Sanyal, ACMOH, Murshidabad, WB (dt. 27.04.16)
- **Fire Fighting & its precautions** – Shri. Kajal Nandi, Station Officer, Fire Brigade, Berhampore, WB (dt. 10.05.16)
- **Shor Documentary Film-** Shri. Tapas Roy, Journalist, Berhampore, WB (dt. 04.06.16)
- **Archaeology of India** – Dr. Sunil Kumar Jha, Asst. Archaeologist, ASI, Murshidabad (dt. 05.07.16)
- **System Analysis** – Shri. Amitav Das, Asst. Professor, IIIT, Andhra Pradesh (dt. 25.07.16)
- **Orthopaedic & Joints** – Dr. Arvind Patnaik, Orthopaedic specialist, Glocal Hospital, Berhampore (dt. 17.08.16)
- **Empowering Rural Industries through Mobile Technology** - Shri A. Kumar, BDM, IFFCO KSL, Kolkata (dt. 11.08.16)
- **Water management and its purity** - Dr. Atasi, Advisor of Brace Foundation India. (dt. 22.08.16)
- **Mental Health Care** - Dr. Arunima Chatterjee, Manobikshan, Berhampore (BHB). (dt. 22.09.16)
- **Anti-Angiogenic therapy- New Avenue for Cancer treatment** - Dr S.N. Banerjee, Assoc. Professor of Rammohan College, Kolkata (dt. 05.10.16)
- **Various skin diseases and its treatment** - Dr. R. S. Prasad Ravi, Skin Specialist, **Doctors Diagnostic Institute**, BHB (dt. 19.11.2016)
- **Female cancer** - Dr. R. Chatterjee, Former Head, Dept. of Tumour Virology, Chittaranjan NCI, Kolkata (dt. 24.12.2016).
- **Agriculture Extension-** Dr. R. N. Mishra, Former Joint Director, West Bengal (dt. 09.01.2017)
- **Ideal Indian Women from the 19th to 21st century and Gender violence -** Dr. Diviani Chaudhuri, Instructor cum scholar, State University New York, Binghamton University, America (dt. 22.02.2017)
- **Innovation in Silkworm breeding and Bio-technology approach-** Dr. R. K. Dutta, Former Director, CSR&TI, Mysore, Central Silk Board (dt. 06.03.2017)

PMCE DIVISION:

Major Activities:
1. Monitoring, co-ordination and evaluation of ongoing, concluded and new research projects / programmes/ pilot studies of Main Institute and RSRSs.
2. Organization and compilation of scientific / technical reports (e.g. agenda explanatory note, progress of ongoing, concluded research projects/ programmes/ pilot studies and follow up actions) of the following meetings:
    (a) Research Council Meeting [2 times per annum]
    (b) Research Advisory Committee Meeting [2 times per annum]
3. Preparation and compilation of Annual Action Plan of the Institute and its nested units.
4. **Implementation of RFD of Institute & nested units and progress submission to CSB:** Preparation of RFD Action plan for the next year. Preparation and submission of RFD of the Scientists and allied staff of the Institute & nested units. Preparation of RFD reports and submission on Quarterly basis. Preparation and submission of results of RFD for the year.
5. Establish, documents, implement and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of the international standard by **Implementing of ISO 9001 – 2015 at the Institute:**
6. Preparation and compilation of Annual Research and Administrative Reports of the Institute and its nested units.
7. Preparation of the Report of the Institute for CSB's Annual Report.
8. Preparation and compilation of Monthly, Quarterly and Yearly Reports on progress of Research Projects, Programmes and Pilot Studies of Main Institute and RSRSs besides correspondences and co-ordination with Central Office on scientific & technical matters.
9. Preparation of follow-up action of RCC, RRAC, AICEM etc. for presentation in the meetings.
10. Correspondences and coordination with universities / institutes/ other organizations for collaborative research projects/programmes.
11. Co-ordination and correspondences to DOSs of different states and other organizations.
12. Correspondences with other organizations regarding '**Patenting**' and '**Commercialization of evolved technologies, products and processes**'.

13. Maintenance of files related to Right-to-Information Act (Updating of different information for websites), preparation of monthly and quarterly reports and disposal of RTI related appeals of the information's seekers.

14. Maintenance and correspondences of subject related to about One hundred and seventeen (117) files and registers (e.g. Publication, Consultancy, Store article, Dead Stock articles etc.)

15. Preparation and compilation of all different kinds of miscellaneous reports of the Institute and its nested units as and when required.

