वार्षिक अनुसंधान एवं प्रशासनिक प्रतिवेदन

Annual Research & Administrative Report

2013-14

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान
Central Sericultural Research & Training Institute
केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार
Central Silk Board, Ministry of Textiles, Govt. of India
बहरमपुर – 742101, पश्चिम बंगाल
Berhampore – 742101, West Bengal

Credit Line.....

Editor-in-Chief

Dr. S. Nirmal Kumar
Director
Central Sericultural Research & Training Institute,
Berhampore (W.B.)

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Scientist-D

Associate Editors

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प्रस्तावना

रेशम कृषि, पूर्वी एवं उत्तर पूर्वी भारत में इस क्षेत्र की स्थलाकृति तथा कृषि जलवायु के कारण अनन्य है। रेशम कृषि के क्षेत्र में प्रमुख केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर अपनी स्थापना वर्ष 1943 से ही पूर्वी एवं उत्तर पूर्वी क्षेत्र के विभिन्न भागों में स्थित अपने 4 क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्रों, 12 अनुसंधान विस्तार केन्द्रों तथा 2 उप- अनुसंधान विस्तार केन्द्रों के विस्तार जालतंत्र (नेटवर्किंग) के माध्यंम से रेशम कृषि के विकास हेतु अनुसंधान विकास, विस्तार, मानव संसाधन विकास (एच.आर.डी.) जैसी सेवा सहयोग शहतूती रेशम कृषकों/स्टेकहोल्डरों को प्रदान करते आ रहा है।

संस्थान के वैज्ञानिकों, अधिकारियों एवं कर्मचारियों के अथक प्रयासों के फलस्वरुप आई एस ओ 9001:2008 मानक को कायम रखते हुए पूर्वी एवं उत्तर पूर्वी क्षेत्रों में रेशम कृषि के विकास में महत्वपूर्ण उपलब्धियाँ दर्ज करने में सफलता प्राप्त हुई है।

वर्ष के दौरान जारी 22 परियोजनाएं, 31 कार्यक्रमों तथा 5 पायलॉट अध्ययनों सहित 2 डीबीटी निधिक परियोजनाएं में से 5 परियोजनाएं, 10 कार्यक्रमों एवं 3 पायलॉट अध्ययनों को संपन्न कर लिया गया है।

मुझे यह अभिलेख प्रस्तुत करते हुए आपार हर्ष हो रहा है कि सात नए शहतूत जीन प्रारुप विकसित किए गए हैं और अल्प पोषकत्व वाली मृदा में इसकी उपयुक्तता की जाँच की जा रही है। एआईसीईएम (चरण- III) को जारी रखते हुए MV-1 को पर्ण उपज में सर्वोत्कृष्ट पाया गया। शहतूत हेतु कैटाइनिक (cationic) सूक्ष्म पोषक का इष्टतम पर्णीय छिड़काव की अपेक्षिता तथा विभिन्न स्थानों में इसके क्रिटिकल स्तर की पहचान कर अपेक्षित छिड़काव सारणी की अनुशंसा की जा रही है। उत्कृष्ट शहतूत के सतत् अधि-उत्पादकता के लिए पार्थिव कार्बन पृथक्करण पर किए गए परीक्षण से यह पाया गया कि एक हेक्टेयर शहतूत हेतु 5.8-7 मैट्रिक टन/वर्ष$^{-1}$ कार्बन अभिग्रहण कर सकता है। जबकि पिछले वर्ष यह 5.4 से 6.6 मैट्रिक टन/वर्ष था।

शहतूत संरक्षण के लिए कवकनाशी की छिड़काव सारणी पर एक रेडी रिकॉनर तैयार कर इसे संस्थान के वेबसाइट www.csrtiber.res.in पर अपलोड किया गया है। यह स्पष्ट है कि शहतूत में चूर्णिल आसिता (पीएम) प्रतिरोध का नियंत्रण बहुगुणी क्यूटियल सहित अप्रभावी युग्मविकल्पियों तथा योज्य जीन प्रक्रिया द्वारा किया जाता है। शहतूत में चूर्णिल आसिता अभिक्रिया की पहचान हेतु आण्विक टैग के रुप में संभाव्य उपयोग के लिए आंशिक रुप से

वैधीकृत 2-3 स्कार व एसएसआर मार्कर्स का विकास तथा 7 महत्वपूर्ण कृषकीय ट्रेटसों हेतु प्रमुख क्यूटियलों की पहचान की गई है।

रेशमकीट में सुधार व उत्पादकता की दिशा में, दो बहुप्रज x द्विप्रज संकरों, N x (SK6 x SK7) तथा M6DPC x SK4 वाणिज्यीकरण के लिए प्राधिकृत किया गया। इसके अतिरिक्त, Gen3 x Dun22, Gen3 x D6(P)N तथा Gen3 x SK6 की पहचान इस क्षेत्र की अत्याधिक परिवर्तनशील एवं विविध जलवायु अवस्थाओं के लिए उपयुक्त संकरों के तौर पर की गई। आई डी जीन सहित द्विप्रज नस्लों की पहचान को अनुसंधान के क्षेत्र में एक नए आयाम के तौर पर लिया जा सकता है, जहाँ स्फूटन हेतु अंडसमूहों का अम्लीय उपचार अपेक्षित नहीं है। प्राधिकोत्तर परीक्षण के अधीन द्विप्रज के लगभग 5 लाख रोमुच, बहुप्रज x द्विप्रज तथा बहुप्रज संकर संवितरित किए गए तथा कोसा उपज /100 रोमुच FC1 x FC2 (47 कि.ग्रा.), M.Con1 x B.Con4 (54.2 कि.ग्रा.) एवं M.con1 x M.Con4 (30.2 कि.ग्रा.) दर्ज की गई।

रेशमकीट फसल संरक्षण उपायों पर जोर देते हुए रेशमकीट फसलों में रोग प्रबंधन हेतु एक नए विस्तृत स्पेक्ट्रम कमरा विसंक्रामक 'घर शोधन' का सूत्रीकरण किया गया है। साथ ही, पश्चिम बंगाल की अवस्था के अनुकूल मोबाईल विसंक्रामक मॉडल का निदर्शन किया गया जिसे यथासमय अंगीकार किया जाएगा।

कड़ी मजदूरी (ड्रडजेरी) में कटौती तथा परिस्थितिकी-मित्र कृषि प्रबंधन के अधीन E3 WM © SH/PM का वैधीकरण प्रक्षेत्र में सफलतापूर्वक क्रियान्वित किया गया। अल्प भूमि वाले कृषकों के आर्थिक लाभ हेतु ग्रीष्म ऋतु के दौरान शहतूत में जल सिंचाई के सफल प्रबंधन का समाधान लागत प्रभावी ड्रम किट ड्रिप सिंचाई प्रणाली (COD^2 IS) का विकास कर किया गया।

कोसोत्तर के क्षेत्र में, 30 मिनट तक स्टीम करने +3-5 मिनट तक उबालने+1मिली/ली वेटिंग एजेंट व 1 ग्राम/लीटर एक्टिव एजेंट के हिसाब से 30 मिनट के लिए सोकिंग + 80 डिग्री सेंटीग्रेट पर धाग़ाकरण करने से प्रतिकूल जलवायु अवस्था के दौरान धाग़ाकरण कार्य निष्पादन में 7-13% तक सुधार हुआ।

रेशम कृषि के अनवरत विकास के लिए स्टेकहोल्डरों तक तकनीकी ज्ञान का हस्तांतरण तथा उनमें क्षमता-निर्माण हेतु विविध मानव संसाधन कार्यक्रम आयोजित कर 1003 व्यक्ति प्रशिक्षित किए गए। इसके अलावे, विभिन्न रेशम कृषि कार्यकलापों पर कृषकों/प्रतिभागियों हेतु नियमित प्रशिक्षण का भी आयोजन किया गया।

इस क्षेत्र में द्विप्रज रेशम के संवर्धन हेतु पश्चिम बंगाल (4), ओडिशा (2), बिहार (1), असम व बीटीसी (3), मणिपुर (2), मिजोरम (1), त्रिपुरा (1) एवं नागालैंड (1) में पन्द्रह द्विप्रज क्लस्टरों की पहचान की गई, जहाँ द्विप्रज उत्पादन में महत्वपूर्ण वृद्धि दर्ज की गई।

संस्थानिक ग्राम संबद्ध कार्यक्रम, शहतूत तथा रेशमकीट दोनों ही के लिए उत्पादन के क्षेत्र में वृद्धि हेतु कारगार साबित हुआ है। प्रौद्योगिकियों के प्रसार हेतु विभिन्न विस्तार कार्यक्रम आयोजित किए गए जिसमें 20976 से अधिक कृषकों / सेरी स्टेकहोल्डरों ने भाग लिया।

अवधि के दौरान, 44 शोध पत्रों एवं 21 अनुसंधान लेखों को राष्ट्रीय तथा अंतर्राष्ट्रीय जर्नलों में प्रकाशित करने के अलावा 59 तकनीकी रिपोर्टों / रेशम सारांश / रिपोर्ट एवं लोकप्रिय लेखों व 13 पुस्तकें, 4 प्रौद्योगिकी सारांश 2 पुस्तक अध्याय्रों, 1 पुस्तिका तथा 20 ब्रोचरों/पंफलेट/बुलेटिन/लीफलैट प्रकाशित किए गए। संस्थान के नवीनतम अनुसंधान उपलब्धियों एवं विशिष्टताओं के बारे में जागरूकता के लिए अर्धवार्षिकी आर एडं डी, न्यूज बुलेटिन 'न्यूज एडं व्यूज" का भी प्रकाशन किया गया।

राजभाषा कार्यान्वयन समिति की चार बैठकें तथा नगर राजभाषा कार्यान्वयन समिति की दो बैठकों का आयोजन कर यह संस्थान राजभाषा कार्यान्वयन की दिशा में अपनी महत्वपूर्ण भूमिका अदा कर रहा है। इसके अतिरिक्त, वर्ष के दौरान चार कार्यशालाओं का आयोजन कर 88 पदधारीगण को प्रशिक्षित किए गए। संस्थान की राजभाषा हिंदी को समर्पित अर्धवार्षिकी "रेशम दर्शन" जून, 2013 पत्रिका, रेशम अनुसंधान - बढ़ते कदम गांव की ओर तथा न्यूज एंड व्यूज हिंदी में प्रकाशित की गई।

विकासात्मक कार्यकलापों हेतु संस्थान में महात्मा गांधी राष्ट्रीय ग्रामीण रोजगार गांरटी योजना का क्रियान्वयन जारी है।

संबद्ध क्षेत्रीय केन्द्रो में की गई अनुसंधनात्मक व विकासात्मक पहल का प्रक्षेत्र तक प्रसार संबंधित क्षेत्रों में रेशम कृषि के विकास के लिए किया गया।

निर्मल कुमार

(डॉ. एस. निमेल कुमार)
निदेशक

FOREWORD

Sericulture is unique in the Eastern & North-Eastern India due to the variation in topography and agro-climatic conditions in this region. The Central Sericultural Research & Training Institute at Berhampore, West Bengal - the premier Sericulture Institute since it establishment in 1943 is rendering Research, Development, Extension, Human Resource Development and Service supports to the mulberry sericulture farmers/ Stake-holders through its extension networking of 4 Regional Sericultural Research Stations, 12 RECs and 3 Sub-RECs located at different parts in the Eastern & North-Eastern region.

The untiring efforts of scientists, officers and staff of this Institute has made possible to maintain ISO 9001:2008 status and many significant achievements for the development of sericulture in the Eastern & North-Eastern region.

During the year, 22 projects, 31 prog. and 5 pilot studies along with 2 DBT funded projects were continued, of which, 5 projects, 10 prog. and 3 pilot studies were concluded.

I am happy to place on record that seven new mulberry genotypes have been developed and are under screening for their suitability for low nutrient soils. AICEM (Phase-III) was continued and MV-1 recorded superiority in leaf yield. Optimum foliar requirement of cationic micronutrients for mulberry and their critical level have been identified in different locations and the required spray schedule being recommended. Experiment on terrestrial carbon sequestration for sustained high productivity of quality mulberry revealed that 5.8- 7 mt year^{-1} Carbon Capturing Efficiency (CCE) for one hectare mulberry.

A ready reckoner on spray schedule of fungicide has been worked out and uploaded in the institute website *www.csrtiber.res.in* for mulberry protection. Control of multiple QTLs with recessive alleles and additive gene action on powdery mildew resistance in mulberry has been elucidated. Developed 2-3 partially validated SCAR and SSR markers for possible use as molecular tags for identification of PM reaction in mulberry and identified major QTLs for 7 important agronomic traits.

In silkworm improvement and productivity front, two multi x bi hybrids, N x (SK6 x SK7) and M6DPC x SK4C were authorized for

commercialization. In addition, Gen3 x Dun22, Gen3 x D6(P)N and Gen3 x SK6 were identified as suitable for high fluctuating and varied climatic conditions of this region. Identification of bivoltine breeds with *Id* gene can be considered as research break through where acid treatment of layings is not required for hatching. Under Post Authorization Trial, around 5 lakh dfls of Bivoltine, Multi x Bi and Multivoltine hybrids were distributed and cocoon yield/100 dfls recorded was - FC1x FC2 (47 kg), M.Con1 x B.Con4 (54.2 kg) and M.Con1 x M.Con4 (30.2 kg).

Emphasizing the stress on silkworm crop protection measures, a new broad spectrum room disinfectant '*Ghar Sodhan'* has been formulated. In addition, Mobile Disinfection Model suitable for West Bengal conditions was demonstrated which will be adopted due course of time.

Validation of E^3 WM © SH / PM is successfully conducted in the field under drudgery reduction and eco-friendly cultivation management. Economic benefit to the small land holding farmers for efficient management of irrigation water in mulberry during summer has been addressed by developing a cost-effective drum kit drip irrigation system (CoD^2IS).

On post cocoon aspects, an improvement in reeling performance by 7-13% was achieved, if cocoons were subjected 30 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L wetting agent & 1g/L surface active agent + reeling at 80°C during adverse climatic condition.

For sustainable development of sericulture through transfer of technological knowledge to the stakeholders and capacity building, various Human Resource Development programmes were organized and 1003 persons were trained, besides, regular training to the farmers/ participants on different activities of sericulture.

To address the promotion of Bivoltine silk in the region, fifteen bivoltine clusters have been identified in West Bengal (4), Odisha (2), Bihar (1), Assam & BTC (3), Manipur (2), Mizoram (1), Nagaland (1) and Tripura (1) where a significant increase of production of bivoltine is achieved.

Institute Village Linkage Prog. has proved to increase the yield both for mulberry and silkworm productivity. Different extension communication prog. were organized for dissemination of technologies and more than 20976 farmers / seri-stakeholders participated.

44 research papers and 21 research articles were published, during the period, in the National and International Journals, besides, 59 Technical Reports/ Silk briefs/ reports and popular articles and 13 Books, 4 compendium of

technologies, 2 book Chapters, 1 booklet and 20 brochures/ Pamphlets/ Bulletins/Leaflets published. Half-yearly R&D news bulletin "**NEWS & VIEWS**" for awareness on latest research findings of the Institute were also published.

On Official language implementation, this Institute has taken a lead role and 4 Internal Official Language Implementation Committee (OLIC) meetings and two Town-OLIC meetings organized. In addition, four workshops conducted and 88 persons trained. Half yearly Institute's Raj Bhasha Magazine "Resham Darshan" and a book "Reshamkit ebang Resham Anusandhan Barte Kadam Gao Ki Oor" and "News and Views" in Hindi were published.

Implemented the MG-NREGA project at the Institute for developmental activities. The R&D interventions made at nested Regional Stations were disseminated to the field for development of sericulture in the respective region.

(Dr. S. Nirmal Kumar)
Director

1. मुख्य सारांश

संस्थान की वर्ष 2013-14 की विशिष्ट उपलब्धियों तथा मुख्य अनुसंधान और विकास गतिविधियां निम्नवत हैः-

शहतूत उत्पादकता सुधारः

- चयन हेतु कार्यिकीय वृद्धि प्राचल का उपयोग मार्कर के तौर पर कर ते हुए 57 संकर संयोजन के कुल 1024 नवोद्भिद पौधों का चयन तथा उसे प्रायोगिक भूखंड में स्थानांतरित किया गया।
- निम्न कोटि (इनपुट} की मृदा हेतु उपयुक्त नए शहतूत जीन प्रारुपों का मूल्यांकन छह स्थानों पर किया जा रहा है।
- एआईसीईएम (चरण-III) के अंतर्गत परीक्षित शहतूत जीन प्रारुपों में आकड़ों का अभिलेखन कर MV-1 जीन प्रारुप को पर्ण उपज में सर्वोत्कृष्ट पाया गया ।
- शहतूत हेतु कैटाइनिक (cationic) सूक्ष्म पोषक का इष्टतम पर्णीय छिड़काव की अपेक्षिता तथा विभिन्न स्थानों से इसके क्रिटिकल स्तर की पहचान कर भारत के पूर्वी तथा उत्तर-पूर्वी क्षेत्रों में अपेक्षित छिड़काव सारणी तैयार किया गया है।
- "उत्कृष्ट शहतूत के सतत् अधि-उत्पादकता के लिए पार्थिव कार्बन पृथक्करण" पर किए गए अध्ययन के अंतर्गत द्वितीय वर्ष के परीक्षण से यह पाया गया कि विविध खेती पद्धति (विविध S-1635) में शहतूत प्रति हेक्टेयर 5.84 से 7.03 मैट्रिक टन/वर्ष कार्बन अभिग्रहण कर सकता है। जबकि पिछले वर्ष यह 5.4 से 6.6 मैट्रिक टन/वर्ष था।
- शहतूत के "विशाला" प्रजाति की उत्पादकता के अध्ययन हेतु 12 स्थानों (आठ क्षेत्रों में) पर पौधरोपण का कार्य संपन्न कर लिया गया है।

शहतूत संरक्षणः

- भारत के पूर्वी तथा उत्तर-पूर्वी क्षेत्रों के लिए कवकनाशी के छिड़काव सारणी पर एक रेडी रिकॉनर तैयार कर इसे संस्थान के वेबसाइट www.csrtiber.res.in में सम्मिलित किया गया है।
- यह स्पष्ट है कि शहतूत में चूर्णिल आसिता (पीएम) प्रतिरोध का नियंत्रण बहुगुणी क्यूटियल सहित अप्रभावी युग्मविकल्पियों तथा योज्य जीन प्रक्रिया द्वारा किया जाता है।
- शहतूत में चूर्णिल आसिता प्रतिक्रिया की पहचान हेतु आण्विक टैग के रुप में संभाव्य उपयोग हेतु आंशिक रुप से वैधीकृत 2-3 स्कार तथा एसएसआर मार्कर्स विकसित की गई।
- S-1 की तुलना में बेहतर उपज की संभाव्यता सहित चूर्णिल आसिता प्रतिरोधी S-1 x वियतनाम संकर से कुछेक अतिक्रामी संततियों की पहचान की गई है। तथापि, इस प्रकार के सभी लाइनें चूर्णिल आसिता प्रतिरोध हेतु अनुमानित स्कार मार्कर के लिए सकारात्मक पाई गई।
- 7 महत्वपूर्ण सस्य विज्ञान ट्रेटसों के लिए प्रमुख क्यूटियलों की पहचान तथा पैतृक वंशक्रम के 127 बहुरुपी (polymorphic) एसएसआर में से 105 का उपयोग कर 16000 मैपिंग डाटा प्वांइट उत्पन्न की गई।

रेशमकीट सुधार एवं उत्पादकताः

- बहुXद्विप्रज NX (SK6XSK7) तथा M6DPCXSK4C संकरों को केन्द्रीय रेशम बोर्ड द्वारा वाणिज्यीकरण हेतु प्राधिकृत किया गया।
- भारत के पूर्वी तथ उत्तर-पूर्वी क्षेत्रों में अत्याधिक परिवर्तनशील एवं विविध जलवायु अवस्थाओं के लिए उपयुक्त तीन संकरों नामतः Gen3XDun22, Gen3XD6(P)N तथा Gen3XSK6 की पहचान की गई।
- परीक्षण से यह पाया गया कि आईडी जीन सहित द्विप्रज नस्लों के स्फुटन हेतु अम्लीय उपचार अपेक्षित नहीं है।

- प्राधिकोत्तर परीक्षण के अधीन द्विप्रज X द्विप्रज के 94,600 रोमुच, बहुXद्विप्रज के 2,87,250 रोमुच तथा बहु Xबहुप्रज के 1,79,270 रोमुच संवितरित किए गए। द्विप्रज संकरों में , बहुXद्विप्रज संकरों तथा बहुXबहुप्रज संकरों में क्रमशः FC1XFC2 (47 कि.ग्रा./100 रोमुच), M.Con1XB.Con4 (54.2 कि.ग्रा. /100 रोमुच) तथा M.Con1XM.Con4 (30.2 कि.ग्रा./100 रोमुच) की अधिकतम उपज दर्ज की गई।

रेशमकीट संरक्षणः

- रेशमकीट फसलों में रोग प्रबंधन हेतु लागत प्रभावी तथा कम हानिकरक कमरा विसंक्रामक 'घर शोधन', एक विस्तृत स्पेक्ट्रम का (Dibromo-dimethoate hydration and para-Dichloro-Benzene based fumigant) सूत्रीकरण किया गया है।

लागत में कमी / कटौतीः

- E3 WM © SH/PM (समान्य फलोत्पादक मितव्ययी परिस्थितिकी-मित्र खर-पतवार मूवर सह प्ररोह फसल प्राप्ति/छँटाई मशीन) का वैधीकरण प्रक्षेत्र में सफलतापूर्वक क्रियान्वित किया जा रहा है।
- ग्रीष्म ऋतु के दौरान शहतूत में जल सिंचाई के सफल प्रबंधन हेतु अल्प भूमि वाले कृषकों के लिए COD2IS [लागत प्रभावी ड्रम किट ड्रिप सिंचाई प्रणाली] विकसित किया गया।
- पश्चिम बंगाल की जलवायु स्थिति के अनुकूल शहतू त में फसल संरक्षण उपायों को सुनिश्चित करने के लिए एमडीएम (मोबाइल रोगाणुनाशी मॉडल) का सफल निदर्शन किया गया।
- परीक्षण से यह पाया गया कि 30 मिनट तक स्टीम करने +3-5 मिनट तक उबालने+1मिली/ली वेटिंग एजेंट व 1 ग्राम/लीटर एक्टिव एजेंट के हिसाब से 30 मिनट के लिए सोकिंग + 80 डिग्री सेंटीग्रेट पर

धाग़ाकरण करनॅ सॅ प्रतिकूल जलवायु अवस्था कॅ दौरान धाग़ाकरण कार्य निष्पादन मॅं 7-13% तक सुधार हॊता है।

प्रौद्योगिकी का हस्तांतरणः

पश्च-आईवीएलपी कृषकॊं का मॉनीटरिंग व पर्यवॅक्षण :

पश्च-संस्थानिक ग्राम संबद्ध योजना कार्यक्रम कॅ मॉनीटरिंग व पर्यवॅक्षण के अंतर्गत 1020 कृषकॊं (सिंचित 270 व वर्षाश्रित 750) 18 स्थानॊं मॅं इसकॅ अधीन लाए गए एवं शहतूत पर्ण उपज एवं कोसा उत्पादन में दर्ज की गई वृद्धि:

शहतूत: सिंचित अवस्था के अधीन पर्ण उपज में नियत्रंण 33.7 मी.टन/हे/वर्ष की तुलना मॅं 14.2% की वृद्धि दर्ज की गई जबकि वर्षाश्रित अवस्था में नियत्रंण (11.3 मी. टन/हे/वर्ष) की अपॅक्षा 17.5% की वृद्धि देखी गई।

रेशमकीट: सिंचित अवस्था के अधीन द्विप्रज x द्विप्रज के 2000 रोग मुक्त चकत्ते, बहुप्रज x द्विप्रज के 109150 रोग मुक्त चकत्ते तथा 2105 बहुप्रज x बहुप्रज के कीटपालन से 55 कि.ग्रा. (द्विप्रज x द्विप्रज), 40.4 कि.ग्रा. (बहुप्रज x द्विप्रज) तथा 28.2 कि.ग्रा. (बहुप्रज x बहुप्रज) प्रति 100 रॊमुच की औसत उपज कॅ साथ क्रमशः 29.1%, 16.6% एवं 23.6% की वृद्धि नियत्रंण की अपॅक्षा दर्ज की गई। वर्षाश्रित अवस्था के अधीन द्विप्रज x द्विप्रज कॅ कुल 27353 रोग मुक्त चकत्ते, बहुप्रज x द्विप्रज कॅ 42900 रोग मुक्त चकत्ते एवं बहुप्रज x बहुप्रज कॅ 18125 रोग मुक्त चकत्तॊं का कीटपालन कर नियंत्रन की अपॅक्षा 44.4कि.ग्रा. (द्विप्रज x द्विप्रज), 41.7 कि.ग्रा. (बहुप्रज x द्विप्रज) एवं 27.9 कि.ग्रा. (बहुप्रज x बहुप्रज) औसत कॊसा उपज प्रति 100 रॊमुच सहित क्रमशः 19.4%, 13%, तथा 10% की वृद्धि पाई गई।

क्लस्टर प्रवर्धन कार्यक्रम का क्रियान्वयनः

- पूर्वी और उत्तर-पूर्वी राज्यों के इर्द्ध-गिर्द्ध पश्चिम बंगाल (4), ओडिशा (2), बिहार (1), असम व बीटीसी (3), मणिपुर (2), मिजोरम (1), त्रिपुरा (1) एवं नागालैंड (1) को सम्मिलित करते हुए पन्द्रह द्विप्रज क्लस्टरों का गठन किया गया है।

मानव संसाधन विकास (एचआरडी):

- रेशम उत्पादन के निरंतर विकास की दृष्टि से प्रौद्योगिकी के हस्तान्तरण हेतु विविध मानव संसाधन विकास कार्यक्रम आयोजित कर कुल 1003 उम्मीदवारों [55 (पीजीडीएस), 20 (प्रबंधन विकास कार्यक्रम), 92 (निपुणता अद्यतन कार्यक्रम), 391 (समाकलित निपुणता विकास योजना) तथा 445 (तदर्थ)] प्रशिक्षित किए गए। साथ ही रेशमकृषि के विभिन्न प्रक्रियाओं यथा शहतूत कृषि, संस्थान द्वारा विकसित रेशमकीट पालन प्रौद्योगिकियों, रोग एवं पीड़क प्रबंधन आदि पर कृषकों / प्रतिभागियों को नियमित प्रशिक्षण प्रदान किया गया।

विस्तार संसूचना कार्यक्रमः

संस्थान द्वारा विकसित प्रौद्योगिकियों के प्रसार तथा कृषकों को शहतूत कृषि एवं रेशम कीटपालन प्रकिया/तकनीकों से प्रशिक्षित करने के लिए संस्थान द्वारा निम्नलिखित कार्यक्रम आयोजित किए गए जिसके अंतर्गत कृषि मेलों, प्रक्षेत्र दिवस, जागरुकता कार्यक्रम, दृश्य-श्रव्य कार्यक्रम एवं मानव संसाधन विकास कार्यक्रमों में आकर 20976 से अधिक कृषकों / सेरी-स्टेकहोल्डर्स ने विविध रेशम प्रौद्योगिकियों पर ज्ञान प्राप्त किया।

क्र.सं.	आयोजित गतिविधि	कार्यक्रमों की संख्या (कृषकों)
1.	रेशम कृषि मेला	4 (2061)
2.	श्रव्य- दृश्य कार्यक्रम	59 (2589)
3.	प्रक्षेत्र दिवस	61 (2294)
4.	प्रदर्शनी	64 (5550)
5.	जागरुकता कार्यक्रम	74 (3799)
6.	समूह चर्चा	71 (2069)
7.	विचार गोष्ठी	19 (1875)
8.	प्रौद्योगिकी निदर्शन	38 (1215)
9.	कृषकों व प्रशिक्षकों का प्रशिक्षण कार्यक्रम	67 (2220)

प्रकाशन:

- संस्थान के नवीनतम अनुसंधान उपलब्धियों एवं विशिष्टताओं के बारे में जागरूकता के लिए अर्धवार्षिकी आर एडं डी, न्यूज बुलेटिन 'न्यूज एडं व्यूज" का प्रकाशन।
- राष्ट्रीय तथा अंतर्राष्ट्रीय जर्नलों में चवालीस (44) शोध पत्रों तथा 21 अनुसंधान लेख प्रकाशित किए गए।
- 19 (उन्नीस) पूर्ण शोध पत्रों तथा 27 अनुसंधान सारांश विभिन्न संगोष्टियों/ सिंपोजियम/ सम्मेलनों के कार्यविवरण में प्रकाशित किए गए।
- 59 तकनीकी रिपोर्ट / रेशम संक्षेपण / रिपोर्ट एवं लोकप्रिय लेखों का प्रकाशन किया गया।

- 13 पुस्तिकाओं, 4 पौद्योगिकी सारांश, 2 पुस्तक-अध्याय, 1 पुस्तिका तथा 20 ब्रोचर / पैम्फलेट / बुलेटिन / लीफलेट प्रकाशित किए गए।

राजभाषा कार्यान्वयनः

- संस्थान में राजभाषा कार्यान्वयन समिति की चार बैठकें क्रमशः दिनांक 14.06.2013, 30.09.2013, 30.12.2013 एवं 25.03.2014 को आयोजित करने के अतिरिक्त नगर राजभाषा कार्यान्वयन समिति की 28वीं व 29वीं बैठक का आयोजन भी दिनांक 05.08.2013 तथा 12.03.2014 को निर्धारित समय सारणी के अनुसार किया गया।
- संस्थान के अधिकारियों/पदधारियों के लिए कुल 4 पूर्ण दिववसीय कार्यशालाएं क्रमशः दिनांक 22.06.2013, 22/23.08.2013, 19/20.11.2013 एवं 04.02.2014 आयोजित कर कुल 88 पदधारीगण प्रशिक्षित किए गए। साथ ही संस्थान के संबद्ध 3 क्षेरेउअके केन्द्रों, 05 अनुसंधान विस्तार केन्द्रों एवं क्षेत्रीय कार्यालय, कोलकाता में भी कार्यशालाएं आयोजित की गई।
- संस्थान की राजभाषा हिंदी को समर्पित अर्धवार्षिकी "रेशम दर्शन" जून, 2013 पत्रिका, रेशम अनुसंधान – बढ़ते कदम गांव की ओर तथा न्यूज एंड व्यूज हिंदी में प्रकाशित की गई।

अन्य महत्वपूर्ण गतिविधियाँ :

- केरेउअवप्रसं, बहरमपुर के आईएसओ 9001:2008 का पर्यावलोकन लेखा परीक्षा कर दिनांक 08.01.2014 को आईएसओ 9001:2008 प्रमाणपत्र का पुनः नवीकरण किया गया।
- संस्थान में महात्मा गांधी राष्ट्रीय ग्रामीण रोजगार गांरटी योजना के अधीन विकासात्मक कार्यकलाप जारी है।

वाह्य निधिक परियोजनाएं :

डीबीटी निधिक : शहतूत के डीएनए मार्कर आधारित आनुवंशिक लिकेंज मैप का विकास एवं कृषकीय महत्वपूर्ण प्लांटा ट्रेटस के लिए क्यूटियल विश्लेषण (सीसीएमबी, हैदराबाद के साथ सहयोग)

डीबीटी निधिक पीआईजी - 3441: शहतूत चूर्णिल असिता प्रतिरोध (फाइलेक्टिनिया कोरॅया) के स्कार मार्कर्स का विकास, वैधीकरण व उपयोग (सीसीएमबी, हैदराबाद के साथ सहयोग)

क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र की उपलब्धियाँ

क्षेरेउअके कालिम्पोंग (पश्चिम बंगाल):

- संस्थान की तीन परियोजनाएं एवं दो कार्यक्रमों समेत क्षेरेउअके के पाँच कार्यक्रमों का संचालन किया जा रहा है।
- कलिम्पोंग तथा सिक्किम के पहाड़ियों में प्ररोह अशन द्वारा रेशमकीट पालन को मितव्ययी पाया गया है। इस प्रौद्योगिकी को अपनाकर 28 मानवदिवस/100 रोमुच की बचत की जा सकती है।
- रेशमकीट संकर SK6 x SK7 कृषक स्तर पर लोकप्रिय बनाया गया है। कुल उत्पादित (10,964 रोमुच) में से रेशम निदेशालय सिक्किम (2300 रोमुच) एवं आंचलिक रेशमकीट बीज संगठन, मालदा (4200 रोमुच) को आपूर्तित की गई तथा शेष 4464 रोमुच को बसंत फसल, 2014 के दौरान आपूर्ति हेतु शीतागार में रखा गया है।

क्षेरेउअके, कोरापुट(ओडिशा):

- संस्थान की तीन परियोजनाओं व दो कार्यक्रमों समेत क्षेरेउअके के एक कार्यक्रम का संचाचन किया जा रहा है।

- कुल 19,500 शहतूत पौध की पैदावार कर रेशम निदेशालय, छत्तीसगढ़ को 12000 (S1635:6000 और 61730: 6000) तथा रेशम निदेशालय, ओडिशा को 7,500 (S1635:5500 C1730: 2000) की आपूर्ति अधिउत्पादक शहतूत उपजाति एकड़ के संप्रासरण हेतु की गई।
- 3388 किग्रा. तथा 1888 किग्रा. द्विप्रज (SK6 x SK7) कोसों का उत्पादन कर पश्चिम बंगाल के बीजागारों को आपूर्तित की गई।

क्षेरेउअके, रांची (झारखण्ड):

- संस्थान की चार परियोजनाओं तथा एक कार्यक्रम समेत क्षेरेउअके के तीन कार्यक्रमों का संचाचन किया जा रहा है।
- वर्षाश्रित अवस्था के अधीन कृषक स्तर पर पोषकत्व पैकेजों के अनुप्रयोग से शहतूत पर्ण उपज में नियंत्रण की अपेक्षा (8.2 मैट्रिक/ हे./ वर्ष) 13% वृद्धि दर्ज की गई।
- कृषक स्तर पर शहतूत कृषि के अधीन कुल 2.5 एकड़ नए शहतूत प्रक्षेत्र एक गैर सरकारी संगठन, रामकृष्ण मिशन के मार्फत लाया गया।

क्षेरेउअके, जोरहाट (असम):

- संस्थान की पांच परियोजनाएं एवं दो कार्यक्रमों समेत क्षेरेउअके की एक परियोजना व तीन कार्यक्रमों का संचालन किया जा रहा है।
- S-1635 शहतूत प्रजाति के अधीन 42 कृषकों को सम्मिलित कर कुल 15.5 एकड़ प्रक्षेत्र नए शहतूत पौध रोपण के अंतर्गत लाया गया।
- उत्कृष्ट द्विप्रज रेशम के संवर्धन हेतु सीपीपी के अधीन आठ द्विप्रज क्लस्टरों को संस्थापित कर 2254 कृषकों समेत 1501 एकड़ शहतूत पौधरोपण प्रक्षेत्र इसके अधीन लाया गया।

1. EXECUTIVE SUMMARY

Salient findings and a brief highlight of Research and Development activities for the year 2013-14.

MULBERRY IMPROVEMENT AND PRODUCTIVITY

- Using physiological growth parameters as marker for selection, 1024 seedlings of 57 cross combinations were selected and transplanted in the experimental plots.
- Evaluation of seven mulberry genotypes being conducted at four locations, suitable for low nutrient soils.
- Under AICEM (Phase-III), data recording initiated and MV-1 has shown superiority in leaf yield among the test mulberry genotypes
- Optimum foliar requirement of cationic micronutrients for mulberry and their critical level have been identified from different locations and the required spray schedule worked out for Eastern and North-Eastern India.
- The second year of experimentation in "Terrestrial carbon sequestration for sustained high productivity of quality mulberry" revealed 5.84 to 7.03 mt $year^{-1}$ **Carbon Capturing Efficiency** (CCE) for one hectare mulberry (var. S-1635) under varying farming practices compared to 5.4 to 6.6 mt $year^{-1}$ during previous year.
- VISHALA variety of mulberry, plantation has been completed at 12 locations (in 8 regions) for studying the productivity.

MULBERRY PROTECTION

- A ready reckoner on spray schedule of fungicide has been worked out for Eastern and North Eastern India and incorporated in the institute website *www.csrtiber.res.in*
- Elucidated that powdery mildew (PM) resistance in mulberry is controlled by multiple QTLs with recessive alleles and additive gene action.
- Developed 2-3 partially validated SCAR and SSR markers for possible use as molecular tags for identification of PM reaction in mulberry.
- Identified few transgressive progenies from S-1 x Vietnam cross having better yield potential than S-1 along with resistance to PM; All such lines were found positive for the putative SCAR marker for PM resistance.
- Identified major QTLs for 7 important agronomic traits and 127 polymorphic SSRs to parental lines; utilizing 105 of those, generated ~ 16000 mapping data points.

SILKWORM IMPROVEMENT AND PRODUCTIVITY

- The Multi x Bi hybrids, N x (SK6 x SK7) and M6DPC x SK4C were authorized by CSB for commercialization.
- Three hybrids namely, Gen3 x Dun22, Gen3 x D6(P)N and Gen3 x SK6 were identified as suitable for the high fluctuating and varied climatic conditions of Eastern and North-Eastern India.
- Bivoltine breeds with *Id* gene have been developed which do not require acid treatment for hatching when crossed either with bivoltine female or multivoltine male.
- Under Post Authorization Trial, 94,600 dfls of Bi x Bi, 2, 87,250 dfls of Multi x Bi and 1,79,270 dfls of Multi x Multi were distributed. Among bivoltine hybrids, Multi x Bi hybrids and Multi x Multi hybrids FC1x FC2 (47 kg/100 dfls), M.Con1 x B.Con4 (54.2 kg/100 dfls) and M.Con1 x M.Con4 (30.2 kg/100 dfls) registered highest yield, respectively.

SILKWORM PROTECTION

- A broad spectrum, cost-effective and less hazardous room disinfectant '*Ghar Sodhan'* (Dibromo-dimethoate hydantoin and Para-Dichloro-Benzene based fumigant) has been formulated for disease management in silkworm crops.
- Successfully demonstrated **MDM** [Mobile Disinfection Model] suitable for West Bengal conditions in mulberry sericulture to ensure crop protection measures.

COST REDUCTION

- Validation of **E^3 WM © SH / PM** (simple Efficient *E*conomic *E*co-friendly Weed Mower cum Shoot Harvest / Pruning Machine) is being successfully carried out in the field.
- Developed **CoD^2IS** [Cost-effective Drum kit Drip Irrigation System] for small land holding farmers for efficient management of irrigation water in mulberry during summer.
- Experiments revealed that there is an improvement in reeling performance by 7-13%, if cocoons are subjected 30 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L wetting agent & 1g/L surface active agent + reeling at 80°C during adverse climatic condition.

TECHNOLOGY TRANSFER

Monitoring and Supervision of the post – IVLP farmers:

1020 farmers (irrigated 270 and rainfed 750) were covered in 18 locations and the increase in mulberry leaf and cocoon yield productivity was:

- **Mulberry:** In irrigated condition, leaf yield increased by 14.2% against 33.7 mt/ha/year in control, while, in rainfed condition, the increment was 17.5 % over the control (11.3 mt/ha/yr).
- **Silkworm:** In irrigated condition, rearing of 2000 dfls of Bi x Bi, 109150 dfls of Multi x Bi and 21050 dfls of Multi x Multi recorded an average yield of 55 kg (Bi x Bi), 40.4 kg (Multi x Bi) and 28.2 kg (Multi x Multi), per 100 dfls with yield gain of 29.1 %, 16.6% and 23.6% respectively over the controls. Under rain fed condition, a total of 27353 dfls of Bi x Bi, 42900 dfls of Multi x Bi and 18125 dfls of Multi x Multi were reared and average cocoon yield/100 dfls was 44.4 kg (Bi x Bi), 41.7 kg (Multi x Bi) and 27.9 kg (Multi x Multi) with 19.4%, 13% and 10% gains respectively over the control.

IMPLEMENTATION OF CLUSTER PROMOTION PROGRAMME

- Fifteen bivoltine clusters in the Eastern and North-Eastern states have been constituted covering West Bengal (4), Odisha (2), Bihar (1), Assam & BTC (3), Manipur (2), Mizoram (1), Tripura (1) and Nagaland (1).

HUMAN RESOURCE DEVELOPMENT (HRD)

- Various Human Resource Development programmes were organized for Transfer of Technology in view of sustainable development of sericulture. A total of 1003 persons were trained [55 (PGDS), 20 (Management Development Prog.), 92 (Skill Updation Prog.), 391 (Integrated Skill Development Scheme) and 445 (Ad hoc)]. Regular training was imparted to the farmers/ participants on different activities of sericulture, such as, mulberry cultivation, silkworm rearing technologies, disease and pest management etc. developed by the Institute.

EXTENSION COMMUNICATION PROGRAMMES

- To disseminate technologies, educate and train the farmers on different aspects of improved mulberry cultivation and silkworm rearing practices/technologies developed by the Institute, different extension prog. were taken up and more than 20976 farmers / seri-stakeholders participated in Krishi Mela, Field Days, Awareness, Audio-visual & HRD programmes and gained knowledge on different improved sericulture technologies.

Sl. No.	Events	No. of events (farmers)
1.	Resham Krishi Mela	4 (2061)
2.	Audio-visual prog.	59 (2589)
3.	Field Day	61 (2294)
4.	Exhibition	64 (5550)
5.	Awareness programme	74 (3799)
6.	Group discussion	71 (2069)
7.	Vichar Gosthi	19 (1875)
8.	Technology demonstration	38 (1215)
9.	Farmers' & Trainers' Training prog.	67 (2220)

PUBLICATION

- Published half-yearly R&D news bulletin "**NEWS & VIEWS**" for awareness on latest research findings and achievements of the Institute.
- Forty four research papers and 21 research articles were published in the National and International Journals.
- Nineteen full research papers and 27 abstracts of research papers were published in the proceedings of Seminars/ Symposium/ Conferences.
- Published 59 Technical Reports/ Silk briefs/ reports and popular articles.
- Published 13 Books, 4 Compendium of technologies, 2 Book Chapters, 1 Booklet and 20 Bochures/ Pamphlets/ Bulletins/Leaflets.

OFFICIAL LANGUAGE IMPLEMENTATION

- Four Internal Official Language Implementation Committee (OLIC) meetings were held and two Town Official Language Implementation Committee (TOLIC) meetings were conducted at the Institute as per schedule.
- Organized one workshop on 22.06.2013 for all officers and 3 workshops on 22/23.08.2013, 19/20.11.2013 and 4.02.2014 for 88 administrative and Technical staff at the Institute. In addition, workshops were also conducted in the nested 3 RSRSs, 5 RECs and R.O., Kolkata.
- Published half yearly Institute's Raj Bhasha (Hindi) Magazine **"Resham Darshan"** for June, 2013, a book **"Reshamkit ebang Resham Anusandhan Barte Kadam Gao Ki Oor"** and **"News and Views"** in hindi.

OTHER SIGNIFICANT ACTIVITIES

- Surveillance audit of **ISO 9001:2008** of CSR&TI, Berhampore has been done and renewed the **ISO 9001:2008** certificate on 08.01.2014.
- Developmental activities at the Institute under MG-NREGA were continued.

EXTERNALLY FUNDED PROJECTS

- **DBT funded:** Development of DNA marker based genetic linkage map of mulberry and QTL analysis for agronomically important *planta* traits (Collaboration with CCMB, Hyderabad).
- **DBT funded PIG-3441:** Development, validation and utilization of SCAR marker(s) for powdery mildew (*Phyllactinia corylea*) resistance in mulberry (Collaboration with CCMB, Hyderabad).

ACHIEVEMENTS AT RSRSs

RSRS, Kalimpong (West Bengal):

- Three projects and two programmes of the Institute along with five prog. of RSRS are being conducted.
- Silkworm rearing with shoot feeding has been found economical at Kalimpong and Sikkim hills. By adopting the technology, 28 mandays / 100 dfls can be saved.
- The silkworm hybrid, SK6 x SK7 has been popularized at farmers level. A total of 10964 dfls of were produced and supplied to DoS, Sikkim (2300 dfls) and ZSSO, Malda (4200 dfls) and remaining 4464 dfls kept in cold storage for supply during Spring crop, 2014.

RSRS, Koraput (Odisha):

- Three projects and two programmes of the Institute along with one prog. of RSRS are being conducted.
- A total of 19,500 saplings of mulberry were raised and supplied 12,000 (S1635: 6000 and C1730: 6000) to DoS, Chhattisgarh and 7,500 (S1635: 5500 and C1730: 2000) to DoS, Odisha for expansion of HYV mulberry acreage.
- Generated 3388 kg and 1888 kg bivoltine (SK6 x SK7) cocoons and supplied to the Grainages of West Bengal.

RSRS, Ranchi (Jharkhand):

- Four projects and one programme of the Institute along with three prog. of RSRS are being conducted.
- With the application of package of nutrients at farmers' level under rainfed condition, mulberry leaf yield was increased by 13% over the control (8.2 mt/ ha/ yr).
- A total of 2.5 acres of new area was brought under mulberry cultivation at farmers' level through NGO Ramkrishna Mission.

RSRS, Jorhat (Assam):

- Five projects and two programmes of the Institute along with one project and three prog. of RSRS are being conducted.
- A total of 15.5 acres new mulberry plantation was brought with S-1635 mulberry variety covering 42 farmers.
- Eight Bivoltine Clusters under CPP was established for promotion of quality bivoltine silk and 2254 farmers with 1501 acres of mulberry plantation were covered.