16. Organizing other regular internal and external meeting as well and ensuring proper follow up.

Besides above activities, Scientists of these sections also associated with following projects/programmes which are figured in the respective sections

- **MTS 3599**: Study on mulberry sericulture production in West Bengal: A statistical approach (Nov. 2016 – April 2018)
- **MOT 3601:** Skill gap analysis and capacity development of sericulture extension workers and farmers in traditional and non-traditional states. (Nov., 2016 to April, 2018)
- **PPF 3585:** Application of growing degree days as a model driver for developing mulberry yield weather model. (Oct., 2016 to Dec., 2018)
- **MOE 3604:** Yield gap analysis in mulberry leaf and cocoon production - A study in Eastern ghat highland zones of Odisha**.** (Dec., 2016 to Nov., 2018)
- **BPR (RP) 022:** Survey and surveillance of mulberry pest in Eastern and North-Eastern region of India. (June, 2016 to May, 2021)

28. METEOROLOGICAL DATA

28.I. CSR&TI, BERHAMPORE (Latitude 24º6´N, Longitude 88º15´E, Altitude 19 M above MSL)

Data taken from meteorological surface observatory installed by India Meteorological Department (IMD) / Regional Meteorological Centre, Kolkata-700 027 in the campus of CSR&TI, Berhampore for daily recording and transmission of meteorological data at 3.30 GMT (08.30 AM) and 12.30 GMT (05.30 PM).

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Rainy days (No)	Avg. Wind velocity (kmph)	Avg. Bright sunshine (hrs)	Avg. Evaporation (mm/hr)
	Max	Min	Max	Min					
Apr., 16	42.60	18.00	98.00	45.00	24.00	3	4.28	7.55	0.26
May,16	42.20	22.00	94.00	44.00	124.00	9	4.25	6.81	0.22
Jun.,16	37.20	21.60	92.00	61.00	162.00	8	3.99	6.88	0.23
Jul.,16	36.20	25.20	97.00	68.00	232.00	19	3.80	3.17	0.01
Aug., 16	37.20	24.40	98.00	66.00	142.00	10	3.64	4.09	0.10
Sept, 16	35.60	20.10	97.00	75.00	250.30	16	2.86	4.00	0.14
Oct., 16	36.20	19.20	95.00	67.00	40.00	4	2.12	6.41	0.18
Nov., 16	32.60	11.20	98.00	67.00	82.00	4	1.76	6.80	0.13
Dec., 16	29.40	10.00	98.00	64.00	18.00	1	2.60	5.21	0.06
Jan.,17	26.80	6.20	98.00	45.00	6.00	1	2.51	6.39	0.61
Feb., 17	34.40	9.40	96.00	36.00	18.00	2	2.43	5.34	4.09
Mar.,17	35.18	15.64	94.44	45.16	42.0	3	3.32	5.89	0.83
Avr./ Tot.	--	--	--	--	1116.30	77	3.03	5.54	0.60

28.II. REGIONAL SERICULTURAL RESEARCH STATION (RSRS):

A. KALIMPONG, WEST BENGAL

This station is situated at an elevation of 950 mts above MSL **(Longitude 89°59'' to 88°53'' and Latitude between 26°31'' to 27°13'')** under the sub-Himalayan belt. Temperature varies from 5°C to 35°C, relative humidity varies from 30% to 99 % and rainfall range from 1600 to 2500 mm with range of 96 to 110 number of rainy days. Soil is sandy-loam, rich in mica and pH ranges between 4.5 and 6.5.

Meteorological data on Temperature, Relative Humidity & Rainfall at RSRS farm

Month	Temperature (ºC)		Relative Humidity (%)		Rainfall (mm)	Rainy days (no.)
	Max	Min	Max	Min		
Apr., 16	32.00	13.00	99.00	15.00	33.3	05
May,16	33.00	14.00	99.00	37.00	104.5	22
Jun.,16	33.00	18.00	100.00	47.00	207.2	21
Jul.,16	31.00	20.00	100.00	57.00	808.7	27
Aug., 16	33.00	21.00	100.00	43.00	339.7	23
Sept, 16	33.00	17.00	100.00	54.00	301.3	22
Oct., 16	32.00	14.00	100.00	17.00	208.4	11
Nov., 16	31.00	12.00	98.00	25.00	0.03	01
Dec., 16	27.00	09.00	97.00	25.00	0.0	00

Jan.,17	27.00	06.00	96.00	21.00	0.4	02
Feb., 17	27.00	11.00	93.00	21.00	0.0	00
Mar.,17	29.00	09.00	100.00	26.00	17.1	09
Average/ Total	**--**	**--**	**--**	**--**	**2020.6**	**143 days**

B. KORAPUT, ODISHA
Meteorological data on Temperature, Relative humidity & Rainfall at RSRS farm

Month & Year	Temperature (^{0}C)		Relative Humidity %		Rainfall	
	Max.	**Min.**	**Max.**	**Min.**	**mm**	**days**
Apr., 16	42.20	19.10	84.30	7.70	31.5	5
May,16	40.00	19.40	98.40	15.50	143.0	14
Jun.,16	38.20	20.70	99.40	20.24	370.0	18
Jul.,16	29.00	23.00	91.00	45.00	220.4	16
Aug., 16	29.00	20.00	91.00	45.00	368.0	21
Sept, 16	30.00	23.00	84.00	09.00	240.2	17
Oct., 16	31.00	19.00	91.00	45.00	97.6	05
Nov., 16	30.00	12.00	84.00	23.00	11.4	01
Dec., 16	31.00	12.00	91.00	39.00	0.0	00
Jan.,17	30.00	13.00	81.00	30.00	0.0	00
Feb., 17	30.00	14.00	81.00	23.00	0.0	00
Mar.,17	34.00	24.00	83.00	29.00	0.0	00
Average/ Total	**--**	**--**	**--**	**--**	**1482.1**	**97**

C. JORHAT, ASSAM

Meteorological data on Temperature, Relative humidity & Rainfall at RSRS farm:

1	Location	In the eastern part of Assam state of India
2	Latitude-Longitude	26°45′N 94°13′E / 26.75°N 94.22°E
3	Elevation	116 m (381 ft)
4	Climate	Semi- Arid
5	Avg. annual temperature Summer temperature Winter temperature	25 °C (77 °F) 23 - 39 °C 31 - 8 °C

Date	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days
	Max.	**Min.**	**Max.**	**Min.**		
Apr., 16	31.00	12.00	97.00	33.00	475.5	17
May,16	38.00	18.00	97.00	28.00	379.0	15
Jun.,16	38.00	21.00	96.00	33.00	361.0	15
Jul.,16	38.00	24.00	97.00	30.00	717.5	19
Aug., 16	39.00	24.00	97.00	28.00	232.0	09
Sept, 16	38.00	24.00	96.00	44.00	318.8	18
Oct., 16	37.00	23.00	96.00	33.00	56.0	04
Nov., 16	31.00	11.00	100.00	21.00	38.0	03
Dec., 16	27.00	08.00	100.00	34.00	9.0	02
Jan.,17	28.00	07.00	100.00	27.00	15.0	02
Feb., 17	33.00	13.00	96.00	25.00	15.6	03
Mar.,17	32.00	13.00	100.00	19.00	211.0	11
Average/ Total	**--**	**--**	**--**	**--**	**2828.40**	**118**

29. ADMINISTRATIVE & FINANCIAL REPORT

Staff position of Central Sericultural Research & Training Institute, Berhampore (West Bengal) and its allied units are as follows:

A. STAFF POSITION : MAIN INSTITUTE AND NESTED UNIT

Category	Sanctioned	Filled	Vacancy
Director	1	1	0
Scientific	50	28	22
Technical	93	73	20
Administrative	100	62	38
Total=	**244**	**164**	**80**

B. OFFICERS & STAFF RETIRED:

#	Name of employees	Designation	Date of retirement/ VR/Resigned
1.	Shri Ananda Das	Technician, CSR&TI	30.04.2016
2.	Shri Amitava Mondal	M.T.S., CSR&TI	30.04.2016
3.	Dr. N.Suresh Kumar	Scientist-D, CSR&TI	31.05.2016
4.	Shri N.R..Rao	Scientist -C, RSRS, KPT	31.05.2016
5.	Shri Amitava Sen	STA, CSR&TI	30.06.2016
6.	Shri Motilal Roy	M.T.S., CSR&TI	30.09.2016
7.	Shri Indrajit Roy	Lib. & Inform. Asst.	31.10.2016
8.	Shri T.N. Srikantha	Asst. Director (Stat)	04.11.2016(VR)
9.	Dr. U.K.Bandopadhyay	Scientist-D, CSR&TI	30.11.2016
10.	Shri Shyamal Kumar Saha	Asst. Director (A&A)	31.01.2017
11.	Smt. Ratna Biswas	Supdt. (Admn.)	31.01.2017
12.	Shri Budhadev Biswas	T.A.	31.01.2017
13.	Shri K. Raghabendra	Scientist-B	20.02.2017 (Resigned)
14.	Dr. Jayeeta Sen (Sarkar)	Scientist - D	28.02.2017

C. BUDGET (Rs. in lakh): (2016-17)

Non-Plan	Plan-Gen	Plan-Cap	NE		Total
			Gen	Cap	
2353.53	591.42	75.10	129.10	24.12	3173.28