2. INTRODUCTION

Mandate:

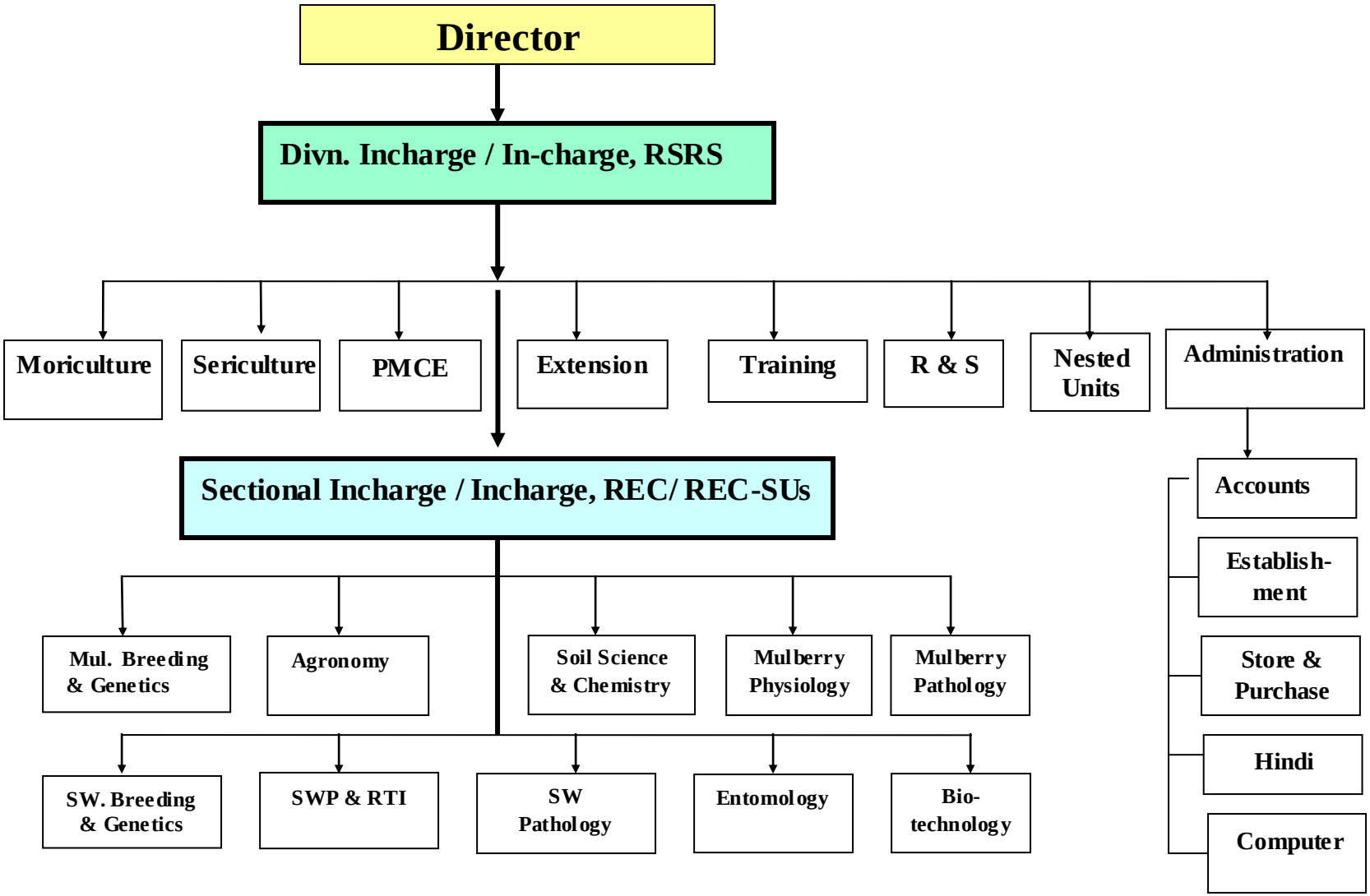
- Constant up-gradation of productivity of silkworm hybrids (Multivoltine x Multivoltine, Multivoltine x Bivoltine and Bivoltine x Bivoltine) and mulberry varieties for irrigated and rainfed mulberry.
- Testing centre for all mulberry silkworms related experiments or feeding technologies evolved in CSB Institutions or referred by other agencies to CSB in the states identified for it.
- Human resources development through training.
- Coordination with DOSs for development of sericulture industry.

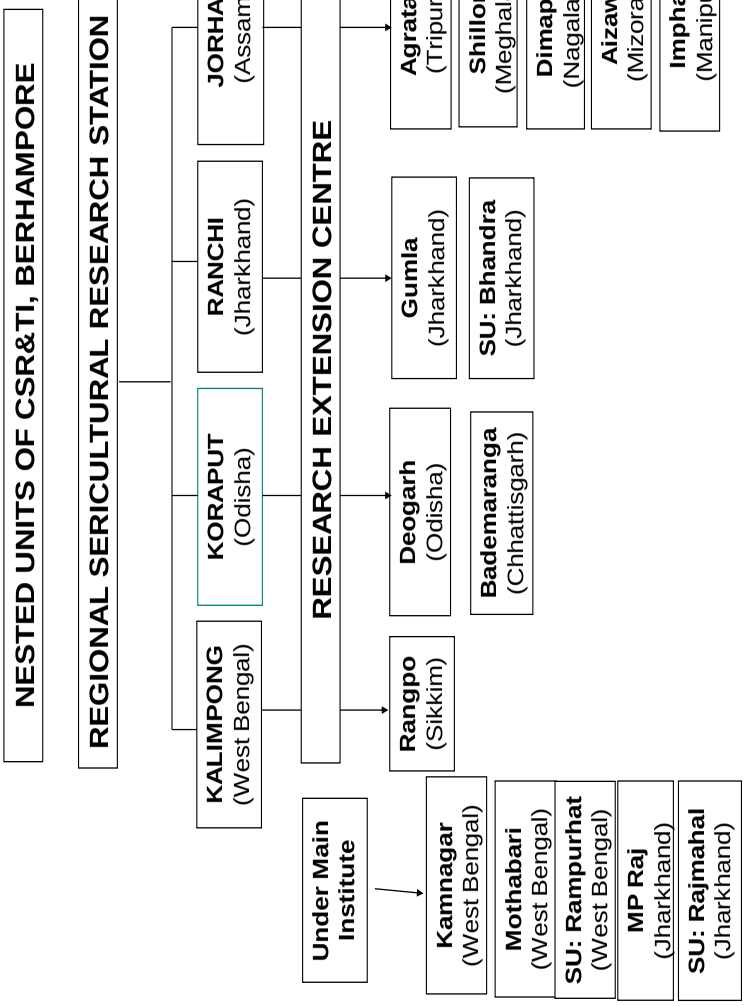
The institute conducts research on all fields of sericulture from soil to silk. Entrusted with the mandate to carry out research, it has made remarkable break through and outstanding contributions for the overall development of silk industry in the region. In the plant side, improved mulberry varieties, suitable to the agro climatic condition of different areas, have been developed along with its package of practices. On the silkworm side, region and season specific high yielding silkworm breeds have been evolved. The institute has developed integrated management of mulberry and silkworm diseases and pests, which are being popularized in the fields and proved to be effective to save the crop losses. With regard to post cocoon technologies improved cooking and the Institute has developed reeling techniques.

ACHIEVEMENTS ON RESULTS FRAME WORK DOCUMENTS (RFD)

#	Objective	Action point / Success indicator	Target for 2013-14	Achievt.	% Achievt.
1	Undertaking Research Projects to enhance quality and productivity	No. of Research Projects/ Prog. to be undertaken. Carry forward from 12-13	**35** (18 Proj. + 1 PS + 16 Prog.)	**52** (22 Proj. + 4 PS + 26 Prog.)	**149 %**
		No. of Projects to be concluded.	**5**	**16** (5 Proj. + 1 PS + 10 Prog.)	**320%**
		No. of New Research Projects/ Prog. to be taken up.	**11**	**17** (4 Proj. + 3 PS + 10 Prog.)	**155 %**
2	Evaluation of improved varieties of mulberry and its dissemination to field.	Development of high yielding mulberry varieties	**1**	**1**	**100%**
		Absorption of the varieties in the field.	**1**	**3**	**300%**
3	Developing improved bivoltine / multivoltine breeds suitable to tropical regions and dissemination to field.	Development of improved bivoltine/ multivoltine breeds.	**1**	**1**	**100%**
		Absorption of the breeds in the field.	**1**	**3**	**300%**
4	Integrated and Disease management and its dissemination to field.	Development of technologies / solutions.	**1**	**2**	**200%**
		Absorption of technologies / solutions.	**1**	**2**	**200%**
5	Food plant / silkworm race authorisation programme.	Area covered in farmers' field for trial of new mulberry varieties.	**5**	**14.55**	**291%**
6	To extend the coverage of proven technologies to larger areas.	Stakeholders sensitized through Krishi melas, awareness & training prog.	**12000**	**19863**	**165%**
7	Adoption of sericulture villages / clusters under IVLP (Farmers covered).	Coverage of cluster/ villages	**285**	**285**	**100%**
8		Coverage of beneficiaries	**600**	**2332**	**389%**
9	Replacement of existing plantation with improved varieties.	Area replaced from existing plantation with better yielding mulberry varieties.	**45**	**55.41**	**123%**
10	Attention to emerging field problems.	Successfully resolving the reported field problems. (No.)	**5**	**45**	**900%**
11	Action Plan for production of import substitute silk	No. of Clusters to be organized. (No.)	**14**	**15**	**100%**
12	Monitoring and Evaluation of the programme	Production of Bivoltine Rawsilk through Captive area. (MT)	**90**	**119.6**	**133%**
		Production of Bivoltine Raw silk in Non-Captive areas. (MT)	**10**	**12.5**	**125%**
		Production of Improved Cross Breed Raw silk. (MT)	**1000**	**1058**	**106%**
13	Identify the disease occurrence in advance & forewarn the benefi-ciaries with remedial measures.	Instances where such activities were undertaken.	**14**	**31**	**221%**
14	Implement ISO 9001 as per approved action plan.	Areas of operation covered	**100**	**100**	**100%**

ORGANIZATIONAL CHART OF CSR&TI, BERHAMPORE




NESTED UNITS OF CSR&TI, BERHAMPORE
REGIONAL SERICULTURAL RESEARCH STATION
KALIMPONG (West Bengal)
KORAPUT (Odisha)
RANCHI (Jharkhand)
JORHAT (Assam)
RESEARCH EXTENSION CENTRE
Rangpo (Sikkim)
Deogarh (Odisha)
Gumla (Jharkhand)
Agratala (Tripura)
Bademaranga (Chhattisgarh)
SU: Bhandra (Jharkhand)
Shillong (Meghalaya)
Dimapur (Nagaland)
Aizawl (Mizoram)
Imphal (Manipur)
Under Main Institute
Kamnagar (West Bengal)
Mothabari (West Bengal)
SU: Rampurhat (West Bengal)
MP Raj (Jharkhand)
SU: Rajmahal (Jharkhand)

3. LIST OF RESEARCH PROJECTS AND PROGRAMMES

Institute/ RSRS	Ongoing			Concluded			Total			Grand Total
	Proj.	PS	Prog.	Proj.	PS	Prog.	Proj.	PS	Prog	
CSR&TI	16	2	14	5	2	5	21	4	19	44
RSRS	1	0	6	-	1	6	1	1	12	14
Total	17	2	20	5	3	11	22	5	31	58

Sl. No.	Project Code	Project Title
A. RAINFED SERICULTURE (2)		
1.	B-RNC(VP) 007	Validation trial of package of nutrient under rainfed condition. (RSRS, Ranchi) (Oct., 2011 to Oct., 2013) **(Concluded)**
2.	PIB 3505	Development of drought tolerant mulberry variety for rainfed sericulture. (Jan., 2014 to Dec., 2019) [Collaborative project with CSGRC, Hosur]
B. PRODUCTIVITY IMPROVEMENT (18)		
3.	AICEM Phase- III	All India Coordinated Experimental Trail for Mulberry (AICEM)- Phase III (April, 2011 to June, 2015). **[A Prog. of C.O. Bangalore]** All India Coordinated Experimental Trail for Mulberry (AICEM)- Phase III (April, 2011 to June, 2015). **[A Prog. of C.O. Bangalore]**
4.	PIB3479	Development of high yielding mulberry varieties using physiological growth parameters as markers for selection. (Oct., 2012 to Sept., 2016).
5.	PIB3481	Evaluation of mulberry varieties for low input soils. (Jan., 2013 to Dec., 2017).
6.	PPF 3487	Decision support system initiative through impact assessment of agro-climate on foliage yield of mulberry (*Morus* sp) for climate resilient sericulture in Eastern India. (Oct., 2012 to Sept., 2013) **(Concluded)**.
7.	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).
8.	PPS 3452	Terrestrial carbon sequestration for sustained high productivity of quality mulberry (July, 2011 to March, 2015).
9.	BPP (P) 020	Evaluation of soil fertility for sustained production of quality mulberry leaf in Eastern India under long-term fertilization. (July, 2010 to June, 2015).

Sl. No.	Project Code	Project Title
10.	**PIP 3469**	Screening of early sprouters and late senescence mulberry variety with better leaf yield and quality under low temperature condition. (Nov., 2011 to Oct., 2014).
11.	**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).
12.	**AIE 3454**	Evaluation of elite bivoltine silkworm germplasm under different agro climatic conditions: All India Silkworm Germplasm Evaluation Programme Phase-II. **[Collaborative with CSGRC Hosur]** (Sept., 2011 to Aug., 2014).
13.	**PPS 3435**	Studies on micronutrients for sustained high productivity of quality mulberry in Eastern and North-Eastern India. **(Collaboration with 4 RSRSs)** (Jan., 2010 to Jun, 2013) **(Concluded)**.
14.	**AIB-3491**	Post-Authorization trial of silkworm hybrids in Eastern and North-Eastern India (July, 2012 to Dec., 2014).
15.	**AIB 3480**	Development of silkworm *Bombyx mori* L. breeds from a gene pool with higher genetic plasticity. (Sept., 2012 to Aug., 2016).
16.	**BPI (P) 025**	Maintenance of mulberry germplasm bank at CSR&TI, Berhampore (W.B). (Jan., 2014 to Dec., 2019)
17.	**MOE 3459**	Yield gap in mulberry sericulture – A study in North-Eastern region of India. (Oct., 2011 to Sept., 2014). **(RSRS, Jorhat)**
18.	**B-KPG (P) 006**	Muga seed multiplication prog.: Raising of Muga host plantation at RSRS-Annex, Kalimpong (As per the Central Office Letter no.:CSB-65/1/2004-05/TS-4/ Dated 16-10-09.). (Nov., 2009 to Oct., 2014).
19.	**B-JRH (PS) 005**	Identification of productive Multi x Bi hybrid for plains of North-Eastern States of India through development of improved multivoltine breed (s) of silkworm, *Bombyx mori* L. utilizing local indigenous strains (April, 2013 to March, 2014) **(Concluded)**
20.	**B-KPG (RP) 008**	Maintenance of Bivoltine silkworm germplasm breeds. (April, 2013 to May, 2014)
C. QUALITY IMPROVEMENT (15)		
21.	**PIB 3424**	Development of low temperature stress tolerant mulberry genotypes for sub-tropical plains. (Jan., 2009 to Dec., 2015).
22.	**AIB-3496**	Development of high temperature and high humidity tolerant bivoltine breeds of silkworm (*Bombyx mori* L.). (July, 2012 to June, 2015).
23.	**BAI (RP) 003**	Maintenance of multivoltine and bivoltine germplasm. (Continuous)

Sl. No.	Project Code	Project Title
24.	**AIB 3501**	Development of high temperature and high humidity tolerant bivoltine breeds of silkworm (*Bombyx mori* L.) Brreds with high shell percentage and high neatness of silk filament. (July, 2013 to June, 2016).
25.	**PIG 3441**	Development, validation and utilization of SCAR marker(s) for powdery mildew (*Phyllactinia corylea*) resistance in mulberry. (Nov., 2009 to Feb., 2014). **[Collaborative with CCMB, Hyderabad] (Concluded)**.
26.	**DBT**	Development of DNA marker based genetic linkage map of mulberry and QTL analysis for agronomically important *Planta* traits. (Mar., 2011 to Feb., 2014). **[Collaborative with CCMB, Hyderabad] (Concluded)**.
27.	**BA I (P) 008**	Screening and identification of bivoltine breeds for Eastern and North-Eastern India. (Aug., 2011 to March, 2014) **(Concluded)**.
28.	**BPP (VP) 008**	Field evaluation of plant growth regulator combination for improvement of quality leaf yield of mulberry especially under cold stress condition (Dec., 2011 to Nov., 2013) **(Concluded)**.
29.	**BPI (P) 026**	Popularization of water logged tolerant mulberry variety C-2028. (Feb., 2014 to Jan., 2017)
30.	**AIP 3472**	Standardization and determination of temperature tolerance potentiality in different developmental stages of silkworm, *Bombyx mori* L. (Sept., 2011 to Aug., 2014).
31.	**APS 3497**	Studies on the environmental effect on P1 rearing, its graining performance followed by commercial rearing of silkworm *Bombyx mori* L., during unfavorable seasons of West Bengal. (May, 2013 to April, 2015)
32.	**BAI (P) 007**	Establishment of molecular IDs for the mulberry silkworm breeds (*Bombyx mori*) evolved by CSR&TI, Berhampore (July, 2011 to June, 2013) **(Concluded)**
33.	**B-KPG (RP) 011**	Multiplication and supply of SK6 x SK7 dfls to Sikkim and plain areas (2012 – continuous)
D. DISEASE & PEST MANAGEMENT (16)		
34.	**CSS 2107**	Forewarning of mulberry diseases of Eastern and North Eastern India (April, 2012 to March, 2017).
35.	**ARE 3464**	Biology and feeding efficacy studies of *Scymnus pallidicolli* (Mulsant) for the eco-friendly management of pink mealy bug, *Maconellicoccus hirsutus* (Oct., 2011 to Sept., 2013) **(Concluded)**

Sl. No.	Project Code	Project Title
36.	**BPR (P) 021**	Development of weather based forecasting models for mulberry pests (January, 2011 – December, 2015).
37.	**BAR(P) 024**	Identification of pathogens causing Gattine like disease in the silkworm *Bombyx mori* L. (July, 2013 to Dec., 2014).
38.	**BAR(PS) 002**	Formulation of broad spectrum room disinfectant for silkworm disease management. (Aug., 2011 to July, 2013) **(Concluded)**.
39.	**BPR (PS) 003**	Identification of DNA markers associated with Bacterial Leaf Spot resistance in mulberry (*Morus spp*.) (April, 2013 to March, 2015).
40.	**BAR(PS) 004**	Testing of immunogens for prevention of silkworm diseases in *Bombyx mori* L. (July, 2013 to June, 2014).
41.	**BAR(RP)005**	Survey and surveillance of silkworm diseases in traditional Sericultural districts of West Bengal [April, 2013 – March, 2014] (Routine programme).
42	**BAI (RP) 006**	Silkworm disease monitoring of seed and commercial crop (SDMSCC) rearing of West Bengal (April, 2013 to March, 2014) (Routine programme).
43	**BPR (VP) 006**	Studies on the field efficacy of selected dose of insecticide in whitefly management (July, 2011 to June, 2013) **(Concluded)**.
44.	**B-KPG (P) 015**	Improvement of rearing technology for autumn crop in Sub-Himalayan region. (Aug., 2012 to Jan., 2014) **(Concluded)**.
45.	**B-RNC (RP) 004**	Survey and surveillance of disease and pest of mulberry and silkworm [April, 2013 to March, 2014] (Routine programme).
46.	**B-KPG (RP) 007**	Monitoring of silkworm diseases in Kalimpong Hill (April, 2013 to March, 2014) (Routine programme) **(Concluded)**.
47.	**BAR(VP) 009**	'Ghar Sodhan' – a fumigant room disinfectant for silkworm disease management. (Jan., 2014 to Dec., 2014).
48.	**B-KPG (RP) 010**	Survey & Surveillance of mulberry and silkworm diseases & Pests in Kalimpong Hill [Oct., 2013 to Sept., 2014] (Routine programme).
49.	**B-JRH (RP) 009**	Survey & Surveillance of mulberry and silkworm pest & diseases of N.E. States [Oct., 2013 to Sept., 2016) (Routine programme).
E. COST REDUCTION (3)		
50.	**BPP(P) 023**	Optimum requirements of irrigation water and its managements for sustainable leaf productivity in high yielding mulberry garden under West Bengal conditions. (May., 2013 to April., 2014)

Sl. No.	Project Code	Project Title
51.	**BPP (VP) 015**	Validation of E3 WM (Efficient Economic Eco-friendly Weed Mower) at nested units and farmers' field level. (Oct., 2013 – Mar., 2015).
52.	**BAI (P) 014**	Studies on the reelability of multivoltine hybrid cocoons during adverse climatic conditions in Eastern & North-Eastern region. (July, 2011 to March, 2014) **(Concluded)**.
53.	**B-KPT (P) 017**	Assessment of fertility status of mulberry growing soils in selected Seri-village of Koraput for appropriate fertilizer management. (Jan., 2012 to Dec., 2013) **(Concluded)**.
54.	**B-JRH (P) 019**	Assessment of fertility status of mulberry growing soils in selected Seri-village of Jorhat for appropriate fertilizer management. (Jan., 2012 to Dec., 2013) **(Concluded)**.
55.	**B-RNC (P) 018**	Assessment of fertility status of mulberry growing soils in selected Seri-village of Ranchi for appropriate fertilizer management. (Jan., 2012 to Dec., 2013) **(Concluded)**.
F. MICRO PROJECTS: 2 Nos.		
56.	**BPP(RP) 001**	Mother culture maintenance of *Azotobacter chrococcum* and Nitrofert mass production. [Micro project, (Continuous)]
57.	**BPP(RP) 002**	Mother culture maintenance of *Glomus mosae* **[***(Arbascular mycorrhizal* fungus (AMF)] and Phosphofert mass production. [Micro project (Continuous)]
G. INNOVATIVE RESEARCH: 1 No.		
58.	**Pilot Study**	Development of multivoltine Congenic /NIL breed of silkworm (*Bombyx mori* L.) through introgression of '*Id*' gene. (April, 2013 to March, 2014).

3.A. ONGOING RESEARCH PROJECTS & PROGRAMMES OF MAIN INSTITUTE

3.A.1. PRODUCTIVITY IMPROVEMENT

3.A.1.1. MULBERRY BREEDING AND GENETICS SECTION

3.A.1.1.1. 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)** and P. K. Ghosh

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

After primary screening in the nursery, a total of 1024 seedlings from 57 cross combinations were transplanted in progeny selection plot with 60 cm × 60 cm spacing. The seedling population is under establishment stage.

3.A.1.1.2. PIB 3481: Evaluation of mulberry varieties suitable for low input soils. (Jan., 2013 to Dec., 2017)

M. K. Ghosh **(PI)**, P. K. Ghosh, S. K. Dutta, M.V. Santhakumar, M. K. Singh, S. N. Gogoi (RSRS, Jorhat), S. K. Misro (RSRS, Koraput), G. S. Singh (Sub-REC, Bhandra, Ranchi)

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

Saplings were transplanted during rainy seasons at RSRSs, Jorhat, Koraput and Sub-REC, Bhandra except main institute where transplantation was done during Feb., 2014. Plants are under establishment stage.

3.A.1.1.3. BPI(P)025: Maintenance of mulberry Germplasm Bank at CSR&TI, Berhampore (W.B.). (Jan., 2014 to Dec., 2018)

M.K. Ghosh **(PI),** P.K.Ghosh, S K Dutta and MV Santha Kumar

Objective: Maintenance of mulberry Germplasm bank at a premier Institute in Eastern India.

A total number of 301 germplasm accessions are being maintained and used in different breeding programmes.

3.A.1.2. MULBERRY PHYSIOLOGY SECTION

3.A.1.2.1. PIP 3469: Screening of early sprouters and late senescence mulberry accessions with better leaf yield and quality under low temperature condition. (Nov., 2011 to Oct., 2014)

A. K. Misra (**PI** upto Sept., 2013) and P. K.Tewary (**PI** from Oct., 2013)

Objective: Screening of mulberry accessions having early sprouting and late senescence characters with better leaf yield and quality under low temperature condition.

Sprouting and senescence characters of 76 germplasm (25 Exotic and 51 Indigenous) and 73 elite mulberry accessions (unpruned plants) were studied. Based on frequency analysis of pooled data, 3 accessions in exotic (Philippines, *M. rotundiloba* and Cyprus), 4 in indigenous (Kolitha-3, Kolitha-8, Tollygunge-A and Mysore local), 3 in C-lines (C-1726, C-741 and C-1540) and 3 in S-lines (S-1622, S-1662 and S-1618) were short listed as early sprouter and late senescent. The days to sprout ranged between 17 and 33 during winter and senescence days ranged from 76 to 91 (Table 1). These 13 short listed accessions were planted in experimental plot in RBD (3 replications) during July, 2013 to study qualitative and quantitative traits. Plants are under establishment stage.

Table 1. Short listed early sprouter and late senescent mulberry accessions.

Accessions		**Days to sprout**	**Days to senesce**
Exotic (3 nos.)	Philippines, *M. rotundiloba*, Cyprus	18-31	80-91
Indigenous (4 nos.)	Kolitha-3, Kolitha-8, Tollygunge-A, Mysore local	18-33	80-88
Elite lines			
C-lines	C-1726, C-741, C-1540	17-27	76-85
S-lines	S-1622, S-1662, S-1618	17-25	81-90

3.A.1.3. AGRONOMY

3.A.1.3.1. PPA 3499: Evaluation of field level performance of Vishala mulberry variety in different locations under irrigated condition in West Bengal. (April, 2013 to March, 2018)

S. K. Mandal **(PI)**

Objectives: To find out the potentiality of Vishala mulberry variety under irrigated condition of West Bengal. To evaluate field performance of Vishala mulberry variety in different locations under irrigated condition of West Bengal.

Selection of farmers and experimental plantation site at 23 locations for plantation of VISHALA mulberry variety along with S1635 as control were done. Plantation in 12 experimental plots at 12 locations completed and intercultural operations were done regularly. Plantation is under establishment stage.

3.A.1.4. SILKWORM BREEDING AND GENETICS SECTION

3.A.1.4.1. AIB 3466: Development of region specific bivoltine breeds suitable for fluctuating and seasonally variable climatic conditions of Eastern and North-Eastern India. (Aug., 2011 to Dec., 2016)

N. Suresh Kumar (**PI)**, A. K. Saha, S. Chakraborty, S. Sreekumar and N. B. Kar

Objective: To develop the bivoltine breeds with genetic potential to tolerate the adverse climatic conditions of Eastern, North Eastern and Uttar Pradesh regions.

The bivoltine silkworm breeds collected from different breeding centres were screened in ambient condition and maintained under congenial environment. Based on overall performance especially the pupation, the breeds namely, GEN3, SK6, SK7, BHR2, BHR3, SK4C, D6PN, KSO1, Dun21, Dun22, KPGA, SK3C, MC4E, CSN, NB18, NB4D2, Chinese peanut and P5 were selected. By utilizing these selected breeds, foundation crosses (Oval x Oval and dumbbell x dumbbell) were made for initiating the breeding process (Table 2 & 3).

Table 2. Performance of oval foundation crosses collected from different breeding centres.

Sl. No.	Oval Foundation cross	Fecun-dity	Yield/10000 larvae by No.	Yield/10000 larvae by wt (kg)	Cocoon weight (g)	Shell weight (g)	Shell (%)	Cumula-tive EI
1	KPGA x MC4(E)	522	8700	12.502	1.556	0.312	20.1	50
2	BHR2 x Gen3	533	9150	13.275	1.518	0.321	21.1	55
3	BHR2 x KPGA	540	8767	10.633	1.53	0.305	19.9	52
4	BHR2 x MC4(E)	562	8567	11.235	1.605	0.321	20.0	56
5	BHR2 x SK3C	486	8100	11.772	1.538	0.303	19.7	63
6	SK3C x Gen3	564	9167	12.003	1.499	0.326	21.7	58
7	SK3C x MC4(E)	463	8500	11.185	1.567	0.304	19.4	57
8	SK3C x BHR3	485	8533	10.752	1.487	0.294	19.8	50
9	Gen3 x MC4(E)	484	9767	13.908	1.615	0.337	20.9	45
10	Gen3 x BHR3	529	9400	13.589	1.516	0.327	21.6	41
11	KSO-1x MC4(E)	537	8400	11.141	1.561	0.312	20.0	42
12	KSO-1 x BHR3	572	9000	12.594	1.532	0.325	21.2	38
13	KSO-1 x SK3C	579	8567	11.019	1.569	0.312	19.9	47
14	MC4(E) x BHR3	484	8955	12.755	1.549	0.308	19.9	48
15	MC4(E) x CSN	559	8567	11.306	1.57	0.31	19.7	48

Table 3. Performance of dumbbell foundation crosses collected from different breeding centres.

Sl. No.	Dumbbell Foundation cross	Fecun-dity (No.)	Yield/ 10000 larvae (No.)	Yield/ 10000 larvae (wt.) (kg)	Cocoon Weight (g)	Cocoon Shell Weight (g)	Cocoon Shell %	Cumula-tive EI
1	NB18 XSK-6	544	7853	11.026	1.573	0.308	19.6	55
2	NB18 XSK-7	582	8000	11.998	1.657	0.324	19.6	53
3	NB18 XBHR-3	510	7958	12.125	1.601	0.307	19.2	60
4	NB18 XP-5	461	8125	12.282	1.597	0.317	19.8	53
5	CHINESE(PN)X P5	494	9167	11.351	1.53	0.324	21.2	54
6	D6(P)N X NB18	550	7968	11.158	1.506	0.288	19.1	55
7	D6(P)N XSK-6	540	9567	13.912	1.509	0.328	21.7	54
8	D6(P)N x SK7	522	8067	11.173	1.495	0.287	19.2	60
9	SK-6 XBHR-3	549	8200	11.406	1.64	0.325	19.8	47
10	SK-6 XCSN	494	8100	10.257	1.51	0.301	19.9	48
11	SK-7 XCHI(PN)	550	8235	11.389	1.528	0.295	19.3	49
12	DUN-21 XDUN-22	586	8956	12.488	1.564	0.308	19.7	42
13	DUN-22 XD6 (P)N	434	9259	14.042	1.544	0.323	20.9	41
14	DUN-22 XNB18	468	9200	12.088	1.582	0.328	20.7	42
15	DUN-22 XSK-6	545	9400	13.759	1.581	0.326	20.6	45
16	NB4D2 XCHI(PN)	471	8775	11.716	1.528	0.286	18.7	42

3.A.1.4.2. AIB 3480: Development on silkworm *Bombyx mori* L. breeds from a gene pool with higher genetic plasticity. (Sept., 2012 to Aug., 2016)

G. K. Chattopadhyay **(PI)**, A. K. Saha, N. Suresh Kumar and N. B. Kar

Objective: To develop bivoltine and multivoltine breeds with higher genetic plasticity.

E01: Development of multivoltine and bivoltine lines from poly-hybrids *i.e.*, convergent gene pool.

After selection of six bivoltine (V_2) breeds namely B.Con.4, CSR-2, KPG-A, DUN-21, RSJ-14 and APS-45 for high shell weight and six multivoltine (V_3) breeds viz. N+*p*, Cambodge, Pure Mysore, M.Con.4, Sarupat and MH-1for higher survival were collected as best performer for the target trait at specific region considering highly variable, congenial, low temperature and low RH, high temperature and low RH climatic situations. Thereafter step-wise crossing was done to raise converged gene pool for genetic assimilation among the genes for target trait to bring genetic plasticity. Two lines were separated from (B.Con.4 x CSR-2) x (KPG-A x DUN-21) x (RSJ-14 x APS-45) as Marked (+*p*) and Plain (*p*) larvae with higher shell weight.

Similarly three lines were separated from (N+*p* x Cambodge) x (Pure Mysore x M.Con.4) x (Sarupat and MH-1) as Golden colour (*C*), White (c) and Light green (*Gr*) cocoon colour for higher survival. After completion of test for genetic plasticity in target trait of different lines, selected lines will be used further to develop congenic bivoltine breed for high survival and multivoltine breed for high shell weight. The performance of these lines is depicted in Table 4.

Table 4. Rearing performance of converged lines of bivoltine breeds and multivoltine breeds.

(B.Con.4 x CSR-2) x (KPG-A x DUN-21) x (RSJ-14 x APS-45)										
Larval character/ Cocoon colour	**Fec.**	**Hat. (No.)**	**Count larvae (No.)**	**Cocoon (No.)**	**Good Cocoon (No.)**	**Cocoon wt (g)**	**ERR (%)**	**SCW (g)**	**SSW (g)**	**Shell (%)**
Marked (+*p*), White	533	510	453	371	374	0.519	7196	1.432	0.286	19.97
Plain (*p*), White	525	505	438	350	308	0.308	7032	1.393	0.276	19.81
N+*p* x Cambodge) x (Pure Mysore x M.Con.4) x (Sarupat x MH-1)										
Plain (*p*), Golden Yellow (*C*)	530	515	437	374	345	0.548	7895	1.570	0.224	14.29
Plain (*p*), White (*c*)	537	525	436	370	344	0.526	7889	1.580	0.237	15.0
Plain (*p*), Light Green (*Gr*)	536	520	434	368	342	0.589	7880	1.595	0.253	16.0

3.A.1.4.3. AIB 3496: Development of high temperature and high humidity tolerant bivoltine breeds of silkworm (*Bombyx mori* L). (July, 2012 to June, 2015)

N. Suresh Kumar **(PI)**, G. K. Chattopadhyay and A. K. Saha

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

Rearing of 10 bivoltine and 5 multivoltine breeds of the institute and 19 breeds (2 bivoltine and 17 multivoltine) of other Institutes designated as high-temperature tolerant were screened. The breeds were evaluated for high temperature and high humidity conditions of West Bengal showed highest survival in SK4C (90.4%) followed by SK7 (87.5%) and B.Con.4 (85.9%). Among the bivoltine breeds, BBE-178, B.Con.4, D6PN, SK7, SK4C, Dun-21 and ATR29 showed

survival of 80% while, in multivoltine breeds MH1, BMI-027, BMI-025, Nistari and M.Con.4 showed survival of above 90%. The short-listed breeds were reared to identify the breeding resource material tolerant to high temperature and high humidity conditions (Table 5& 6).

Table 5. Performance based selection of Bivoltine breeds at high temperature and high humidity.

Sl. No.	Breed (Bivoltine)	Survival rate (32±1°C and 85±5% RH)	Survival rate (25±1°C and 65±5% RH)	Cumulative EI
1	ATR29	50.5	85.8	40
2	B.Con.1	65.4	89.4	58
3	B.Con.4	67.4	90.4	61
4	SK4C	60.2	90.1	55
5	SK7	50.0	90.5	47
6	SK6	52.7	90.1	49
7	Gen3	65.7	88.7	57
8	BHR3	62.7	86.5	51
9	BHR2	60.8	85.3	47
10	D6(P)N	55.4	80.4	35

Table 6. Performance based selection of multivoltine breeds at high temperature and high humidity.

Sl. No.	Breed (Multivoltine)	Survival rate (32±1°C and 85±5% RH)	Survival rate (25±1°C and 65±5% RH)	Cumulative EI
1	BMI-027	80.3	92.8	43
2	BMI-025	80.0	91.8	36
3	Nistari	81.3	95.4	65
4	M.Con.4	80.4	94.8	53
5	MH1	80.1	93.7	45
6	M.Con.1	81.4	94.2	61
7	M6DPC	80.4	93.4	47
8	M6M81	81.2	92.1	49
9	Cambodge	80.6	93.5	49
10	Sarupat	61.2	85.7	52

3.A.1.4.4.BAI(RP)003: Maintenance of bivoltine and multivoltine germplasm and newly developed breeds and their lines. (April, 2013 to March, 2014) (Continuous)

G. K. Chattopadhyay (**PI**), N. Suresh Kumar, A. K. Verma and A. K. Saha

Objective: To maintain the silkworm breeds confirming to their original breed characteristics.

A total of 24 multivoltine and 35 bivoltine silkworm breeds/ strains were maintained as stock lots (Table 7 & 8).

Table 7. Performance of multivoltine germplasm.

Sl. No.	Breed	Fecundity (No.)	Hatch-ing(%)	ERR (kg)	Pup. (%)	SCW (g)	SSW (g)	Shell %
1	Nistari (M)+*p*	412	94	10.75	90.5	1.042	0.126	12.09
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.9-1.1**	**0.100-0.125**	**11-13**
2	Nistari (P) *p*	408	98	9.98	88.8	1.067	0.129	12.09
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.9-1.1**	**0.100-0.125**	**11-13**
3	Chalsa	411	95	8.75	86.7	1.220	0.176	14.41
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.9-1.1**	**0.125-0.150**	**11-13**
4	Sarupat	383	91	8.78	88.9	1.152	0.139	12.06
	Bench Mark	**350-400**	**90-95**	**9-10**	**85-90**	**0.9-1.1**	**0.120-0.145**	**11-13**
5	Pure (PM)	392	96	9.23	87.1	1.226	0.151	13.96
	Bench Mark	**350-400**	**90-95**	**9-10**	**85-90**	**0.9-1.1**	**0.120-0.150**	**11-13**
6	G	524	93	9.56	89.1	1.412	0.200	14.16
	Bench Mark	**450-500**	**90-95**	**9-10**	**85-90**	**0.12-0.15**	**0.17-0.20**	**12-14**
7	M2	429	93	9.65	86.5	1.328	0.187	14.38
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.12-0.15**	**0.17-0.200**	**12-14**
8	O (Oval)	496	96	9.25	87.3	1.520	0.223	14.67
	Bench Mark	**450-500**	**90-95**	**9-10**	**85-90**	**0.12-0.15**	**0.170-0.225**	**12-15**
9	CB5	423	92	9.75	87.8	1.258	0.168	13.35
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.12-0.15**	**0.15-0.17**	**12-14**
10	Cambodge	394	92	9.23	87.5	1.010	0.124	12.27
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.10-0.12**	**0.10-0.12**	**12-14**
11	M12W	455	91	6.72	78	1.154	0.144	12.48
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.10-0.12**	**0.11-0.15**	**12-14**
12	M6M81	511	94	8.78	72	1.322	0.195	14.75
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.10-0.12**	**0.15-0.19**	**12-14**
13	M9A	455	94	9.47	87.4	1.451	0.204	14.06
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.12-0.15**	**0.15-0.19**	**12-14**
14	M6DP*C*	459	95	9.32	87.8	1.148	0.144	12.54
	Bench Mark	**400-450**	**90-95**	**9-10**	**85-90**	**0.10-0.12**	**0.15-0.19**	**12-14**
15	M6DP(*Gc*)	423	95	9.86	82.7	1.272	0.165	12.97
	Bench Mark	**400-450**	**90-95**	**9-10**	**80-85**	**0.10-0.12**	**0.15-0.19**	**12-14**
16	M6DPC(E)	484	93	9.42	87.9	1.409	0.186	13.20
	Bench Mark	**400-450**	**90-95**	**9-10**	**80-85**	**0.12-0.14**	**0.15-0.19**	**12-14**
17	M15	451	94	9.40	82.7	1.120	0.148	13.21
	Bench Mark	**400-450**	**90-95**	**9-10**	**80-85**	**0.12-0.14**	**0.15-0.19**	**12-14**
18	M.Con.1	512	94	9.55	85.6	1.413	0.236	16.70
	Bench Mark	**500-550**	**90-95**	**9-10**	**85-90**	**0.12-0.14**	**0.15-0.19**	**12-14**
19	M.Con.4	545	95	10.16	87.7	1.490	0.231	15.50
	Bench Mark	**500-550**	**90-95**	**9-10**	**85-90**	**0.12-0.14**	**0.15-0.19**	**12-14**
20	OS616	525	92	9.62	87.5	1.247	0.171	13.71
	Bench Mark	**500-550**	**90-95**	**9-10**	**85-90**	**0.12-0.14**	**0.15-0.19**	**12-14**
21	M12(W)-Auto-sex +*p* Female	423	92	4.42	80.1	1.198	0.152	12.69
	Bench Mark	**400-450**	**90-95**	**9-10**	**80-85**	**0.12-0.14**	**0.15-0.19**	**12-14**
22	M12W(Auto-	389	91	4.22	82.4	1.132	0.148	13.07

	sex) Dirty female							
	Bench Mark	**350-400**	**90-95**	**9-10**	**80-85**	**0.12-0.14**	**0.15-0.19**	**12-14**
23	Nistari (Auto-sex) Yellow cocoon (Y) Female	446	94	4.98	80.4	1.209	0.152	12.57
	Bench Mark	**400-450**	**90-95**	**9-10**	**80-85**	**0.12-0.14**	**0.15-0.19**	**12-14**

Table 8. Rearing performance of bivoltine silkworm germplasm.

Sl. No.	Breed	Fecundity (No.)	Hatch-ing (%)	ERR (kg)	Pup. (%)	SCW (g)	SSW (g)	Shell %
1	KPG-A	498	97	12.72	88.2	1.434	0.259	18.09
	Bench Mark	**450-500**	**90-95**	**10-12**	**85-90**	**0.35-0.45**	**0.25-0.29**	**15-19**
2	KPG-B	489	95	11.89	82.8	1.608	0.300	18.67
	Bench Mark	**450-500**	**90-95**	**10-12**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
3	KPG-11	478	96	13.13	83.5	1.384	0.257	18.60
	Bench Mark	**450-500**	**90-95**	**10-13**	**85-90**	**0.350-0.40**	**0.25-0.30**	**15-19**
4	P5	494	95	13.56	85.4	1.592	0.287	18.03
	Bench Mark	**450-500**	**90-95**	**10-13**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
5	SH-6	464	96	15.42	83.4	1.496	0.263	17.58
	Bench Mark	**450-500**	**90-95**	**13-15**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
6	SK3	495	95	15.00	87.8	1.561	0.279	17.87
	Bench Mark	**450-500**	**90-95**	**13-15**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
7	SK4	482	96	11.46	87.5	1.497	0.264	17.63
	Bench Mark	**450-500**	**90-95**	**13-15**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
8	D5	456	96	11.67	87.6	1.504	0.281	18.68
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
9	D6M	545	96	13.96	92.1	1.493	0.267	17.88
	Bench Mark	**500-550**	**90-95**	**13-15**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
10	D6p	463	95	16.98	88.5	1.775	0.343	19.35
	Bench Mark	**450-500**	**90-95**	**15-17**	**85-90**	**0.50-0.65**	**0.28-0.35**	**15-19**
11	BHR1	461	96	11.79	87.8	1.577	0.298	18.89
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
12	BHR 2	512	96	11.87	87.0	1.609	0.296	18.43
	Bench Mark	**500-550**	**90-95**	**13-15**	**85-90**	**0.50-0.65**	**0.25-0.30**	**15-19**
13	BHR3	491	96	14.01	90.1	1.735	0.319	18.41
	Bench Mark	**450-500**	**90-95**	**15-17**	**85-90**	**0.50-0.65**	**0.28-0.35**	**15-19**
14	MJ 1	470	96	12.13	88.3	1.437	0.245	17.08
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.40-0.45**	**0.25-0.30**	**15-19**
15	MJ 2	484	95	12.58	93.1	1.445	0.253	17.54
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.40-0.45**	**0.25-0.30**	**15-19**
16	MC4(E)	458	96	11.95	87.8	1.504	0.262	17.42
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.45-0.50**	**0.25-0.30**	**15-19**
17	MC4(O)	468	96	11.67	88.3	1.456	0.247	16.96
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.40-0.45**	**0.25-0.30**	**15-19**
18	MC2	489	93	9.29	87.0	1.460	0.266	18.25
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.40-0.45**	**0.25-0.30**	**15-19**
19	BG(W)	498	96	13.23	90.1	1.468	0.276	18.80
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.40-0.45**	**0.25-0.30**	**15-19**
20	YB	529	96	12.10	87.7	1.429	0.247	17.28
	Bench Mark	**500-550**	**90-95**	**11-13**	**85-90**	**0.40-0.45**	**0.25-0.30**	**15-19**
21	NB18	500	95	12.44	87.8	1.656	0.305	18.42

	Bench Mark	**500-550**	**90-95**	**11-13**	**85-90**	**0.40-0.45**	**0.25-0.30**	**15-19**
22	Chinese(PN)	497	95	13.37	85.8	1.560	0.294	18.88
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.50-0.55**	**0.25-0.30**	**15-19**
23	JPN	502	93	13.24	93.0	1.368	0.275	20.10
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.30-0.35**	**0.25-0.30**	**16-20**
24	NB4D2	492	95	10.14	87.1	1.613	0.316	19.62
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.50-0.55**	**0.25-0.30**	**16-20**
25	CSN	478	95	11.74	88.2	1.378	0.247	17.92
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.30-0.35**	**0.25-0.30**	**16-20**
26	SK3C	469	96	15.95	88.5	1.401	0.256	18.27
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.35-0.40**	**0.25-0.30**	**16-20**
27	SK4C	498	96	12.55	88.0	1.656	0.299	18.05
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.50-0.55**	**0.25-0.30**	**16-20**
28	SK3N	567	96	12.93	88.4	1.436	0.262	18.28
	Bench Mark	**550-600**	**90-95**	**11-13**	**85-90**	**0.50-0.55**	**0.25-0.30**	**16-20**
29	SK4N	469	96	12.02	92.1	1.437	0.271	18.86
	Bench Mark	**450-500**	**90-95**	**11-13**	**85-90**	**0.40-0.45**	**0.25-0.30**	**15-19**
30	D6(P)N	560	97	12.57	87.5	1.491	0.277	18.58
	Bench Mark	**500-550**	**90-95**	**11-13**	**85-90**	**0.45-0.50**	**0.25-0.30**	**15-19**
31	SK6	551	96	14.40	90.7	1.661	0.325	19.59
	Bench Mark	**500-550**	**90-95**	**11-15**	**85-90**	**0.55-0.65**	**0.28-0.35**	**17-20**
32	SK7	547	96	15.56	91.5	1.706	0.295	18.82
	Bench Mark	**500-550**	**90-95**	**13-16**	**85-90**	**0.55-0.65**	**0.28-0.35**	**17-20**
33	B.Con.1	515	97	15.04	91.4	1.569	0.286	18.23
	Bench Mark	**500-550**	**90-95**	**13-16**	**85-90**	**0.55-0.65**	**0.28-0.35**	**17-20**
34	B.Con.4	536	95	15.24	91.8	1.579	0.296	18.63
	Bench Mark	**500-550**	**90-95**	**13-15**	**85-90**	**0.55-0.65**	**0.28-0.35**	**17-20**

3.A.1.4.5. AIB-3501: Development of multivoltine silkworm (*Bombyx mori,* L) breeds with high shell percentage and high neatness of silk filament. (July, 2013 to June, 2016)

A. K. Verma **(PI)**, Sunita Mukherjee (upto 31.5.13), N. Suresh Kumar, N. B. Kar, G. K. Chattopadhyay and A. K. Saha

Objective: To develop multivoltine breed with high cocoon shell % and high neatness of silk filament to suit the adverse climatic conditions of West Bengal.

Twenty breeds (BMI-0001, BMI-0065, BMI-0023, BMI-0074, BMI-0072, BMI-0069, BMI-0066, BMI-0070, BMI-0043, BMI-0048 with high shell percentage; BMI-0004, BMI-0008, BMI-0015, BMI-0011, BMI-0038, BMI-0014, BMI-0003 BMI-0016, BMI-0007 and BMI-0042 with high neatness) were brought from CSGRC, Hosur and 4 from other places, which will be used as donor after sort listing. Four breeds namely M.Con.1, M.Con.4, M6DP*E* and N(+p) of CSRTI, Berhampore to be used as receptor. Out of 24 breeds collected, only 9 survived during summer in West Bengal condition. Based on SR% and neatness, only one breed i.e. MH1 was selected as donor. By utilizing the selected breeds, crosses were made for initiating breeding process (Table 9). Reciprocal crosses were also considered to get homozygous progeny for shell%.

Table 9. Performance of F-1s raised between Hosur and Berhampore breeds. (Oct.-Nov. 2013)

Sl. No.	Breed	Fecundity (No.)	ERR (No.)	ERR (kg)	Pupation (%)	SCW (g)	SSW (g)	Shell %	Cumulative EI
1	M.Con.4 x M2	487	7667	12.70	75	1.581	0.247	15.62	52
2	M6DP*E* x M2	426	6667	11.33	67	1.577	0.227	14.39	45
3	M6M81 x M6DP*E*	488	7783	11.72	77	1.513	0.23	15.44	50
4	M.Con.2 x M6DP*E*	442	5889	9.79	57	1.597	0.257	16.10	45
5	BMI70 x BMI69	430	9300	10.38	91	1.338	0.165	12.33	44
6	M.Con.4 x Lm	558	8991	11.5	95	1.294	0.174	13.45	49
7	M.Con.4 x MH1	563	8700	12.5	97	1.442	0.228	15.81	55
8	M.Con.1 x Lm	512	8895	13.4	99	1.542	0.225	14.60	55
9	M6DP*E* x MH1	421	8746	12.52	92	1.502	0.225	14.98	51
10	N(M) x PM	416	7277	8.4	93	1.152	0.132	11.60	36
11	N(M) x MH1	479	9481	12.26	99	1.252	0.181	14.46	50
12	MH1 x M.Con.1	554	9140	12.43	99	1.451	0.255	17.57	58
13	M.Con.1 x MH1	401	9667	15.67	95	1.651	0.282	17.05	60

From 13 crosses, 5 have been selected for further back crossing based on target characters. All the back crosses were having higher shell % than their parents except the cross N (+p) x MH1. Rearing performance of back crosses and their parents during Feb., 2014 were depicted in Table 10.

Table 10. Performance of Back crosses vis-à-vis their parents.

Sl. No.	Breed	Fecundity (No.)	ERR (No.)	ERR (kg)	Pupation (%)	SCW (g)	SSW (g)	Shell %	Cumulative EI
	Parents								
1	M.Con.1	502	8900	10.60	93	1.232	0.200	16.23	48
2	MH1	490	8956	13.80	94	1.563	0.258	16.53	57
3	M.Con.4	482	8711	13.38	93	1.487	0.244	16.40	53
4	M6DP*E*	484	8550	13.03	94	1.422	0.217	15.26	50
5	N(+p)	412	9333	10.00	98	1.169	0.132	11.32	43
	Back crosses								
1	M.Con4 x MH1-BC1	484	9022	14.00	93	1.574	0.263	16.70	48
2	M6DPE x MH1-BC1	552	9044	13.60	96	1.478	0.257	17.36	53
3	N(+p) x MH1-BC1	557	9133	12.50	98	1.398	0.213	15.23	46
4	MH1 x M. Con.1-BC2	539	9000	13.80	96	1.502	0.249	16.58	50
5	M.Con.1 x MH1-BC2	522	8956	14.90	95	1.553	0.265	17.06	53

INNOVATIVE RESEARCH:

Development of multivoltine Congenic/NIL breed of silkworm (*Bombyx mori* L.) through introgression of '*Id*' gene. (March, 2013 to April, 2014)

G. K. Chattopadhyay **(PI)**, A. K. Saha, N. B. Kar and S. Nirmal Kumar

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.

Developed the method of introgression of **'*Id*'** gene carrier homozygous females and males using Berhampore^{Id} as diapause inhibitor pseudo pigmented homozygous *Id* gene carrier breed as a resource material. During identification and fixation process, two types of egg phenotype were separated (i) Pseudo pigmented and (ii) Non pseudo pigmented. Both are homozygous dominant for diapause inhibitor character over the obligatory sex linked maternal inherited character *i.e.*, voltinism in *Bombyx mori* L. Based on egg phenotype, cocoon colour and shape three *Id* gene carrier breeds were developed (Table 11 and Fig. 1-3) among which non-pseudo diapause inhibitor breed was the first report in sericulture. The homozygous *Id* gene carrier either male or female have potentiality to break the diapause as *Id* gene 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* gene 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.

Fig.1

Fig.2

Fig.3

Normal multivoltine Eggs **Pseudo pigmented egg (Diapause inhibitor)** **Non pseudo pigmented (Diapause inhibitor)**


Golden Yellow


Butter Colour


Golden Yellow

Table 11. Rearing data of breeds after introgression of *Id* gene.

#	Breed	Eggs Character	Cocoon Colour & shape	Fecun - dity	Hat %	Count Larvae No	ERR No.	Yield/ 10,000 (kg)	SC W (g)	SSW (g)	Shell %	F.L (m)
1.	**M.Con.4^{Id}**	Non pseudo pigmented, Diapause Inhibitor	Golden Yellow (*C*), Oval shape	516	95	350	8050	10.75	1.37	0.218	15..9	665
2.	**M.Con.4^{Id}**	Pseudo pigmented, Diapause inhibitor	Butter colour, Oval shape	608	98	504	8440	10.74	1.32	0.297	20..3	615
3.	**M.Con.4^{Id}**	Pseudo pigmented, Diapause inhibitor	Golden Yellow (*C*), Oval shape	459	98	385	9025	11.25	1.34	0.285	21.3	678
4	M.Con.4 **(Check)**	Non pseudo Non pigmen-ted, No diapause Inhibitor	Golden Yellow (*C*), Oval shape	539	96	449	8315	10.12	1.29	0.224	17.37	589
5.	**B.Con.4^{Id}**	Pseudo pigmented, Diapause inhibitor	Butter colour, Oval shape	583	92	445	8100	10.82	1.39	0.257	18.38	698
6.	B.Con.4 **(Check)**	Pigmented, Diapause	Faint constrict-ed, White (*c*) Colour	532	90	440	8200	14.12	1.52	0.289	19.05	715
7.	**BHB^{Id}**	Pseudo pigmented, Diapause Inhibitor	White (*c*), Oval shape White (*c*), Faint dumbbell	479	89	341	7400	12.02	1.29	0.212	16.43	589

3.A.1.4. SILKWORM PHYSIOLOGY AND RTI SECTION

3.A.1.4.1. AIP 3472: Standardization and determination of temperature tolerance potentiality in different developmental stages of silkworm, *Bombyx mori* L. (Sept., 2011 to Aug., 2014)

A. K. Saha **(PI)**, T. Datta (Biswas) and G. K. Chattopadhyay

Objectives: Determination of stage specific effect of different temperature (30-35°C) and humidity (>90%) on silkworm rearing. Determination of

temperature and humidity tolerance potentiality based on 50% lethality and period of exposure for a specific instar.

Experiment wise progress:

A. **Day and Instar specific effect of thermal stress (32±1°C with + >90% RH), exposed during Photoperiod and unexposed during Scotoperiod:**

Each day of 1st, 2nd, 3rd, 4th and 5th instar larvae of B.Con.4, SH6 and Sarupat were exposed under above temperature and humidity. In B.Con.4**,** survival ranged between 25.8 (1st day of 3rd instar) and 92 (1st and 2nd day of 5th instar). Lethality observed during 1st and 2nd day of 1st instar, 3rd instar and 4th day of 5th instar only. In SH6, survival ranged between 7 (3rd day of 4th instar) and 56 (4th day of 5th instar). Lethality observed during each day of 1st, 3rd and 4th instar; 2nd day of 2nd instar, and each day of 5th instar except 4th day, whereas, in Sarupat, survival was 19 (5h day of 5th instar) to 73 (1st day of 5th instar). Lethality was during each day of 1st instar to 3rd instar and 4th day & 5th day of 5th instar only. B.Con.4 performed better than SH6 (Table 12).

Table 12: Day & Instar specific effect of thermal stress (32 ± 1°C) + >90% RH exposed during photophase and unexposed during scotophase, on rearing performance of silkworm.

Day	B.Con.4		SH6		Sarupat	
	Survival (%)	Yield / 100 dfls (kg)	Survival (%)	Yield / 100 dfls (kg)	Survival (%)	Yield / 100 dfls (kg)
1st instar						
1st day	35.7 **L**	18.1	34.8 **L**	11.8	32.2 **L**	12.9
2nd day	31.9 **L**	16.2	49.2 **L**	21.0	29.5 **L**	12.4
3rd day	60.2	29.1	46.2 **L**	18.4	49.6 **L**	21.4
2nd instar						
1st day	59.9	33.1	51.4	21.0	37.0 **L**	14.1
2nd day	59.1	39.3	24.6 **L**	7.0	30.2 **L**	12.9
Day	**B.Con.4**		**SH6**		**Sarupat**	
	Survival (%)	**Yield / 100 dfls (kg)**	**Survival (%)**	**Yield / 100 dfls (kg)**	**Survival (%)**	**Yield / 100 dfls (kg)**
3rd instar						
1st day	25.8 **L**	11.2	48.2 **L**	16.4	33.3 **L**	14.6
2nd day	26.8 **L**	14.4	32.7 **L**	10.6	35.2 **L**	14.2
3rd day	49.1 L	28.8	49.6 **L**	20.7	30.6 **L**	13.5
4th instar						
1st day	70.0	49.3	16.0 **L**	7.7	54.0	20.8
2nd day	63.0	41.5	17.0 **L**	7.8	70.0	26.1
3rd day	66.0	44.9	7.0 **L**	3.1	71.0	29.3
4th day	68.0	44.0	8.0 **L**	4.4	54.0	20.8
5th instar						
1st day	92.0	61.1	22.0 **L**	11.5	73.0	29.9
2nd day	92.0	61.2	24.0 **L**	10.7	71.0	28.6
3rd day	72.0	45.6	48.0 **L**	28.9	58.0	22.8
4th day	48.0 L	31.3	56.0	28.4	41.0 L	16.6
5th day	72.0	39.4	44.0 **L**	20.5	19.0 **L**	6.8
Control	74.5	44.8	72.0	32.9	74.0	32.2

B. Day and Instar specific effect of thermal stress (35±1°C with + > 90% RH), exposed during Photoperiod and unexposed during Scotoperiod:

Severe lethality was recorded in multivoltine breed, Sarupat. In SH6, lethality was also recorded in each instar. B.Con.4, performed best among the three breeds tested (Table 13).

B. Con. 4: Survival ranged between 40 (5th day of 5th instar) and 75 (2nd day of 1st instar) and lethality was 1st day of 1st instar; 2nd and 3rd day of 3rd instar; 2nd day of 4th instar and 2nd to 5th day of 5th instar.

SH6: Survival was 6 (4th day of 5th instar) to 96 (5th day of 5th instar) with lethality during 1st and 2nd day of 1st instar; 2nd day of 2nd instar, each day of 3rd and 4th instar and 1st to 4th day of 5th instar.

Sarupat: Survival was 0 (2nd day of 5th instar) to 72 (5th day of 5th instar) and lethality was during each day of 1st instar to 3rd instar; 1st, 3rd and 4th day of 4th instar and 1st to 4th day of 5th instar.

Table 13. Day & Instar specific effect of thermal stress (35 ± 1°C) + >90 % RH exposed during photophase and unexposed during scotophase, on rearing performance of silkworm.

Instar / Day	B.Con.4		SH6		Sarupat	
	Survival (%)	Yield / 100 dfls (kg)	Survival (%)	Yield / 100 dfls (kg)	Survival (%)	Yield / 100 dfls (kg)
1st instar						
1st day	48.7 **L**	22.8	41.4 **L**	21.7	14.7 **L**	5.6
2nd day	74.7	35.7	20.3 **L**	8.8	12.2 **L**	5.3
3rd day	66.4	39.9	51.6	29.3	1.9 **L**	0.9
2nd instar						
1st day	70.2	42.6	58.9	31.1	29.5 **L**	11.3
2nd day	60.0	32.3	22.9 **L**	11.4	4.5 **L**	2.0
3rd instar						
1st day	56.8	33.8	48.2 **L**	23.6	16.6 **L**	5.4
2nd day	47.4 **L**	28.6	45.0 **L**	24.0	14.7 **L**	6.2
3rd day	44.0 **L**	22.9	32.3 **L**	16.3	18.0 **L**	6.6
4th instar						
1st day	53.0 **L**	30.1	7.0 **L**	3.5	20.0 **L**	8.3
2nd day	44.0 **L**	25.7	16.0 **L**	7.3	64.0	27.5
3rd day	51.0	26.7	9.0 **L**	4.3	34.0 **L**	13.7
4th day	55.0	29.4	7.0 **L**	4.8	32.0 **L**	11.6
5th instar						
1st day	64.0	34.7	10.0 **L**	4.9	6.0 **L**	2.2
2nd day	49.0 **L**	27.4	20.0 **L**	10.0	Nil **L**	-
3rd day	47.0 **L**	22.9	31.0 **L**	15.5	2.0 **L**	0.8
4th day	43.0 **L**	22.4	6.0 **L**	2.5	8.0 **L**	3.0
5th day	40.0 **L**	20.8	96	62.1	72.0	29.6
Control	77.0	45.5	77.0	39.3	74.0	32.2

C. **Instar specific effect of 35±1°C temperature and RH >90% exposed during photoperiod and unexposed during scotoperiod (including moulting period).**

Instar specific effect of temperature (35 ± 1°C) and R.H. >90% was found lethal for all the bivoltine breeds B.Con.4, SH6 and NB4D2. However, with the thermal stress, survival was B.Con.4 > SH6 > NB4D2. NB4D2 failed to survive with treatment of 35 ± 1°C and RH>90% including moulting period (Table 14).

Table 14. Instar specific effect of 35±1°C temperature and RH >90% (Including moulting period), exposed during photophase and unexposed during scotophase, on rearing performance of silkworm.

Instar / Day	B.Con.4		SH6	
	Survival (%)	Yield / 100 dfls (kg)	Survival (%)	Yield / 100 dfls (kg)
1st Instar	23.2 **L**	10.0	8.9 **L**	3.3
2nd Instar	19.5 **L**	9.0	8.9 **L**	3.1
3rd Instar	16.8 **L**	5.9	17.4 **L**	7.0
Control	80.5	44.8	72.8	36.2
4th Instar	7 **L**	3.4	10.0 **L**	3.6
5th Instar	4.5 **L**	0.4	9.5 **L**	3.6
Control	82.5	46.9	76.0	37.8

Congenic bivoltine breed B.Con.4 was resistant to the imposed stress condition compared to pure bivoltine breeds NB4D2 and SH6. However, Sarupat also showed susceptibility to thermal stress although a multivoltine breed.

3.A.2. QUALITY IMPROVEMENT

3.A.2.1 MULBERRY BREEDING AND GENETICS SECTION

3.A.2.1.1. PIB 3424: Development of low temperature stress tolerant mulberry genotypes for sub-tropical plains. (Jan., 2009 to Dec., 2015)

M. K. Ghosh **(PI)** and P. K. Ghosh

Objective: Development of low temperature stress tolerant mulberry genotype capable of providing higher leaf yield during Agrahayani (Nov.) and Falguni (Feb.) silkworm rearing seasons than the ruling variety, S-1635.

S01: Hybridization, selection and preliminary screening of genotypes.
E 02: Primary screening of genotypes through Progeny Row Trial (PRT).

A total of 15 progenies were identified for primary evaluation.The performance of the progenies is shown in Table 15.

Table 15. Sprouting duration in winter, winter leaf yield, EC, NRA and annual leaf yield of 15 selected progenies.

Progeny No.	Sprouting duration (days after pruning)	Leaf yield during November (g/plant)	Leaf yield during February (g/plant)	Annual (5 crops) leaf yield (g/plant)	EC (dS/m)	NRA (µ mol NO_2^- g^{-1} fr. wt.)
29	9.5	350	300	2404.9	2.95	10.24
33	8.5	452	400	2701.1	3.03	10.52
39	8.5	380	370	2263.1	2.75	10.20
44	8.5	530	410	2037.6	3.53	11.24
45	8.5	574	450	2314.0	3.32	11.34
75	8.5	430	360	2977.0	3.41	10.47
108	10.5	475	395	2614.9	2.73	10.23
193	10.0	340	350	2828.9	3.57	9.40
212	10.5	360	330	2790.8	2.92	9.92
225	8.0	358	450	2980.1	3.43	12.4
232	9.5	382	340	3110.4	2.84	9.81
294	9.5	340	390	2616.8	2.89	10.27
304	10.5	460	290	3391.1	2.93	9.96
371	9.5	340	390	2470.5	3.15	10.47
384	10.5	450	250	3866.3	2.88	9.82
S-1635 (check)	12.5	220	180	1583.3	2.30	8.48
cv %	9.35	18.53	12.43	17.49	9.23	7.08
t value	6.90**	4.57**	7.84**	4.25**	4.64**	4.40**

3.A.2.2 SOIL SCIENCE & CHEMISTRY SECTION

3.A.2.2.1. PPS 3452: Terrestrial carbon sequestration for sustained high productivity of quality mulberry. (July, 2011 to June, 2015)

R. Kar **(PI)**

Objective: To enumerate the enhanced organic carbon stock of the soil due to the induction of altered farming practices in mulberry dim fit to carbon sequestration with comparison to existing one.

The experiment comprises six combinations of farming practices along with a fallow replicated thrice in a RBD. Mulberry variety S-1635, spaced at 60 cm x 60 cm, is being cultivated under different farming practices. Data pertaining to five crop-harvests of the year revealed significant variations for farming practices and seasons with respect to productivity and carbon assimilation by mulberry (Table 16 & 17).

Table 16. Seasonwise mulberry productivity under different farming practices.

Farming practices	Leaf yield (mt ha^{-1})/season					Shoot yield (mt ha^{-1})/season				
	May	July	Sep	Nov	Feb	May	July	Sep	Nov	Feb
Intensive Tillage (IT)	9.19	8.96	8.95	7.99	4.69	6.29	6.38	6.95	3.99	2.44
IT + Grass	8.79	8.60	8.36	8.43	4.85	5.47	6.41	7.27	4.76	3.04
IT + Grass + Cover crop	8.09	7.56	7.85	7.39	4.44	5.35	5.84	6.07	4.09	2.36
Moderate Tillage (MT)	8.11	8.14	8.25	7.82	4.87	4.63	5.68	6.85	4.69	2.69
MT + Grass	9.22	8.82	8.75	8.42	4.89	6.06	6.58	6.69	4.85	3.00
MT + Grass + Cover crop	8.30	8.09	7.71	7.76	4.44	5.41	6.59	6.46	4.89	2.54
CD* $_{\text{farming practice}}$	0.329					0.320				
CD* $_{\text{season}}$	0.301					0.292				

Table 17. Seasonwise carbon assimilation by mulberry under different farming practices.

Farming practices	Carbon assimilation by leaf (mt ha^{-1})/ season					Carbon assimilation by shoot (mt ha^{-1})/ season				
	May	July	Sep	Nov	Feb	May	July	Sep	Nov	Feb
Intensive Tillage (IT)	0.82	0.89	0.89	0.78	0.44	0.63	0.71	0.86	0.46	0.26
IT + Grass	0.81	0.82	0.82	0.82	0.45	0.56	0.71	0.89	0.55	0.30
IT + Grass + Cover crop	0.78	0.74	0.69	0.70	0.40	0.58	0.63	0.65	0.44	0.23
Moderate Tillage (MT)	0.76	0.79	0.82	0.77	0.45	0.53	0.67	0.82	0.51	0.27
MT + Grass	0.86	0.86	0.89	0.86	0.49	0.61	0.72	0.86	0.56	0.33
MT + Grass + Cover crop	0.82	0.83	0.81	0.71	0.42	0.58	0.74	0.83	0.56	0.27
CD* $_{\text{farming practice}}$	0.051					0.044				
CD* $_{\text{season}}$	0.046					0.040				

3.A.2.3.2. BPP (P) 020: Evaluation of soil fertility for sustained production of quality mulberry leaf in Eastern India under long-term fertilization. (July, 2010 to June, 2015; next phase)

R. Kar **(PI)**

Objectives: To study the sustenance of mulberry productivity under long-term fertilization, Evaluation of soil fertility of mulberry gardens by the rational use of fertilizers and manures on long-term basis.

The study conducted with three combinations of nutrient-inputs replicated thrice in RBD with S1635 mulberry variety at a spacing of 60 cm x 60 cm. Five crop-harvests data of the year revealed significant variations for nutrient-inputs and seasons on productivity and NPK uptake by mulberry (Table 18 & 19).

Besides, analysis of soil samples collected after seventh year of experiment revealed that the performance of fertilizers application in conjunction with manure was better than only fertilizers as well as control in terms of soil fertility.

Table 18. Seasonwise leaf yield and N uptake by mulberry under different nutrient-inputs.

Treatment (kg/ha/year)	Leaf yield (mt ha^{-1}) / season					N uptake (kg ha^{-1}) / season				
	May	July	Sep	Nov	Feb	May	July	Sep	Nov	Feb
No Nutrient	1.79	1.66	1.36	1.71	1.14	16.53	18.23	12.37	15.75	12.33
$N_{336}P_{180}K_{112}$	5.21	5.86	6.93	4.31	3.19	47.35	60.47	60.38	36.10	37.27
$N_{336}P_{180}K_{112}$ + FYM_{20mt}	7.16	8.92	8.89	7.12	5.66	71.30	89.75	85.90	65.15	61.04
CD* $_{nutrient}$	0.464					4.75				
CD* $_{season}$	0.599					6.13				
CD* $_{nutrient\ x\ season}$	1.036					10.61				

Table 19. Seasonwise P and K uptake by mulberry under different nutrient-inputs.

Treatment (kg/ha/year)	P uptake (kg ha^{-1}) / season					K uptake (kg ha^{-1})/ season				
	May	July	Sep	Nov	Feb	May	July	Sep	Nov	Feb
No Nutrient	2.80	2.81	3.06	3.22	1.98	14.02	14.60	11.60	12.61	9.63
$N_{336}P_{180}K_{112}$	6.34	8.23	10.27	5.85	5.41	35.47	46.01	50.25	25.50	23.84
$N_{336}P_{180}K_{112}$ + FYM_{20mt}	9.33	11.49	13.31	10.04	7.54	53.94	69.37	69.28	47.27	38.21
CD* $_{nutrient}$	0.75					3.85				
CD* $_{season}$	0.97					4.97				
CD* $_{nutrient\ x\ season}$	1.67					8.61				

3.A.2.3. BIOTECHNOLOGY SECTION

3.A.2.3.1.BPR(P)003: Identification of DNA markers associated with bacterial leaf spot resistance in mulberry (*Morus* spp.). (Apr., 2013 to Mar., 2015)

R. Banerjee **(PI)** and N. Lalitha

Objectives: To **c**onfirm bacterial leaf spot (BLS) reaction of the segregating progeny under field/artificial inoculums study. To utilize SSRs for BLS resistance analysis. To identify putative DNA tags associated with BLS resistance.

A segregating BLS specific population (~175 no) derived from the control crosses of *Morus multicaulis* (as resistant donor) with three susceptible recipients (KPG-1, C-2028 and S-1) was established in the experimental field of the Institute in ARBD under seven blocks each with 4 sets of parents for confirmation of BLS disease reaction pattern and associated inheritance study. One round each of BLS scoring under field as well as under artificial inoculums was completed during Sept., 2013. BLS scoring under natural field inoculums

showed significant variation (DSI range: 3.20 – 25.5) across the 175 segregating progenies (Fig. 4). High (r^2=0.76) correlation between DSI values in field and artificial inoculums based study indicated stability of progeny lines for BLS reaction and *In planta* characterization of morpho-agronomic traits across the population showed significant variability.

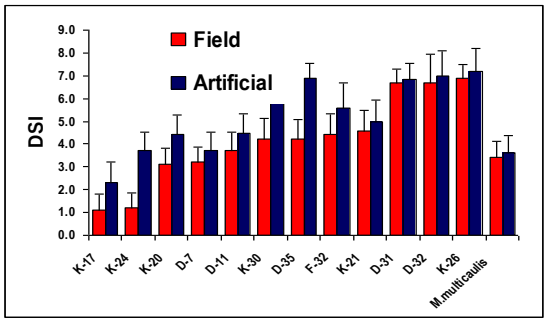
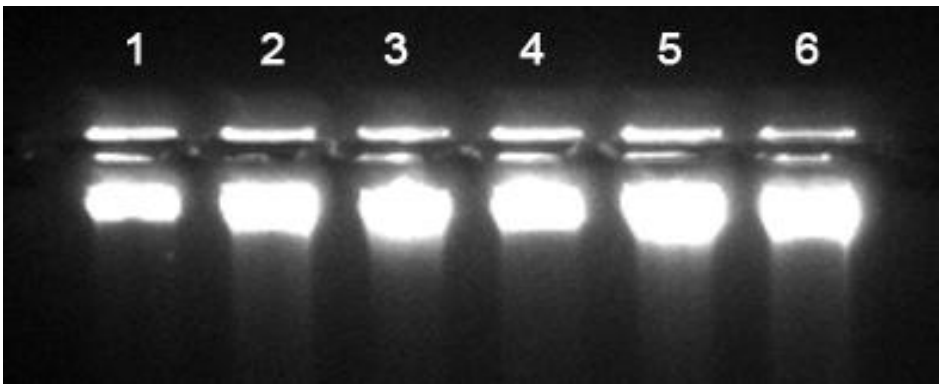


Fig.4. BLS disease severity of parent and progeny in field and artificial inoculums based study.

DNA extraction from parental as well as 70 selected (contrast responsive to BLS) progieny leaf samples and quantified by 0.8% agarose gel electrophoresis and spectrophotometrically were done.

The range of the DNA yield was 1.6 - 2µg per mg fresh mass (Fig 5). About 10 mulberry specific genic SSRs were tested for parental polymorphism. The amplified products were compared with 3% agarose and 5% metaphor agarose gels; six of the SSRs showed useful parental polymorphism (Fig 6) to use further in progeny profiling.



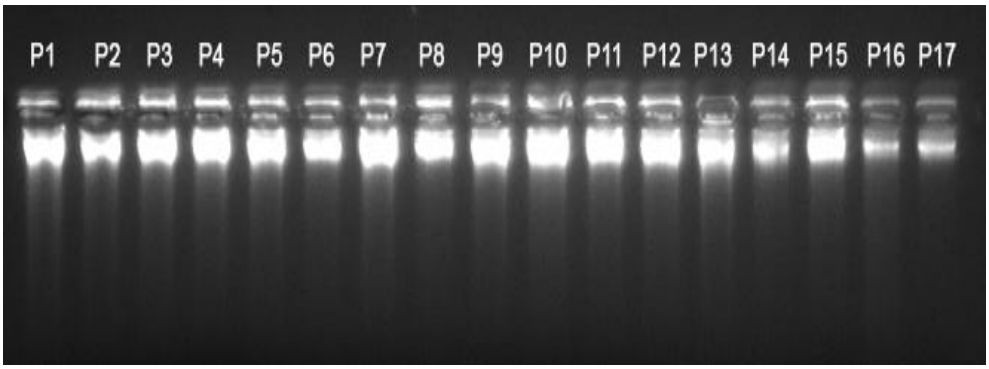


Fig. 5. 0.8% Agarose gel of genomic DNA for (a) 6 parental and (b) 17 progenies of bacterial leaf spot specific segregating lines.

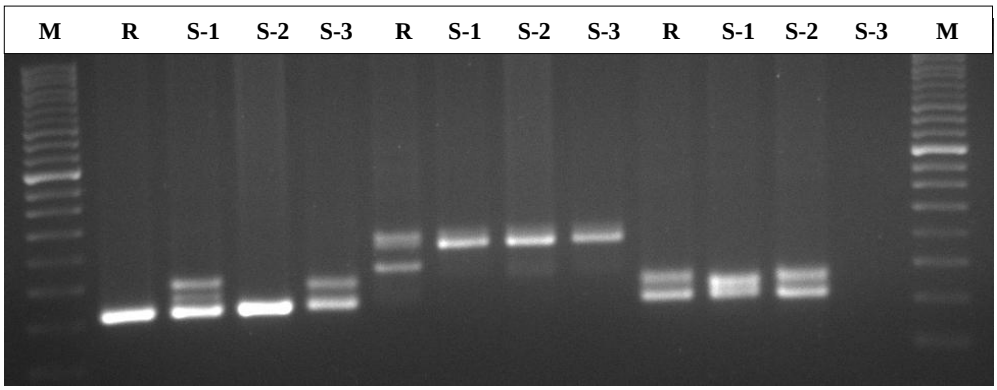


Fig. 6. DNA profiling of four parents contrast responsive to BLS resistance using three promising SSRs markers M: Marker; R: M. *multicaulis*; S-1:KPG-1, S-2:S-1 and S-3: C-2028

3.A.3. DISEASE & PEST MANAGEMENT

3.A.3.1 MULBERRY PATHOLOGY SECTION

3.A.3.1.1. CSS-2107: Forewarning of mulberry diseases of Eastern and North Eastern India. (April, 2012 to March, 2017)

S. K. Dutta **(PI)**, N. K. Das, M. D. Maji, S. P. Chakraborti, A. K. Dutta, D. Pandit, S. T. Lepcha, A. H. Naqvi, S. K. Misroo, M. Shankar, A. Borah, G. B. Singh, B. N. Choudhuri and L. S. Singh

Objectives: Collection of disease incidence (in weekly interval) and meteorological data (day wise) from Eastern and North Eastern states. Publicity and recommendation of package of forewarning system in different locations. 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. 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. Due to climatic change existing disease calendar (as developed in the XI plan period) to be fine tuned at the end of XII plan.

The project was conducted at the Institute alongwith 13 centers. All centers collected the disease incidence data from the farmers' fields at weekly interval and day wise meteorological data. Disease severity was correlated with meteorological data i.e., max. and min. temperature, max. and min. relative humidity and no. of rainy days. In Eastern and North Eastern states different disease severity of different months were recorded.

Forewarning of mulberry diseases in Eastern and North Eastern India.

1. **Murshidabad:** *Myrothecium* leaf spot (MLS) was recorded during April to March with maximum severity during Dec. with PDI value of 10.2. *Pseudocercospora* leaf spot (PLS) was also recorded during April to March with maximum severity of 13.9 PDI during Sept. Bacterial leaf spot (BLS) recorded during June to Oct. with maximum severity of 17.9 PDI in July. Powdery mildew (PMLD) was recorded during Dec. to Feb. ranging from 4.7 to 9.9 PDI. Leaf rust (LR) was recorded during Dec. to Feb. with maximum severity of 10.7 PDI.
2. **Birbhum:** Sporadic incidences of BLS MLS and PLS were reported. Maximum severity of BLS was recorded as 5.8 PDI during Sept. MLS was recorded during July to Sept. with maximum severity of 5.7 PDI and minimum of 4.3 PDI. PLS was recorded during July to Sept. with PDI ranging from 4.3 to 8.3.
3. **Malda:** During Aug. and Oct., BLS was observed with PDI ranging from 0.03 to 3.9. MLS during April to Nov. and PDI was ranging from 1 to 5.8. PLS was recorded during Nov. as maximum PDI of 0.9.
4. **Kalimpong:** Incidence of brown leaf rust, yellow leaf rust and Powdery mildew was recorded. PMLD was recorded during May, Sept. and Oct. with PDI ranging from 0.3 to 2.6. Brown leaf rust was observed during Sept. and Oct. with PDI ranging from 18.9 to 37.5.
5. **Rangpo:** Incidence of PMLD and LR were recorded. PMLD was recorded during June to Nov. with PDI value ranging from 0.6 to 2.2. LR was recorded during Sept. to Nov. and PDI value was 1.2 to 2.4.
6. **Koraput:** PMLD, LR and MLS were recorded in this region. MLS were recorded during Sept. to Dec. with PDI value ranging from 2.1 to 3.3. PMLD recorded during Dec. and PDI was ranging from 3.9 to 4.6 PDI. LR recorded during April to June and Sept. to Dec. with PDI value ranging between 1.2 and 4.2.

7. **Ranchi:** Low incidence of PMLD was recorded during Sept. to Dec. with PDI value ranged from 0.4 to 3.6.
8. **Maheshpur Raj:** Sporadic incidence of BLS was observed during Sept. and severity was recorded as 2.1 to 2.7 PDI.
9. **Jorhat:** Disease severity of PMLD and LR was recorded during Oct. PDI of PMLD was ranging from 1.8 to 4.2 while LR with 4.6 PDI.
10. **Dimapur:** Sporadic incidence of MLS, LR and PMLD were recorded. Severity of LR was ranging from 1.2 to 2 PDI. Incidence of MLS was recorded as PDI ranging from 0.8 to 1.7. Moreover, PMLD was recorded as 0.4 to 0.6 PDI.
11. **Imphal:** The intensity of PMLD was recorded during May, Oct. and Nov. with PDI values ranged between 0.3 and 0.6.
12. **Aizawl:** Sporadic incidence of PMLD and LR was recorded. During April to May and Dec. incidence of PMLD was recorded and in case of LR, sporadic incidence was recorded during Dec. PDI of PMLD was recorded as 4.6 PDI to 8.2 but in LR PDI ranged from 1.9 to 2.
13. **Agartala:** Sporadic **i**ncidence of PMLD was recorded during Dec. and PDI ranged from 4.6 to 8.7.

Developed ready reckoner for spraying of fungicide for Eastern and North Eastern India (ANNEXURE – I) .

Annexure-I

Month-wise Ready reckoner for disease forewarning of Eastern and North Eastern India

Month	Week	Place	Action to be taken (*Application*)
January	III	Murshidabad (West Bengal)	0.1% Carbendazim
	IV	Singhanpur (Chattisgarh)	0.2% Mancozeb
February	I	Koraput (Odisha)	0.2% Mancozeb
		Aizawl (Mizoram)	0.1% Carbendazim
		M.P.Raj (Jharkhand)	
March	I	Imphal (Manipur)	0.1% Carbendazim
	IV	Malda (West Bengal)	0.1% Carbendazim
April	III	Agartala (Tripura)	0.1% Carbendazim
May	II	Birbhum (West Bengal)	0.1% Carbendazim
	III	M.P.Raj (Jharkhand)	0.01% plantomycin
	IV	Murshidabad (West Bengal)	0.01% Plantomycin
		Birbhum (West Bengal)	
June	I	Malda (West Bengal)	0.1% Carbendazim
	II	Birbhum (West Bengal)	0.1% Carbendazim
		Rangpo (Sikkim)	
	III	Malda (West Bengal)	0.01% Plantomycin
July	I	Jorhat (Assam) / Rangpo (Sikkim)	0.1% Carbendazim / 0.2% Mancozeb
	II	Dimapur (Nagaland)	0.1% Carbendazim
	III	Singhanpur (Chattisgarh)	0.2% Mancozeb
	IV	Koraput (Odisha)/ Dimapur (Nagaland)	0.1% Carbendazim / 0.2% Mancoze
August	I	Kalimpong (WB) / Jorhat (Assam)	0.1% Carbendazim / 0.2% Mancozeb
	II	Koraput (Odisha)	0.2% Mancozeb
	III	Murshidabad (West Bengal)	0.01% Plantomycin / 0.1% Carbendazim
		Jorhat (Assam) / Aizawl (Mizoram)	
	IV	Imphal (Manipur) / Agartala (Tripura)	0.1% Carbendazim
September	I	Aizawl (Mizoram) / Imphal (Manipur)	0.2% Mancozeb / 0.1% Carbendazim
	II	Ranchi (Jharkhand)	0.1% Carbendazim
	III	Malda (West Bengal)	0.1% Carbendazim
	IV	Koraput (Odisha)	0.1% Carbendazim
October	I	Malda (West Bengal)	0.1% Carbendazim
	II	Koraput (Odisha)	0.2% Mancozeb
	III	Murshidabad (WB) / Ranchi (Jharkhand)	0.1% Carbendazim
November	I – IV	NIL	NIL
December	I – IV	NIL	NIL

3.A.3.3 SILKWORM PATHOLOGY SECTION

3.A.3.3.1. BAR(PS)004: Testing of immunogens for prevention of silkworm diseases in *Bombyx mori* L. (July, 2013 to June, 2014)

S. Chakrabarty **(PI)** and A. K. Saha

Objectives: Formulation of a synergistic preparation of immunogen with eco-friendly, cost effective bio-molecules for immunization of silkworm, *Bombyx mori* to control silkworm diseases. Increase the cocoon productivity.

E-01: Testing of synergistic effect three immunogens for formulation of effective immunogen against silkworm pathogens:

Seven formulated combinations (1:1:1, 1:1:2, 1:2:2, 1:2:1, 2:2:1, 2:1:2 and 2:1:1) of Proline, Nicotinic acid and Ascorbic acid ~ 20mg / ml was tested for synergistic effect against silkworm pathogens namely *Staphylococcus vitulinus*, Nuclear Polyhedrosis virus (*Bm*NPV) and *Beauveria bassiana* causing common silkworm diseases. Data have been recorded and analyzed statistically (Table 20).

Table 20. Pool data analysis for effect of treatments (immunogens) on susceptible, ruling and control breeds.

Treat-ments	V wt (g)	ERR (NO)	SCW (G)	SSW (G)	ERR (g)	FL (M)	NBFL (m)	Dr	Smith Index
Treat-I	2.42	79.15	1.04	0.13	79.09	381	327	2.29	1
Treat-II	2.38	76.45	1.05	0.13	75.89	376	318	2.30	4
Treat-III	2.39	79.95	1.01	0.13	78.93	374	315	2.33	2
HC	2.45	79.95	1.04	0.13	77.66	359	301	2.34	3
Mean	2.41	78.88	1.03	0.13	77.89	373	316	2.31	
SD	0.03	1.44	0.01	0.0	1.28	8.1	9.27	0.02	
Criterion1	3	3	3	3	3	3	3	3	
Criterion2	10	10	6	6	6	6	6	6	

E-02: Testing of effective immunogen formulations in susceptible silkworm breed.

Most effective three immunogen formulations were shortlisted and tested on susceptible silkworm breeds namely S2, O, G and CB5 along with M6DP(C) as ruling breed used for hybrid seed preparation and Nistari as control. Data recorded and analyzed statistically (Table 21).

E03: Assessment of reeling and crop performance and post cocoon parameters in suitable breeds / hybrids.

Reeling parameters such as like Filament length, Non-breakable filament length and Denier were recorded on silkworm breeds/ hybrids in normal condition and results were analyzed statistically (Table 21).

Table 21: Effect of immunogens for rearing conducted on susceptible, ruling and control breeds (Pool data July, 13 to Jan., 14).

Breeds	V wt (g)	ERR (NO)	SCW (G)	SSW (G)	ERR (g)	FL (M)	NBFL (m)	Dr	Smith Index
M6DPc	2.000	76	0.920	0.111	61.452	336	286	2.184	5
G	2.508	87	1.081	0.145	81.095	366	330	2.424	1
CB5	2.575	82	1.111	0.144	87.252	394	328	2.268	3
O	2.608	80	1.059	0.142	89.666	427	365	2.284	2
S2	2.253	84	0.942	0.121	80.328	354	337	2.132	4
Nistari	1.882	96	0.811	0.092	73.363	281	256	2.173	6
Mean	2.300	84.71	0.987	0.13	78.86	360	318	2.24	
SD	0.28	6.24	0.11	0.02	9.38	45.52	35.65	0.10	

E04: Determination of shelf life of effective formulation of Bio-product.

Assessment of shelf life of new formulation of immunogen is under process by freezing from - 5°C to 25°C for one month to six months.

3.A.3.3.2. BAR (RP) 005: Survey and surveillance of silkworm diseases in traditional sericultural districts of West Bengal. (April, 2013 to March, 2014)

S. Chakrabarty **(PI),** A. K. Verma, A. K. Dutta(REC, Mothabari), D. Pandit, (REC M P Raj), S. P. Chakrabarti (REC, Kamnagar) and A. H. Naqvi (Sub-REC, Rajmahal)

Objectives: To suggest the effective remedial measures 'on spot' to the farmers' to control the disease and forewarn them for ensuing commercial crop in West Bengal. To prepare database on the incidence of various diseases of silkworm, *B. mori* during commercial crops in the traditional sericultural districts of West Bengal.

Crop wise survey of silkworm diseases was conducted at 365 farmers' in 75 villages in the districts of West Bengal namely Murshidabad, Malda and Birbhum. Pooled data analysis revealed that incidence of all the diseases were less (Pebrine 0.12%, Grasserie 0.26%, Flacherie 0.01%, Muscardine 0.35% and Gattine 0.06%) in three districts. However, critical analysis revealed that the incidence of 'Grasserie' was throughout the seasons to the tune of 0 - 1.2 % during March-April, 0 – 4.9 % during May-June, 1.9 - 30.1 % in Aug. – Sept., 3.1 - 16.5% during Nov. and 0.5 – 9.7% in Feb. in hot spot areas.

In Murshidabad, ~ 28.3% and ~ 32.8% crop loss was reported due to incidence of 'Muscardine' disease during 'Baisakhi' and 'Jaistha' Commercial

crop, 13 respectively; ~ 20.3 crop loss was reported due to incidence of 'Pebrine' during Aghrayani Commercial crop, 13. However, ~16.6 % 'Grasserie' disease was during Aghrayani,13. In Birbhum, high incidence of around 27.8 and 24% of 'Muscardine' was recorded during Jaistha, 13 and Falguni commercial crop, 14 respectively. High incidence of Grasserie (~30.1%) was recorded during Aswina commercial crop, 14. In Malda, high incidence of Grasserie (~10%) was observed during Shravani, 13; high incidence of Pebrine (~15.0%) and Grasserie (~12.7%) was recorded during Aghrayani, 13 (Fig.7).

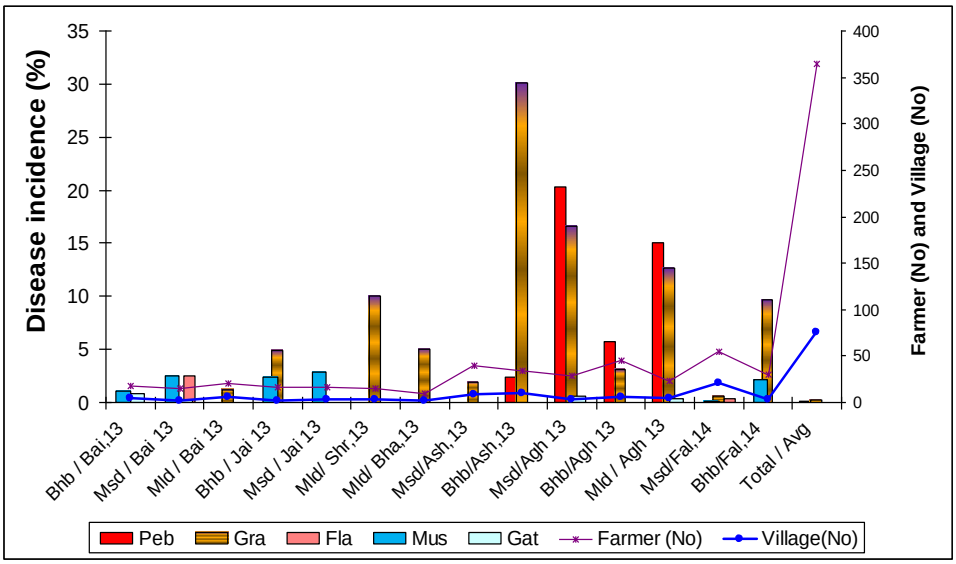


Fig. 7. Survey and surveillance of silkworm diseases in traditional Sericultural districts of West Bengal for 2013-14

3.A.4. COST REDUCTION

3.A.4.1 AGRONOMY SECTION

3.A.4.1.1 BPP (RP) 001: Mother culture maintenance of *Azotobacter chroococcum* and mass multiplication for Nitrofert production. (Micro project) (April, 2012 to March, 2013) (Continuous)

S. Rajaram **(PI)**

Objective: To reduce nitrogenous chemical fertilizer requirement and expenditure to sericulture farmers in mulberry cultivation, to protect and improve soil health conditions in mulberry garden for sustainable productivity.

A total of 41.3 kg of Nitrofert supplied to 52 farmers covering 26 acres of mulberry. Details of production and supply of nitrofert was:

Nitrofert : Production and supply details (2013-14)			
Particulars	**Unit**	**Rate**	**Amount (Rs.)**
Production details			
Opening Balance (kg)	13.11	25	327.75
Production [2013-14] (kg)	33.93	25	848.25
Total	**47.04**	**25**	**1176.00**
Sale proceed details			
Total quantity supplied (kg)	**41.3**	**25**	**1032.50**
Mulberry area covered (acre)	26.00		
Number of farmers covered	52		
Closing Balance			
Closing Balance Nitrofert (kg) *	0	25	0.00
Total Expenditure			**426.06**
Cost of production / kg #			**12.56**
# (Without establishment charges including wage) 5.74 kg applied in experiment field			

3.A.4.1.2. BPP(RP) 002: Mother culture maintenance of *Glomus mosae* [Arbuscular Micorhizal Fungus (AMF)] and mass multiplication for Phosphofert production. (Micro project) (April, 2012 to March, 2013) (Continuous)

S. Rajaram **(PI)**

Objective: To reduce phosphorous chemical fertilizer and expenditure on the same to sericulture farmers in mulberry cultivation. To protect and improve soil health conditions in mulberry garden for sustainable productivity.

A total of 104 kg of Phosphofert supplied to 2 new farmers covering one acre for raising of mulberry saplings. Details of production and supply of phosphofert was:

Phosphofert : Production & Supply details (2013-14)			
Particulars	**Unit**	**Rate**	**Amount (Rs.)**
Production details			
Opening Balance (kg)	0	25	0.00
Production [2013-14] (kg)	308	25	7700.00
Total	**308**	**25**	**7700.00**
Sale proceed details			
Total quantity supplied (kg)	**104**	**25**	**2600.00**
Mulberry area covered (acre)	1.0		
Number of farmers covered (New)	2		
Closing Balance			
Closing Balance Phosphofert (kg)	0	25	0.00
Total Expenditure			**512.00**
Cost of production / kg #			**1.66**
# (Without establishment charges including wage) * unsold 204 kg Phosphofert reactivated with stock culture			

3.A.4.1.3. BPP(P)023: Optimum requirement of irrigation water and its management for sustainable leaf productivity in high yielding mulberry garden under West Bengal conditions. (May, 2013 to April, 2014)

S. Rajaram **(PI)**

Objective: To find out actual irrigation water requirement for high yielding mulberry under different climatic conditions; to find out optimum level of irrigation water of irrigation for quality linked sustainable leaf productivity in high yielding mulberry garden.

Table 22. Requirements of irrigation water for mulberry (3 crops data)

Sl. No.	Particulars	Crop 1	Crop 2	Crop 3
1	Season	18, May - 23, Jul. 2013	01, Sep. - 06, Nov.2013	08, Jan. - 15, Mar.2013
2	Total rainfall received (mm)	486.1	456.0	44.0
3	Effective rainfall (mm)	467.5	300.1	20.5
4	Total rain loss (mm)	18.6	155.9	20.5
5	Efficiency of rain (%)	96.2	65.8	46.5
5	Actual irrigation requirement (mm)	-169.0	-54.6	155.1
6	Potential water use by crop (mm)	298.0	245.5	175.6
7	Actual water use by crop (mm)	298.0	245.5	175.6
8	Etc / cumulative yield reduction	0	0	0

3.A.4.1.4. BPP (VP) 015: Validation of E3 WM (Efficient Economic Eco-friendly Weed Mower) at nested units and farmers' field level. (Oct., 2013 to Mar., 2015)

S. Rajaram **(PI)**

Objective: To bring improvement in utilization of manpower and natural resources in mulberry cultivation through use of simple cost effective tools, devices and machines. To remove drudgery and facilitate completion of work in time.

► **Salient features of the E^3 WM © SH / PM designed and developed and efficiency index recorded were :**

- Free from fuel, clutch and trouble.
- As very simple user friendly technology is employed in the machine it is free from hurdle and maintenance is very easy.
- Alternate energy (electric) used reduces the operational costs considerably & it is eco-friendly.
- Efficient engine (motor) used to undertake the work efficiently at faster rate.

- All safety measures like **guards, MCB. / ELCB.,** / **Main switch** etc., used to keep away from all major risks anticipated.
- Provision made available for mowing hardy shrubs and grasses.
- Circular teeth disc replace wire for shoot harvest and pruning of mulberry in the field.
- **HRUE** index commensurate with the power and efficient functioning of the machine was recorded as **>15** on validation and hence it is undoubtedly **E^3** (Efficient Economic Eco-friendly Weed Mower). (Table 23.)

Table 23. Validation of performance of E^3 WM © SH / PM

Particulars	Fuel machine in the market	E3 WM © SH / PM
Cost of machine (Rs)	Very high (> 30000)	< 15000 (incl. 100 m cable)
Operation cost (Rs)	Very high (> 150 / hr)	< 7 / hr.
Maintenance	Very high (parts are costly) frequent	Very minimum & very rare
Vibration / body pain	Very high results in tired to operator	Nil
HRUE Index	Weeding, shoot harvest & pruning <7	>15 (14-17)
Use of battery/solar energy	Not feasible	Feasible

3.B.ONGOING OWN RESEARCH PROJECTS & PROGRAMMES OF RSRSs

3.B.1.KALIMPONG

3.B.1.1. B-KPG(P)-006: Muga Seed Multiplication Programme. **(***Collaborative programme with MSSO, Guwahati*). (Nov., 2009 to Oct., 2014).

M. D. Maji **(PI)** and C. Maji

Objectives: To establish Som/ Soalu plantation at P-4 farm. To maintain muga host plantation with required cultural practices. To rear muga silkworm for production of muga dfls.

Establishment of muga host plants is under progress. Six acres of Som and Soalu plantation (4000 nos.) at Hill Nursery was taken on lease for three years from DoT (Seri), West Bengal to conduct muga silkworm rearing. Progress of the prog. was:

Muga Plantation: Regular maintenance like weeding, application of manures and crop protection measures were done as per schedule in the newly established som and soalu plantation at P-4 farm. At Hill Nursery, maintenance of 4000 (Som and Soalu) plantation through regular cultural operations, such as, weeding, application of manures, punning, pollarding and application of crop protection measures were done as per schedule.

Rearing: A total of 400 muga dfls were brushed during July pre-seed crop. Rearing could not be continued due to political unrest in the hills.

3.B.1.2. B-KPG (RP) 008:Maintenance of bivoltine silkworm germplasm breeds. (April, 2013 to March, 2014)

R. Bhutia **(PI)**

Objective: To maintain the bivoltine silkworm breeds true to their original racial characters and to study their qualitative and quantitative traits.

A total of 81 bivoltine breeds were maintained in the bivoltine germplasm bank as stock lot at RSRS Kalimpong. Rearing was conducted during spring crop (April-May) 2013 and the performances are in Table 24.

Table 24. Rearing performance of bivoltine silkworm germplasm breeds, 2013

Sl. No	Race	Fec No	Hatch (%)	Larval period day/hrs	Wt. of 10 larvae	Yield/ 10,000 larvae Wt. g)	S.C.W. (g)	S.S.W. (g)	Shell Ratio (%)	Pupa-tion (%)
1	BL1	560	96.42	24.08	44.16	16.80	1.888	0.340	18.00	88.0
2	BHR1	534	97.19	24.08	45.23	12.63	1.742	0.340	19.51	83.3
3	BHR2	539	93.13	24.08	46.77	15.27	1.762	0.363	20.60	88.3
4	BHR3	559	94.09	25.00	46.96	14.60	1.877	0.363	19.33	94.3
5	B.Con1	578	95.15	24.08	46.80	16.43	1.637	0.314	19.18	88.3
6	B.Con2	518	94.59	25.00	45.51	15.83	1.765	0.341	19.32	85.0
7	B.Con4	533	94.37	24.08	45.24	17.27	1.868	0.355	19.00	89.3
8	BP(C)	478	96.23	24.16	31.36	13.70	1.495	0.207	13.84	87.3
9	BP(B)	458	96.50	25.00	30.10	13.03	1.563	0.204	13.05	90.6
10	B37	559	93.55	25.08	44.11	17.50	1.787	0.338	18.91	96.0
11	CC1	558	94.80	24.16	44.84	15.57	1.712	0.338	19.74	91.0
12	C108	579	96.71	24.08	47.44	16.77	1.836	0.357	19.44	93.3
13	C110	574	92.33	26.00	45.63	14.97	1.960	0.388	19.79	91.3
14	C122	554	93.68	24.16	45.45	15.40	1.665	0.312	18.73	92.6
15	CSR2	602	94.18	24.08	41.94	14.60	1.838	0.340	18.49	82.3
16	CSR4	600	96.50	24.08	46.11	16.10	1.725	0.345	20.00	93.3
17	CSR5	599	94.99	25.00	46.60	13.60	1.730	0.350	20.23	88.3
18	CSR8	603	95.52	26.00	42.12	14.97	1.969	0.378	19.19	84.6
19	CSR18	610	94.59	25.00	46.19	14.57	1.952	0.382	19.56	86.3
20	CSR19	592	94.59	24.08	46.70	14.87	1.744	0.321	18.40	84.0
21	Changnan	599	93.65	24.08	45.52	12.00	1.802	0.329	18.25	85.3
22	D3SL	525	93.90	25.00	40.11	16.30	1.758	0.328	18.65	88.0
23	D4	597	94.97	25.08	45.67	16.60	1.874	0.359	19.15	81.0
24	D5	605	95.04	25.00	40.49	11.77	1.698	0.307	18.08	81.3
25	D6(M)	600	97.66	26.00	47.00	16.33	1.790	0.343	19.16	87.6
26	D6(P)	564	96.45	24.08	45.12	15.43	1.761	0.314	17.83	81.3
27	D7	581	96.38	24.16	47.00	17.43	1.836	0.332	18.08	93.3
28	J112	540	94.81	24.16	45.19	13.57	1.607	0.312	19.41	96.3
29	J122	560	96.07	25.08	43.11	14.77	1.818	0.358	19.69	88.3
30	JD6	568	94.89	25.08	42.10	16.33	1.741	0.325	18.66	88.0
31	KPG A	558	94.98	25.08	46.46	14.80	1.861	0.348	18.69	95.3
32	KPG B	524	92.55	25.08	40.22	17.87	1.908	0.372	19.49	94.0
33	KPG 6	530	94.90	25.08	42.55	16.80	1.894	0.360	19.00	94.0
34	KPG 7	551	96.00	26.00	46.12	17.20	1.753	0.339	19.33	90.6
35	MJ1	512	93.94	24.08	40.30	16.27	1.571	0.280	17.82	96.3
36	MJ2	528	96.78	24.08	40.81	14.70	1.844	0.349	18.92	87.6
37	MC1	575	93.91	25.08	41.23	15.87	1.647	0.311	18.88	88.0
38	MC2	539	94.43	25.00	40.50	15.27	1.765	0.350	19.83	92.0
39	MC3	584	94.69	24.16	41.67	17.60	1.829	0.343	18.75	90.6
40	MC4(O)	573	95.63	24.16	45.12	17.17	1.949	0.369	18.93	86.3
41	MC4(E)	572	96.50	24.16	46.18	15.23	1.584	0.313	19.76	88.6
42	NB18	567	95.06	25.16	47.76	17.63	1.910	0.365	19.10	91.6
43	NB4D2	596	94.12	26.00	48.92	17.17	1.839	0.362	19.68	96.0
44	O1	601	96.83	26.00	46.00	14.27	1.683	0.307	18.24	90.0
45	O2	600	95.33	26.00	42.19	17.17	1.782	0.336	18.85	87.6

46	O3	596	94.46	26.00	44.76	17.23	1.938	0.361	18.62	88.3
47	O4	602	96.01	25.00	45.22	17.57	1.728	0.336	19.44	92.6
48	P5	600	93.33	25.00	45.09	17.73	1.774	0.358	20.18	88.3
49	Pam 105	605	95.86	25.00	42.00	14.03	1.744	0.330	18.92	91.6
50	SK1	598	94.14	25.08	45.20	15.50	1.679	0.307	18.28	89.3
51	SK3	532	95.30	25.00	41.80	17.23	1.858	0.341	18.35	93.3
52	SK4	547	93.05	25.08	42.57	15.50	1.697	0.327	19.26	94.6
53	SK4(S)	522	96.36	24.16	45.11	11.87	1.674	0.313	18.69	75.6
54	SK4(II)	540	95.00	24.16	40.63	12.90	1.709	0.315	18.43	85.6
55	SK4(III)	570	94.56	24.08	46.13	13.63	1.601	0.307	19.17	91.3
56	SK6	506	95.11	24.16	44.19	16.63	1.933	0.381	19.71	89.6
57	SK7	504	94.69	24.00	42.72	14.37	1.747	0.322	18.43	97.6
58	SH6	560	93.92	24.08	46.95	14.93	1.792	0.353	19.69	73.6
59	SF19	549	94.35	24.06	47.14	11.87	1.828	0.330	18.05	74.0
60	YB	430	93.95	24.08	33.90	10.57	1.486	0.225	15.14	86.6
61	YS3	568	94.71	24.16	46.26	16.27	1.648	0.315	19.11	95.0
62	Howlok	502	97.41	25.08	40.27	15.50	1.671	0.316	18.91	91.3
63	CC(SL)	529	93.95	25.08	44.62	13.10	1.734	0.339	19.55	81.6
64	Feng Zhong	539	94.99	25.00	42.62	14.20	1.758	0.331	18.82	87.0
65	HongZhou(G)	550	92.36	25.00	42.62	15.13	1.813	0.341	18.80	87.0
66	HongZhou(R)	540	95.74	25.00	41.27	13.00	1.591	0.288	18.10	93.3
67	JPN5xB-25	549	93.62	25.00	40.23	18.80	1.729	0.343	19.83	96.0
68	JPN6xA-26	530	91.88	25.00	45.14	13.20	1.864	0.365	19.58	78.3
69	JPN6xB25	510	94.50	25.08	43.80	16.77	1.766	0.331	18.74.	90.0
70	JPN 12D	599	94.49	25.08	42.98	12.20	1.844	0.364	19.73	77.3
71	SMGS-12	600	92.50	25.08	46.50	11.97	1.779	0.350	19.67	83.3
72	SMGS-1	588	92.68	24.00	42.75	10.80	1.917	0.370	19.30	73.0
73	SMGS-2	550	92.72	24.08	40.33	11.20	1.743	0.334	19.16	73.3
74	SMGS-3	570	93.68	24.08	47.00	10.33	1.678	0.307	18.29	66.6
75	SMGS-4	587	93.35	25.00	40.55	17.63	1.816	0.334	18.39	97.3
76	SMGS-5	590	93.72	24.08	43.20	11.17	1.792	0.349	19.47	71.3
77	SMGS-6	590	94.74	25.00	45.40	15.73	1.881	0.362	19.24	83.3
78	Thai-I	594	93.09	25.00	40.73	15.90	1.706	0.316	18.52	93.3
79	Thai-II	554	95.12	25.00	41.15	15.33	1.708	0.315	18.44	96.6
80	Anjali	600	92.66	24.00	46.22	10.73	1.694	0.332	19.59	74.6
81	101-D	594	94.61	25.08	46.00	15.00	1.940	0.358	18.45	86.0

3.B.1.3. B-KPG (RP) 011: Multiplication and supply of SK6 x SK7 dfls to Sikkim and plain areas. (2012 – continuous)

M. D. Maji **(PI)**, R. Bhutia and C. Maji

Objective: To popularize of SK6 and SK7 at farmers field.

Rearing and grainage performances of SK6 and SK7 dfls as parents were:

Rearing : To produce SK6 x SK7 dfls, 50 dfls of SK6 and 35 dfls of SK7 were reared during spring crop and cocoons yield was 34.8 kg of SK6 and 26.6 kg of SK7 @ 68.1 kg and 76.1 kg per 100 dfls respectively. During Autumn crop, 40 dfls of SK6 and 30 dfls of SK7 were brushed and

harvested 23.2 kg of SK6 and 17.3 kg of SK7 cocoons @ 58.1 kg and 57.8 kg /100 dfls respectively. Crop wise rearing performance of SK6 and SK7 is presented in Table 25.

Table 25. Rearing performance of SK6 and SK7 at Kalimpong.

Crop	Breeds	Dfls brushed	Fecundity (nos.)	Hatching(%)	Cocoon harvested (kg)	ERR		S.C.W (g)	S.S.W (g)	Shell (%)
						No.	Wt. (Kg)			
Spring	SK6	50	550	94.91	34.75	7897	13.29	1.68	0.310	18.41
	SK7	35	561	94.34	26.59	8773	14.16	1.61	0.288	17.85
Autumn	SK6	40	553	97.39	23.23	7655	10.45	1.387	0.237	16.96
	SK7	30	594	95.34	17.33	7386	9.76	1.339	0.221	16.44

Grainage: A total of 6500 and 4464 dfls of SK6 x SK7 produced during Spring and Autumn crop respectively, of which, 2300 dfls were supplied to DoS, Sikkim and 4200 dfls to ZSSO, Malda and remaining 4464 dfls kept in cold storage for supply during Spring crop 2014.

3.B.2.KORAPUT

3.B.2.1. Studies on High Bush and Tree type mulberry plantation under rainfed condition of Odisha. (Nov., 12 to Oct., 17)

Rushi Sahu **(PI)**

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

Transplantation of mulberry saplings of S1635 and C1730 varieties in experimental plots during July 2013 was done. Chemical fertilizers were applied as per recommended doses. Plantation is under establishment stage.

3.B.3. RANCHI

3.B.3.1.B-RNC(RP)004:Survey & Surveillance of disease and pest of mulberry and silkworm. (Apr., 13 to Mar., 14)

M. Alam **(PI)** and Ch. Sudhakara Babu

Objectives: To assess the incidence of different diseases periodically and to take protective and curative measures to check the outbreak of diseases.

Survey and surveillance in respect of silkworm diseases conducted, revealed that grasserie incidence was 1%, 205% and 4.5% during Feb.- March, Aug. and Oct., respectively. However, flacherie was reported during Aug., 13 to the tune of 1.2%.

3.B. 4.JORHAT

3.B.4.1. MOE 3459: Yield gap in mulberry sericulture - a study in North – Eastern region of india. (Oct., 2011 to Sept., 2014)

M. Pamehgam (**PI**) and M. Sankar

Objectives: To study the socio economic profile of the farmers of NE India. To determine the yield gap at farmer's level as compared to the institute level and demonstration plots. To identify different factors responsible for such yield gap. To suggest possible options for reducing the gap.

The study was conducted in six North Eastern states: Assam, Nagaland, Manipur, Mizoram, Meghalaya and Tripura by adopting multi stage random sampling. A total of 300 farmers from 94 villages were covered. Data on age, educational status, occupation, land holding and rearing capacity of the farmers, adoption of HYV of mulberry, rearing practices and infrastructure facilities were considered for the study. The data were collected based the structured questionnaire based interview method, compiled and analyzed.

I. Identifying the yield gaps between Research station, demonstration plots and farmer's field.

Data on mulberry leaf yield and silkworm rearing performance were collected in three seasons (spring, summer and autumn) (Table 26 & 27).

Table 26. Mulberry leaf yield in different states of North Eastern region

State	Leaf yield (mt/ha/yr.)			Yield gap (%)	
	Institute (A)	Demonstration plot (B)	Farmers field (C)	A - C	(A – B)
Assam	18.00	15.96	12.20	47.54	12.78
Tripura	14.50	12.52	10.58	37.05	15.81
Mizoram	14.36	12.34	11.64	23.36	16.37
Meghalaya	14.48	12.98	10.20	41.96	11.16
Nagaland	16.20	14.52	11.25	44.02	11.57
Manipur	16.30	14.80	12.27	32.84	10.14
Average	15.64	13.85	11.18	39.80	12.92

Table 27. Cocoon yield in different states.

State	Cocoon yield (kg/100 dfls)			Yield gap (%)	
	Institute (A)	Demonstration plot (B)	Farmers field (C)	A - C	(A – B)
Assam	50.30	45.24	42.00	19.76	11.18
Tripura	39.40	37.97	33.87	16.33	3.77
Mizoram	49.15	44.67	42.00	17.02	10.03
Meghalaya	47.73	42.61	40.00	19.33	12.01
Nagaland	39.57	34.67	29.00	35.45	14.13
Manipur	45.34	42.48	38.00	19.32	6.73
Average	44.75	41.27	37.47	19.43	11.44

The yield gaps were higher between Institute and farmers fields, where gaps in mulberry leaf yield was 39.8% mt/ha/yr and cocoon yield was 19.4 kg/100 dfls. However, the gaps between Institute and Demonstration plot was 2.9% and 11.4% for mulberry cultivation and silkworm rearing respectively which indicated that material supplied and frequent extension personnel supports helped in increasing cocoon and leaf yield production compared to farmers field.

II. Identifying the gap in technology adoption:

Yield gaps analysis at different states showed that the gaps occurred due to non-adoption/partial adoption of technologies of mulberry cultivation and silkworm rearing. State wise technology adoption data are presented in Table 28 and 29.

Table 28. Adoption level in mulberry cultivation technologies.

Technology	Adoption level (%)					
	Assam	Mizoram	Manipur	Meghalaya	Nagaland	Tripura
Mulberry Variety						
S1635	76	100	92	62	34	78
Local	24	0	8	38	66	22
Spacing (cm)						
90 x 90	42	100	98	64	70	44
150 x 150	58	0	2	46	30	56
Chemical fertilizer (NPK)						
Full dose (150:50:50::N:P:K)	0	88	32	8	6	4
Partial dose: 75:25:25	0	12	68	92	94	96
FYM (mt/ha/yr)						
Full	80	4	6	7	2	10
Partial	20	96	94	93	98	90
Plant protection measures						
Full	0	0	0	14	0	0
Partial	100	100	100	86	100	100
Pruning						
Pruning(twice)	100	-	100	-	100	100
Pruning (Once)	-	100	-	100	-	-
Cultural operations						
Full	100	8	96	100	100	0
Partial	0	92	4	0	0	100

Table 29. Adoption level in silkworm rearing technologies.

Technology	Adoption level (%)					
	Assam	Mizoram	Manipur	Meghalaya	Nagaland	Tripura
Improve silkworm breed (BxB)						
100 %	100	100	100	100	100	100
Disinfection of rearing house						
Fully adopted	94	100	100	100	36	82
Partially adopted	6	-	-	-	64	18
Use of bed disinfectant						
Fully adopted	60	100	98	100	40	52
Not adopted	40	-	2	-	60	48
Leaf preservation method						
Fully adopted	79	98	89	91	5	65
Partially adopted	21	2	11	9	95	35
Type of rearing house						
Pucca	28	100	48	100	62	2
Kuchcha	72	--	42	-	48	98
Black boxing concept						
Fully adopted	6	56	24	28	0	4
Not adopted	97	44	76	72	100	96
Chawki garden						
Fully adopted	0	0	0	0	0	0
Not adopted	100	100	100	100	100	100
Rearing net						
Fully adopted	-	100	74	47	-	5
Not adopted	100	-	-	-	100	95

III. Constraints of farmers in sericulture:

One of the major constraints identified at farmers' level was lack of irrigation facilities (64.7%), followed by rearing houses (40.3%). However, other constraints were technical knowledge - needs training (34.3%), rearing appliance (33%), finance (30%), fencing for mulberry protection (27.3%), cocoon marketing facilities (16.3%), need of weeding machines (15% for Mizoram), Extension services - need of frequent extension help (8%) and scarcity of suitable land (1.7%) and shortage of labour (1.3%). (Table 30)

Table 30. Constraints for yield gaps at farmers' level:

Particulars	Lacking (%)						
	Assam	Mizoram	Manipur	Meghalaya	Nagaland	Tripura	Avg.%
Rearing House	62	-	62	-	20	98	40.3
Rearing Appliances	60	-	20	-	20	98	33.0
Shortage of labour	-	-	8	-	-	-	1.3
Need of Training	-	32	76	21	42	35	34.3
Extension service -Frequent Extension personnel help	22	-	26	-	-	-	8.0
Cocoon Marketing facilities	96	-	2	-	-	-	16.3
Finance	100	-	80	-	-	-	30.0
Need Weeding Machine	-	90	-	-	-	-	15.0
Fencing	-	64	-	100	-	-	27.3
Scarcity of suitable land	8	-	2	-	-	-	1.7
Irrigation aid	-	94	94	96	92	12	64.7

3. B-JRH(009) : Survey and surveillance of mulberry and silkworm pests and diseases of North-Eastern states. (Oct., 2013 to Sept., 2016)

Smt M. Pamehgam **(PI)**

Objectives: To monitor the incidence of various diseases and pests of mulberry and silkworm in the region throughout year. To record meteorological data and correlate the same with the data collected. To recommend remedial measures. To develop forecasting models for various pests & diseases.

Data recorded on mulberry and silkworm diseases and pests at weekly intervals at farm and farmers' field alongwith meteorological data presented in Table 31 and 32.

Table 31. Incidence of mulberry diseases

Sl. No	Station (State)	Diseases in PDI			Pests (No.)		
		Leaf Rust	Leaf Spot	Powdery Mildew	Mealy Bug (Tukra) [No./shoot]	White Fly (No./sh.)	Thrips [No./pl]
1	Jorhat (Assam)	3.92 (Oct) 0.25 (Nov)	-	3.19 (Oct) 0.28 (Nov)	2.25 (Oct) 2.00 (Nov)	123.75 (Oct) 31.50 (Nov)	-
2	Dimapur (Nagaland)	1.60 (Oct) 2.07 (Nov)	1.29 (Oct) 1.70 (Nov)	-	-	-	-
3	Shillong (Meghalaya)	-	-	2.61 (Oct)	-	-	-
4	Imphal (Manipur)	-	-	0.49 (Oct) 0.51 (Nov) 0.50 (Dec)	-	-	-
5	Agartala (Tripura)	-	-	1.91 (Dec)	6.8 (Mar)	11.66 (Mar)	-
6	Aizawl (Mizoram)	3.18 (Nov) 3.07(Dec)	-	4.21(Nov) 3.60 (Dec) 3.54 (Feb)	-	-	-

Table 32. Incidence of Silkworm Diseases

Sl. No.	Station (state)	Silkworm Diseases (%)					Pests (%)
		Grassarie	Flacherie	Muscardine	Gattine	Pebrine	Uzifly
1	Jorhat (Assam)	-	-	-	-	-	-
2	Dimapur (Nagaland)	3.0 (Oct)	-	-	-	-	-
3	Shillong (Meghalaya)	2.19 (Oct)	3.4 (Oct)	1.22 Oct	-	-	-
4	Imphal (Manipur)	-	-	-	-	-	-
5	Agartala (Tripura)	61 (Dec)	-	-	-	-	-
6	Aizawl (Mizoram)	3.76 (Oct)	0.73 (Oct)	-	-	-	-

3.C. COLLABORATIVE RESEARCH PROJECTS /PROGRAMMES WITH RSRSs & RECs

3.C. 1. ENOTOMOLOGY SECTION

3.C.1.1. BPR (P) 021: Development of weather based forecasting models for mulberry pests. (Jan., 2011 to Dec., 2015)

S. K. Mukhopadhyay **(PI),** M.V. Santha Kumar, M. Patnaik (upto 27.05.2013), N. Lalitha, N. K. Das, U. K. Bandyopadhyay (RSRS, Kalimpong), S. P. Chakrabarti (REC, Kamnagar), J. Sarkar (REC, Mothabari), N. R. Rao (RSRS, Koraput) and Y. Devaraj (RSRS, Jorhat)

Objectives: To develop a data base on climatic factors and incidence of major pests of mulberry; to establish pest incidence and weather relationship; to develop region wise forecasting models for different pests of mulberry.

Incidence of major mulberry pests were recorded at the Institute's field, three traditional districts of Gangetic plains (Malda, Murshidabad and Birbhum) and Kalimpong hills of West Bengal at weekly intervals. At the institute's plot, thrips incidence prevailed during the month of May to July, 2013 and Jan. to March, 2014. The max. population was recorded during Feb., 2014 (23/leaf). Whitefly population was recorded during Sept. to Nov. and max. population of 13/leaf during Nov., 2013 (Fig 8). In Murshidabad district, thrips population was from April to August, due to prevailing drought with max. population of 26/leaf during May. During the other months, thrips population remained below Economic Threshold Level (ETL) with a range of 7.3 – 18.1/leaf. From Sept., 2014 onwards, the population receded and from Jan., 2014 onwards the population (6.9/leaf) started to build up (Fig 9). White fly population recorded during Sept. to Nov., 2013 and max. population (9/leaf) was recorded during Sept., 2013. In Birbhum district, same trend of incidence of white fly was recorded. Max. population of thrips was recorded during May (41/leaf) and whitefly 13/leaf during Sept. (Fig 10). In Malda district, thrips population was low during June to August, 2013, while white fly recorded during Sept. – Dec. with a range of 1 to 3/leaf (Fig 11). In Kalimpong hills, incidence of root mealy bug prevailed throughout the year and maximum infestation (10/plant) was recorded during July, 2013. The leaf webber was found prevalent during April – Dec. with a population of 0.11/plant – 1.07/plant (Fig 12).

Pest incidence data recorded at the farmers' field and at RSRS, Jorhat revealed that in Jorhat, thrips population (2-6/leaf) was recorded during April – June, Tukra (2-8%) during the same period (Fig 13). Whitefly incidence was found during Aug. & Sept. with a population of 10-26/leaf. In Koraput, though all the

major pests: thrips, whitefly and mealy bug were found throughout the year but their incidence was below ETL.

Fig. 8. Pest Incidence at Institute field

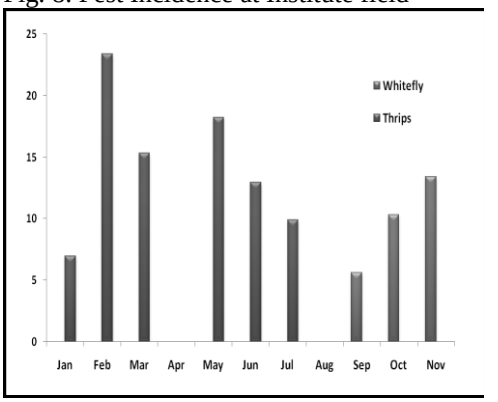


Fig. 9. Pest Incidence in Murshidabad

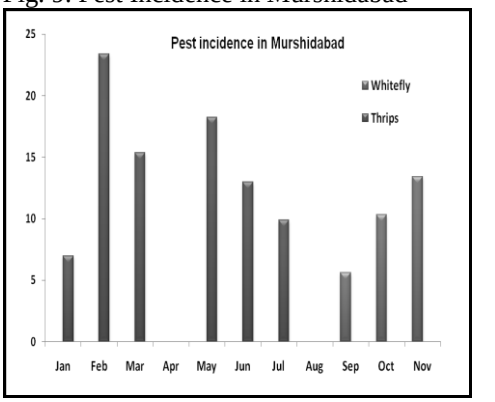


Fig. 10. Pest Incidence in Birbhum

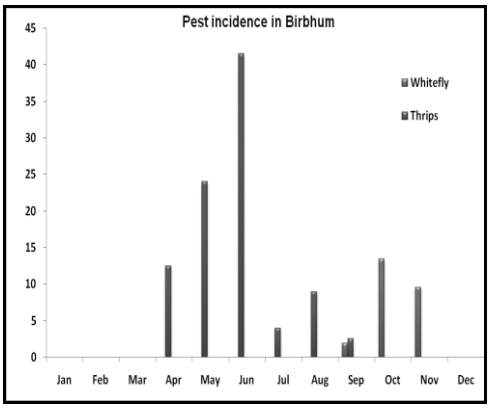


Fig. 11. Pest Incidence in Malda

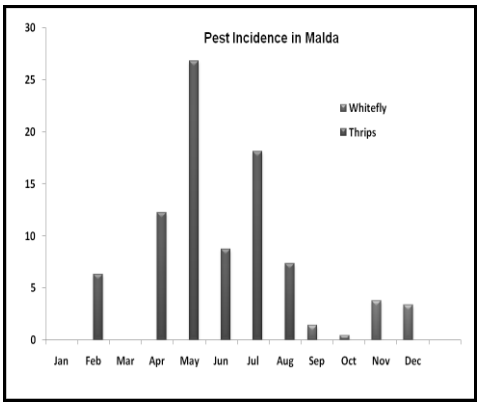


Fig. 12. Pest Incidence in Kalimpong

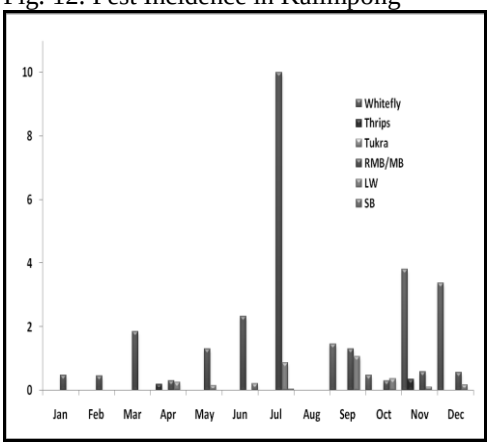
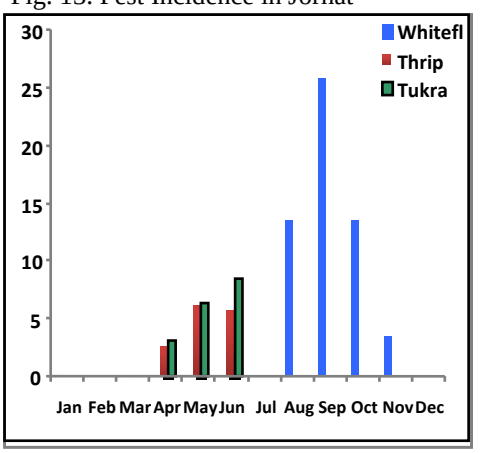


Fig. 13. Pest Incidence in Jorhat



3.C. 2. SILKWORM BREEDING & GENETICS SECTION

3.C.2.1. AIB 3491: Post authorization trials of silkworm hybrids in Eastern and North Eastern India. (Collaborative project) (July, 2012 to Dec., 2014).

N. Suresh Kumar **(PI)**, G. K. Chattopadhyay, A. K. Saha, One scientist each of 4 RSRSs and 14 RECs and Officials from all 11 DOT/DOSs

Objective: To popularize authorized silkworm hybrids among the farmers of Eastern and North Eastern India.

A total of 83,550 dfls of multi x bi hybrids and 15,300 dfls of bivoltine hybrids were distributed in Falguni 2013 crop followed by 97300 dfls (multi x bi) in Bhaishakhi, 35050 dfls (multi x multi) in Jaistha, 20,000 dfls (multi x multi) in Shravani, 67,920 dfls (multi x multi) in Bhaduri, 56,300 dfls (multi x multi) in Aswina and 1,02,250 dfls (Multi x bi) in Agrahayani along with 57,300 dfls of bivoltine hybrids. The farmers recorded encouraging results wherein they have got better yield than the control hybrids and better returns. The performance of silkworm hybrids under PAT programme is presented in Table 33.

Table 33. Performance of silkworm hybrids under PAT programme

Hybrid	Target (Dfls)	Achievement (Dfls)	Yield/100 dfls (Kg)	Yield range (Kg)
Bivoltine hybrids				
Gen3 x Gen2	36600	48600	43.75	27-74
SLD4 x SLD8	36600	8600	37.00	27-45
FC1 x FC2	-	19450	47.00	45-50
NB18 x P5	18300	13950	40.73	22-62
Total	**91500**	**90600**	-	-
Multi x bi hybrids				
MCon1xBCon4	131400	141600	54.16	46-64
MCon4 xBCon4	131400	119750	53.54	42-67
N x NB4D2	65700	97300	43.82	32-56
Total	**328500**	**358650**	-	-
Multi x multi hybrids				
M.Con.1 x M.Con.4	56800	71910	30.18	22-36
Nistari x M.Con.4	56800	59460	29.71	21-35
Nistari x M12 (W)	28400	47900	25.58	20-28
Total	**142000**	**179270**		
Grand Total	**562000**	**628520**		

3.C. 3. SILKWORM PATHOLOGY SECTION

3.A.3.1. BAI(RP)006:Silkworm disease monitoring of seed and commercial crop (SDMSCC) rearing of West Bengal. (Apr., 2013 to Mar., 2014)

Satadal Chakrabarty **(PI),** A.K.Dutta (REC, Mothabari); J.Sarkar (REC, Mothabari), S.P. Chakrabarty (REC, Kamnagar), U.K.Bandyopadhya (RSRS, Kalimpong), S.Chatterjee (RSRS, Kalimpong), Shibnath (BSF, Karnasubarna), K. K. Sinha (SSPC, Kalitha), P. K. Biswas (BSF, Banguria), B. C. Roy (ZSOO, Malda), L. M. Saha (SSPC, Berhampore), M. K. Ghosh (SSPC, D.B.Pur), In-charge (BSF, Ambarifalakata), S. Sen (SSPC, Raiganj), S. K. Majumdar (BSF, Dhubulia), Z. Hossain, A. K. Varma and 10 Extension Officers, DoT(Seri), West Bengal

Coordinators: B. Mukherjee, Addl. Director, DoT(Seri.), West Bengal and K. Mandal, Sci.-D, ZSSO, Malda

Objectives: To identify the disease responsible for crop loss at DoT(Seri), NSSO and farmers' field during seed and commercial crops and to suggest effective remedial measures 'on spots' to the farmers'/farms' to prevent / management the disease for ensuing crop. Strict vigils of disease 'out break' reported at seed and commercial crops and suggest effective remedial measures 'on spot' to the farmers'/ farms' to prevent / management of the disease for ensuing crop.

A total of 2104 samples (1455 for seed and 649 for commercial) were examined from farmers of 160 villages and DoS farms during parental (P3/P2/P1) and commercial rearing in the districts namely Murshidabad, Birbhum, Nadia, Malda, Uttar Dinajpur, Dakshin Dinajpur, Jalpaiguri, Darjeeling (Plain and Hill), Coochbehar and Midnapore of West Bengal. Pooled data analysis of 1455 seed samples showed disease incidence of Pebrine (0.1%), Grasserie (1.7%), Flacherie (0.7%) and Muscardine (0.6%) where as of 649 commercial samples showed more disease severity of Pebrine (1.3%), Grasserie (5.7%), Flacherie (1.6%), Muscardine (8.4%) and Gattine (1.8%). (Fig.14 &15)

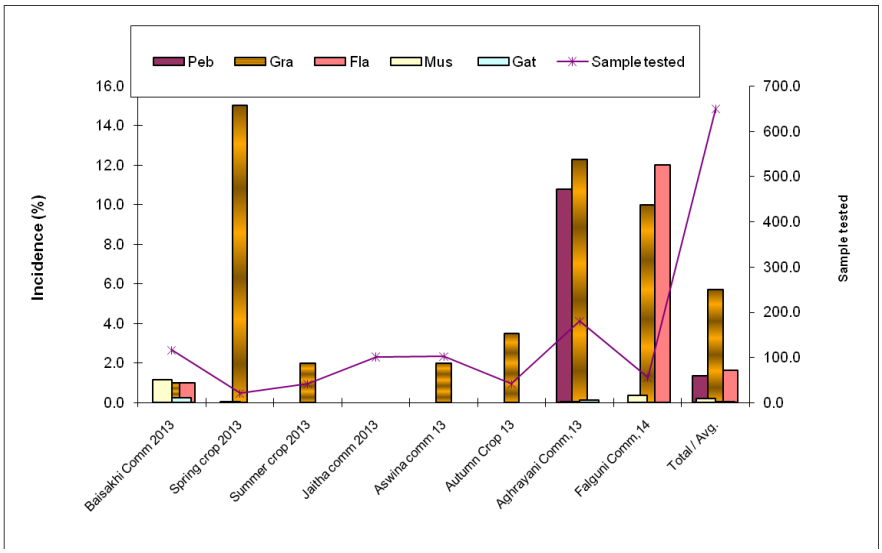


Fig.14. Silkworm diseases at commercial crop for 2013 -14

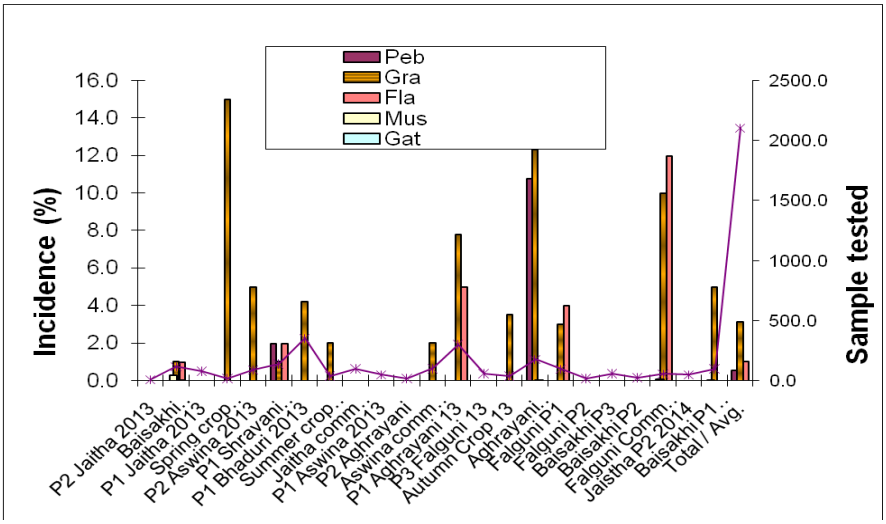


Fig.15. Silkworm diseases at P3,P2,P1 seed and commercial level for 2013 -14

3. D. CONCLUDED RESEARCH PROJECTS / PROGRAMMES

3. D.1. RAINFED SERICULTURE: Nil

3. D.2. PRODUCTIVITY IMPROVEMENT

3. D.2.1. AGRONOMY SECTION

3.D.2.1.1. PPF 3487: Decision support system initiative through impact assessment of agroclimate on foliage yield of mulberry (*Morus* sp.) for climate resilient sericulture in Eastern India. (Oct., 2012 to Sept., 2013)

Monica Chaudhuri **(PI)** and M. K. Ghosh

Objectives: To develop a synthetic yield-weather model mining archived and spatio-temporal historical satellite data on mulberry leaf yield and corresponding agro meteorology.

Temporal historical weather data was mined on geo-referenced location of CSR&TI, Berhampore mulberry farm at 24^0 06´ N latitude and 88^0 15´ E longitude (courtesy: Responsible NASA Official: John M. Kusterer) for the period from Sept., 2002 to 2012 on daily basis. Foliage yield data of ruling mulberry variety S1635 raised under irrigation and standard package of practices in separate blocks of 90 cm x 90 cm and 60 cm x 60 cm spacings were retrieved on per plant basis for five crops in a year from CSR&TI, Berhampore recorded over the same period. The data sets were analyzed retrospectively crop-wise into 16 agro-meteorological variables vis-à-vis mulberry foliage yield. During the entire period of each crop growing season i.e. from the day after foliage harvest till the day before next harvest, daily agro meteorological data on the following 16 parameters corresponding a total of 52 foliage yield harvests were *re*-analyzed for impact assessment. The parameters studied were:

- 5 crop harvest seasons.
- Heat stress day: total no. of days above 37°C.
- Heat stress load: total amount of temp. accumulation above 37°C.
- Cold stress day: total no. of days below 13°C.
- Cold stress load: total amount of temp. accumulation below 13°C.
- Mean day time temp.
- Mean night time temp.
- Mean diurnal temp. variation.
- Daily insolation incident on a horizontal surface.
- Maximum air temp. at 2m above the earth surface.
- Minimum air temp. at 2m above the earth surface.
- Wind speed at 10m above the surface of the earth.
- Dew/frost point temperature at 2m.

- Av. air temperature at 2m above the surface of the earth.
- Relative humidity at 2m.
- Diurnal temp. range.
- Mulberry foliage yield during 5 crop growing harvests.

All the 15 agro-meteorological variables were used as independent predictors in a stepwise backward multiple regression over crop wise foliage yield as dependent variable. Chi square (χ^2) test was conducted for retrospective model validation by ascertaining the relative deviation of the calculated impact by putting values of actual historical data in regression equation vis-à-vis that of respective predictors.

Results: Inclusion of 5 agro-meteorological variables as independent predictors-vs-foliage yield as dependent variable resulted in the most comprehensive and workable model which was tested to be fit too.

Mulberry Foliage yield =3.244 -0.153X(1) + 0.003X(3) - 0.03X(9) -0.101X(10) + 0.042X(14)

The tenability of the model was verified the histogram of regression standardized residuals matched the normal distribution (Chart 1 and 2), the indicative that the sample can predict a normal distribution in the population. The impact of each of the final predictors on the yield are portrayed by the scatter plots on Charts 3-7 deciphering homoscedasticity.

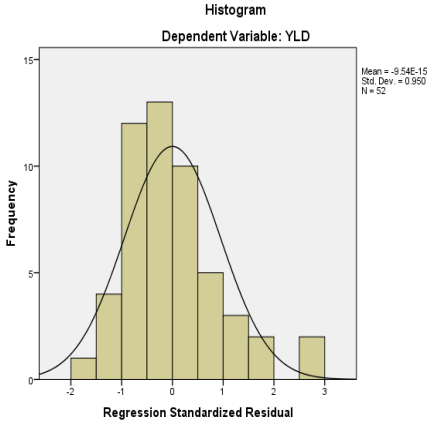


Chart 1

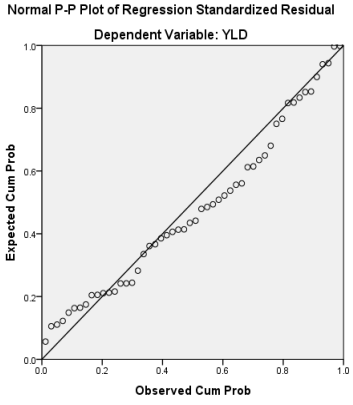


Chart 2

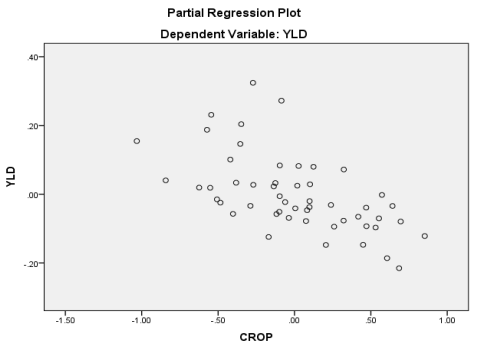


Chart 3

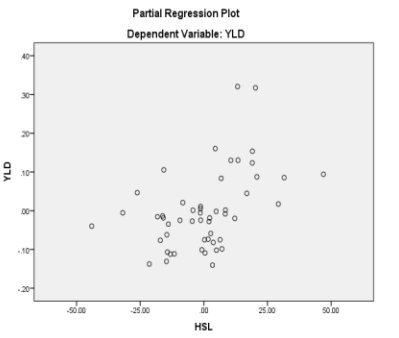


Chart 4

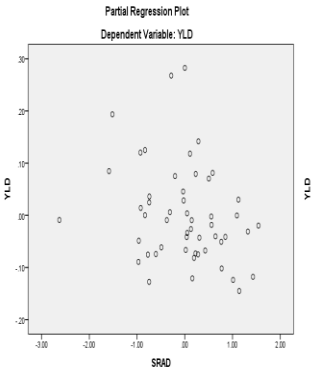


Chart 5

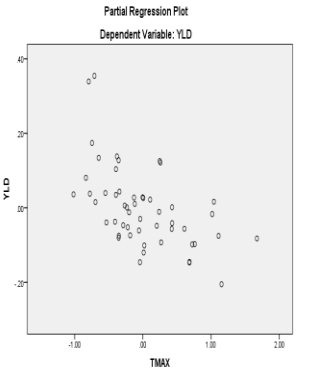


Chart 6

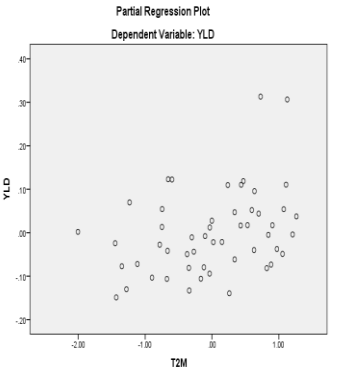


Chart 7

Inference: The outcome of the project predicted in retrospection that with the earlier harvests among five the crop harvest schedule within a year, increased heat stress load on cold stressed days having daily minimum temperature less than 13°C periods having reduced solar insolation as well as maximum temperature but higher daily mean temperature, greater foliage yield was realized. The findings of the present project are made ready to be validated in real time for a full-proof anytime-yield-forecasting model application.

3.D.2.2.SOIL SCIENCE AND CHEMISTRY SECTION

3.D.2.2.1.PPS3435: Studies on micronutrients for sustained high productivity of quality mulberry in Eastern and North-Eastern India. (Jan., 2010 to Jun., 2013)

R. Kar **(PI),** S. Chatterjee, A. H. Naqvi, S.K. Misro and S. N. Gogoi

Objectives: To evaluate the micro-nutrients' status of mulberry growing soils and of mulberry as well as their order of requirement and to work out the recommendation for individual micronutrient through the exercise on multilocational leaf productivity along with the order of micronutrient requirement by mulberry under appropriate statistical package of DRIS.

Zn, Cu, Fe and Mn are reported to be substantially deficient in Indian soils. In mulberry cultivation, studies on micronutrients are mostly restricted to Southern India and virtually no recommendation is available with respect to micronutrient in Eastern and North-Eastern India. The study was initiated to work out the strategy for micronutrient management in mulberry gardens of Eastern and North-Eastern India through the employment of Nutrient Indexing Survey (NIS) as well as Diagnosis and Recommendation Integrated System (DRIS) norms. These norms can be used irrespective of variety and in addition conducting of large number of field experiments on different soil types involving tremendous expenditure to work out the recommendation for micronutrient can be averted.

Methodology:

- Soil samplings under NIS from mulberry growing regions of Eastern and North-Eastern India and their evaluation for cationic micronutrients' (Cu, Zn, Fe and Mn) availability (Lindsay and Norvell, 1978).
- Mulberry leaf samplings from the corresponding sites and their evaluation for cationic micronutrients' status (Jackson, 1973).
- Recording of leaf productivity corresponding to the sampling sites.
- Analysis of generated data by means of appropriate statistical package in terms of DRIS norms (Sumner, 1978; Hundal and Arora, 1996).
- Enumeration of site-specific DRIS functions (*f*) for micronutrient ratios of leaf tissues.
- Enumeration of site-specific DRIS indices for individual micronutrient based on DRIS functions (*f*).
- Evaluation of order of micronutrients' requirement by mulberry based on DRIS indices for individual micronutrient and multilocational leaf productivity.
- Development of recommendation for individual micronutrient.

Micronutrients' availability in soil:

Under NIS, soil samples have been collected from mulberry vegetation of Eastern and North-Eastern India comprising 372 units under 124 sites. DTPA extracts of collected soil samples was analyzed for estimation of available Cu, Zn, Fe and Mn contents and location wise distribution of the same is presented in Table 34.

Table 34. Micronutrients' availability in soils under mulberry vegetation of Eastern and North-Eastern India.

Location	Micronutrients' availability (mg kg^{-1}) in soil			
	Cu	Zn	Fe	Mn
West Bengal Plains	2.46 ±0.176 (0.57-6.08)	0.89 ±0.057 (0.09-1.98)	10.53 ±0.575 (2.88-33.57)	18.66 ±0.701 (3.58-32.12)
West Bengal Hills	1.19 ±0.108 (0.31-5.40)	1.67 ±0.143 (0.04-5.11)	44.76 ±1.358 (20.98-65.11)	4.44 ±0.734 (0.28-27.00)
Orissa and Jharkhand	0.62 ±0.052 (0.16-2.11)	0.70 ±0.091 (0.19-4.04)	20.01 ±1.485 (6.16-58.22)	28.05 ±2.910 (5.79-89.31)
North Eastern states	0.67 ±0.069 (0.002-3.22)	0.95 ±0.128 (0.13-11.82)	30.49 ±1.637 (4.18-77.18)	10.91 ±1.186 (0.18-80.00)

Micronutrients' availability in the mulberry growing soils of Eastern and North-Eastern India as indicated above was compared with the critical level of DTPA extracted Cu (0.2 mg kg^{-1}), Zn (0.6 mg kg^{-1}), Fe (4.5 mg kg^{-1}) and Mn (2.6 mg kg^{-1}) from soil as per literature available (Lindsay and Norvell, 1978). The results of NIS reveal that mulberry growing soils of this region was mostly deficient in Zn (47.3%) followed by Mn (23.7%) and Cu (19.1%) while Fe deficiency was negligible (1.6%). Considering the location wise distribution of these cationic micronutrients, mulberry vegetation under plains of West Bengal was mostly deficient in Zn (25.6%) followed by Fe (8.9%). Mn was found to be the most deficient (65.4%) micronutrient in mulberry growing soils under hills of West Bengal followed by Zn (25.6%). In the states of Orissa and Jharkhand, deficiency of Zn is mostly prevalent (65.1%) in soils under mulberry vegetation followed by Cu (3%) while in the North-Eastern states the order of deficiency is Zn (62%) > Cu (46%) > Mn (24.7%) > Fe (0.7%).

Employment of DRIS for foliar diagnosis of cationic micronutrients in mulberry in terms of its productivity

Mulberry leaf samples corresponding to the soil samplings were collected season wise maintaining the crop-schedule of different locations. Corresponding leaf productivity data was also recorded and locationwise micronutrient status in mulberry leaves were analyzed in Table 35. The collected leaf samples were processed as per the requirement of tri-acid extraction (Jackson, 1973) for subsequent analysis of the extracted aliquots for estimation of Cu, Zn, Fe and Mn contents.

Table 35. Micronutrients' contents in mulberry leaf.

Location	Micronutrients' status (mg kg^{-1}) in mulberry leaf			
	Cu	Zn	Fe	Mn
West Bengal Plains	6.7 ±0.22 (3.7-14.7)	19.2 ±0.74 (10.6-46.5)	144.2 ±6.33 (73.4-305.5)	47.3 ±2.41 (12.3-112.3)
West Bengal Hills	3.8 ±0.15 (1.6-7.3)	16.3 ±0.79 (4.3-36.5)	58.6 ±4.13 (7.2-124.4)	48.3 ±3.86 (10.9-118.8)
Odisha and Jharkhand	5.1 ±0.44 (0.1-21.7)	15.5 ±0.87 (4.0-34.8)	126.9 ±11.38 (18.9-301.5)	89.7 ±6.91 (12.3-219.3)
North Eastern states	5.4 ±0.13 (1.8-10.8)	24.5 ±0.87 (11.4-74.3)	89.2 ±4.10 (13.0-201.4)	66.8 ±3.06 (4.8-203.2)

As per the requirement of computation under DRIS, micronutrient ratios were enumerated from the status of foliar micronutrient (Table 36).

Table 36. Micronutrient ratios of mulberry leaf.

Location	Micronutrient ratios					
	Cu/Zn	Fe/Zn	Mn/Zn	Fe/Cu	Mn/Cu	Fe/Mn
West Bengal Plains	0.37±0.03 (0.17-0.94)	7.92±0.64 (3.55-15.32)	2.68±0.36 (0.92-9.68)	22.31±1.70 (6.11-44.60)	7.37±0.78 (0.98-20.43)	3.56±0.35 (1.09-8.05)
West Bengal Hills	0.26±0.02 (0.10-0.41)	4.88±0.95 (0.34-21.56)	3.29±0.44 (0.49-8.00)	17.64±2.41 (1.43-41.46)	13.61±2.05 (2.45-38.90)	1.79±0.34 (0.16-8.62)
Odisha and Jharkhand	0.36±0.05 (0.09-1.29)	7.84±0.93 (2.69-16.10)	6.83±0.96 (0.53-15.07)	29.18±4.30 (3.66-64.03)	20.77±2.93 (2.85-55.55)	3.47±1.16 (0.25-21.67)
North Eastern states	0.24±0.01 (0.07-0.37)	3.92±0.32 (0.77-9.08)	2.89±0.21 (0.31-9.16)	17.01±1.41 (3.14-55.25)	13.23±1.22 (1.08-55.69)	1.53±0.13 (0.24-4.09)

Micronutrient ratios of mulberry leaf tissues were, further, exercised under an orthogonal mathematical model (Hundal *et al.*, 2008) to work out the DRIS functions (*f*) as follows:

$$f(A/B) = [(A/B)/(a/b) - 1] \times 1000/CV, \text{ when } A/B \geq a/b \ldots\ldots\ldots (1)$$

or

$$f(A/B) = [\,1 - (A/B)/(a/b)\,] \times 1000/CV, \text{ when } A/B < a/b \ldots\ldots\ldots (2)$$

In these equations, A / B is the tissue micronutrient ratio of the plant to be diagnosed, a / b is the optimum value or norm for that given ratio and CV is the coefficient of variation associated with the norm. The enumerated DRIS functions for leaf micronutrient ratios are tabulated (Table 37).

Table 37. DRIS functions (*f*) for leaf micronutrient ratios.

Location	DRIS functions (*f*)					
	f (Cu/Zn)	*f* (Fe/Zn)	*f* (Mn/Zn)	*f* (Fe/Cu)	*f* (Mn/Cu)	*f* (Fe/Mn)
West Bengal Plains	-31.96 to +40.46	-29.77 to +22.64	-28.29 to +38.68	-68.24 to +25.73	-121.96 to +33.02	-45.48 to +25.16
West Bengal Hills	-46.36 to +29.39	-135.73 to +34.57	-83.78 to +20.96	-162.98 to +19.39	-59.33 to +24.20	-107.33 to +39.27
Odisha and Jharkhand	-43.48 to +37.44	-34.28 to +18.86	-176.78 to +18.31	-100.95 to +17.29	-95.12 to +25.33	-82.19 to +33.46
North-Eastern states	-76.25 to +17.97	-72.75 to +23.30	-158.62 to +41.91	-76.17 to +38.77	-174.34 to +49.64	-88.78 to +28.01

The DRIS functions (*f*) are further exercised following the norms of Hundal and Arora (1996) to compute the DRIS indices (I) for individual micronutrient, which was the quantitative evaluation of relative degree of imbalance of the micronutrients and location wise DRIS indices (I) for individual micronutrient along with corresponding leaf productivity were worked act (Table 38).

Table 38. DRIS indices for individual micronutrient and leaf productivity of mulberry.

Location	Leaf productivity (mt ha^{-1} $year^{-1}$)	DRIS indices (I) for individual micronutrient			
		I_{Cu}	I_{Zn}	I_{Fe}	I_{Mn}
West Bengal Plains	24.88 – 39.00	-11.09 to +76.88	-17.91 to +26.25	-20.77 to +24.51	-55.11 to +39.06
West Bengal Hills	8.26 – 16.16	-16.71 to +66.50	-19.78 to +75.95	-104.02 to +31.08	-42.29 to +45.87
Odisha and Jharkhand	7.00 – 11.55	-25.45 to +54.30	-51.49 to +64.01	-46.13 to +21.83	-95.96 to +36.74
North Eastern states	6.10 – 19.43	-34.87 to +79.58	-16.69 to +65.90	-79.23 to +19.33	-118.69 to +33.50

Order of micronutrient requirement by mulberry was evaluated based on the DRIS indices (I) value for individual micronutrient and the same was compared with the leaf productivity recorded. Through this exercise, relatively insufficient (limiting) micronutrient was identified in different locations and its impact of being limited in terms of affecting leaf productivity was also reckoned (Table 39).

Comparing the values of DRIS indices with respect to individual micronutrient, the order of micronutrient requirement by mulberry was ascertained in different locations. The micronutrient with most negative index w considered relatively the most insufficient/ most limiting. The increasing indices represent the order of limitation, up to the most relatively excessive or least limiting micronutrient. Different order of micronutrient requirements were further compared with the corresponding leaf productivity in different locations.

Zn as the relatively most limiting micronutrient was found to limit the mulberry crop yield substantially in West Bengal plains (28.8 mt ha^{-1} $year^{-1}$ against the productivity range of 24.9–39 mt ha^{-1} $year^{-1}$), Orissa and Jharkhand (7.7 mt ha^{-1} $year^{-1}$ against the productivity range of 7–11.6 mt ha^{-1} $year^{-1}$) as well as North-Eastern states (7.4 mt ha^{-1} $year^{-1}$ against the productivity range of 6.1–19.4 mt ha^{-1} $year^{-1}$). In North-Eastern states, Cu was also found to limit the productivity substantially (8.6 mt ha^{-1} $year^{-1}$) while becoming relatively most limiting micronutrient. In the hills of West Bengal, leaf productivity was substantially retarded (9.9 mt ha^{-1} $year^{-1}$ against the productivity range of 8.3–16.2 mt ha^{-1} $year^{-1}$) while Mn becoming the relatively most limiting micronutrient.

Mulberry vegetation of different locations under Eastern and North-Eastern India requires special attention for management of location-specific micronutrient in terms of affecting productivity. Thus, Zn for West Bengal plains, Orissa and Jharkhand, Mn for West Bengal hills and both Zn as well as Cu for North-Eastern states.

Table 39. Order of micronutrient requirement by mulberry in relation to leaf productivity.

Order of micronutrient requirement	Leaf productivity (mt ha^{-1} year^{-1}) corresponding to the most limiting* micronutrient			
	Cu	**Zn**	**Fe**	**Mn**
West Bengal plains (Mean leaf yield: 32.92±0.37 mt ha^{-1} year^{-1})				
Zn>Cu>Fe>Mn/ Zn>Fe>Cu>Mn/ Zn>Mn>Cu>Fe/ Zn>Cu>Mn>Fe		28.82*		
Cu>Zn>Fe>Mn	35.31			
Mn>Zn>Cu>Fe/ Mn>Cu>Zn>Fe/ Mn>Fe>Cu>Zn/ Mn>Cu>Fe>Zn/ Mn> Fe>Zn>Cu				34.39
Fe>Mn>Zn>Cu/ Fe>Mn>Cu>Zn/ Fe>Cu >Mn>Zn/ Fe>Zn>Mn>Cu/ Fe>Zn>Cu>Mn/ Fe>Cu>Zn>Mn			33.95	
West Bengal hills (Mean leaf yield: 11.67±0.21 mt ha^{-1} year^{-1})				
Mn>Cu>Fe>Zn/ Mn>Fe>Zn>Cu/ Mn>Zn >Cu>Fe/ Mn>Fe>Cu>Zn/ Mn>Zn>Fe>Cu				9.88 *
Fe>Mn>Cu>Zn/ Fe>Mn>Zn>Cu/ Fe> Zn>Cu>Mn/ Fe>Cu>Zn>Mn			13.10	
Cu>Mn>Fe>Zn/ Cu>Fe>Mn>Zn/ Cu>Zn>Fe>Mn	11.71			
Zn>Cu>Mn>Fe/ Zn>Mn>Fe>Cu/ Zn>Mn>Cu>Fe		11.27		
Odisha and Jharkhand (Mean leaf yield: 9.26±0.15 mt ha^{-1} year^{-1})				
Zn>Fe>Cu>Mn/ Zn>Fe>Mn>Cu/ Zn>Mn>Cu>Fe		7.68*		
Fe>Zn>Cu>Mn/ Fe>Cu>Zn>Mn/ Fe>Zn>Mn>Cu/ Fe>Cu>Mn>Zn			9.91	
Cu>Fe>Mn>Zn/ Cu>Fe>Zn>Mn	9.78			
Mn>Cu>Zn>Fe/ Mn>Fe>Cu>Zn				9.82
North-Eastern states (Mean leaf yield: 10.27±0.25 mt ha^{-1} year^{-1})				
Zn>Fe>Cu>Mn/ Zn>Cu>Mn>Fe/ Zn>Cu>Fe> Mn/ Zn>Mn>Cu>Fe/ Zn>Fe>Mn>Cu/ Zn>Mn> Fe>Cu		7.44*		
Cu>Fe>Mn>Zn/Cu>Fe>Zn>Mn/Cu>Zn>Mn>Fe	8.63*			
Mn>Fe>Zn>Cu/ Mn>Cu>Zn>Fe/ Mn>Zn>Cu>Fe				11.99
Fe>Zn>Mn>Cu/ Fe>Mn>Zn>Cu/ Fe>Mn>Cu>Zn/ Fe>Cu>Mn>Zn/ Fe>Cu>Zn>Mn/ Fe>Zn>Cu>Mn			11.98	

Location wise optimum requirement of micronutrients:

Location wise relatively inadequate (limiting) micronutrient has been considered for this analysis to work out its optimum requirement for mulberry. Optimum foliar concentration with DRIS was established by determining the foliar micronutrient content that produces the null DRIS index. The optimum requirement of the limiting micronutrient in different locations was computed from the relationship (Table 40).

Table 40. Optimum requirement of the location-wise limiting micronutrient in terms of foliar content.

Location	Limiting micro-nutrient	Regression equation	R^2	Optimum require-ment (mg kg^{-1})
West Bengal Plains	Zn	y = 23.159 Ln(x) – 65.009	0.446**	16.56
West Bengal Hills	Mn	y = 21.628 Ln(x) – 80.174	0.722**	40.73
Odisha and Jharkhand	Zn	y = 34.739 Ln(x) – 87.833	0.554**	12.53
North Eastern states	Zn Cu	y = 1.054x – 20.047 y = 8.274x – 41.436	0.479** 0.458**	19.02 5.01

Optimum foliar requirement of limiting micronutrients were varied with difference of locations. Zn being the most limiting micronutrient registered different optimum requirement for mulberry vegetation of North-Eastern states (19.02 mg kg^{-1}), West Bengal plains (16.5 mg kg^{-1}) as well as Odisha and Jharkhand (12.5 mg kg^{-1}). Cu was another limiting micronutrient under mulberry vegetation of North-Eastern states and its optimum requirement was determined as 5.01 mg kg^{-1}. On the other hand, Mn was limiting micronutrient for mulberry in the hilly region of West Bengal and it registers its optimum requirement as 40.7 mg kg^{-1}.

Critical level of limiting micronutrient availability in soils of different locations was ascertained for desired growth of mulberry on relationship between DRIS indices of the foliar micronutrient and its availability in soil. (Table 41)

Table 41. Regression analysis relating DRIS indices of foliar micronutrient (y) with its availability in soil (x).

Location	Limiting micro-nutrient	Regression equation	R^2	Critical value (mg kg^{-1})
West Bengal Plains	Zn	y = 15.895x – 11.601	0.661**	0.73
West Bengal Hills	Mn	y = 13.192 Ln(x) – 13.066	0.527**	2.69
Odisha and Jharkhand	Zn	y = 32.689 Ln(x) – 23.806	0.807**	0.48
North Eastern states	Zn Cu	y = 15.060 Ln(x) – 12.319 y = 21.086x – 9.587	0.415** 0.717**	0.44 0.45

The critical value of soil available Zn was 0.73 mg kg^{-1} in West Bengal plains followed by 0.48 mg kg^{-1} in Odisha, Jharkhand and 0.44 mg kg^{-1} in North-Eastern states. The critical value of soil available Cu was 0.45 mg kg^{-1} in North-Eastern states and Mn was 2.69 mg kg^{-1} in West Bengal hills.

Recommendations:

Based on the information generated on optimum foliar requirement of micronutrient for mulberry in different locations of Eastern and North-Eastern India, spray-response for correcting nutritional imbalance under the principles of DRIS, spray schedule of required micronutrient for mulberry was derived (Table 42).

Table 42. Spray schedule of required micronutrient for mulberry.

Location	Micronutrient diagnosed critical	Optimum foliar requirement (mg kg^{-1})	Spray concentration recommended for critical micronutrient based on soil deficiency	Criteria for soil deficiency (mg kg^{-1})
West Bengal Plains	Zn	16.56	0.22% Zn, twice in each crop	< 0.73
West Bengal Hills	Mn	40.73	0.10% Mn, twice in each crop	< 2.69
Odisha and Jharkhand	Zn	12.53	0.17% Zn, twice in each crop	< 0.48
North Eastern states	Zn	19.02	0.25% Zn, twice in each crop	< 0.44
	Cu	5.01	0.11% Cu, twice in each crop	< 0.45

3. D.2.3. MULBERRY PHYSIOLOGY SECTION

3.D.2.3.1.BPP(VP)008: Field evaluation of plant growth regulator combination for improvement of quality leaf yield of mulberry especially under cold stress condition. (Dec., 2011 to Nov., 2013)

P. K. Tewary **(PI)** and A. K. Misra (up to Sept., 2013) and Inchages, DoT(Seri.) Khosbag, Kumarpur, Kotasur, Sadullapur and Ranaghat, Akhrighata & NSSO, W.B., Karnasubarna & Dhubulia

Objective: To confirm the effect of Benzyl adenine + KCl combination in respect to increase leaf yield of mulberry.

Methodology: Existing mulberry plantation of S-1635 variety was selected at DoT(Seri.) and NSSO farms viz. Mulberry Graft Nursery Farm, Kumarpur, Mulberry

Farm, Khoshbag and Akherighata (Murshidabad) and Sadullapur (Malda), Sericulture Composite Unit, Kotasur (Birbhum), Sericulture Nursery Farm, Ranaghat (Nadia), Basic Seed Farm, NSSO, Karnasubarna (Murshidabad) and Dhubulia (Nadia). First foliar spray of PGR combination was done on mulberry after 15-20 days of pruning and subsequently, 2nd foliar spray was done after 15-20 days of 1st spray keeping no spray as control during 1st year (Dec, 11-Nov., 12) of the prog. and further water spray as control during 2nd year (Dec., 12-Nov., 13). After 25-30 days of 2nd spay, leaf yield data was recorded during February and November crop seasons. Cultural operation and irrigation were given as and when required.

Pooled leaf yield data of S-1635 mulberry variety of Feb. and Nov., 2012 crop exhibited an increase of 25.9% at DoT(Seri.) farm, Khosbag; 27.8% increase at DoT(Seri.) farm, Kumarpur; 27.7% increase at DoT(Seri.) farm, Kotasur; 36.7% increase at DoT(Seri.) farm, Sadallapur and 32.4% increase at DoT(Seri.) farm, Ranaghat over the control (Table 43). The pooled data of 2 winter crops registered an overall increase of 29.2% in leaf yield through foliar application of PGR combination which was found to be significantly higher over the control irrespective of locations.

Similarly, pooled leaf yield data of S-1635 mulberry variety of February and November (2013) crop exhibited an increase of 24.1 % at DoT(S) farm, Khosbag; 24.0 % increase at DoT(S) farm, Kumarpur; 31.7 % increase at DoT(S) farm, Kotasur; 27.3 % increase at DoT(S) farm, Sadallapur; 26.9 % increase at DoT(S) farm, Akherighata; 34.6% increase at NSSO farm, Karnasubarna and 33.2 % increase at NSSO farm, Dhubulia over the control (Table 44). The pooled data of 2 winter crops registered an overall increase of 28.6 % in leaf yield through foliar application of PGR combination which was found to be significantly higher over the control irrespective of locations.

Table 43. Leaf yield of S-1635 mulberry variety (pool of Feb. and Nov., 2012 crops at DoT(Seri), WB., farms).

DoT(S) Farms	Leaf yield (kg/ha)		% increase over control
	Control	Treatment	
Koshbag (Mursidabad)	5272	6638	25.9
Kumarpur (Mursidabad)	5033	6434	27.8
Kotasur (Birbhum)	4345	5551	27.7
Sadullapur (Malda)	3388	4634	36.7
Ranaghat (Nadia)	1505	1993	32.4
Mean	3909	5050	29.2
CD at 5 %	281		

Table 44. Leaf yield of S-1635 mulberry variety (pool of February and November crops, 2013 at DoT(S) &NSSO, WB., farms).

DoT(Seri) & NSSO Farms	Leaf yield (kg/ha)		% increase over control
	Control	Treatment	
Koshbag (Mursidabad)	3957	4914	24.1
Kumarpur (Mursidabad)	5565	6905	24.0
Kotasur (Birbhum)	4485	5910	31.7
Sadullapur (Malda)	3249	4136	27.3
Akherighata (Murshidabad)	3728	4734	26.9
Karnasubarna (Murshidabad)	3459	4657	34.6
Dhubulia (Nadia)	3987	5312	33.2
Mean	4061	5224	28.6
CD at 5 %	222		

Plant growth regulator (5mg/litre Benzyl adenine in combination with 5 mg/litre potassium chloride) combination exhibited leaf yield gain of 29.2 % (in 1st year with no spray as control) and 28.6% (in 2nd year with water spray as control) over the control irrespective of locations, where the Benefit- Cost ratio calculated 4.3:1 (Table 45).

Table 45. Economics.

Treat-ment	Leaf yld. (mt/ha/ crop)	Addl. leaf yld.(mt/ha / crop)	Expndt. (Rs.)/ha /crop	Income by selling leaves(Rs.)	Net profit by selling addl. leaves (Rs.)	B:C
Control	3.9	-	-	-	-	-
Treatment	5.1	1.2	698	3000	2302	4.3:1
Cost of chemical/ha: Rs.438; Cost of labour/ha: Rs.260 (2 labour);Cost of leaf: Rs. 2500/mt						

Recommendations: The Plant growth regulator combination (5 mg/ litre Benzyl adenine in combination with 5 mg/ litre Potassium chloride) can be recommended as foliar spray in mulberry field especially during winter season to increase leaf productivity.

3. D.2.4. BIOTECHNOLOGY SECTION

3.D.2.4.1.PIG-3441: Development, validation and utilization of SCAR marker(s) for powdery mildew (*Phyllactinia corylea*) resistance in mulberry. (Nov., 2009 to Feb., 2014). (Sanction No. BT/PR11675/PBD/19/196/2008 dated 26.08.2009)

A. K. Bajpai **(PI)** (upto 24.09.2010) B. B. Bindroo **(PI)** (from 13.09.2011 to 22.03.2013) and S. Nirmal Kumar **(PI)** (since

23.03.2013), R. Banerjee, S. Chattopadhyay and S. Sarkar (11.01.2011 to 31.08.2013)

Objectives: To develop SCAR marker(s) linked to resistance response to powdery mildew. To validate of the developed SCAR marker(s) for their stability/inheritance using powdery mildew specific mapping progenies. To test the validated SCAR marker(s) for their potential utility as efficient selection markers in MAS approach based disease resistance breeding.

At the Institute: To develop powdery mildew specific segregating progeny. To develop advance breeding lines by transfer of resistant trait to commercial cultivar for MAS based breeding approach. To evaluate both segregating population and advance breeding lines for powdery mildew resistance and associated features for SCAR validation and utilization potential assessment.

Establishment of powdery mildew (PM) specific mapping populations:

Controlled crossing was undertaken in three phases (2008-10), utilizing 2 useful resistant sources (Vietnam-2 and Thailand lobed) and 3 susceptible lines (Kolitha-9, Philippines and Xuan-9) and obtained around 4000 pseudo-F_2 seeds. Preliminary disease scoring data showed segregation of all six progenies with varied degrees (Table 46). As the segregation of Vietnam-2 derived descendants were significantly higher than the Thailand lobed derived descendants, randomly selected around 260 progenies of former lines were transplanted in field in two phases under ARBD along with parents and spreader.

Table 46. Powdery mildew disease assessment at seedling nursery under natural infection.

Cross	Progeny no	DSI		
		Range	Mean	Variation (fold)
Kolitha-9 x Vietnam-2	182	10.5 - 42.1	25.40	4.0
Philippines x Vietnam-2	305	9.7 - 43.6	28.40	4.4
Xuan-9 x Vietnam-2	567	12.3 - 56.0	29.10	4.6
Kolitha-9 x Thailand lobed	234	5.4 - 19.7	9.30	3.6
Philippines x Thailand lobed	265	6.8 - 24.0	12.00	3.5
Xuan-9 x Thailand lobed	340	5.8 - 22.5	11.00	3.9
S-1 x Vietnam-2	352	5.0 - 18.2	10.00	3.6

Data are mean of three observations of 30 days old seedlings.

Crossing of promising cultivar with PM resistance donor to develop advance breeding progeny for possible MAS based breeding/advancement:

Attempt had been made to transfer PM resistant trait of Vietnam-2 to commercial widely grown cultivar S-1 (susceptible to PM) for possible MAS based advancement use and/or assessing the direct utilization potential of PM resistance variety in field. Around 400 seeds were sown to nursery seedlings in early 2011. Subsequently, 120 randomly selected seedlings were transplanted in the field following ARBD to establish the progeny population.

Evaluation of segregating population for PM resistance and associated parameters after establishment under ARBD design in natural epiphytotics:

Altogether seven rounds disease scoring was conducted with the onset of natural incidence of PM coincided with the commercial silkworm rearing seasons of Oct. –Nov. and Jan. – Feb. during 2011 to 2014. Disease reaction to the progenies was scored using Horsefall-Barratt (1 to 10 points) scale and expressed as disease severity index (DSI) and accumulative area under disease progression curve (AUDPC). In the established plantation, the average disease response variation of DSI ranged from 2.4 to 39.1 (Table 47). The contrast of disease reaction was significantly higher in the Philippines derived lines (~16fold) than other two lines. However, PM responsiveness was predominated by susceptible reactions. The percent of resistant (resistant + moderately resistant) responsive progenies were almost identical with the range of 14.3% to 19.3 % of their respective total populations.

Table 47. Powdery mildew assessment of segregating progenies sources after natural infection with *Phyllactinia corylea* in field environment at Berhampore.

Cross	Class	DSI			%	
		Range	Mean	Progeny (No.)	R group	S group
Kolitha-9 x Vietnam-2	R	5.0 - 5.6	5.3	2	19.1	80.1
	MR	6.6 - 10.4	8.7	7		
	MS	12.1 - 23.4	19.0	25		
	S	25.2 - 31.7	27.9	13		
Variation (fold)		6.2				
Philippines x Vietnam-2	R	2.4 - 4.9	3.9	3	19.3	80.7
	MR	6.2 - 11.1	8.8	13		
	MS	13.3 - 24.9	19.9	39		
	S	25.0 - 39.1	28.9	28		
Variation (fold)		16.2				
Xuan-9 x Vietnam-2	R	4.3 - 6.1	5.2	2	14.3	85.7
	MR	7.5 - 11.8	9.3	13		
	MS	12.2 - 24.6	19.2	64		
	S	25.1 - 29.1	27.9	26		
Variation (fold)		6.8				

R group = resistant and moderately resistant and S group = susceptible and moderately susceptible progenies

It is noteworthy to mention that variation / responsiveness of nursery raised seedlings and 'adult plants' in established garden to PM varied significantly.

Moreover, pooled PM disease responsiveness (after seven rounds of evaluations) of all three pseudo-test cross descendants showed that segregation was transgressive towards susceptibility with continuous distribution skewed to susceptibility at varied degrees in for DSI (Fig. 16) and AUDPC (Fig.17). The segregation genetics (based on X^2 –analysis) indicated that at least three independent genes segregated for PM resistance in mulberry. Overall results suggest quantitative nature of PM resistance in mulberry dominated by recessive alleles with possible involvement of multiple QTLs of additive gene action.

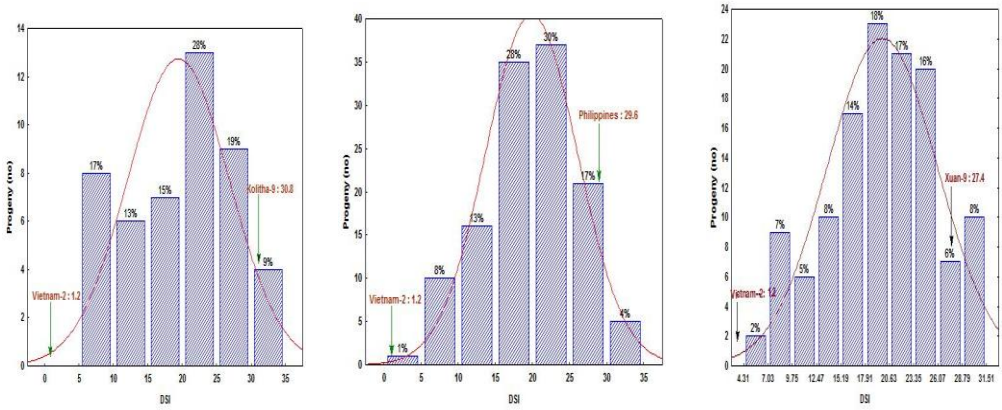


Fig. 16. Disease severity index (DSI) based frequency distribution of F_1 progenies derived from crosses of Kolitha-9 x Vietnam-2, Philippines X Vietnam-2 and Xuan-9 X Vietnam-2 under natural epiphytotics.

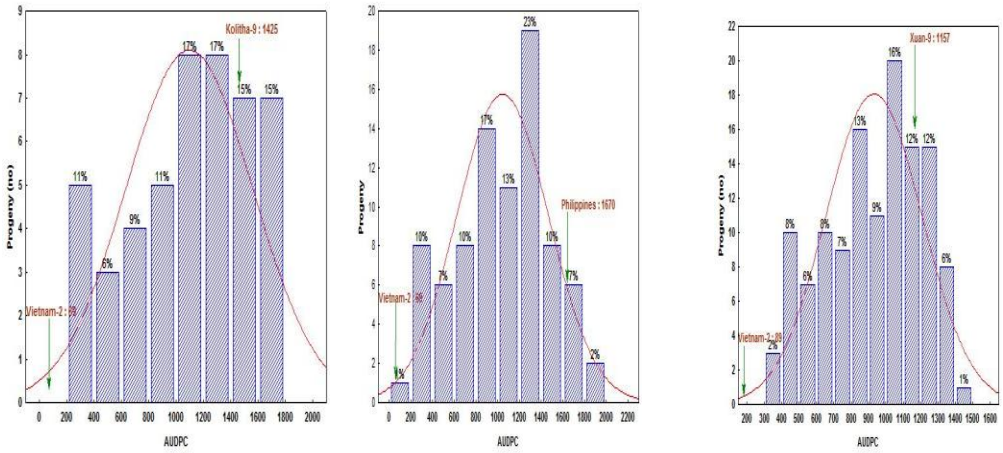


Fig. 17. Accumulative area under disease progress curved (AUDPC) based frequency distribution of F_1 progenies derived from crosses of Kolitha-9 x Vietnam-2, Philippines X Vietnam-2 and Xuan-9 X Vietnam-2 under natural epiphytotics.

Six estimated traits like, stomata frequency, trichome density, total soluble sugar, polyphenol, total chlorophyll and relative water content indicated significant

variability in all three PM responsive progenies; while, strong negative association of DSI was found with trichome density (r^2 = - 0.72) and stomata frequency (r^2 = - 0.67). While, polyphenols had a strong positive association (r^2 = 0.66) with DSI values (data not shown). It suggests that these three traits may be useful as additional indices for stable detection of PM resistance in mulberry.

Evaluation of segregating population for PM resistance under artificial inoculums (as per DBT Task Force recommendation):

A highly positive correlation (R^2 = 0.83) between the DSI values for natural and artificial infections (Fig.18) indicates the durability of the assessed progeny under natural inoculum. The DSI rating of all resistant and susceptible accessions was consistent and within the limit of 95% confidence for field and greenhouse trials with the exception of susceptible and 2 resistant progenies (Fig. 19).

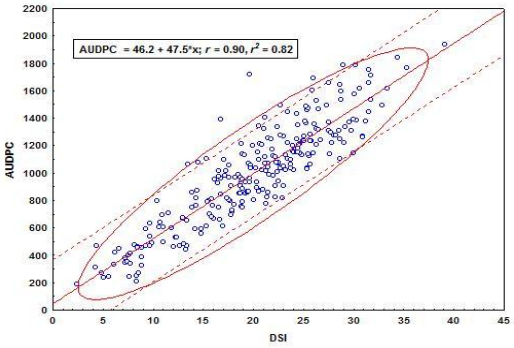


Fig. 18. Relationship between the mean powdery mildew disease severity index (DSI) of natural and artificial inoculum based experiments. The bold line is the line of best fit; the dotted lines are the 95% predicted intervals.

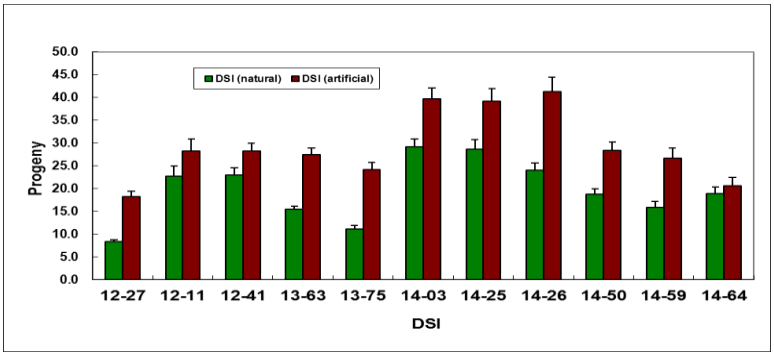


Fig.19. Disease severity index values of eleven differential responsive progenies under natural and artificial inoculum based experiments.

Evaluation of advance breeding lines for PM resistance with foliage yield under natural inoculums:

Eight progenies showed resistant response to PM and three of them exhibited useful PM resistance with ≥ 20% better leaf yield over S-1 in minor scale evaluation (5 plants progeny^{-1}; Table 48). Besides, two other progenies, though having slightly moderate disease reactions in HB scale but showed significantly higher foliage biomass yielding potential (~ 22 -26%) than S-1.

Table 48. Disease severity and leaf biomass yield potential of some promising advance breeding lines derived from the cross of S-1 x Vietnam-2.

Progeny/ parent	Disease reaction			Leaf biomass	
	DSI	Grade	< S-1 (%)	gm plant^{-1}	> S-1 (%)
15-10	4.9	R	82.2	267.3	20.2
15-28	5.4	R	80.4	278.4	23.3
15-12	5.8	MR	79.0	152.7	
15-40	6.5	MR	76.4	284.5	25.0
15-08	6.6	MR	76.1	172.6	
15-22	7.5	MR	72.8	188.4	
15-27	19.3	MS	30.1	310.7	31.3
S-1	27.6	S	100	213.4	
Vietnam-2	0.94	R		155.7	

Data are mean of three separate observations (n = 9)

At CCMB, A total of 24 RAPD fragments identified to be putatively associated with the resistance or susceptible response were cloned into pTZ57T/R (INSTA clone kit) plasmid vector. PCR conditions were standardized and the best working primer pairs were further validated. The validation was firstly on the reference panel (comprising the 29 genotypes) used originally to identify the RAPD fragment, and then tested on the 143 genotypes used in earlier project. In ~5 cases, the putative SCAR primers showed a highly positive association with the disease response (resistance phenotype in one case, and susceptible response in 4 cases). As per the recommendation of the Task Force, ~ 80 mulberry specific microsatellite markers (developed in-house at CCMB) were also tested on the segregating progenies for finding any new putative linked marker(s). One marker is revealed to be a good candidate for use as molecular tag for PM resistance. Some of the putative SCAR markers, and a few mulberry microsatellite markers were used to test the potential for foreground selection, which is an important step in MAS. One SCAR marker was found positive in most of the resistant progenies, especially, all the putative transgressive segregating HY progenies were positive for the marker.

Salient outcome and future course of action:

1. Development/establishment of an important genetic resource of mulberry in the form of three test mapping populations that can be useful for dissecting out the genetics/inheritance of the PM resistance. Desirable combinations of qualitative and quantitative resistance (high r^2 for DSI and AUDPC) with durability (high r^2 for natural and artificial inoculums) are available in the population. Overall results suggest quantitative nature of PM resistance dominated by recessive alleles with possible involvement of multiple QTLs of additive gene action.

2. Development of advance breeding lines by crossing a promising, widely grown but PM susceptible variety S-1 with resistant donor Vietnam-2. Identification of a few transgressive progenies from S-1 x Vietnam cross having better yield potential then S-1 and resistance of Vietnam.

3. Development of a few partially validated SCAR and two SSR markers for possible use as molecular tags for PM reaction of mulberry plants. Interestingly, all identified lines with better yield and PM resistance over S-1 were positive for the developed SCAR markers.

4. As PM responsive traits turned out to be quantitatively dominated by recessive alleles, trait refinement of 2-3 promising F-1 segregants by sib-mating and /or backcross breeding of resistant x susceptible lines/parents of resistant x susceptible lines essential to confirm the segregating genetics and foolproof validation of identified SCARs /SSR markers (>80%).

5. Promising lines identified from the advance breeding population (~ 2-3 progenies with better yield potential and PM resistant than S-1) need further on-farm thorough evaluation for field utilization.

3.D.2.4.2. Development of DNA marker based genetic linkage map of mulberry and QTL analysis for agronomically important *planta* traits. (Mar., 2011 to Sept., 2014). (Sanction No. BT/ PR11872/ PBD/ 19/200/2009 dated 16.03.2011)

R. Banerjee (**PI**), S. Chattopadhyay and D. Biswas (up to 31-11-2013)

Objectives: To develop mulberry specific SSR markers for genetic studies. Extensive phenotyping of the mapping population derived from 'Mysore local x V-1' for agronomically important *planta* traits and major foliar diseases. Construction of reasonably dense molecular linkage map and identification of major QTLs for important phenotypic traits. Development of third generation population utilizing promising progeny lines.

At the Institute: Extensive phenotyping of the mapping population for various agronomical traits and responses of important foliar diseases.

Identification/crossing of some promising progeny plants for possible trait refinement and/or mapping validation.

I. Establishment and thorough phenotyping of the mapping progenies:

The mapping progeny (150) derived from cross between Mysore local and V-1 were established in the Institute Farm in ARBD design with 6 clones per lines distributed in five blocks. Total of 25 agronomically important planta traits were measured so far. The quantitative traits were assessed altogether 10 rounds; while qualitative (non-parametric) traits were evaluated three times following mulberry descriptor.

a) **Assessment of qualitative traits:** Evaluation of individual progeny clones for 13 qualitative (= non-parametric) traits indicated significant variability in most of the parameters. About 62% of the tested qualitative traits were followed a test cross configuration of 1:1, while traits like petiole scar shape, leaf color and leaf thickness showed segregation ratio of 3:1, 2:1 and 1:2:1, respectively. However, traits like phyllotaxy and leaf tip shape did not matched with any definitive segregation pattern.

b) **Assessment of quantitative traits:** Phenotypes of progeny lines and two parents were evaluated for 12 agronomic traits during over 2011 to 2013 covering 4 seasons per year. All the traits indicated significant variation (except water retention capacity) between lines ($p<0.0001$). Moreover, each trait indicated significant ($p<0.05$) genotype x season interactions (Table 49). The phenotypic values of the 2 parents were consistent in all seasons for all the traits.

Besides, correlation of all the 11 measured traits was estimated based on mean trait values over 4 seasons (Table 50). Leaf biomass was significantly correlated with all the traits with varying magnitude. Correlation of the leaf biomass was maximum with above ground biomass (0.94), followed by shoot number (0.62), leaf length (0.52), shoot length (0.46) and leaf area (0.40). Nodal distance and leaf length should significant correlation with all the traits. Most importantly, in our minor scale evaluation (6-plants. progeny^{-1}.crop^{-1}), three progenies showed significantly higher foliage yield potential than V-1 (Fig.20).

Table 49. Performance of agronomical traits of parents and 150 mapping population derived from cross of Mysore local x V-1.

	Season*	Parents		Progeny lines			*P* value	
		ML	V-1	Mean	Range	EMS[b]	Lines	LxS[c]
Shoot length (cm)	April	99.0	110.4	102.2	70.5-282.0	47.0	<0.0001	<0.0001
	June	108.7	199.6	121.2	83.3-151.2	37.9	<0.0001	
	September	88.2	108.1	95.6	46.0-138.3	59.9	<0.0001	
	November	147.7	173.1	131.8	83.4-165.1	70.8	<0.0001	
Nodal distance (cm)	April	2.9	3.6	3.5	2.1-4.8	0.07	<0.0001	<0.0001
	June	2.8	3.3	3.3	2.4-4.6	0.08	<0.0001	
	September	2.5	2.8	2.5	1.5-3.5	0.07	<0.0001	
	November	2.6	2.9	3.1	2.0-4.6	0.04	<0.0001	
Petiole length (cm)	April	2.2	3.2	2.7	1.9-4.0	0.06	<0.0001	<0.0001
	June	2.5	3.0	2.9	1.9-4.6	0.06	<0.0001	
	September	2.1	2.8	2.3	1.2-4.6	0.08	<0.0001	
	November	2.9	3.8	3.1	2.0-4.8	0.03	<0.0001	
Petiole width (cm)	April	0.23	0.25	0.29	0.16-0.41	0.001	<0.0001	<0.0001
	June	0.20	0.25	0.23	0.15-0.37	0.001	<0.0001	
	September	0.17	0.24	0.21	0.11-0.40	0.001	<0.0001	
	November	0.17	0.26	0.24	0.10-0.36	0.0002	<0.0001	
Leaf length (cm)	April	12.0	16.1	13.7	9.3-19.2	1.63	<0.0001	<0.0001
	June	13.1	15.2	13.9	9.7-19.9	1.06	<0.0001	
	September	11.2	15.2	12.6	8.4-18.7	1.18	<0.0001	
	November	13.8	16.8	13.9	10.1-18.4	0.44	<0.0001	
Leaf width (cm)	April	9.7	11.2	11.0	7.4-15.7	1.03	<0.0001	<0.0001
	June	10.0	11.0	10.6	6.8-17.1	0.98	<0.0001	
	September	9.4	11.2	10.2	6.8-16.1	0.85	<0.0001	
	November	12.9	13.8	11.0	7.5-14.2	0.22	<0.0001	
Shoot no	April	7.0	7.7	9.1	3.3-13.0	2.43	<0.0001	<0.0001
	June	7.2	9.6	8.4	4.3-13.8	1.92	<0.0001	
	September	7.0	8.3	7.6	4.5-11.7	0.83	<0.0001	
	November	9.8	11.8	8.8	5.6-15.9	3.39	<0.0001	
Leaf biomass(g)	April	325.5	459.1	383.5	192.3-755.3	1160.1	<0.0001	<0.0001
	June	291.9	460.5	375.4	177.0-774.5	1069.0	<0.0001	
	September	256.3	370.3	282.3	127.0-580.0	398.2	<0.0001	
	November	157.0	223.6	264.8	126.1-513.3	351.93	<0.0001	
Above ground biomass(g)	April	652.0	902.1	741.1	317.7-1178.7	10703.9	<0.0001	<0.0001
	June	589.1	795.3	698.5	247.8-1249.7	5156.6	<0.0001	
	September	333.9	401.1	428.4	196.2-839.7	911.4	<0.0001	
	November	372.0	432.5	390.1	205.2-686.2	912.58	<0.0001	

Table 50. Association of leaf biomass with other nine quantitative agronomical traits of 150 mapping population derived from the cross of Mysore local x V-1 mulberry varieties at CSR&TI, Berhampore.

Trait	ND	PL	PW	SN	LL	LW	AGB	MC	LA	LM
SL	0.47**	0.44**	0.30**	0.30**	0.37**	0.31**	0.47**	0.36**	0.25**	0.46**
ND		0.44**	0.39**	0.29**	0.39**	0.40**	0.33**	0.29**	0.27**	0.36**
PL			0.26**	0.03ns	0.64**	0.66**	0.29**	0.23**	0.33**	0.33**
PW				0.07ns	0.32**	0.28**	0.27**	0.34**	0.34**	0.33**
SN					0.28**	0.23**	0.70**	0.12ns	0.31**	0.62**
LL						0.82**	0.48**	0.25**	0.37**	0.53**
LW							0.38**	0.16*	0.34**	0.43*
AGB								0.25**	0.40**	0.94**
MRC									0.15ns	0.29**
LA										0.40**

SL=shoot length; ND=nodal distance; PL=petiole length; PW=petiole width; SN=shoot number; LL=leaf length; LW=leaf width; AGB=above ground biomass. MC= moisture content; LA=leaf area; LM=leaf biomass

**and ^{ns} are significant at 0.05 , 0.01% probability levels and non-significant, respectively.

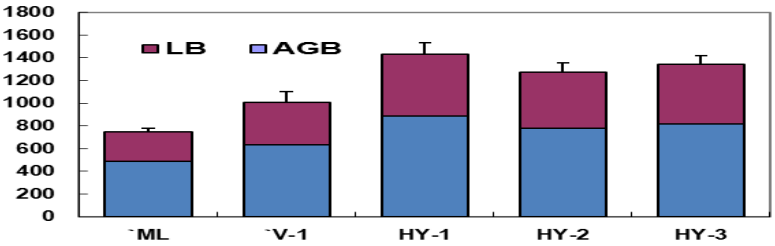


Fig. 20. Leaf biomass (LB) and above ground biomass potential (AGB) of of parent and three superior progenies of the mapping population [data are mean 10 seasonal values, n = 50]

c) **Assessment of leaf micro-morphological traits:** Significant variability for stomata density, stomata area and trichome density was observed across the population (Table 53). Stomata density (no. mm^{-2}) ranges from 252.3 to 376.7, while stomata area varied from 255.4 to 597.2 μm^2 respectively. Similarly, mean trichome density (no. μm^2) was recorded as 0.33 and its variation was ranged from 0.21 to 0.65, exhibited ~2 fold decrease in the lowest entry.

d) **Assessment of biochemical traits:** Estimation of total chlorophyll, total soluble sugar and polyphenol exhibited significant variability in the population (Table 53). Chlorophyll content (mg.g^{-1}fresh wt) varied from 0.8 to 5.7 d/mg g^{-1}fresh leaf mass; while, total soluble sugar and polyphenol variations were ranged from 3.5 fold and 6 fold, respectively.

e) **Assessment of *in situ* leaf gas exchange traits:** Evaluation of mapping progeny for net photosynthetic rate, transpiration rate, photosynthetic water use efficiency and stomatal conductance were completed (Table 51). Net photosynthetic rate ranged from 1.56 to 21.7µmol m^{-2} s^{-1}.

Table 51. Statistical summary of anatomical, biochemical and physiological traits of 150 mapping progenies derived from cross between Mysore local x V-1.

Trait	Unit	Mean		Mapping population			
		ML	V-1	Min	Max	Mean	SEM±
Anatomical							
Stomata density	(no.mm^{-2})	245.4	240.1	133.4	376.7	252.3	4.47
Stomata area	(μm^2)	282.1	277.5	64.32	597.2	255.4	8.52
Trichome density	(no.μm^{-2})	0.33	0.32	0.21	0.65	0.39	0.004
Biochemical							
Chlrophyll-a	(mg.g^{-1}fresh wt)	1.31	1.63	0.64	4.24	1.4	0.03
Chlrophyll-b	(mg.g^{-1}fresh wt)	0.23	0.64	0.007	1.46	0.6	0.03
Total Chlrophyll	(mg.g^{-1}fresh wt)	1.45	2.01	0.76	5.69	2.1	0.05
Total soluble sugar	(mg.g^{-1}fresh wt)	5.4	7.1	3.4	11.95	4.6	0.22
Total phenol	(mg.g^{-1}fresh wt)	0.06	0.05	0.02	0.12	0.05	0.001
In situ gas exhange							
Net photosynthetic rate	(µmol m^{-2} s^{-1})	11.39	13.68	1.56	21.7	9.2	0.31
Transpiration rate	(mmol m^{-2} s^{-1})	0.024	0.025	0.01	0.03	0.02	0.0003
Physiological WUE	(ϕ_p)	0.05	0.06	0.01	0.09	0.04	0.001
Stomatal conductance	(mmol m^{-2} s^{-1})	1.23	1.53	0.21	2.03	0.79	0.03

Data are average of two seasonal values (n = 6)

II. Evaluation of mapping progenies for major foliage diseases:

Four rounds of three major foliar diseases i.e. *Myrothesium* leaf spot (MLS), *Xanthomonas* leaf spot (XLS) and powdery mildew (PM) were conducted under natural field condition. Significant variability was observed across the progeny for MLS (DSI range: 4.1-31.6) disease reaction. MLS segregation of susceptible to resistance fits well with 3:1 ratio suggesting monogenic pattern of inheritance of the resistant trait (Table 52).

Table 52. DSI values and segregation genetics of 150 mapping population to Myrothecium leaf spot.

	Disease Grade				
	Resistant	Moderately resistant	Moderately susceptible	Susceptible	
DSI	0-5	5-10	10-25	>25	
	2	19	128	3	
Phenotype		**Hypothesis**	**Observed ratio**	χ^2	***P***
Resistant : Susceptible		1:3	31:119	1.50	0.22

III. Crossing of identified promising progeny lines for specific trait refinement :

Identified promising progeny lines for better foliage biomass and resistant to MLS and XLS and subjected to two–phased (2012-2013 and 2013-2014) crossing programme through sib-mating/backcross breeding based on sexual compatibility. The developed pseudo F_3 trait specific progenies will be used for QTLs analysis and for MAS based utility breeding in mulberry.

CCMB has designed a total of 1484 primer pairs. Identified 127 polymorphic SSRs to parental lines; utilizing 105 of them, generated ~ 16000 mapping data points and the process with remaining 22 was under way to saturate the existing linkage map. The phenotypic data collected over multiple seasons/years at CSRTI, Berhampre was used, along with mapping data used to generate the framework linkage map of mulberry to identify/map the putative QTLs for different traits of interest. QTL analysis was attempted for seven agronomically important traits. QTLs for some of the traits were found to be overlapping/co-localized.

Salient outcome and future course of action:

1. Generation of the extensive phenotyping data (for >25 important in planta traits) of the mapping population (over multiple seasons) in CSRTI, Berhampore environment;
2. Phenotyping data provided new insights about the genetic basis/inheritance nature (momogenic vs. polygenic) of a number of traits.
3. Identified major QTLs for 7 important agronomic traits.
4. Leaf biomass exhibited significant positive associations with four traits like shoot number, leaf length, shoot length and leaf area. This information will be useful for co-mapping of QTLs and/or identification of best QTLs for simultaneous improvement of multiple traits through MAS.
5. Identified three progenies of high foliage biomass potential. Initiated full-sib mating/crossing of these progenies for further trait refinement, as well as, for possible QTL validation.
6. Identified 127 polymorphic SSRs to parental lines; utilizing 105 of them, generated ~ 16000 mapping data points and the process with remaining 22 was under way to saturate the existing linkage map.
7. The leads of the present study can be utilized in the following directions during the extension / next phase of the project:

   - ✓ On farm trial of identified promising lines for direct field utilization.
   - ✓ In planta charcterisation of foliage micro-morphological and root-morphological traits for validation of associated QTLs.
   - ✓ Crossing of identified promising lines for trait refinement/QTLs validation.
   - ✓ Fine-mapping of identified QTLs, and also analyzing epistatic interactions between different QTLs and traits, if feasible.

3.D.2.5. SILWORM BREEDING & GENETICS SECTION

3.D.2.5.1. BAI(P) 007: Establishment of molecular IDs of the silkworm breeds evolved by CSRTI, Berhampore. (July, 2011 to June, 2013)

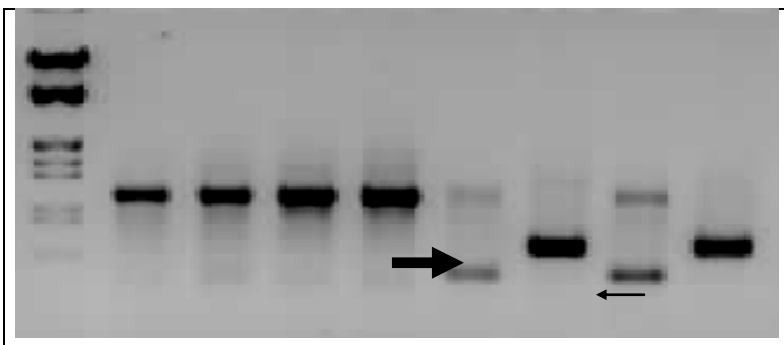
S. Sreekumar (**PI**), N. Suresh Kumar, A. K. Saha, B. B. Bindroo and S. Nirmal Kumar

Objectives: To establish molecular IDs of silkworm breeds developed at CSR&TI, Berhampore.

Genomic DNA from few silkworm breeds were extracted from the whole larval body of V instar larvae using the phenol-chloroform method, and/or using DNAzol reagent and purified. The purified DNA was diluted to a final concentration of 20 ng/µl. Single Nucleotide Polymorphic DNA primers pertaining to 28 linkage group (LG) supplied generously by the silkworm genome group, National Institute of Agrobiological Sciences, Tsukuba, Japan were used for amplifying template DNA of the silkworm breeds. SNP primer sequences, $MgCl_2$ concentration, annealing temperature and PCR cycle were standardized. The PCR products of the silkworm breeds were checked in a 1.5% agarose stained with ethidium bromide and photographed. Like wise, RAPD primers (Operon) were also be used for screening polymorphism among the selected breeds for the establishment of molecular IDs. A total of 240 EST SNP primers (forward and reverse) pertaining to the 28 linkage groups generously supplied by Insect Genome Research Group, National Institute of Agrobiological Sciences, Tsukuba, Japan, were used to amplify the DNA of parents and F-1 progeny. PCR reaction consisted of 20 ng of template DNA, 0.2 mM each of dATP, dCTP, dGTP, and dTTP (Fermentas Inc, Maryland, USA), 1 µM of SNP primer, and 0.45 U of *Taq* DNA polymerase (Fermentas Inc, Maryland, USA) in a 10 µl volume. 35 cycles of PCR were performed on a PTC 200 Thermocycler Enginee (Bio Rad Laboratories, CA, USA) as follows: 94°C for 2 min, followed by 35 cycles of 94°C for 30 sec, 60°C for 30 sec, 72°C for 1 min with a final extension of 72°C for 1 min. PCR products were analyzed by electrophoresis on 2% agarose gels and stained with ethidium bromide and visualized under UV light (Table 53; plate 1 and 2).

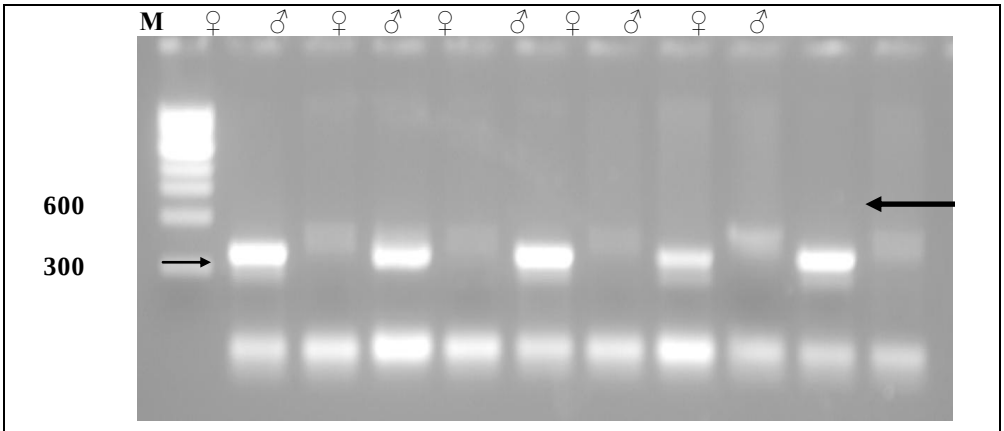
Table 53. Primer sequences and the Linkage Group pertaining to the Molecular IDs established.

Breeds	Nucleotide Sequence	Marker size	LG
SK6	**F: GGTTGCATAACTAAGCTGCG R: TTGGCGTGATTCTTAATACCG**	600 bp	4th LG
B.Con.1	**F: GGTTGCATAACTAAGCTGCG R: TTGGCGTGATTCTTAATACCG**	1000 bp (1 kb)	4th LG
Female W-specific markers in all breeds	**Two Decamer Primers were identified**	1.45 Kb 0.80 kb	1st Linkage Group
Z-specific markers in all breeds	**Z60 (Expression Sequence Tagged Single Nucleotide Polymorphic marker)**	700 bp	1st Linkage Group
Cathodic amylase specific DNA markers	**Forward – CCGAACGAAAACCTGGTGATT (21 nt) Reverse - ACGCAATCGCCGCCTTTATACT (22nt)**	2.60kb	8th LG
Sex-limited markers for larval markings	**OPA 08 (Random Amplified Polymorphic DNA marker)**	0.70 bp	Unknown. Possible pertaininig to 2nd LG
Sex-limited markers for yellow cocoon colour	OPA10 **(Random Amplified Polymorphic DNA marker)**		
Multi voltine & Bivoltine	**SNP0850**	0.50kb	8th LG



Thick Arrow indicate Bivoltine sex-limited (Yellow Cocoon colour) DNA bands.Thin Arrow indicate Bivoltine Normal (White cocoon colour) specific DNA bands.Lanes 1-4 are polyvoltine breeds.

Plate 1. DNA finger printing for Poly, Bivoltine (SL) and Bivoltine (Normal) silkworm breeds



An SNP primer Z60 and Rikishi together amplifies Z and W chromosome. Thick arrow (600bp) indicate W chromosome in all females, where as the thin arrow (300 bp) indicate Z chromosome present in both sex=

Plate 2. A Multiplex PCR for amplification of Z and W together

3.D.2.5.2.BAI (P) 008: Screening and identification of bivoltine breeds for Eastern and North Eastern India. (Aug., 2011 to Mar., 2014)

N. Suresh Kumar **(PI)**, A. K. Saha, S. Sreekumar, G. K. Chattopadhyay, H. Lakshmi and N. B. Kar

Objective: Screening and identification of bivoltine breeds for Eastern and North Eastern India.

Collection and screening of bivoltine breeds from different breeding centers were carried out. After screening based on overall performance, the breeds viz., ATR-16, ATR-29, Dun-6, Dun-21, Dun-22, KSO1, Gen3, D6PN, SK4C, BHR2, SK6, SK7, BHR3 were selected as breeding resource materials and foundation crosses (oval x oval) and (dumbbell x dumbbell) were made for further combinations. Further, all possible hybrid combinations (104) were made for further evaluations. Evaluation and short listing of hybrids are under progress to identify suitable bivoltine hybrids for Eastern and North Eastern India. Evaluating 35 hybrids utilizing the selected breeding resource materials, three hybrids namely, Gen3 x Dun22, Gen3 x D6(P)N and Gen3 x SK6 were identified as suitable for the highly fluctuating and varied climatic conditions of Eastern and North-Eastern India. The performace of F1 hybrids are given below (Tables 54 and 55).

Table 54. Comparative rearing performance of shortlisted hybrids.

Sl. No.	Hybrid	Fec.	Yield/ 10000 larvae (No.)	Yield/ 10000 larvae (wt; kg.)	Cocoon wt. (g)	Shell wt. (g)	Shell (%)	Cumula-tive EI
1	KPG-A X CHINESE(PN)	521	7325	11.12	1.454	0.254	17.47	48
	25°C	524	9458	14.56	1.465	0.302	20.61	45
2	MC4 (E) X DUN-22	568	7012	11.05	1.448	0.249	17.20	47
	25°C	557	9384	13.96	1.462	0.294	20.11	41
3	GEN-3 X DUN-22	578	7585	11.15	1.462	0.257	17.58	56
	25°C	595	9715	14.65	1.598	0.324	20.28	58
4	GEN-3 X D6(P)N	562	7954	10.58	1.438	0.275	19.12	55
	25°C	574	9687	14.15	1.635	0.345	21.10	58
5	GEN-3 X SK-6	524	7767	10.25	1.441	0.278	19.29	51
	25°C	568	9701	14.75	1.543	0.321	20.80	56
6	CSN X P-5	531	7318	10.85	1.438	0.246	17.11	43
	25°C	542	9564	14.21	1.502	0.288	19.17	41

Table 55. Comparative reeling performance of short listed hybrids.

Sl. No.	Hybrid	Filament Length (m)	Raw silk %	Reelability (%)	Neatness (p)	Cumula-tive EI
1	KPG-A X CHINESE(PN)	751	13.1	74.5	73	40
	25°C	762	15.1	80.5	85	42
2	MC4(E) XDUN-22	728	13.4	74.1	74	40
	25°C	768	15.4	77.1	84	40
3	GEN-3 XDUN-22	828	14.8	80	82	58
	25°C	908	16.8	83.8	92	61
4	GEN-3 XD6 (P) N	819	14.7	80.8	84	59
	25°C	919	16.7	84.4	90	60
5	GEN-3 XSK-6	835	15.1	81.2	85	62
	25°C	875	16.1	85.7	90	58
6	CSN XP-5	732	13.4	73.9	75	41
	25°C	787	14.4	77.9	85	39

3.D.2.6. ENTOMOLOGY SECTION

3.D.2.6.1. ARE 3464: Biology and feeding efficacy studies of *Scymnus pallidicolli* (Mulsant) for the eco-friendly management of pink mealy bug, *Maconellicoccus hirsutus* (Green) (Oct., 2011 to Sept., 2013)

M. Patnaik **(PI)** (Upto 27.05.2013), M. V. Santha Kumar and A. K. Saha

Objectives: To study the life cycle, longevity and fecundity of the native predator on pink mealy bug, *Maconellicoccus hirsutus* (Green). To find out the feeding efficacy of the predator on the life stages of mealy bug.

E01: Studies on the biology of *Scymnus pallidicolli* (Mulsant) : *S. pallidicolli* was reported as the native predator of mealy bug for the first time by this institute. The life cycle of the predator was completed in 23 days. The life cycle consists of four distinct stages viz., egg, grub, pupa and adult (Plate 3).

Egg: Eggs were elliptical, laid single beneath the egg masses of *M. hirsutus* were bright yellow in colour. Egg measured 0.04 mm and 0.02 mm in length and breadth respectively. Incubation period ranged for 4-5 days.

Grub: The newly hatched grubs were light yellow colour. They develop white waxy strands within 2-3 hours after hatching. Duration of first and second instar grubs ranged for 2-3 days measured 0.5 & 0.8 mm length and 0.1 mm and 0.4 mm breadth. The third and fourth instar grubs lasted for 3-4 days and measured about 1.7 and 3.3 mm in length and 0.8 and 1.3 mm in breadth respectively.

Pupa: Pre-pupa was slow moving and non-feeding stage and covered with waxy strands. Pre-pupal stage lasted for 1day. Pre-pupa measured 2.8 mm in length and 1.5 in breadth. Pupa is oval, yellow in colour covered with white waxy strands and lasted for 6-7 days. Pupa measured 2.4 mm in length and 1.7 mm in breadth.

Adult: Adults are black in colour. Females measure 3.4 mm x 2.4 mm and males measure 2.9 mm x 1.9 mm.

Mating studies: The pre-mating period was 4 days. The 1st mating occurred on 5th /6th day after emergence. The coitus lasted for 5-6 minutes. The mating and post-mating periods were 30.9 and 21.6 days respectively.

Oviposition studies: Oviposition behaviour revealed that the pre-oviposition, oviposition and post oviposition periods were 10.4, 32.3 and 14.4 days. The fecundity was 28.

E02: Studies on the feeding efficacy of predatory grubs on eggs and nymphs of *M. hirsutus*.

Feeding efficacy of grub:
Studies on feeding efficacy revealed that a grub consumed 1379 eggs or 61 nymphs or 13 adults of mealy bug. (Fig.13)

Feeding efficacy of adult:

A male predator consumed 1612.4 eggs or 211 nymphs or 32 adults and a female predator consumed 1672.4 eggs or 231 nymphs or 42 adults of mealy bug during its life period respectively. (Fig.21)

The predator being possessing potential attributes such as, shorter life cycle than the pest, longer mating and ovipositional periods and very good feeding potential on all the life stages of the pest, it can be successfully augmented and field tested for the eco-friendly management of mealy bug.

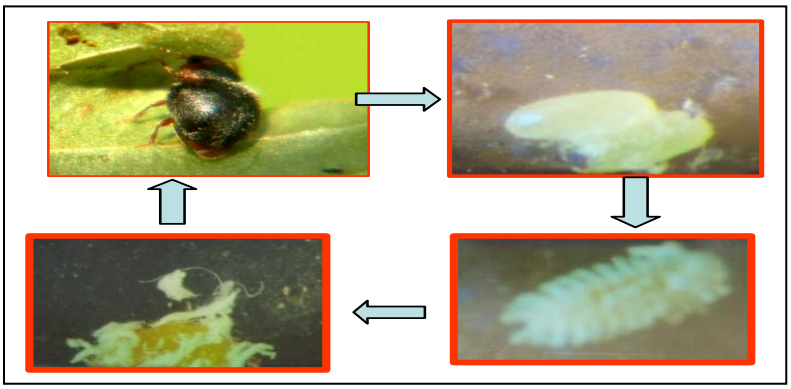


Plate 1. Life cycle of *Scymnus pallidicolli*.

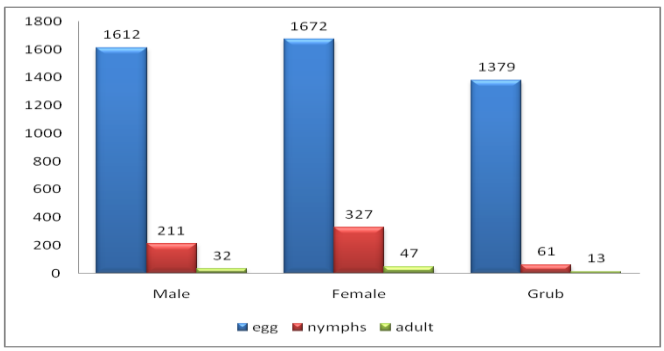


Fig .21. Feeding efficacy of *Scymnus pallidicolli*

3.D.2.6.2. BPR (VP) 006: Studies on the field efficacy of selected dose of insecticide in whitefly. (July 2011 to June, 2013)

M.V. Santha Kumar **(PI)**, M. Patnaik and A. K. Saha

Objective: To confirm the efficacy of selected dose of pesticide (0.015% thiamethoxam) in regulating the population of whitefly through validation of the findings emanated from the concluded project PRE 3394 conducted at DoT(Seri.) farms and farmers' fields.

The study was conducted at 3 DoT(Seri.) farms and 105 farmers' fields viz., DoT (Seri.) farm, Ramkrishnapur, Khikirbona, Maushimpur, Khanpara, Pyesbari and Bakharpore villages of Malda district, DoT (Seri.) farm, STC, Berhampore, Kharjoura, Ballaspore, Sayedpur villages of Murshidabad District and DoT (Seri.) farm, Karimpur, Kuchaidanga, Barbakpur, Harekrishnapur, Tokipur, Pipulkhola, Rahmatpur villages of Nadia District. Prior to the onset of each crop, when the foliage becomes 20-30 days old, pre-treatment population was recorded followed by application of thiamethoxam (0.015%) (Treatment), 0.1% dichlorvos (Control) in demarcated areas. Further in each farmer's plot, the remaining area was considered as unsprayed control for comparing the effect of treatment. The crop wise data for two years reveals that in **Malda** district, during Bhaduri (July-Aug.) (Fig.22) and Agrahayani (Sept.-Nov.) crops (Fig.23), at 5 villages (43 farmers), foliar application of thiamethoxam (0.015%) suppressed the whitefly population to an extent of 83% and 77% and thereby with a leaf yield gain of 18% and 20% respectively. In **Nadia** district, during Aswina (Aug.-Sept.) (Fig.24) and Agrahayani (Oct.-Nov.) (Fig.25) crops, at DoT (Seri.) farm, Ranaghat and by 20 farmers' at 7 villages showed that application of thiamethoxam (0.015%) suppressed the whitefly population by 73% and 86% with a leaf yield gain of 15% and 24% respectively. In **Murshidabad** district, during Aswina (Aug. to Sept.) (Fig.26) and Agrahayani (Oct. to Nov.). (Fig.27) crops, at DoT (Seri.) farm, Berhampore by 42 farmers at 4 villages revealed that application of thiamethoxam (0.015%) suppressed the whitefly population upto 69% and 87% and the leaf yield gain was 23% and 21%.

Fig. 22. Effect of thiamethoxam on Whitefly population (no/ leaf) in Malda (July - Aug.)

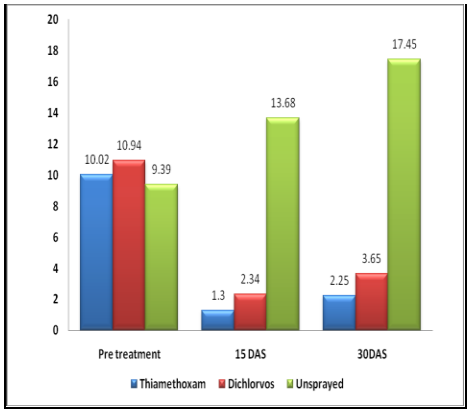


Fig. 23. Effect of thiamethoxam on Whitefly population (no/ leaf) in Malda (Sept.- Nov.)

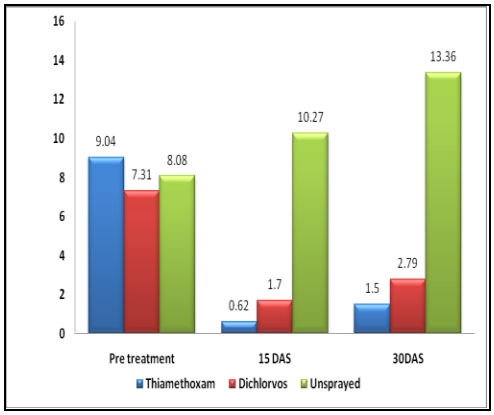


Fig. 24. Effect of thiamethoxam on Whitefly population (no/ leaf) in Murshidabad (Aug- Sept)

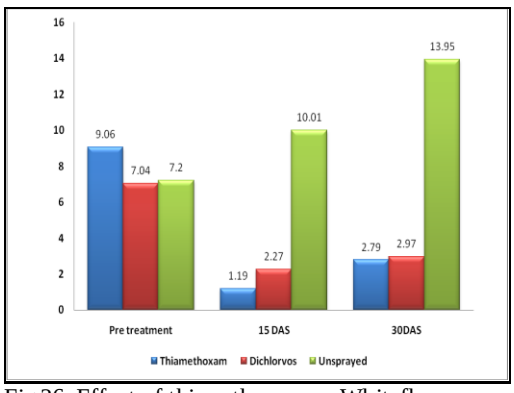


Fig. 25. Effect of thiamethoxam on Whitefly population (no/ leaf) in Murshidabad (Oct. – Nov.)

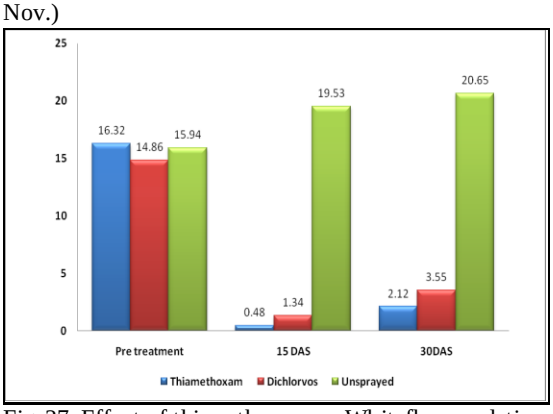


Fig.26. Effect of thiamethoxam on Whitefly population(no/ leaf) in Nadia (Aug- Sept)

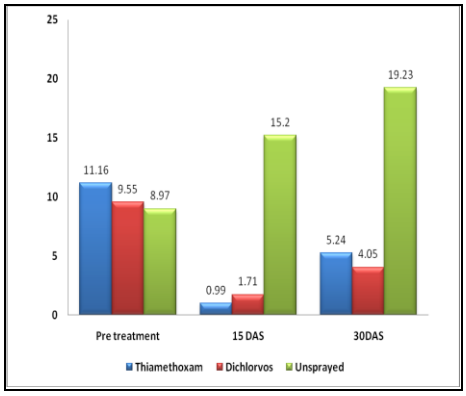
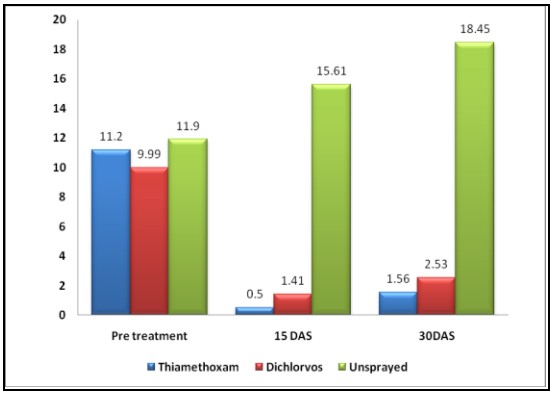


Fig. 27. Effect of thiamethoxam on Whitefly population in Nadia (Oct - Nov)



3.D.3. DISEASE AND PEST MANAGEMENT

3.D.3.1. SILWORM PATHOLOGY SECTION

3.D.3.1.1.BAR (PS) 002: Formulation of broad spectrum room disinfectant for silkworm disease management. (Aug., 2011 to July, 2013)

S. Chakrabarty **(PI)** and A. K. Saha

Objectives: To formulate a broad spectrum, cost effective, less hazardous and eco-friendly fumigant room disinfectant. Disease management in silkworm crops and increase cocoon productivity.

Methodology:

1. ***In vitro* and *in vivo* screening of disinfectant formulations against silkworm pathogens.**

1.1. **Selection of chemicals and formulation of disinfectants:** Three fumigant chemicals (1,3 Dibromo, 5, 5 Dimethyl Hydantoin; Para Dichlorobenzene and Dichlorobenzene) were for the study and their mixtures was taken in different concentrations for selection of new and effective fumigant disinfectant.

1.2. ***In vitro* and *in vivo* screening and testing of disinfectant formulations against silkworm pathogens and identification of most effective one:** Disinfectant formulations were prepared and tested for their efficacy against *Nosema bombycis*, *Staphylococcus vitulinus*, *Bacillus thuringiensis* etc., nuclear polyhedrosis virus (*Bm*NPV) and *Beauveria bassiana* causing common silkworm diseases. Disease causing agents were smeared on mulberry leaves and fed to the larvae of 3rd instar 1st day to test their viability. Healthy control batch larvae were maintained for comparison. Three replications each with 100 larvae was maintained. The experiments were conducted upto cocoon stage and individual larva was examined for study the disease incidence. For *in vitro* study the experiment was conducted in desiccators. The formulations were kept in desiccators for 6 hours and later on inoculated with mulberry leaves, *N. bombycis* were fed to larvae of 3rd instar 1st day continued upto cocoon stage with the control set.

1.3. **Disinfection of the rearing house including rearing appliances using newly formulated disinfectant with existing disinfectants:** Rearing house and appliances were disinfected with the formulated room disinfectant, screened from previous experiments. Silkworm rearing was conducted with three replications each of 300 larvae alongwith, a control batch. A control set of disinfectants i.e. 5% Bleaching powder and Chlorine dioxide solution available in other products were kept for comparison.

1.4. **Assessment of crop performance and disease incidence with new formulations compared with existing disinfectants:** On the basis of rearing performance, reproductive fitness and reeling performance, Two fumigant

chemicals, 1, 3, Dibromo 5, 5, Dimethyl Hydantoin (DBDMH) and Paradichlorobenzene (*p*-DCB) were selected through *in vitro* and *in vivo* study. Twelve different room disinfectant formulations along with two fumigant chemicals were studied for *in vitro*, *in vivo* and *in room* condition and most effective formulation was identified. Statistical analysis (*Smith Index*) revealed that performance of newly formulated room disinfectant with fumigant chemicals was better compared to the room disinfectants e.g., 5% Bleaching powder solution, Sanitech and Serichlor 20. The formulated room disinfectant was cost - effective, less- hazardous and user friendly for disease management. Benefit cost ratio worked out as 4.7:1 and 11.8:1 over existing room disinfectants, 5 % Bleaching powder and Chlorine dioxide (Sanitech / Serichlor 20) respectively. The comparative study of room disinfectant showed similar trend, as such, performance of one crop has been shown in Table 56-59.

Table 56. Pooled data of silkworm (Nistari) rearing for *in vivo* screening of fumigant chemicals against silkworm disease causing agents during 2011-12 (D - Treatment with pDCB, E- Treatment with DB, F – Treatment with DBDMH; 1 - larvae challenged with *Nosema bombycis*, 2- larvae challenged with *Bm*NPV, 3- larvae challenged with Bacterial suspension contain *Staphylococcus vitulinus*, *Bacillus thuringiensis* etc. and 4- larvae challenged with *Beauveria bassiana* ; H1, H2 and H3 - Treatment with D, E and F chemicals in Dessicator and then challenged with *Nosema bombycis* ; CON - Control, Avg - Average of four healthy control for four pathogens; mean- arithmetic mean and sd- standard deviation, Surv% - Larval survival%, ERR- Effective rearing rate, SCW- Single Cocoon wt in g, SSW- Single Shell Weight in g, FL-Filament length in mtr., NBFL- Non breakable Filament Length in mtr.)

Treatment	V wt	Survi %	ERR	SCW	SSW	Shell %	Moth emergence%	FL	NBFL	Denier	Smith index
D1	2.971	83.833	81.000	1.443	0.216	15.650	89.200	566	566	2.61	2
D2	2.926	83.500	80.833	1.263	0.213	16.884	87.215	564	564	2.59	3
D3	2.861	81.500	79.000	1.282	0.209	16.317	91.608	531	531	2.51	11
D4	2.938	84.667	81.333	1.327	0.207	15.718	91.732	551	551	2.54	6
E1	2.945	85.333	85.333	1.205	0.204	16.937	87.760	510	425	2.65	7
E2	2.890	85.833	81.000	1.207	0.209	17.269	89.080	506	506	2.49	10
E3	2.819	88.167	85.000	1.299	0.208	16.125	88.888	384	320	2.49	13
E4	2.893	88.000	83.500	1.245	0.205	16.484	82.415	435	311	2.56	14
F1	2.884	87.167	83.500	1.310	0.209	15.945	85.833	484	484	2.61	9
F2	2.856	87.167	85.833	1.312	0.211	16.128	82.340	483	483	2.61	8
F3	2.857	86.500	84.500	1.289	0.210	16.396	84.360	537	537	2.68	5
F4	2.899	86.500	84.167	1.296	0.215	16.578	90.942	550	550	2.61	1
H1	2.757	79.000	85.833	1.297	0.208	16.046	90.523	495	495	2.47	12
H2	2.695	76.000	85.500	1.276	0.202	15.877	91.083	405	405	2.58	15
H3	2.788	76.333	84.333	1.293	0.207	16.038	87.723	377	377	2.44	16
CON Avg	2.902	86.875	87.833	1.258	0.208	16.544	93.750	536	505	2.41	4
Mean	2.867	84.148	83.656	1.288	0.209	16.308	88.403	494.625	475.641	2.553	
sd	0.073	3.947	2.389	0.054	0.004	0.457	3.339	62.853	83.635	0.078	

Table 57. Pooled data of silkworm rearing for screening of fumigant chemicals *in room* during 2011-12 (Room 1, 2, 3 are three rearing rooms where the rearing was conducted with three fumigant chemicals, Control – water spray, mean- arithmetic mean and sd- standard deviation, V wt- Weight of single mature larva, Surv% - larval survival%, ERR-Effective Rearing Rate, SCW-Single Cocoon weight in gram, SSW- Single Shell weight in g, FL-Filament length in mtr, NBFL-Non Breakable Filament Length)

Treatment	V wt	Survi %	ERR	SCW	SSW	Shell %	Moth emergence%	FL	NBFL	Denier	Smith Index
Room 1	2.882	94.667	91.417	1.230	0.211	17.175	89.958	533.667	476.667	2.550	2
Room 2	2.924	93.083	89.083	1.241	0.210	16.956	91.833	482.667	428.000	2.513	3
Room 3	2.956	94.250	88.917	1.239	0.213	17.220	95.517	513.333	459.000	2.563	1
Control	2.787	89.167	85.333	1.214	0.205	16.870	89.750	418.333	418.333	2.560	4
Mean	2.887	92.792	88.688	1.231	0.210	17.055	91.765	487.000	445.500	2.547	
Sd	0.074	2.508	2.511	0.013	0.004	0.169	2.671	50.349	27.067	0.023	

Table 58. Pooled data of silkworm (Nistari) rearing for *in vivo* screening of fumigant formulations prepared with two chemicals against silkworm pathogens during 2012-13 (Chemical 1- DBDMH, Chemical 2- pDCB, Control – healthy control, Avg. - Average of four healthy control for four pathogens; mean- arithmetic mean and sd- standard deviation Control – water spray, V wt- Weight of single mature larva, ERR- Effective Rearing Rate, SCW-Single Cocoon weight in gram, SSW-Single shell weight in g)

#	Formulation	Chemical-1	Chemical-2	V wt	ERR	SCW	SSW	Shell%	Smith Index
1	I	10	90	1.552	90.36	0.762	0.088	11.48	6
2	II	20	80	1.558	83.42	0.754	0.086	11.35	7
3	III	30	70	1.574	92.94	0.745	0.091	12.20	5
4	IV	40	60	1.062	42.75	0.940	0.112	11.94	11
5	V	50	50	1.000	61.00	0.859	0.082	9.60	12
6	VI	60	40	1.045	52.75	0.927	0.100	10.76	13
7	VII	70	30	1.388	80.88	0.757	0.091	11.99	8
8	VIII	75	25	1.377	77.60	0.708	0.064	9.08	10
9	IX	80	20	1.484	75.88	0.692	0.063	9.03	9
10	X	85	15	1.950	98.25	0.968	0.149	15.39	1
11	XI	90	10	1.798	97.50	0.964	0.155	16.12	2
12	XII	95	5	1.766	96.75	0.946	0.132	13.93	3
Control				1.574	75.75	0.921	0.116	12.64	4
Mean				1.471	78.91	0.842	0.10	11.96	
St.dev.				0.284	16.92	0.10	0.03	2.11	
Criterion 1				3	3	3	3	3	
Criterion 2				10	10	6	6	6	

Table 59. Comparative study of silkworm (Nistari) rearing of effective room disinfectant with existing room disinfectants during March- April, 2013 (Room 1- fumigant chemicals, Room-2 - 5% bleaching powder sol as control and Room 3- Chlorine dioxide, mean- arithmetic mean and sd- standard deviation, V wt- Weight of single mature larva, ERR-Effective Rearing Rate, SCW-Single Cocoon weight in gram, Shell% - [Single shell weight in gram / Single cocoon weight in gram)x100], FL-Filament length, NBFL-Non Breakable Filament Length, Dr-Denier, St.dev.- Standard deviation, CD- Critical difference, NS- Non significant, * significant at 5% level and ** significant at 1% level).

Treat-ment	V wt	ERR	SCW	SSW	Shell %	FL	NBFL	Dr	Smith Index
Room 1	2.018	98.00	0.823	0.095	12.38	300	293	1.99	1
Room 2	2.003	96.33	0.814	0.099	12.20	351	313	2.03	2
Room 3	1.955	95.00	0.809	0.099	12.29	311	311	2.00	3
Mean	1.99	96.44	0.815	0.098	12.29	321	305	2.00	
St.dev.	0.03	1.23	0.01	0.00	0.08	22.0	9.11	0.02	
Criterion 1	3	3	3	3	3	3	3	3	
Criterion 2	10	10	6	6	6	6	6	6	
CD	NS*	NS*	NS*	NS*	NS*	NS**	NS*	NS*	

Conclusion: Newly formulated broad spectrum room disinfectant has been named as 'Ghor Sodhan' is a cheap, less- hazardous and user friendly for silkworm disease management. The product is under validation in RSRSs / RECs and at the Institute.

3.D.4. COST REDUCTION

3.D.4.1. REELING & SPINNING SECTION

3.D.4.1.1. BAI(P)014: Studies on the reelability of multivoltine hybrid cocoons during adverse climatic condition in Eastern and North Eastern region. (July, 2011 to March, 2014)

N. B. Kar **(PI),** A. K. Saha, D. Chakravarty (upto 22.12.2012), S.P.Chakraborti (fr. 23.12.2012) and M. K. Majumder

Objectives: To find out proper reasons for poor reelability of multivoltine hybrid cocoons in adverse seasons; To explore the possibilities of improvement of reelability by manipulating the process technique; To explore the possibilities of improvement of reelability by incorporation of modest changes in the original design of the machine; To suggest for remedial measures for improving the reelability.

Treatments:

The mid-course correction in the cooking process was:

T_1 = 3-5 minutes boiling + reeling in boiling water (Control)

T_2 = 30 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L Wetting Agent & 1g/L Surface Active Agent + reeling at 80^0 C

T_3 = 40 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L Wetting Agent & 1g/L Surface Active Agent + reeling at 80^0 C

T_4 = 50 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L Wetting Agent & 1g/L Surface Active Agent + reeling at 80^0 C

T_5 = 60 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L Wetting Agent & 1g/L Surface Active Agent + reeling at 80^0 C

T_6 = 70 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L Wetting Agent & 1g/L Surface Active Agent + reeling at 80^0 C

T_7 = 80 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L Wetting Agent & 1g/L Surface Active Agent + reeling at 80^0 C

Although the experiment was concluded as per the milestone, a mid-course correction in the cooking treatment was done during June- July, 2012 and continued till the last crop reeling. The cocoons were reeled under the modified cooking technique. The pooled reeling data are furnished in table 60.

Table 60.Reelability of cocoons (M.Con1 x M.Con.4) against different treatments during unfavourable seasons

Treatment	AFL	NBFL	Denier	Reelability %
T1 (Control)				42
T2				55
T3				49
T4	385	168	2.46	51
T5				50
T6				48
T7				49
CD at 5%				**0.66**
CV%				**2.89**

Table 60A. Primary field evaluation report at M/s Bhagirathi Silk Industry, Madhughat, Malda (Nov.-Dec., 2013)

#	Hybrid Combinations			
	M.Con.1 x B.Con.4		SK6 x SK7	
	Renditta	Reelability %	Renditta	Reelability %
Control	8.04	75.6	9.70	75.8
Treatment (T2) with little Refinement	7.82	84.6	9.06	87.5

Table 60B. Economics of reeling during field evaluation (Nov.-Dec., 2013)

Combina - tion	Net gain of raw silk over Control per basin per day(gms.)	Net gain of raw silk over Control per machine (6-basin per day (gms.)	Net economic gain per day (Rs.)	Net economic gain per month (Rs.) (Projected)	Net economic gain per year (Rs.) (Projected)
M.Con.1 x B.Con.4	20	120	340	8500=00	102,000=00
SK6 x SK7	40	240	820	20500=00	246,000=00

Assumption: Raw Silk Price: M x Bi = Rs.3000/- & BV = Rs, 3500/- per kg

Inference:

- Overall reeling performance was better with the improved package of practice of rearing than the traditional practice irrespective of silkworm breeds and treatments employed during reeling.
- On reelability cooking with surface and wetting agent were shown better edge over that of without any treatment.
- All the treatments performed better over the control.
- T_2 i.e., 30 minutes steaming + 3-5 minutes boiling + soaking for 30 minutes @ 1ml/L Wetting Agent & 1g/L Surface Active Agent + reeling at 80^0 C was best among all in almost all the crops.
- A Field level validation trial will be conducted during 2014-15.

3.D.II. REGIONAL SERICULTURAL RESEARCH STATION

3.D.II.1. KALIMPONG

3.D.II.1.1. B-KPG(P)015: Improvement of rearing technology for autumn crop in Sub-Himalayan region. (Aug., 2012 to Jan., 2014)

R. Bhutia (**PI**)

Objectives: To simplify the rearing technology with an aim towards reducing inputs both in respect of labour and mulberry leaves by introducing branch/twig feeding during autumn crop. To utilize the limited quantity of food resources effectively by introducing shoot rearing technique.

Rearing was conducted during autumn (Aug.-Sept., 2012) and late autumn (Sept.- Oct., 2013) crops with the silkworm hybrid SK6 x SK7 with standard rearing package of practices upto third instar. Shoot feeding was given from 3rd instar onwards. Pooled data of two years (2012 & 2013) revealed that the performance of shoot rearing was better over the rearing with plucked leaf in respect of yield/10,000 larvae, pupation rate, yield/100dfls and reelability of cocoon (Table 61).

Table 61. Performance of rearing technology during autumn crop

Sl No	Treat-ment	Wt of 10 mature larvae	Yield/10000 larvae		Yield/ 100 dfls (kg)	SCW (g)	SSW (g)	Shell Ratio (%)	Pupat ion (%)	Ren-dita (%)	Raw silk (%)
			No.	Wt. (kg)							
1.	Shoot feeding	37.82	8159	12.31	49.06	1.538	0.292	18.98	77.12	9.57	10.46
2.	Pluck leaf feeding	36.71	7770	11.64	46.56	1.491	0.275	18.44	73.13	10.09	9.99
t value at 5%		NS	4.10	3.51	3.75	NS	NS	NS	3.12	NS	NS

Assessment of requirement of manpower in shoot feeding, 37 man days required during 4th and 5th instar for shoot harvesting and silkworm rearing, where as, in plucked leaf method 65 man days were required. Thus, 28 man days can be saved in shoot rearing technology.

3.D.II.2. Ranchi (Jharkhand)

3.D.II.2.1. B-RNC(VP)007:Validation trial of package of nutrient management under rainfed condition. (Oct., 2011 to Oct., 2013)

G. Singh **(PI)**

Objective: To validate the finding of the project on integrated nutrient management for increasing leaf productivity.

Application of vermicompost @10 mt./ha/year + Azotobactor @ 10 kg/ha/year + 75 N: 50P: 50K for mulberry field under rainfed condition of

Jharkhand state increased mulberry leaves yield to the tune of 9% over the control (8.2mt/ ha/ yr). The technology will be popularized.

3.D.II.2.2. B-RNC(P)018: Assessment of fertility status of mulberry growing soils in seri-villages. (Jan., 2012 to Dec., 2013)

G. Singh **(PI)**

Objective: To popularize the soil test based fertilizer application among farmers as per the fertility rating chart.

Soil test based fertilizer application was effective for increasing mulberry leaf yield to the tune 13% over the control (8.5 mt/ ha/ yr) under rainfed condition. Therefore, application of test based fertilizer application has been recommended in mulberry field under rainfed condition of Jharkhand.

3.D.II.3. Koraput (Odisha)

3.D.II.3.1. B-KPT (P) 017: Assessment of fertility status of mulberry growing soils in selected seri- villages of Koraput for appropriate fertilizer management. (Jan., 12 to Dec., 13).

Sri S.K.Misro **(PI)**

Objectives: To study the NPK content of the soils of the region. Standardization of the supplemented NPK for KBK region of Odisha.

The soil samples were tested for assessment of NPK, pH and EC. Fertilizer recommendations were made as per ready reckoner and accordingly supplied to the farmers for application in the mulberry fields. The leaf yield data were collected periodically. The average leaf yield gain was 7.9% and 5.7% in the test based dosage and recommended dosages respectively against control (not followed the recommended dose) yield of 8 mt/ha/year.

3.D.II.4. Jorhat

3.D.II.4.1 B-JRH (P) 019: Assessment of fertility status of mulberry growing soils in selected seri-villages of Jorhat for appropriate fertilizer management. (Apr., 2011to Mar., 2014)

S. N. Gogoi **(PI)**

Objective: To know the initial fertility status of mulberry growing soils (pH, EC, Organic carbon, N, P and K) for better fertilizer management.

Methodology: Soil samples from selected farmers were collected and estimated the pH, electrical conductivity (EC), organic carbon, N, P and K. Based on

soil analysis, recommended the dose of NPK in the farmers' field. Data on the growth and leaf yield of mulberry, silkworm rearing in (T0) Farmer's practices (Control) and (T1) Recommended dose NPK fertilizers application was recorded.

Result: Based on NPK levels in the soils of farmers, recommended dose of chemical fertilizers was applied in mulberry fields of 20 farmers. Conventional practices of farmers' were taken as control. The numbers of branches and leaf yield were recorded in control and the treatment plots during 3 seasons *i.e*. March, June and Sept. including silkworm's performance in two seasons. Analysis of data showed wide variations in soil characteristics i.e., pH (4.8-6.9), electrical conductivity (0.035 to 0.274) and organic carbon (0.35 to 1.62), nitrogen (121 to 295.7 kg/ha), phosphorus (14.36 to 125.27 kg/ha) and potash (30.5 to 246.42 kg/ha) in mulberry growing areas in the district.

Inferences: Significant effect of seasons on leaf yield was recorded. Number of branches and leaf yield showed significant improvement in chemical fertilizer application over the conventional farmers' practices. Number of branches increased from 6.9 to 8.7 and leaf yield increased from 2.8 to 4.3 (mt /crop/ hectares) (Table 62) for application of NPK in fields. Performance of silkworm rearing did not show any effect of seasons on cocoon yields. Application of chemical fertilizers (NPK) in farmer's fields had increased the numbers of mulberry branches, leaf yield and cocoon yield in fields (Table 63).

Table 62. Effect of seasons and application of NPK on the growth, leaf yield of mulberry and cocoon yield in field.

Seasons	Nos. of branches	Leaf yield (mt/ha/crop)	Cocoon yield (kg/100dfls)
March (S-I)	7.78	2.94	45.79
June (S-II)	7.88	4.20	-
Sept. (S-III)	7.80	3.63	45.74
CD at 5%	NS	0.258	NS

Table 63. Effect of NPK on the growth, leaf yield of mulberry and cocoon yield in field.

Treatments	No. of branches	Leaf yield (mt/ha/crop)	Cocoon yield (kg/100dfls)
T0 (Control)	6.88	2.81	36.35
T1 (Treatment)	8.75	4.37	55.18
CD at 5%	0.80	0.315	1.85

T0=Framer practices T1= Recommended dose of chemical fertilizers.

4. TRANSFER OF TECHNOLOGY

4.1. EXTENSION ACTIVITIES OF RSRSs, RECs AND REC(SU)s

4.1.1. REGIONAL SERICULTURAL RESEARCH STATIONS

A. RSRS, KALIMPONG:

- **Bivoltine seed cocoon generation prog.:** A total of 6500 and 4464 dfls of SK6 x SK7 were produced during Spring and Autumn crop respectively, of which, 2300 dfls were supplied to DoS, Sikkim and 4200 dfls to ZSSO, Malda and remaining 4464 dfls kept in cold storage for supply during Spring crop 2014.
- **Testing of new mulberry variety TR-23:** A total of 1000 saplings were prepared and distributed among two farmers.

***B.* RSRS, KORAPUT :**

- **Bivoltine seed cocoon generation prog.:** 100 dfls of SK6 x SK7 were reared and produced 46 kg cocoons.
- **Post-Authorization Trial (PAT):** Rearing conducted at farmers' level with 2000 dfls (M.Con.4 x B.Con.4 -1800 and N x NB4D2–200 dfls) yielded 46.2 kg and 36.5 kg cocoon/100 dfls respectively.

***C.* RSRS, RANCHI :**

- **Bivoltine seed cocoon generation prog.:** One hundred dfls of SK6 x SK7 were reared and the cocoon yield recorded was 69.4 kg/100 dfls.
- **Post-Authorization Trial (PAT):** Rearing was conducted at farmers' level with 200 dfls of M.Con.4 x B.Con.4 and M.Con.1 x B.Con.4 which yielded 33 kg and 32 kg/100 dfls respectively.

***D.* RSRS, JORHAT :**

- **Bivoltine seed cocoon generation prog.:** 100 dfls of SK6 x SK7 were reared and the yield was 54.1 kg/100 dfls.
- **Post-Authorization Trial (PAT):** Four thousand dfls of SLD 4 x SLD 8; 4000 Gen 3 x Gen 2; 8000 FC1 x FC2 and 4000 NB18 x P5 were reared and the cocoon yield was 27.3 kg, 29.4 kg, 44.2 kg and 33.6 kg/100 dfls respectively.
- **Popularization of botanical pesticides for management of major mulberry pests:** Mulberry Leaf yield was 3.2 mt/ha/crop against the control yield of 2.9 mt.
- **Popularization of Thiamethoxam for Whitefly management:** Leaf yield recorded was 3.3 mt/ha/crop against control yield of 2.9 mt.

4.1.2. RESEARCH EXTENSION CENTRES (RECs)

State	Programme	
	Bivoltine Seed Cocoon Generation prog.	**Post Authorization prog.**
AGARTALA	B.Con.1 x B.Con.4: 110 Dfls ; 54.8kg/100 dfls	SLD4 x SLD8: 1800 Dfls ; 38.2 kg/100 dfls Gen 3 x Gen 2: 600 dfls ; 30.2 kg/100 dfls FC1 x FC2: 1200 dfls ; 43.8 kg /100dfls NB18 x P5: 850 dfls; 61.6 kg/100 dfls
AIZAWL	SK6 x SK7: 1000 dfls ; 41.4 kg/100 dfls	SLD4 x SLD8: 3000 Dfls ; 45 kg /100 dfls Gen 3 x Gen 2: 1000 dfls ; 43 kg /100dfls FC1 x FC2: 2000 dfls ; 48.2 kg/ 100dfls NB18 x P5: 1500 dfls; 38.3 kg/100 dfls
DIMAPUR	SK6 x SK7: 140 dfls; 42.5 kg/100 dfls	SLD 4 x SLD8: 600 dfls ; 38.2 kg/100 dfls Gen 3 x Gen 2 : 200 dfls 41 kg/100 dfls FC1 x FC2: 400 dfls ; 30.2 kg/100 dfls
IMPHAL	B.Con.1 x B.Con.4 : **150** dfls; 50.5 kg/100 dfls .	SLD 4 x SLD8: 3000 dfls ; 40.4 kg /100 dfls Gen 3 x Gen 2 : 1000 dfls; 36.4 kg /100 dfls FC1 x FC2: 2000 dfls ; 47 kg /100 dfls NB18 x P5: 1500 dfls; 39.8 kg/100 dfls
SHILLONG	B.Con.1 x B.Con. 4 **150** dfls; 57.2 kg/100 dfls	SLD 4 x SLD8 : 1000 dfls ; 31.4 kg/100 dfls Gen 3 x Gen 2: 1500 dfls ; 26.6 kg/100 dfls FC1 x FC2: 2000 dfls ; 50.8 kg/100 dfls NB18 x P5: 500 dfls ; 48.6 kg/100 dfls
RANGPO	-	-

DEORAGH	-	M.Con.1 x B. Con. 4: 2000 dfls; 45.3 kg/ 100 dfls N X NB4D2: 1000 dfls; 40.1 kg/100 dfls
BADEMARENGA	SK6 x SK7 : 50 dfls; 42 kg/100 dfls	M Con.4 X B Con 4: 1200 dfls; 45 kg/ 100 dfls N X NB4D2: 500 dfls; 41kg/ 100 dfls
GUMLA	SK6 x SK7 : 500 dfls; 29.2 kg/100 dfls	FC1 x FC2: 1000 dfls ; 38 kg/100 dfls NB18 x P5: 500 dfls; 20.5 kg /100 dfls
MOTHABARI	SK6 x SK7: 500 dfls; 42.9 kg/100 dfls	**Favourable season:** M.Con.1 x B. Con. 4: 5000dfls; 48.6 kg/100 dfls M. Con.4 x B. Con. 4: 2950dfls; 48.7 kg/100 dfls N x NB4D2: 4000 dfls; 44.5 kg/100 dfls **Unfavourable season:** M. Con.1 x M. Con. 4: 4550 dfls; 20.5 kg/ 100 dfls N x M. Con. 4 : 6000 dfls; 26 kg/ 100dfls N x M12W: 3000 dfls; 23.5 kg/ 100 dfls
KAMNAGAR	-	**Favourable season:** M.Con.1 x B.Con.4: 5500 dfls; 36.9 kg/ 100 dfls N x M.Con.4: 6500 dfls; 34.8 kg/ 100 dfls N x M12W: 3000 dfls; 29.2 kg/ 100 dfls **Unfavourable season:** M.Con.1 x M.Con. 4: 1000 dfls; 30.4 kg/ 100 dfls N x M.Con.4 : 2000 dfls; 28.9 kg/ 100 dfls N x M12W: 3000 dfls; 26.9 kg/ 100 dfls
MAHESH PUR RAJ	-	Multi x Multi: 10,000 dfls; N x M.Con.1 (34.7 kg /100dfls), M. Con.1 x M.Con.4 (32 kg/ 100 dfls)

		and N x MW12 (33.2 kg/ 100dfls). Multi x Bi : 13,000 dfls ; M.Con.1 x B. Con. 4 (47.4 kg/ 100dfls), M. Con.4 x B. Con. 4 (46.5 kg/ 100 dfls) and N x NB4D2 (44.1 kg/ 100 dfls) Bi x Bi :1000 dfls; 33.2 kg/100 dfls
REC (SU) BHANDRA	SK6 x SK7: 300 dfls;11.9 kg /100dfls.	FC1 x FC2: 1000 dfls; 38 kg/ 100dfls NB18 x P5: 500 dfls; 20.5 kg/100 dfls.
REC(SU) RAJMAHAL	-	M. Con.1 x B.Con.4: 1600 dfls; 48.4 kg/ 100dfls M. Con.4 x B.Con.4 : 3800 dfls; 50.7 kg/ 100dfls N x NB4D2: 1400 dfls; 43.3 kg/100 dfls Gen2 x Gen3: 900 dfls; 39 kg/ 100 dfls NB18 x P 5: 100 dfls; 38 kg/100 dfls

OTHER ACTIVITIES

Table 64 A. FARMERS TRAINED THROUGH FARMERS FIELD SCHOOL

Name of the centre	No. of Prog.	No. of Participants	Name of the centre	No. of Prog.	No. of Participant
Ranchi	1	44	Deogarh	2	55
Jorhat	1	17	Rangpo	0	50
Kalimpong	2	32	Aizwal	2	144
Koraput	2	50	Imphal	2	155
Mothabari	10	241	Dimapur	2	126
Kamnagar	8	209	Shillong	2	102
Rajmahal	4	268	Agartala	2	53
M.P.Raj	8	189	Gumla	2	44
Bademaranga	2	46	CSR&TI	6	168
Total				**58**	**1993**

Table 64 B. Extension Communication Programe, HRD and Expansion of improved mulberry varieties by different Units under CSR&TI, Berhampore.

Name of the Units	Extension Communication Programme								HRD	New mulberry area covered with HYV		
	RKM	Awar. Prog.	Vichar Gosthi	Field day	Exhibi -tion	A.V. Prog.	Group Disc.	Techno. Demo.	TTP/ FTP	No. of farmers	Area (ha)	Variety
CSRTI, Berhampore	1 (1006)	5 (680)	1 (97)	3 (134)	8 (2139)	3 (268)	5 (112)	2 (29)	--	10	3.16	S1635
RSRS, Koraput	-	4 (147)	2 (218)	3 (144)	3 (144)	3 (144)	3 (78)	2 (75)	4 (34)	5	2.5	S1635
RSRS, Ranchi	1 (713)	5 (374)	1 (172)	2 (68)	4 (205)	3 (175)	3 (33)	1 (35)	2 (40)	6	2.5	S1635
RSRS, K'pong	1 (132)	5 (137)	1 (104)	2(31)	2 (216)	6 (175)	3 (43)	3 (43)	3 (46)	23	2.5	BC259, TR-23
RSRS, Jorhat	1 (210)	3 (149)	1 (129)	2 (107)	3 (171)	3 (169)	2 (91)	2 (42)	3 (38)	13	3.0	S1635
REC, Mothabari	-	6 (327)	1 (185)	3 (97)	4 (191)	4 (184)	7 (205)	2 (58)	3 (66)	17	5.1	S1635
REC, Kamnagar	-	7 (255)	1 (88)	5 (190)	5 (192)	6 (224)	5 (180	2 (87)	5 (52)	21	4.0	S1635
REC, M.P.Raj	-	3 (164)	1 (100)	3 (238)	3 (208)	3 (120)	3 (209)	2 (67)	3 (160)	21	2.5	S1635
REC(SU), R'mahal	-	5 (320)	1 (50)	5 (324)	4 (266)	5 (327)	5 (329)	3 (205)	5 (311)	7	2.5	S1635
REC, Gumla	-	3 (111)	1 (43)	3 (119)	5 (205)	3 (128)	4 (119)	2 (40)	5 (184)	5	2.5	S1635
REC, Deogarh	-	3 (134)	1 (52)	3 (198)	3 (198)	3 (198)	3 (100)	2 (91)	5 (158)	5	2.5	S1635
REC, B'maranga	-	3 (111)	1 (53)	-	-	-	-	-	-	5	2.5	S1635
REC, Rangpo	-	3 (83)	1 (34)	3 (118)	3 (118)	3 (84)	3 (21)	1 (38)	2 (56)	5	2.5	BC259, Kosen
REC, Aizwal		3 (156)	1 (104)	3 (152)	3 (163)	3 (132)	4 (172)	2 (90)	5 (233)	5	2.5	S1635
REC, Agartala	-	3 (153)	1 (188)	3 (76)	3 (597)	3 (80)	3 (45)	3 (91)	5 (152)	5	2.5	S1635
REC, Shillong	-	3 (137)	1 (68)	2 (74)	3 (303)	2 (108)	3 (81)	2 (41)	5 (357)	6	2.5	S1635
REC, Imphal		4 (160)	1 (85)	4 (109)	3 (80)	3 (92)	3 (76)	2 (60)	5 (141)	5	2.5	S1635
REC, Dimapur		3 (77)	1 (65)	3 (83)	3 (83)	3 (81)	3 (81)	2 (52)	5 (106)	5	2.5	S1635
REC(SU), Bhandra		3 (124)	1 (40)	1 (32)	1 (71)	-	3 (94)	2 (71)	5 (86)	5	2.5	S1635

Figure in parentheses indicates the number of person sensitized.

Table 64 C. Details of supply of cuttins/ saplings, farm rearing & income generation

Name of the nested units	Supply of mulberry		Farm/Farmers' rearing		Income generated (Rs)
	Saplings (nos.)	Cuttings (mt.)	Dfls reared (No.)	Cocoons prod. /100dfls.(Kg.)	
RSRS:					
Kalimpong	4600		50	-	11400
Koraput	30000		100	46.00	46500
Ranchi			100	54.15	47608
Jorhat		-	100	54.15	69110
RECs:					
Mothabari		4.6	500	42.92	10590
Kamnagar	40000	-	-	-	46800
Rangpo		-	-	-	-
Deogarh		-	50	42.00	
Bademaranga	--	-	-	-	8100
M.P.Raj			-	-	
Gumla	3000		500	29.15	33413
Aizwal		-	1000	47.00	7280
Agartala		-	110	54.80	14538
Shillong		-	110	57.70	15700
Imphal		-	150	50.50	20140
Dimapur		-	140	42.50	13280
REC(SU)					
Rajmahal		-	-	-	1344
Bhandra	3600	-	300	11.93	8860

5. HUMAN RESOURCE DEVELOPMENT (TRAINING COURSES)

5. A. STRUCTURED TRAINING COURSE

5.A.1. Post Graduate Diploma in Sericulture (Mulberry):

Duration: 15 months

L. M. Saha, Sci.-D (up to 31.05.2013), Subhra Chanda, Sci.-D (w.e.f . 04.06.2013), Jalaja S. Kumar, Sci.-D, Zakir Hossain, Sci.-C (w.e.f. 02.07.2013), and M. K. Ghosh, Sci.-D (w.e.f. 01.06.2013 upto 11.03.2014)

Objectives: 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 26 students of the session 2012-13, successfully completed PGDS course on 30th September, 2013 and the next batch of 29 students of the session 2013-14 are undergoing training. The course is affiliated under University of Kalyani.

Table 65. Details of Post Graduate Diploma in Sericulture (Mulberry):

Sl. No.	Sponsoring Agencies	No. of candidates	
		Completed the course on 30.09.2013	Started the course on 01.07.2013
1	Govt. of Manipur	09	13
2	Govt. of Meghalaya	07	-
3	Govt. of Nagaland	03	01
4	Govt of Sikkim	05	-
5	Govt. of Assam	-	05
6	Govt. of Tripura	-	06
7	Govt. of A.P.	-	01
8	Direct admission	02	03
Total:		**26**	**29**

				
Students are plucking mulberry leaves	Students are feeding the worms	Students learning the process of egg washing at SSPC, Berhampore	PGDS students are in the cocoon market at Ramanagaram	PGDS student is giving feeding to the chawki worms at commercial CRC of CSRTI, Mysore

5.B. NON- STRUCTURED TRAINING COURSE

5.B.1. MDP/ SUP Training Prog.:

Duration: 5 – 10 days

L. M. Saha, Sci.-D (Upto 31.05.2013), Jalaja S. Kumar, Sci.-D, Zakir Hossain, Sci.-C (w.e.f. 02.07.2013), S. Chanda, Sci.-D (w.e.f 04.06.2013) and M. K. Ghosh, Sci.-D (w.e.f. 01.06.2013 upto 11.03.2014)

Objectives: The objective of MDP is to orient the knowledge of scientists / officers / officials of CSB / DoS with reference to need–based technologies recently developed by the research Institute for its effective translation in the field of their respective states for promotion of enterprise to achieve the target. The objective of SUP is to impart practical training to the lead farmers about application of sericulture technologies in their enterprise.

Keeping in view of this specific objective Management Development Programme (MDP) for technical staffs of Central Silk Board and Skill Updating Programme (SUP) for farmers was initiated under Central Sector Scheme (CSS). A total of 20 and 92 persons were trained under MDP and SUP respectively in different disciplines as appended below:

Table 66A. Details of MDP courses conducted.

Name of the course	Duration (Days)	Persons trained (No.)
		CSB
Mulberry cultivation, Rearing Technology Vermi-composting, green manure training Programme for Officers/ Scientists/ of CSB/ DoS/ Technical staff of CSB/ DoS	5	**20**

Table 66B. Details of SUP courses conducted.

Name of the course	Duration (Days)	Persons trained (No.)
		CSB
Chawki Silkworm Rearing Technique.	10	33
Mulberry varieties and cultivation technique.	5	33
Integrated disease & pest Management component & concepts.	5	26
Total:	**-**	**92**

Fig.1 One of the trainees under MDP is interacting with the scientists

Fig.2 Dr. M. K. Ghosh, Sc-D is taking class of farmers under SUP

Fig.3 Dr. S. Nirmal Kumar, Director is speaking on the valedictory session

Fig.4 Dr. Jalaja S. Kumar, Sc-D is giving certificate to a woman farmer.

C. INTEGRATED SKILL DEVELOPMENT SCHEME (ISDS):

Duration: Nov. 2011 to Oct. 2016

Zakir Hossain, Sci.-C (w.e.f. 02.07.2013), Jalaja S. Kumar, Sci.-D, L. M. Saha, Sci.-D (upto 31.05.2013), S. Chanda, Sci.-D (w.e.f 04.06.2013) and M. K. Ghosh, Sci.-D (w.e.f. 01.06.2013 upto 11.03.2014)

Objectives: To train and motivate rural/semi-urban youth/women for developing employable skill in them to start sericulture based enterprise. To empower the rural youth/women with entrepreneurial and managerial skill. To address the shortage of trained manpower and to tap the huge employment potential.

At this Institute, the ISDS envisages to train youth/women in the fields of mulberry cultivation, commercial silkworm rearing, cocoon handicrafts, cocoon reeling and spinning skill updating of extension agents. The trainees were identified and selected from an exhaustive list prepared course wise in coordination with the DoS. While selecting a candidate, the eligibility criteria taken were educational qualification, age, category etc. The programme was conducted at free of cost and all the selected persons were provided free boarding and lodging. The duration of the training period was 15 days.

Table 67. Details of ISDS courses conducted

Sl. No.	Name of the course	Duration (Days)	Persons trained
1.	Skill updating of Extension Agents	15	60
2.	Cocoon handicraft	15	40
3.	Mulberry cultivation	15	104
4.	Commercial Silkworm rearing	15	127
5.	Cocoon reeling & spinning	15	60
Total:		-	**391**

Training on cocoon handicrafts is under progress

Dr.S.Nirmal Kumar, Director distributing prize to the winner among ISDS trainees

Dr. M. Banerjee, DD, DoT(Seri.), Murshidabad taking class of ISDS trainees

ISDS trainee is preparing polythene bags for kisan nursery after training

D. AD HOC TRAINING PROGRAMME CONDUCTED ON THE REQUEST OF DIFFERENT AGENCIES

L. M. Saha, Sci.-D (upto 31.05.2013), Jalaja S. Kumar, Sci.-D, S. Chanda, Sci.-D (w.e.f 04.06.2013), Zakir Hossain, Sci. -C (w.e.f. 02.07.2013) and M. K. Ghosh, Sci.-D (w.e.f. 01.06.2013 upto 11.03.2014)

Table 68. Details of Adhoc training programmes conducted.

Sl. No.	Course	Duration (Days)	Sponsoring authority	Persons trained	Objective
1.	Spinning Training Prog. for women under Natural Fibre Mission(BRGF).	21	DoT(Seri), Murshidabad	100	To impart practical training to the Matka spinners of Murshidabad district in motorized spinning machine to upgrade the operational skill of the spinners, with the improved technologies, to improve the quality of yarn and production efficiency, to facilitate enhancement in wage earning.

2.	Computer training.	02	CSRTI, Berhampore	52	To impart practical training to the officers/officials of CSRTI, Berhampore to update the knowledge in handling MS-Word, MS-Excel & internet.
3.	Beneficiary Empowerment Programme for Farmers	03	MESDP, Kishanganj &DoS(Seri), Assam	215	To impart skill based exposure on latest technologies developed by the Institute to the farmers of CSB / DoS.
4.	Orientation programme for CDF	03	C.O.,CSB, Bangalore	21	To orient the knowledge and deliver guidelines for creating and managing the bivoltine sericulture clusters in the eastern region of India.
5.	Focussed Training Programme on Store Purchase Procedure	05	C.O.,CSB, Bangalore	29	To impart training on purchase procedure of store materials to the Scientific Officers under NSSO and Administrative officials of NSSO & CSRTI, Berhampore.
6.	Training Programme on bivoltine silkworm rearing	15 & 09	CSRTI, Berhampore	11	To impart bivoltine practical training programme to the scientists, technical assistants of RSRSs and DoS, Kalimpong.
7.	Collaborative Training Programme on Extension Management Approaches for promotion of Sericulture Industry (with MANAGE, Hyderabad)	03	C.O.,CSB, Bangalore	17	To impart training on extension management in the field of sericulture.
Total:		-	-	**445**	-

			
Expert of Reeling & Spinning Section, CSRTI, Berhampore is imparting practical training to women spinners	Computer training is under progress	Participants of bivoltine practical training programme are with Director, CSRTI, Berhampore and other scientists	Focussed Training programme is going on

E. VISIT OF STUDENTS FROM UNIVERSITIES/ COLLEGES/ SCHOOLS/ ORGANIZATIONS AND FARMERS FOR AN EXPOSURE TO MULBERRY SERICULTURE

A total of **827 persons** (682 students, 6 Railway staff and 139 farmers along with escorts) were exposed to modern technologies pertaining to sericulture activities during 2013-14 at this Institute.

Sl. No.	Date	Sponsored by	Persons (No.)
1.	23.04.2013	CTR&TI, Ranchi, Jharkhand	22
2.	03.05.2013	Suri Vidyasagar College, Birbhum,W.B.	8
3.	18.06.2013	Sripat Singh College, Jiaganj, Murshidabad,W.B.	15
4.	25.09.2013	Loreto House, Kolkata,W.B.	139
5.	01.10.2013	Patha Bhavan, Kolkata,W.B.	73
6.	04.10.2013	Loreto House, Kolkata,W.B.	150
7.	07.12.2013	Kendriya Vidyalaya, Berhampore,W.B.	79
8.	10.12.2013	Jogamaya Devi College, Kolkata,W.B.	40
9.	24.01.2014	Basirhat College, North 24 Parganas,W.B.	32
10.	12.02.2014	Tehatta High School (H.S.), Nadia,W.B.	60
11.	21.02.2014	Sargachi Ramakrishna Mission High School	64
Total			**682**
1.	11.04.2013	District Sericulture Officer, Meghalaya	25
2.	15.02.2014	Railway employees, Kolkata	06
3.	25.03.2014	Mulberry Silk Development Project, Araria	114
Total			**145**

	
Students of Loreto School are taking photograph of silkworms	Students of Sargachi Ramakrishna Mission High School are in the Reeling & Spinning laboratory
	
Railway employees are visiting the museum of CSRTI, Berhampore	Farmers of Araria with their escorts are standing in front of Training Division of CSRTI, Berhampore

F. TRAINING / WORKSHOP ATTENDED BY THE SCIENTISTS:

Institute/Place	Subject	Duration	Participants
National Agricultural Bioinformatics Grid at National Bureau of Agriculturally Important Insects (NBAII), ICAR, Bangalore.	Bioinformatics-*In vitro* to *In silico* pproaches in Entomology	18th to 30st Nov., 2013.	N. Lalitha, Sci-C,
National Institute of Agricultural Extension Management (MANAGE), Hyderabad.	Management *for promotion of Seri-Industry*	28th to 31st Jan., 2014.	Satadal Chakrabarty, Sci-C, N. Lalitha, Sci-C, R.L.Ram, Sci-B

6. AWARDS AND RECOGNITIONS

6. A. ISO 9001-2008 Award


BMSCERT
Quality Assessors

CERTIFICATE OF REGISTRATION

This is to certify that the Quality Management System of

Central Sericultural Research & Training Institute
Central Silk Board, Ministry of Textiles, Govt. of India
P.O. Berhampore-742 101, Murshidabad Dist. West Bengal, India

has been assessed and approved in accordance with the guidelines of

ISO 9001:2008

for the following areas

Research, Development, Technical, Technological, Innovation, Training, Extension, Administration, Service support to Sericulture Industry

Certified Locations: Central Silk Board, Ministry of Textiles, Govt. of India P.O. Berhampore-742 101, Murshidabad Dist. West Bengal, India

Validity of this certificate can be verified at www.bmscert.com/verify

Director Director

Date of Registration: January 17, 2013
Date of Continuation: January 08, 2014
Valid Upto: January 16, 2015
Recertification Due: January 16, 2016

Q-2333/13
Certificate No.

317, Aggarwal Modern Bazar, C-33, Lawrence Road, Delhi – 35, India Ph. 91-11-27101017
Website: www.bmscert.com email : info@bmscert.com

CSR&TI, Berhampore has been continued with ISO 9001-2008. The renewal Certificate granted on 08.01.2014 for one year.

6.B. Best oral Presentation award

SanthaKumar, M.V., Datta, P., Chakrabarti, S., Das, N.K., Mukhopadhyay, S.K., Lalitha, N., Saha, A.K. and Nirmal Kumar, S. (2013). Factors influencing the incidence pattern of whitefly, *Aleuroclava pentatuberculata* in mulberry. Abstract SEB 12 presented in "Recent Advances in Modern Biology & Sericulture for women empowerment and rural development," held at Karnataka State Sericulture Research & Development Institute, Bangalore during 24-26th October, 2013. pp. 39-40.

7. COLLABORATIVE RESEARCH PROJECTS & PROGRAMMES WITH OTHER INSTITUTES /ORGANIZATIONS

7. A. MULBERRY BREEDING AND GENETICS SECTION (CSB funded: Collaboration with CSGRC, Hosur)

7.A.1. PIB 3505: Development of drought tolerant mulberry variety for rainfed sericulture [Collaborative project with CSGRC, Hosur (Jan., 2014 to Dec., 2019)**]**

M. K. Ghosh **(PI)**, P. K. Ghosh, S. K. Dutta, M. V. S. Kumar, K. Jhansi Lakshmi and M. M. Borpuzari

Objective: Development of drought tolerant mulberry variety.
Step-01: Strategic trait based crossing and raising of progeny.

At CSGRC, Hosur, parents were suitably pruned for obtaining desired numbers of flowers and hybridization of desired parents was made.

Table 69. List of cross combinations.

Sl. No.	Cross combination	Sl. No.	Cross combination
1	MI-0437 × ME-0125	7	MI-0762 × ME-0065
2	MI-0437 × MI-0256	8	MI-0763 × MI-0012
3	MI-0670 × ME-0065	9	MI-0836 × V-1
4	MI-0685 × MI-0314	10	MI-0768 × ME-0244
5	MI-0828 × ME-0125	11	MI-0835 × ME-0244
6	MI-0827 × MI-0012		-

7.B. SILKWORM BREEDING AND GENETICS SECTION (Collaboration with NSSO & CSTRI, Bangalore)

7.B.1. AIB 3491: Post Authorization trials of silkworm hybrids in Eastern and North Eastern India. (Sept., 2012 to Dec., 2014)

N. Suresh Kumar **(PI)**, G. K. Chattopadhyay, A. K. Saha and One scientist each from 4 RSRSs and 14 RECs Officials from all 11 state DOSs

Objective: To popularize authorized silkworm hybrids among the farmers of Eastern and North Eastern India.

A total of 179270 dfls of multivoltine hybrid (Jaistha, 35,050; Shravani, 20,000; 67,920 Bhaduri 56,300 Aswina), 287250 dfls of multi x bi (97,300 Bhaishakhi, 1,02,250 Agrahayani and 87,700 Falguni) and 94600 dfls of bivoltine hybrid (57,300 Agrahayani and 37,300 Falguni) were reared under the programme. The hybrid yielded more cocoons and the farmers got better yield than the control

hybrids and better returns. The performance hybrids under PAT programme is presented in Table 70.

Table 70. Performance of silkworm hybrids under PAT programme.

Hybrid	No. of Dfls		Yield/100 dfls (kg)	Yield range (kg)
	Target	Achievement		
Bivoltine hybrids				
Gen3 x Gen2	36600	49900	43.75	27-74
SLD4 x SLD8	36600	13600	37.00	27-45
FC1 x FC2	-	19450	47.00	45-50
NB18 x P5	18300	11650	40.73	22-62
Total	**91500**	**94600**		
Multivoltine x bivoltine hybrids				
MCon1xBCon4	101800	136950	54.16	46-64
MCon4 xBCon4	101800	93600	53.54	42-67
N x NB4D2	50900	56700	43.82	32-56
Total	**254500**	**287250**		
Multivoltine x multivoltine hybrids				
M.Con.1 x M.Con.4	56800	71910	30.18	22-36
Nistari x M.Con.4	56800	59460	29.71	21-35
Nistari x M12 (W)	28400	47900	25.58	20-28
Total	**142000**	**179270**		
Grand Total	**488000**	**561120**		

7.C. SILKWORM PHYSIOLOGY & RTI SECTION (In Collaboration with NSSO)

7.C.1. APS 3497: Studies on the environmental effect on P1 rearing, its' grainage performance followed by commercial rearing of Silkworm B*ombyx mori* L., during unfavourable seasons of West Bengal (May, 2013 to April, 2015)

T. Datta (Biswas) (**PI**), A. K. Saha, L. M. Saha and B. C. Roy

Objectives: Determination of the effect of environmental factors on P1 seed crop rearing during adverse crop seasons at farmers' level and its subsequent effects on commercial grainage performance and finally on commercial rearing at farmers' level.

Ten P1 farmers under SSPC, Berhampore were selected from two villages namely Banjetia and Kalitala Diar, Murshidabad @ 5 farmers per village.

E01: Studies on the effect of temperature and humidity on P1 rearing during unfavorable seasons.

During P1 June – July, 13 (Bhaduri) crop, cocoon yield of 28.2 kg/ 100 dfls and 26.8 kg /100 dfls was recorded with Nistari and M12(W) respectively at Institute level (controlled condition) against 22.1 and 20.4 kg /100 dfls respectively at farmers' level. [Temp 29.5ºC (27- 34ºC) & RH 88.2% (84 – 96%)]

During P1 July – August, 13 (Ashwina) crop, 35.5 kg/100 dfls & 32 kg/100 dfls cocoon yield was recorded with Nistari and M12(W) respectively at Institute level (controlled condition) against 26.2 kg/ 100 dfls and 26.05 kg / 100 dfls at the farmers' level [Temp 29.3ºC (25- 35ºC) & RH 85.5% (77 – 93%)]. Number of cocoons/ kg was also found less under controlled condition in both the crop seasons, thereby depicting quality cocoon production at Institute level. During Bhaduri (June – July), 13 crop, cocoon / kg was recorded as 982 & 1056 for Nistari and 950 & 1025 for M12(W) under controlled condition & Farmers' condition respectively. During July – Aug., 13 (Ashwina) crop, 847 and 1013 cocoon/kg for Nistari and 980 and 1021 for M12(W) under controlled and farmers condition respectively were recorded.

E02: Studies on the effect of temperature and humidity prevailing during P1 rearing on commercial grainage performance.

Grainage was conducted during Bhaduri crop showed egg recovery of 54.8 g/ kg of cocoon at the Institute followed by 30.3 g/ kg cocoon at SSPC, whereas, during P1 Ashwina crop, egg recovery was 60.1 g/ kg cocoon at the Institute against 30.7 g/kg cocoon at SSPC level.

E03: Studies on the effect of temperature and humidity prevailing during P1 rearing on subsequent commercial rearing at farmers' level.

Bhaduri commercial rearing was conducted during July, 13 at farmers' level with the dfls produced from the cocoons reared under controlled condition as well as with dfls produced at SSPC Berhampore with P1 cocoons reared at farmers' condition. Cocoon yield of 27.5 kg/ 100 dfls was recorded with dfls produced from controlled rearing against 21.9 kg/ 100 dfls with dfls produced at SSPC level. Ashwina commercial rearing (Sept., 13) conducted with the dfls produced at the Institute from cocoons reared under controlled condition showed cocoon yield of 29 kg/100 dfls against 22.3 kg/100 dfls.

7.C.2. AIE 3454: Evaluation of elite bivoltine silkworm germplasm under different agro-climatic conditions: All Silkworm Germplasm Evaluation Prog. (Phase II). (Net Working Project) (Sept., 2011 to Aug., 2014). **[CSB funded: Collaboration with CSGRC, Hosur]**

M. K. Singh **(PI)** and T. Dutta (Biswas)

Objectives: To identify the suitability of Bivoltine silkworm Germplasm for specific agro climatic area; To identify the Bivoltine Silkworm Germplasm, which have a wide adaptability to varied climatic condition; To identify the potential germplasm as parent for silkworm hybridization programme suitable for different agro climatic condition.

At Main Institute:

During autumn (Oct.,–Nov.,13) crop, BBE-164, BBE-266, BBE-225, BBI- 338, BBE- 263 and BBI-348 dfls worms were discarded due to pebrine infestation during 3rd stage. However, among the remaining survived accessions BBE-216 performed best in respect of wt. of 10 matured larvae (39.7g). During spring (Feb.,–Mar., 14) season most of the accessions were rejected due to heavy grasserie infestation during the final stage. However, BBE 268 recorded highest shell% (18.3), where as, wt. of 10 matured larvae was observed highest in National Control (37.7g).

At RSRS, Kalimpong:

Twelve bivoltine accessions were received from CSGRC, Hosur and reared during the spring (April–May) crop, out of which, BBE-164 performed better in respect of shell % (20.1) followed by BBE-329 (18.6).

At RSRS, Jorhat:

Rearing conducted during spring & autumn seasons with 12 silkworm accessions including one each of national and local control under this programme. The yield performance revealed that the highest cocoon yield/10000 larvae recorded in BBE-268 (8200; 11.6 kg) in spring crop and in autumn crop, 7133; 9 kg in BBE-202. The low yield during autumn crop was due to unfavorable climatic condition.

8.A. CENTRAL OFFICE PROJECTS & PROGRAMMES (NATIONAL)

8.A.1. All India Co-ordinated Experimental Trial on Mulberry (Phase-III) (April, 2011 to December, 2016)

Zonal Coordinator: **S. Nirmal Kumar**
Team Leader: M. K. Ghosh
Member: S. N. Gogoi, G. S. Singh, R. Sahoo, M. D. Maji, and L. S. Singh.

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

Experimental Design:

- Experimental Design – RBD
- Replications – 6
- Spacing - – 90×90 cm
- Total No. of plants/plot – 9×9 = 81
- No. of experimental plants/plot – 7×7 = 49 (excluding border plants)
- Block size – L×B = 40.5 × 8.1 = 328.05 Sq.m
- Experimental area – 328.05 × 6 = 1968.3 Sq.m

First pruning was given during July, 2013 in all the test centers except RSRS, Kalimpong and DoT(Seri.) farm, Boswa where it was applied during Dec., 2013 and Feb., 2014 respectively. Soil fertility status of all the test centers was analyzed (Table 71).

Table 71. Soil fertility status of 8 test centers.

Particulars	Test Center							
	BHB	**KPT**	**JRT**	**KPG**	**RNC**	**IMF**	**Boswa**	**Falakata**
Available N (kg ha^{-1})	218	164	221	246	168	231	225	220
Available P (kg ha^{-1})	33	19	18	62	16	22	35	25
Available K (kg ha^{-1})	362	276	162	430	238	185	350	330
pH	6.90	5.05	5.57	4.58	5.53	5.52	6.87	5.85

Survival of mulberry plants was recorded at six test centers with one year old plants. The experiment was conducted with 6 replications. At Berhampore and Imphal test centers, survival of mulberry test varieties were at par in all the five test varieties except MV-3 where, survival was significantly lower. The test variety MV-5 showed significantly higher survival at Koraput, Bhandra and Jorhat test centres. At DoT(Seri.) Farm, Ambari Falakata, survival of MV-1, 4 and 5 was found at par as compare to MV-2 & 3. (Table 72).

Table 72. Survival (%) performance of mulberry test varieties (after 90 days of plantation).

Test Center	Survival (%) of cuttings (after 90 days)					CD value
	MV-1 C-038	MV-2 FYT/99	MV-3 Suvarna-2	MV-4 Vishala	MV-5 S-1635	
Irrigated						
CSR&TI, Berhampore	78.50	77.17	54.00	76.83	78.50	2.16**
Rain fed						
RSRS, Jorhat, Assam	79.33	64.17	49.33	80.17	85.33	4.07**
DoT(S), Ambari Falakata	81.33	73.45	63.67	78.00	78.17	3.21**
REC(SU), Bhandra, Ranchi	78.17	65.67	51.83	76.50	80.50	2.85**
RSRS, Koraput, Odisha	76.17	75.33	49.33	66.50	84.17	2.86**
REC, Imphal, Manipur	81.67	77.50	54.33	78.83	81.50	4.32**

** at 1% level

First leaf yield was recorded during Sept., 2013 in six test centers. At Berhampore, Jorhat, Bhandra and Koraput, highest leaf yield was recorded in MV-1 which is significantly higher than all the test varieties. At Ambari Falakata, although leaf yield was highest in MV-1, but significantly less than Vishala. (Table 73).

Table 73. Leaf yield performance of test varieties (kg/ ha/ yr) (Sept.-Oct.,13).

Test Center	Leaf yield (Sept. – Oct., 13)					CD value
	MV-1 C-2038	MV-2 FYT/99	MV-3 Suvarna-2	MV-4 Vishala	MV-5 S-1635	
Irrigated						
CSR&TI,Berhampore	10068	8836	8431	9194	9176	444.34**
Rain fed						
RSRS, Jorhat, Assam	5480	4359	3939	4926	4982	281.19**
DoT(S), Ambari, Falakata	5312	4461	4978	5690	5549	175.51**
REC(SU), Bhandra, Ranchi	6484	5875	5770	5469	5652	407.51**
RSRS, Koraput, Odisha	7765	6577	6098	5879	5948	531.87**
REC, Imphal, Manipur	8790	6989	6343	7460	7494	573.99**

** at 1% level

8.B. BIVOLTINE CLUSTER PROMOTION PROGRAMME

The Central Silk Board has envisaged an ambitious plan to produce 5000 mt import substitute BV silk through organization of clusters across the country in co-ordination with DoT (Seri.)/ DOS of the respective states in a mission mode approach during XII plan period. CSR&TI, Berhampore functioning as Nodal Centre for Eastern & North Eastern India, where, 15 clusters at West Bengal (4), Odisha (2), Bihar (1), Manipur (2), Assam (3), Mizoram (1), Nagaland (1), and Tripura (1) were being organised with the active support of the respective DOSs.

Based on the diagnostic and feasibility study, clusters identified and Cluster Promotion Committees (CPCs) were constituted for effective implementation. Zonal Bivoltine Review committee has been constituted under the chairmanship of the Director, CSR&TI and the Director of Sericulture, DoS/ DoT as the members along with in-charges of ROs, RSRS, and CDFs.

For effective monitoring of the clusters, CPCs were meeting 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.

Sl. No.	State	Cluster	Cluster Development Facilitator	
			CSB Representative	**DOS Representative**
1.	**West Bengal**	**Malda**	Sri A. K. Datta, Scientist-C, REC, Mothabari, Malda ; Chairman	Sri S. K. Das, Dy. Director of Textile (Seri) DOT(S), Malda; Member Convener
2.		**Murshidabad**	Dr. S. P. Chakraborty, Sci-D REC, Kamnagar, Murshidabad; Chairman	Dr. M. Banerjee, Dy. Director of Textiles (Seri), DOT(S),Murshidabad; Member Convener
3.		**Birbhum**	Dr. M. Patnaik, Scientist-C, REC (SU), Rampurhat, Birbhum; Chairperson	Mrs. Kaberi Mitra, Asst. Director of Textiles DOT(S), Suri, Birbhum; Member Convener
4.		**Nadia**	Sri G. C. Das, Sci-C, CSR&TI,Berhampore; Chairman	Sri A. K. Pani, Asst. Director of Textiles, DOT(S), Krishnagar, Nadia; Member Convener

Sl. No.	State	Cluster	Cluster Development Facilitator	
			CSB Representative	**DOS Representative**
5.	**Odisha**	**Ghatgaon, Keonjhar**	Sri Satyabrata Dey, Scientist-C, BSM&TC, Keonjhar; Chairman	Sri Tapan Kumar Kar, Asst. Director, DOS, Keonjhar; Member Convener
6.		**Kashipur, Rayagada**	Sri Sunil Kr. Mishra, Scientist-C, RSRS, Koraput; Chairman	Sri Bijaya Kumar Mishra, Asst. Director of Sericulture, DOS, Koraput; Member Convener
7.	**Manipur**	**Chura-chandpur**	Dr. L. Somen Singh, Scientist-D, REC, Imphal;Member Convener	Sri N. Vialkhanthang, Dy. Director, DOS, Manipur; Chairman
8.		**Ukhrul**	Dr. L. Somen Singh, Scientist-D, REC, Imphal;Member Convener	Sri C. M. Paul, Asst. Director, DOS, Manipur; Chairman
9.	**Mizoram**	**Aizawl**	Sri B.N. Choudhury, Sci-D, REC, Aizwal; Member Convener	Sri Lalremsiama, Asst. Director, DOS, Mizoram; Chairman
10	**Nagaland**	**Peren**	Dr. Anukul Barah**,** Scientist-C, REC, Dimapur; Member Convener	Mrs. Zachivelu K. Dolie, District Sericulture Officer, DOS, Nagaland; Chairman
11	**Assam**	**Darrang**	Dr. S.N. Gogoi**,** Sci-D, RSRS, Jorhat; Member Convener	Sri H.N. Goswami, Asst. Director of Sericulture, DOS, Darrang;Chairman
12		**Jorhat**	Smt. Mina Pamehgam, Scientist-C, RSRS, Jorhat; Member Convener	Sri Dhrubajyoti Borah, Asst. Director of Sericulture, DOS, Assam; Chairman
13		**Udalguri, BTC**	Dr. Y. Debaraj**,** Sci-D, RSRS, Jorhat; Member Convener	Sri H. K. Hazarika, Asst. Director, DOS, Udalguri, BTC; Chairman
14	**Tripura**	**Champak-nagar**	Dr. G. B. Singh, Sci-D, REC, Agartala; Member Convener	Sri Shakti Pada Bhowmik,Superintendent of Sericulture, DOS, Tripura; Chairman
15	**Bihar**	**Kishanganj**	Dr. R. K. Pandey, Sci-D, MSEDP, Kishanganj; Chairman	Sri N. P. Verma, Asstt. Director (Ind.) Resham, Govt. Of Bihar, Purnea; Member Convener

Progress of clusters activities during the year 2014-2015 is presented in Table-74

Table-74: Cluster wise achievement.

Sl. No.	State	Cluster	Dfls (Lakh)				Raw silk Production (MT)			
			Target	Achievement			Target	Achievement		
				BV	ICB	Total		BV	ICB	Total
1	West Bengal	Malda	1.5	1.248	0.610	1.858	4.65	6.824	2.520	9.344
2		Murshidabad	1.5	1.202	0.342	1.544	4.65	6.286	2.427	8.713
3		Birbhum	1.5	0.250	1.780	2.030	4.65	0.999	5.280	6.279
4		Nadia	1.5	0.230	1.862	2.092	4.65	1.045	8.378	9.423
5	Odisha	Ghatgaon, Keonjhar	0.50	0.083	0.047	0.130	1.75	0.025	0.093	0.118
6		Kashipur, Rayagada	0.50	0.080	-	0.080	1.75	0.047	-	0.047
7	Manipur	Chura-chandpur	2.0	0.700	0.100	0.80	8.0	1.773	0.338	2.111
8		Ukhrul	2.0	0.520	0.080	0.60	8.0	2.670	0.276	2.946
9	Mizoram	Aizawl	2.0	0.428	-	0.428	8.0	2.422	-	2.422
10	Nagaland	Peren	2.0	0.07	-	0.0	8.0	0.0	-	0.0
11	Assam	Darrang	2.0	0.360	-	0.360	8.0	0.928	-	0.928
12		Jorhat	2.0	0.282	-	0.282	8.0	0.554	-	0.554
13		Udalguri, BTC	2.0	0.190	-	0.190	8.0	0.327	-	0.327
14	Tripura	Champaknagar	2.0	0.111	0.025	0.136	8.0	0.286	0.100	0.386
15	Bihar	Kishanganj	0.50	-	0.268	0.268	1.75	-	1.012	1.01
	Total		**23.5**	**5.754**	**5.114**	**10.868**	**87.85**	**24.186**	**20.424**	**44.61**

9. RESEARCH PUBLICATIONS

Sl. No.	Particulars	Total
1.	**Research papers:**	
	A. International journals	**16**
	B. National journals	**28**
2.	**Research articles**	**21**
3.	**News/ reports/silk briefs**	**59**
4.	**Books**	**13**
5.	**Compendium of technologies**	**4**
6.	**Book Chapters**	**2**
7.	**Booklet**	**1**
8.	**Bochures/ Pmphlets/ Blletins/ Calenders**	
	A. Brochures	**1**
	B. Pamphlets	**10**
	C. Bulletins	**2**
	D. Leaflet	**7**
9.	**Full papers published in the proceedings of Seminar/ Workshop/ Symposium**	
	A. International	**1**
	B. National	**18**
10.	**Abstracts of presented papers in Seminar/ Workshop/ Symposium**	
	A.International	**4**
	B.National	**23**
	Total	**210**

RESEARCH PAPERS

A. International

1. Banerjee, R., Chattopadhyay, S., Saha, A. K. and Nirmal Kumar, S. (2013). Association of morphological and biochemical features of mulberry lines with resistance to bacterial leaf spot. *Archives of Phytopath. & Plant Protec.* (Taylor & Francis, UK). *doi.org/10.1080/03235408.2013.868693.*

2. Chakrabarty, S., Saha, A. K., Manna, B. and Bindroo, B. B. (2013). Gender influenced dimorphism in *Nosema bombycis* Nageli, causing pebrine disease in silkworm, *Bombyx mori* L. *Walilak J. of Sci. & Tech.*, Thailanad – (Ref: 303 -1065 -1-SP.DOC 2012-03-09) (**I**SSN: 1686-3933). (Impact factor 0.086) Online ISSN: 2228-835X http://wjst.wu.ac.th. 10(**2**):103-111.

3. Chakrabarty, S., Saha, A. K., Manna, B. and Nirmal Kumar, S. (2013). Secondary contamination is the main source for spread of *Nosema bombycis* resulting in outbreak of pebrine diseases in *Bombyx mori* L. *Int. J. of Indust. Entomol*. ISSN 1598-3579, http:// dx.doi.org /10.7852/ ijie.2013.27.2.282 **27(2):** 282-288.

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II. RESEARCH ARTICLES

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III.NEWS/ REPORTS/ SILK BRIEFS:

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14. Chaudhury, B. N. and Pachuau, L. (2013). Report on Awareness cum audio-visual programme at Sesawng village, Mizoram. *Indian Silk*. **4 (6&7):** 48.

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27. Purohit, K. M. and Das Mohapatra, D. P. (2013). Farmers' Training Programme at Gopapur. *Indian Silk.* **3 (10&11):** 44-45.

28. Purohit, K. M. and Das Mohapatra, D. P. (2013). Farmers' Field School Programmes at Gopapur. *Indian Silk.* **3 (10&11):** 45.

29. Purohit, K. M. and Das Mohapatra, D. P. (2013). Field Days at Mituani and Madhyapur, Awareness Programme at Saraskola, Farmers' Training Programme at Purunapani and Farmers' Field School Programmes at Madhyapur. *Indian Silk.* **4 (1&2):** 42.

30. Purohit, K.M., Das Mohapatra, D. P. and Bindroo, B. B. (2013). Awareness Programme at Gadia. *Indian Silk.* **4 (4&5):** 43.

31. Purohit, K. M., Das Mohapatra, D. P. and Bindroo, B. B. (2013). Field Day at Badajamposi. *Indian Silk.* **4 (4&5):** 47.

32. Purohit, K. M., Das Mohapatra, D. P. and Bindroo, B. B. (2013). Farmers' Training Programme at Saraskola. *Indian Silk.* **4 (4&5):** 50.

33. Purohit, K. M. and Das Mohapatra, D. P. (2013). Farmers' training Programme at Madhyapur. *Indian Silk.* **4 (6&7):** 53.

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43. Santha Kumar, M. V., Mukhopadhyay, S. K. and Bindroo, B. B. (2013). Exhibition at Krishi Vigyan Kendra, Kalukhali, Murshidabad *Indian Silk.* **4 (3):** 43.

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52. Verma, A. K. and Bindroo, B. B. (2013). A training programme cum exhibition at Bangalgram, Malda Dist., W.B. *Indian Silk.* **4 (1&2):** 45.

53. Verma, A. K. and Bindroo, B. B. (2013). An awareness programme at Bangalgram, Malda Dist., W.B. *Indian Silk.* **3 (12):** 36.

54. Verma, A. K. and Nirmal Kumar, S. (2013). Awareness-cum-Training programme at Rajmahal. *Indian Silk*. **4 (4&5):** 43.

55. Verma, A. K. and Nirmal Kumar, S. (2013). Field day-cum-audio visual programme at Bangalgram and Laxmipur village. *Indian Silk.* **4 (6&7):** 50.

56. Verma, A. K. and Nirmal Kumar, S. (2013). Awareness-cum-training programme at Bangalgram village. *Indian Silk.* **4 (6&7):** 47.

57. Verma, A. K., Kumar, S. and Bindroo, B.B. (2013). Field day-cum-audiovisual programme at Manikchawk and Laxmipur village. *Indian Silk.* **4 (3):** 41.

58. Verma, A. K., Kumar, S. and Bindroo, B. B. (2013). Field Day-cum-Audio Visual programme at Bangalgram and Laxmipur village. *Indian Silk.* **4 (1&2):** 44.

59. Verma, A. K., Bindroo, B. B., Ghosh, P. and Santhakumar, M.V. (2013). Awareness-cum-training programme at Bangalgram village. *Indian Silk.* **3 (9):** 35.

IV. BOOKS

1. Ghosh, M. K. and Bindroo, B. B. (2013). Mulberry Cultivation (In English and Bengali)
2. Ghosh, M. K., and Bindroo, B. B and Nirmal Kumar, S. (2013). Sahatut Krishi (In Hindi)
3. Gogoi, S. N., Biswas, T. K., Ghosh, M. K. and Nirmal Kumar, S. (2013). Nuni Kheti.(*Assamese*).
4. Manna, S. and Nirmal Kumar, S. (2014). Byabaharik pustika: Barjya Guti O Barjya Reshamer Banijyil Proyog. (*Bengali*).
5. Misro, S. K. (2014). Commercial Silk worm rearing: Byabasayika Reshama Keetapalana Margadarshika" (*Oriya)***.**
6. Nirmal Kumar, S., Roy Chowdhuri, S., Singh, M. K. and Chakravarty, D. (2014). Serculture Technolgies XI and XII Plan (Upto 2014).
7. Nirmal Kumar, S., Tewary, P. K. and Hossain, Z. (2014**)**. Resham Anusandhan, Ek Kadam Gaon Ki Or (*Hindi*).
8. Nirmal Kumar, S. (2013). Training manual on Silkworm Seed Production.
9. Pamehgam, M., Sankar, M. Biswas, T. K. and Roy Chowdhuri, S. (2013). Sangat Dakshata Unnayan Aachani (ISDS) Samprasaran Sevakar Dakshta Unnatikaran. *(Assamese*).
10. Roy Chowdhuri, S., Singh, M. K., Mukhopadhyay, S. K. and Chakravarty, D.(2014). Drectory of Concluded Projects Vol.-II. (2012-2014).
11. Sankar. M, Pamehgam, M., Biswas,T.K and Saha, A. K.(2014). Anijyik bhitit nuni polu paalan (*Assamese*).
12. Sahu. R. (2014). Mulberry cultivation: *Tut Chas* (Oriya).
13. Sahu, R. (2014). Skill updation of Extension agents: Bistara Pratinidhinka Nipunata Adhunika Adhunikee Karana (*Oriya*).

V. COMPENDIUM OF TECHNOLOGIES

1. Serculture Technologies XI and XII Plan. (2014). Nirmal Kumar, S., Roy Chowdhuri, S., Singh, M. K. and Chakravarty, D.
2. Sericulture technologies developed for West Bengal. (2013). Bindroo, B. B., Santha Kumar, M. V., Mukhopadhyay, S. K., Das, D., Chanda, S., Singh, M. K. and Roy Chowdhuri, S.

3. Sericulture technologies developed for Odisha, Chhattisgarh, Jharkhand. (2013). Bindroo, B. B., Santha Kumar, M. V., Mukhopadhyay, S. K., Das, D., Chanda, S., Singh, M. K. and Roy Chowdhuri, S.
4. Sericulture technologies developed for Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura & Sikkim. (2013). Bindroo, B.B., Santha Kumar, M.V., Mukhopadhyay, S.K., Das, D., Chanda, S., Singh, M. K. and Roychowdhury, S. A compendium of technologies, Published by CSR&TI, Berhampore, April, (2013).

V. BOOK CHAPTER

1. Chakrabarty, S., Deb, S., Saha, A. K., Hazra, N., Singh, M. K., Manna, B. and Bindroo, B. B. (2013). Light, scanning and transmission electron microscopical study on integument and innate protein profile study due to Nuclear Polyhedrosis Virus (Family: *Baculoviridae*) infection in *Bombyx mori* L. (Lepidoptera: *Bombycidae).*In: *Research and development in India sericulture (*Eds. Sharma, Pandey, Jaiswal, Kumar, Kumari, Rajauddin, Kumar).pp.242-257.
2. Maji, M. D., Maji, C. and Bindroo, B. B. (2013). Epidemiology and prediction of *Myrothecium* leaf spot of mulberry caused by *Myrothecium roridum*. In: *Plant Disease Management and Microbes*, Edited by Nehra, S, Aaviskar Publisher, Distributors, Jaipur. pp.159-165.

VI. BOOKLET

1. Saha, A.K., Dutta (Biswas), T. and Nirmal Kumar, S. (2014). *Japanee (Bivoltines) Palupalaner Nirdeshika* (Bengali).

VII. BROCHURES/ PAMPHLETS/ BULLETINS/CALENDERS

A. BROCHURES

1. Chakrabarty, S., Saha, A.K. and Nirmal Kumar, S. *Sericillin* – a disinfectant for silkworm body and bed. (Bilingual), January, 2014.

B. *PAMPHLETS*

1. Bandyopadhyay, U. K., Chatterjee, S., Maji, C. and Nirmal Kumar, S. (2014). Root Mealy bug *Paraputo sp* (Homoptera: Pseudococcidae) and its management. *Pamphlet No. 2* (English), January, 2014.
2. Bandyopadhyay, U. K, Chatterjee, S. Maji, C. and Nirmal Kumar, S. (2014). *Jarama Paine Kira* Ani Yasko Babyastapan. *Pamphlet No. 2* (Nepali), January, 2014.
3. Maji, M. D., Maji, C and Nirmal Kumar, S. (2014). Mulberry package of practices of mulberry plantation for Sub-Tropical Hills. *Pamphlet No. 1* (English), January, 2014.
4. Maji, M. D., Maji, C. and Nirmal Kumar, S. (2014). Pahari khetrama kimbu khetiko abhyas prasatab. *Pamphlet No. 1* (Nepali). January, 2014.

5. Sankar, M., Pamehgam, M. and Biswas, T. K. (2013). Nuni polur rog nibaron aru Niramoi. *(Assamese*).
6. Sankar, M., Gogoi, S. N. and Biswas, T. K. (2013). Nuni gachor Vyadhi Aru Pratirodh. *(Assamese*).
7. Santha Kumar, M.V., Lalitha, N., Das, D., Mukhopadhyay , S. K. and Saha, A. K. (2014). Whitefly and its management in mulberry. *Pamphlet No. 10* (English), January, 2014.
8. Santha Kumar, M.V., Lalitha, N., Das, D., Mukhopadhyay , S. K. and Saha, A. K. (2014). Tutgache Sadamacheer Niyantran. *Pamphlet No. 11*(Bengali), January, 2014.
9. Santha Kumar, M.V., Lalitha, N., Das, D., Mukhopadhyay , S. K. and Saha, A. K. (2014). Management of Thrips in mulberry. *Pamphlet No. 12* (English), January, 2014.
10. Santha Kumar, M.V., Lalitha, N., Das, D., Mukhopadhyay , S. K. and Saha, A. K. (2014). Tutgache Thrips niyantran. *Pamphlet No. 13 (*Bengali), January, 2014.

C. BULLETINS

1. News & Views, June, 2013 (English & Hindi).
2. Resham Darshan, June, 2013 (Hindi)

D. LEAFLETS

1. Alam, M. and Naqvi, A. H. (2013). Resham udyog mei kitpalangrih evam kitpalan upakaranonka visankraman tatha iska mahatwa.
2. Babu, Ch Sudhakar, Sharma, S., Alam, M., Kumar, R. and Singh, G. (2014). Resha Keetpalan (Hindi).
3. Babu, Ch Sudhakar, Sharma, S., Alam, M., Kumar, R. and Singh, G. (2014). Sahatut paudharopon (Hindi).
4. Chakrabarty, S., Hossain, Z., Saha, A. K., Bindroo, B. B. and Nirmal Kumar, S. (2013). Technical Description,'Sericillin- a synergistic composition for disinfecting silkworm body and silkworm bed'.
5. Naqvi, A. H. and Bindroo, B. B. (2013). Vriksha pranali adharit sahatut pranali.
6. Naqvi, A. H. and Alam, M. (2013). Kisan Nurseries: Krishakonki Atirikt Yaay ka Sadhan.
7. Purohit, K. M., Das Mohapatra, D. P., Ghosh, M. K. and Nirmal kumar, S. (2014). Tuta Bagichare Peedak Poka Parichalana. (In Oriya) pp. 1-6.

VIII. PROCEEDINGS OF SEMINAR/WORKSHOP/ SYMPOSIUM:

Full Papers

International

Proceedings of 6th Bacsa International Conference, Building Value Chains in Sericulture, "BISERICA" 2013, Padua, Italy, 7th –12th April, 2013.

1. Moorthy, S. M., Das, S. K., Kar, N. B. and Mandal, K. (2013). Breeding of hardy bivoltine silkworm breed and identification of polyvoltine x bivoltine silkworm hybrid suitable for variable climatic conditions of the tropics of India. pp. 269-280.

National

1. Proceedings in Golden Jubilee Conference - Sericulture Innovations: Before and Beyond 2011, CSR&TI, Mysore in R&D Advancements in Indian Sericulture during December, 2013.

1. Banerjee, R., Chhetri, P. B., Lalitha, N., Saha, A. K. and Bajpai, A. K. (2013). Correlation of morphological and anatomical features of mulberry with resistance to bacterial leaf spot. pp. 86-93.
2. Chakravarty, D., Chaudhuri (nee Mukhopadhyay), M. and Bajpai, A. K. (2013). Studies on the relationship between lamina yield and yield components of some high foliage yielding castor (*R. communis* L.) suitable for ericulture. pp. 315-317.
3. Chattopadhyay, S, Sangma, C. D. and Tikader, A. (2014). Evaluation of some morphotypes for resistance caused by *phyllosticta persae* in field environment. pp. 321-326.
4. Chaudhuri (nee Mukhopadhyay), M., Chakravarty, D., Das, N. K., Ghosh, A. and Bajpai, A. K. (2013). Genetic variability and association of yield traits in castor (*R. communis* L.) variety RG-2824 – A promising food plant for Eri silkworm. pp. 312-314.
5. Dikshit, B. K. and Purohit, K. M. (2013). Intercropping leguminous crops with mulberry and enhancing soil health of rain fed mulberry garden in Odisha state. pp. 56-62.
6. Jalaja, S. K., Reddy, M. M., Mogili, T., Saha, S. and Bajpai, A. K. (2013). Sodium: Potassium ratio for determining alkalinity tolerance in mulberry Ed. by B. B. Bindroo & Mukund V. Kirsur. pp. 24-27.
7. Kar, N. B., Majumdar, M. K., Chanda, S., Saha, L. M., Saha, A. K. and Bajpai, A. K. (2013). Studies on inter and intra-cocoon variation in physical and tensile properties of raw silk of different voltinism of *Bombyx mori* L. available in West Bengal. pp. 372-381.

8. Patnaik, M., Mitra, P., Santha Kumar, M. V., Kar, N. B., Das, N. K., Bhattacharya, D. K., Saha, A. K. and Bajpai, A. K. (2013). Efficacy of new pesticides in controlling whitefly and its impact on silkworm rearing. pp 110- 113.
9. Purohit, K. M., Dash, B. D., Dikshit, B. K. and Bajpai, A. K. (2013). Performance of some improved mulberry varieties under rainfed conditions in the eastern ghat high land zone of Odisha. pp. 51-55.
10. Purohit, K. M., DAS Mohapatra, D. P., Naik, B. N. and Bajpai, A. K. (2013). Impact of Institute Village Linkage Programme (IVLP) in Deogarh, Keonjhar and Mayurbhanj districts of Odisha under rain fed conditions. pp. 453-455.
11. Santha Kumar, M.V., Datta, P., Chakrabarti, S., Mukhopadhyay, S. K., Das, N.K., Mitra, P., Saha, A.K. and Bajpai, A.K. (2013). Effect of whitefly population and abiotic factors on Population dynamics of a native predator, *Micraspis discolor*. pp. 127- 131.

2. **Proceedings of 1st Bodoland National Seminar cum Workshop on Sericulture industry and its role in socio-economic upliftment in rural society during 10th to 11th August, 2013 at BTC, Kokrajhar, Assam.**
    1. Choudhury, B.N., Engzaanga, D., Vanlallawma C., Pachuau L., Deori, S. and Biswas T.K. (2013)**:** Development of Sericulture in Mizoram: an alternative source of livelihood for the Tribal communities. pp. 139-145.
    2. Choudhury B. N., Engzananga D., Vanlallawma C., Pachuau, L., Deori, S. and Biswas, T. K. (2013**).** Development of Sericulture in Mizoram: an alternative source of livelihood for the Tribal Communities. pp.139-145
    3. Das, G. C., Deuri, J., Sahu, A.K., Giridhar, K., and Nath, D. (2013).Status of Muga and Eri Silk production and its quality standards in Bodoland Territorial Autonomous Districts (BTAD), Training impact on its improvement - A field study. pp. 63-72.
    4. Das, R., Sankar, M., Mech, D. and Choudhury, B. N. **(**2013**):** Role of sericulture developmental schemes in women Empowerment in Assam with special reference to Muga and Eri culture. pp. 155-158.
    5. Das, R., Sankar, M., Chaudhury, B. and Mech, D. (2013). Delicacy in Sericulture. pp. 256-260.

3. **Proceedings of National seminar on Management of Natural Resources for Sustainable Development: Challenge and opportunities held on 6-7th March 2014 at Mizoram University.**
    1. Das, R., Choudhary B.N., Giridhar K. (2013). Status of muga culture and technology adoption in Assam. pp. 125-128.

2. Das R., Sankar, M., Chaudhury, B., Mech, D. and Chaudhury B.N. (2013). Role of Sericulture Development Schemes in Women Empowerment In Assam with special reference to Muga & Eri Culture. pp. 155-158.

IX.ATTENDED & PRESENTED PAPER IN WOEKSHOP/SEMINAR /SYMPOSIUM

Abstracts

National

1. **Proceedings of the International Conference on *Biodiversity, Bioresources and Biotechnology* held at Mysore on 30th -31st January, 2014.**

    1. Banerjee, R., Chattopadhyay, S., Biswas, D., Saha, A.K. and Nirmal Kumar, S. (2014). Assessment of genetic diversity through RAPD and ISSR markers in mulberry (*Morus* spp.): a host plant of domesticated silkworm. p. 61.

    2. Chattopadhyay, S., Sarkar, S., Biswas, D., Banerjee, R., Saha, A. K. and Nirmal Kumar, S. (2014). Assessment of genetic diversity of mulberry species using molecular markers and antioxidative biochemical parameters. p. 61.

2. **Proceedings of XXXIII International Congress on Integrated Decentralized Planning: Geospatial Thinking, ICT and Good Governance held on 19th to 21st September, 2013 at Regional Remote Sensing Centre, Jodhpur.**

    1. Chaudhuri (nee Mukhopadhyay), M. and Nirmal Kumar, S. (2013). Geospatial thinking initiative in sericulture: assessment of real time photothermal impact on growth and yield of mulberry. p. 24.

3. International Conference on Harmony with Nature in Context to Ecotechnological Intervention and Climate change (Harmony-2013) during 11th - 13th November, 2013, D. D. U. Gorakhpur University, Gorakhpur, U.P.

1. Maji, M. D., Das, N. K., Maji, C. and Nirmal Kumar, S. (2013). Epidemiology and prediction of powdery mildew (*Phyllactinia corylea*) of mulberry (*Morus* spp.) for the gangetic plains of West Bengal. *Abs.* 104, p. 30.

National

1. **Plenary Lecture presented in National Conference on Recent trends in Life Sciences with reference to biotechnology and applied Zoology, held at Yashwantrao Chavan College of Science, Karad, Maharashtra during 27th - 28th September, 2013.**

    1. Santha Kumar, M.V., Lalitha, N., Mukhopadhyay, S. K., Das, D., Das, N. K., Singh, M. K., Saha, A. K. and Nirmal Kumar, S. (2013). Efficacy of various pesticides on thrips management in mulberry. Abs. p. 43.

2. **Proceedings of Proceedings of National Conference on Sericulture for Livelihood Security held at the College of Sericulture, Chintamani, Karnataka during 29th-31st January, 2014.**

   1. Das D., Mukhopadhyay, S. K., Santha Kumar, M.V., Saha, A. K. and Nirmal Kumar, S. (2013). Technology intervention and its impact on sericulture in the Eastern and North Eastern region of India. Abs. SEO-11, p.144.
   2. Dikshit, B. K., Purohit, K. M. and Jaishankar, C. (2014). Micro nutrient and soil health management of mulberry garden through intercropping of leguminous crops under rainfed condition. Abs. MPO- 02, pp.1-2.
   3. Purohit, K. M., Das Mohapatra, D. P., Ghosh, M. K., Bindroo, B. B. and Nirmal Kumar, S. (2014). Studies on the Impact of Improved Package of Practices for rainfed mulberry sericulture in western and northern Odisha through farmer participatory mode under Institute Village Linkage Programme. Abs. SEO-01, p.134.
   4. Suresh Kumar, N., Saha, A. K., Chatterjee, G. K. and Nirmal Kumar, S. (2013). Evaluation and identification of bivoltine hybrids of the silkworm, *Bombyx mori* L. suitable for the highly fluctuating and varied climatic conditions of West Bengal. Abs. CPO-39, p. 82.

3. **Proceedings of National Conference at KSSRDI, Thalaghattapura, Bangalore on "Recent advances in modern biology & sericulture for women empowerment and rural development", held on 24th -26th Oct., 2013.**

   1. Chakrabarty, S., Saha, A. K., Varma, A. K., Manna, B. and Bindroo, B. B. (2013). Spread of *Nosema bombycis* and outbreak of pebrine disease in *Bombyx mori* L. in relation to source of contamination. Abs. SED-29, p.115.
   2. Chanda, S., Mukhopadhyay, S. K., Das, N. K., Saha, L. M., Ghosh, M. K. and Nirmal Kumar, S. (2013). Adoption level of technologies by the women sericulturists of Karimpur, Nadia, West Bengal SEF-26, p. 148.
   3. Chaudhury, B.N., Pachuau, L.,Das, R,and Bindroo, B.B. (2013). Evaluation of mulberry based vegetable intercropping system for additional income in Mizoram condition. Abs. SEA-15, p. 11.
   4. Chaudhury, B.N., Bindroo, B.B., Pachuau, L., Biswas, T. K. and Das, R. (2013). Development of mulberry sericulture in Mizoram through adoption of improved technologies and cluster mode approach. Abs. SEC-12, pp. 51-52.
   5. Datta (Biswas), T., Nath, T. N., Saha, A. K., Biswas, P. K., Banerjee, T., Shibnath, Kar, N. B. and Nirmal Kumar, S. (2013). Effect of planting geometry in chawki mulberry garden on cocoon production. Abs. SEA – 41, p. 27.

6. Santha Kumar, M.V., Datta, P., Chakrabarti, S., Das, N.K., Mukhopadhyay, S.K., Lalitha, N., Saha, A.K. and Nirmal Kumar, S. (2013). Factors influencing the incidence pattern of whitefly, *Aleuroclava pentatuberculata* in mulberry. Abs. SEB- 12. pp. 39-40.
7. Sreekumar, S., Ashwath S.K. and Nirmal Kumar, S. (2013). Identification of molecular markers linked to gene/s controlling susceptibility/non-susceptibility against BmNPV in the mulberry silkworm, *Bombyx mori*. Abs**.** SEC-63, p. 84.
8. Srinivasa, G**.,** Rahmathulla, V. K., Vindhya, G. S. and Jalaja S. Kumar (2013). Value addition to by-products of sericulture industry by better resource management. Abs. MBC-74, p. 227.

4. Proceedings of National symposium on crop Pathosystem interactions under aberrant weather and perspectives for crop health management. 24-25th October, 2013, Central Rainfed Upland Rice Research Station, Indian ICAR, Hazaribag, Jharkhand.

1. Maji, M. D., Dutta, S. K., Maji, C. and Nirmal Kumar, S. (2013). Role of weather conditions in the development of brown leaf rust (*Peridiopsora mori*) diseases of mulberry (*Morus* sp.) under subtropical hills of Kalimpong. Abs.No. O.L. 1.05, p. 8.

5. Proceedings of National Symposium on application of Clay Science in Agriculture, Environment and Industry Regional Centre, NBSS & LUP, Delhi held on 27-28th September, 2013.

1. Ram, R. L., Maji, C., Ahmed, N., Bindroo, B. B and Nirmal Kumar, S. (2013). Characterization, Classification and Mineralogy of Benchmark soils of Kalimpong hills under mulberry farming. Abs. No. T-3/6. p.35.

6. Proceedings of National Conference on Bio-diversity and Ecological Sustainability held at Puri Odisha during 15-16th February, 2014.

1. Babu, A. M., Jalaja S. Kumar, Chikkanna and Bindroo, B. B. (2014). A comparative anatomical study on the development of the root-knot nematode, *Moloidogyne incognita* in the roots of two mulberry varieties with varying disease tolerance. Abs. p. 16.
2. Tewary, P. K., Misra, A. K., Ghosh, M. K. and Nirmal Kumar, S. (2014). Effect of plant growth promoting Rhizobacteria (*Pseudomonas fluorescens*) strain on leaf quality and quantity improvement of mulberry. *Abs*. p. 72.

7. Proceedings of National Seminar on "Emergent Conservation of Bio-diversity Void of Sustainable Vision is a Threat to Mankind" on 22nd and 23rd May, 2013 organized by Department of Zoology, Nabajyoti, College, Kalgachia, Assam.

1. Choudhury, B. N., Pachuau, L., Ahmed, M., Lalfelpui, R. and Biswas, T. K. (2013). Prospect of Eri culture in Mizoram and scope for sustainability.

8. Proceedings of National conference on Recent advances in Modern biology and Sericulture for women empowerment and rural development during 24-26th October 2013 at Thalaghattapura, Karnataka, Bengaluru– 560 062

1. Choudhury, B. N., Pachuau, L., Das, R., Bindroo B. B. and Lalfelpuii R. (2013). Evaluation of Mulberry based vegetable intercropping system for additional income in Mizoram condition.

9. Proceedings of National seminar on Recent Advances in Natural Products Research during 29th November to 1st December, 2013 at Pachhunga University College. Aizawl.

1. Esther, L., Gurusubramanian, G., Lalfelpuii, R., Senthil Kumar, N. and Pachuau, L. (2013). Wild silk producing insects (Lepidoptera: Saturniidae) of Mizoram – their potential and prospects.

10. Proceedings of National Conference on recent advances in modern biology & Sericulture for Women Empowerment and Rural Development, held on 24th to 26th October 2013 at Karnataka State Sericulture Research and Development Institute, Bangalore.

1. Das, R., Dutta, P., Choudhary, B. N. and Singh, R. (2013). Present status of uzi fly, exorista bombysis (Louis) (Diptera;Tachinidae): Incidence on Muga Silkworm, *Antheraea assamensis* helfer (Lepidoptera : saturnidae) in upper Assam. p. 98.

2. Das, R., Rajkhowa, G., Choudhary, B. N. and Mech, D. (2013). Role of Self Help Group in women Empowerment through muga and eri culture in Assam. p. 131.

10. Proceedings of All India Rajbhasha Sangosthi DRDO, Tejpur, held on 15th January 2014 at Tejpur, Assam.

1. Roy Choudhuri, S., Chakrabarty, D., Chaudhury, B. and Nirmal Kumar, S. (2014). Shahatoot Resham Keet (*Bombyx mori* L.) ka ek matra parposhi podha manav jiban ka iska arthik mahatva. p.22.

10. RESEARCH PROJECTS AND PROGRAMMES

Total: 58 (22 Projects + 5 Pilot study + 31 Prog.)
Projects: 22

Sl. No.	Code No.	Title	PI
1.	**PIB 3424**	Development of cold tolerant mulberry genotypes for sub-tropical plains. (Jan., 09 to Dec., 15)	M. K. Ghosh, Sci-D
2.	**PPS 3435**	Studies on micronutrients for sustained high productivity of quality mulberry in Eastern and North-Eastern India. **(Collaboration with 4 RSRSs)** (Jan., 10 to June, 13) **(Concluded)**	R. Kar, Sci-D
3.	**PPS-3452**	Terrestrial carbon sequestration for sustained high productivity of quality mulberry. (July, 11 to June, 15)	R. Kar, Sci-D
4.	**PIG 3441 (DBT)**	Development, validation and utilization of SCAR marker(s) for Powdery Mildew (*Phyllactinia corylea)* resistance in mulberry. (In collab. with CCMB, Hyderabad). (Oct., 09 to Aug., 13) **(Concluded)**	S. Nirmal Kumar, Sci-D
5.	**(DBT)**	Development of DNA marker based genetic linkage map of mulberry and QTL analysis for agronomically important *Planta* traits (Mar., 11 to Feb., 14) **(Concluded)** R. Banerjee, Sc-D	R. Banerjee, Sci-D
6.	**MOE-3459**	Yield gap in mulberry sericulture – A study in North-Eastern region of India (Oct.,11 to April,14)	M. Pamehgam, Sci-D
7.	**ARE 3464**	Biology and feeding efficacy studies of *Scymnus pallidicolli* (Mulsant) for the eco-friendly management of pink mealy bug, *Maconellicoccus hirsutus* (Oct., 11 to Sept., 13) **(Concluded)**	M. Patnaik, Sci-C
8.	**AIB 3466**	Development of region specific bivoltine breeds suitable for highly fluctuating and seasonally variable climatic conditions of Eastern and North-Eastern India (Aug., 11 to Dec., 16)	N. Suresh Kumar, Sci-D
9.	**PIP 3469**	Screening of early sprouters and late senescence mulberry variety with better leaf yield and quality under low temperature condition (Nov., 11 to Oct., 14)	A. K. Misra, Sci-C (upto Sept., 13) P. K. Tewary Sci-D (w.e.f. Oct., 13)
10.	**AIP 3472**	Standardization and determination of temperature tolerance potentiality in different developmental stages of silkworm , *Bombyx mori* L. (Sept., 11 to Aug., 14)	A.K. Saha, Sci- D

Sl. No.	Code No.	Title	PI
11.	**AIE 3454**	Evaluation of elite bivoltine silkworm germplasm under different agro climatic conditions: All India Silkworm Germplasm Evaluation Programme Phase-II". (Sept., 11 to Aug., 14)	M. K. Singh, Sci-D
12.	**AIB 3496**	Development of high temperature and high humidity tolerant bivoltine breeds of silkworm (*Bombyx mori* L.(June.,12 to May.,15**)**	N.Suresh Kumar, Sci-D
13.	**AIB 3480**	Development of silkworm of silkworm *(Bombyx mori* L) breeds from a gene pool with higher genetic plasticity**.** (Sept., 12 to Aug., 16)	G. K. Chattopa-dhyay, Sci-C
14.	**CSS 2107**	Forewarning of Mulberry diseases of Eastern and North Eastern India.(Sept., 12 to Aug., 17**)**	S .K. Datta, Sci-D
15.	**AIB 3491**	Post Authorization Trials of Silkworm Hybrids in Eastern & North-Eastern India.(Sept., 12 to Dec., 14)	N. Suresh Kumar, Sci-D
16.	**PIB 3479**	Development of high yielding mulberry varieties using physiological growth parameters as markers for selection. (Oct., 12 to Sept., 16)	Jalaja S. Kumar, Sci-D
17.	**PPF 3487**	Decision support system initiative through impact assessment of agro-climate on foliage yield of mulberry (*Morus* sp) for climate resilient sericulture in Eastern India.(Oct., 12 to Sept., 13) **(Concluded)**	Monica Choudhuri, Sc-C
18.	**PIB 3481**	Evaluation of mulberry varieties suitable for low in put soils (Jan., 13 to Dec., 17).	M.K.Ghosh, Sci-D
19.	**PPA 3499**	Evaluation of field level performance of Vishal mulberry variety in different locations under irrigated conditions in West Bengal (Apr., 13 to Mar., 18)	S.K. Mondal, Sci-D
20.	**APS 3497**	Studies on the environmental effect on P1 rearing, its graining performance followed by commercial rearing of silkworm *Bombyx mori* L., during unfavorable seasons of West Bengal. (May, 13 to April, 15)	T. Datta (Biswas), Sci-D
21.	**AIB 3501**	Development of high temperature and high humidity tolerant bivoltine breeds of silkworm (*Bombyx mori* L.) Brreds with high shell percentage and hifh neatnes of silk filament. (July,13 to June,16)	A.K.Verma, Sci-C,
22.	**PIB 3505**	Development of drought tolerant mulberry variety for rainfed sericulture. (Jan.,14 to Dec.,19) [Collaborative project with CSGRC, Hosur]	M.K.Ghosh, Sci-D

Pilot Study: 5

Sl. No.	CODE No.	TITLE	PI
23.	**BAR (PS)002**	Formulation of broad spectrum room disinfectant for silkworm disease management. (Aug., 11 to July,13) **(Concluded)**	S. Chakraborty, Sci-C
24.	**BPR (PS) 003**	Identification of DNA markers associated with Bacterial Leaf Spot resistance in mulberry (*Morus spp*.) (April., 13 to March,15)	R. Banerjee, Sci-D
25.	**BAR (PS) 004**	Testing of immunogens for prevention of silkworm diseases in *Bombyx mori* L. (July,13 to June,14)	S. Chakraborty, Sci-C
26.	**B-JRH (PS) 005**	Identification of productive Multi X Bi hybrids for plains of NE states of India through development of improved multivoltine breeds of silkworm, *Bombyx mori* L utilizing local indigenous strains. (April,13 to May,14)	T.K. Biswas, Sci-D
27.	**PS**	Development of multivoltine Congenic /NIL breed of silkworm (*Bombyx mori* L.) through introgression of '*Id*' gene. (April, 13 to March, 14).	G. K. Chattopa-dhyay, Sci-C

Programmes: 31

Sl. No.	CODE No.	TITLE	PI
28.	**BPR (P) 021**	Development of weather based forecasting models for mulberry pests. **(Collaboration with 3 RSRSs & 2 RECs)** (Apr., 05 to Dec., 10; Extn. up to Dec., 15)	S. K. Mukhopadh yay, Sci-D
29.	**BPP(P) 020**	Evaluation of soil fertility for sustained production of quality mulberry leaf in Eastern India under long-term fertilization. (Jul., 05 to Jun., 10; Extn. up to Dec., 15**)**	R. Kar, Sci-D
30.	**AICEM (Ph-III)**	All India Coordinated Experimental Trail for Mulberry (AICEM)- Phase III, (A prog. of C.O., Bangalore) (April, 11 to June, 15)	M.K.Ghosh, Sci-D
31.	**BPI (P) 025**	Maintenance of mulberry germplasm bank at CSR&TI, Berhampore (W.B). (Jan., 14 to Dec., 19)	M.K.Ghosh, Sci-D
32.	**BPP (RP) 001**	Production of Azotobacter *(Nitrofert.)*. Continuous	S. Rajaram, Sci-D
33.	**BPP (RP) 002**	Production VA- Mycorrhiza (*Phosphofert*) Continuous	S. Rajaram, Sci-D
34.	**BPR (VP) 006**	Studies on the field efficacy of selected dose of insecticide in whitefly management (July, 11 to June, 13) **(Concluded)**	M.V Santha Kumar, Sci-D

Sl. No	Code No.	Title	PI
35.	**B-RNC (VP) 007**	Validation trial of package of nutrient under rainfed condition (**RSRS, Ranchi)** (Oct.,11 to Oct.,13) **(Concluded)**	Ghanshyam Singh, Sci-D
36.	**B-KPG (P) 006**	**Muga seed multiplication prog.**: Raising of Muga host plantation at RSRS-Annex, Kalimpong (As per the Central Office Letter no.:CSB-65/1/2004-05/TS-4/ Dated 16-10-09.). (Nov., 09 to March, 14)	M. D. Maji, Sci-C **(RSRS, Kalimpong)**
37.	**BAI (P) 007**	Establishment of molecular IDs for the mulberry silkworm breeds (*Bombyx mori*) evolved by CSR&TI, Berhampore (Jul., 11 to Jun., 13) **(Concluded)**	S. Sree Kumar, Sci-D
38.	**BAI (P) 014**	Studies on the reelability of multivoltine hybrid cocoons during adverse climatic conditions in Eastern & North-Eastern region. (July, 11 to March, 14) **(Concluded)**	N.B. Kar, Sci- D
39.	**B-KPT (P) 017**	Assessment of fertility status of mulberry growing soils in selected Seri-village of Koraput for appropriate fertilizer management. (Jan., 12 to Dec., 13) **(Concluded)**	S.K. Mishro, Sci-C **(RSRS, Koraput)**
40.	**B-RNC (P) 018**	Assessment of fertility status of mulberry growing soils in selected Seri-village of Ranchi for appropriate fertilizer management. (Jan., 12 to Dec., 13) **(Concluded)**	Ghanshyam Singh, Sci-D **(RSRS, Ranchi)**
41.	**B-JRH (P) 019**	Assessment of fertility status of mulberry growing soils in selected Seri-village of Jorhat for appropriate fertilizer management. (Jan., 12 to Dec., 13) **(Concluded)**	S. N. Gogoi, Sci-D **(RSRS, Jorhat)**
42.	**BAI (RP) 003**	Maintenance of multivoltine and bivoltine germplasm. (Continuous)	G. K. Chattopadhyay, Sci-C
43.	**B-KPG (P) 015**	Improvement of rearing technology for autumn crop in Sub-Himalayan region. (Aug., 12 to Jan., 14) **(Concluded)**	R. Bhutia, Sci-D **(RSRS Kalimpong)**
44.	**BAI (P) 008**	Screening and identification of bivoltine breeds for Eastern and North-Eastern India. (Aug.,11 to March, 13) Extended 1 year upto March., 14. **(Concluded)**	N. Suresh Kumar, Sci-D

Sl. No	Code No.	Title	PI
45.	**BPP (VP) 008**	Field evaluation of plant growth regulator combination for improvement of quality leaf yield of mulberry especially under cold stress condition (Dec.,11 to Nov.,12) Extended 1 year upto Nov.,13. **(Concluded)**	P.K. Tewary, Sci- D
46.	**BPP(P) 023**	Optimum requirements of irrigation water and its management s for sustainable leaf productivity in high yielding mulberry garden under West Bengal conditions. (May., 13 to April., 14)	S. Rajaram, Sci-D
47.	**BAR (P) 024**	Identification of pathogens causing Gattine like disease in the silkworm *Bombyx mori* L. (July,13 to Dec.,14)	Z. Hossain, Sci-C
48.	**BAI (RP) 006**	Silkworm disease monitoring of seed and commercial crop rearing of West Bengal. (April,13 to May,14)	S.Chakraborty, Sci-C
49.	**B-KPG (RP) 007**	Monitoring of silkworm diseases in Kalimpong hill. (April,13 to May,14)	U.K.Bandyopadhyay, Sci-D
50.	**B-KPG (RP) 008**	Maintenance of Bivoltine silkworm germplasm breeds. (April,13 to May,14)	R.Bhutia, Sci-D
51.	**B-JRH (RP)009**	Survey and survillance of mulberry and silkworm pests and diseases of N.E.states. (Oct.,,13 to Sept.,14) Routine activity.	M.Pamehgam, Sci-D
52.	**B-KPG (RP)010**	Survey and survillance of mulberry and Silkworm diseases & pest in Kalimpong hills. (Oct.,13 to Sept.,14) Routine activity.	S.Chatterjee, Sci-C
53.	**BPI (P) 026**	Popularization of water logged tolerant mulberry variety C-2028 (Feb.,14 to Jan.,17)	P.K.Tewary, Sci-D
54.	**BAR (VP) 009**	"Ghar Sodhan" – a fumigant room disinfectant for silkworm disease management. (Jan.,14 to Dec.,14)	S.Chakraborty, Sci-C
55.	**B-KPG (RP) 011**	Multiplication and supply of SK6 x SK7 dfls to Sikkim and plain areas (Routine programme)	M. D. Maji, Sci-D
56.	**BAR (RP) 005**	Survey and surveillance of silkworm diseases in traditional Sericultural districts of West Bengal (April, 13 – March, 14) (Routine prog.)	S. Chakraborty, Sci.-C
57.	**B-RNC (RP) 004**	Survey and surveillance of disease and pest of mulberry and silkworm (April, 13 to March, 14) (Routine programme).	M. Alam, Sci-D
58.	**BPP (VP)015**	Validation of E3 WM (Efficient Economic Eco-friendly Weed Mower) at nested units and farmers' field level. (Oct., 13 to Mar., 15).	S.Rajaram, Sci-D

11. CONSULTANCY & OTHER SERVICES RENDERED

A. Filed Indian Patent for 'Sericillin' – a silkworm bed disinfectant through NRDC New Delhi (Ref: IPR/11082-L/2012 dt.18-5-12) through R.K.Dewan & Co (Ref: 650 / Kol / 2012 dated 11.06.12). Commercialization and further development of 'Sericillin' has been done based on the Agreement Deed executed between this Institute and NRDC, New Delhi (vide letter No. NRDCHQ / AS/ RG/ 225B10 / 101464 / 2013 dated 18.02.13). The product has been published in Indian Patent Journal on 13.12.13. Two entrepreneurs have also purchased License from NRDC, New Delhi. The technology has been released to the party after completion of 3 days trainings at this Institute in this year.

B. Right to information Act, 2005:

Sl. No	Date of request	Compliance (vide letter No.)
1	08/04/2013	CSB/CSR&TI/PMCE/R-38/ 2013-14/128 dated 24.10.2013
2	-	CSB/CSR&TI/PMCE/R-38/ 2013-14/ 1656 dated 3.05.2013
3	12/06/2013 & 22/07/2013	CSB/CSR&TI/PMCE/R-38/ 2013-14/311 dated 21/22.06.2012 CSB/CSR&TI/PMCE/R-38/ 2013-14/311 dated 21/22.06.2012 CSB/CSR&TI/PMCE/R-38/ 2013-14/ 7576 dated 10.09.2013 CSB/CSR&TI/PMCE/R-38/ 2013-14/ 7811 dated 18.09.2013 CSB/CSR&TI/PMCE/R-38/ 2013-14/ 9361 dated 24.10.2013
4	2/08/2013	CSB/CSR&TI/PMCE/R-38/ 2013-14/6674 dated 26.08.2013
5	13/01/2014	CSB/CSR&TI/PMCE/R-38/ 2013-14/13916-18 dated 31.01.2014

12. INSTITUTE RAC/IBSC /RC /EOM/ RRAC: MAJOR SCIENTIFIC RECOMMENDATIONS

Place	RAC	IBSC	RC	EOM	RRAC
CSR&TI, Berhampore	12-13/08/2013 & 6-7/03/2014	14/06/ 2013 & 14/03/2014	30/09 & 01/10/2013	15-16/ 05/2013	-
RSRS, Kalimpong	-	-	13/12/2013	13/12/2013	17/06/2013 & 25/01/2014
RSRS, Koraput	-	-	07/11/2013	07/11/2013	04/07/2013 & 18/02/2014
RSRS, Jorhat	-	-	20/09/2013	21/09/2013	27/06/2013 & 01/03/2014
RSRS, Ranchi	-	-	20/12/2013	21/12/2013	29/08/2013 & 25/02/2014

Major Recommendations:

A. Research Advisory Committee:

1. 38th meeting held on 12th - 13th Aug., 2013.

- ☞ RSRSs in coordination with DoT (Seri)/ DoS should put more efforts to meet the requirements of specific region.
- ☞ Institute should have equal share of work load for collaborative projects to avoid dominance of either ends.
- ☞ Outcome of each concluded project should be followed-up properly for its best utilization.

2. 39th meeting held on 6th - 7th March, 2014.

- ☞ Each division should have its own mandate based on which projects should be formulated considering the interest of the stakeholders.
- ☞ Improve the quality of silk and reduce the cost of production and improving the productivity.
- ☞ Scientists have to take advantage from the funding agencies. Collaborations with University are also essential. RSRSs should have to come forward to formulate projects on regional problems.

B. Institute Biosafety Committee (IBSC):

1. 1st meeting held on 14th June, 2013 held at CSR&TI, Berhampore, West Bengal.

- ☞ Finalization of Action Plan for testing of transgenic "Nistari" and "CSR2" silkworm hybrids.
- ☞ Multi-location study of transgenic silkworm along with preparedness of containment facility.
- ☞ Creating the required environment testing of transgenic hybrids. Necessary proposal to send to APSSRDI, Hindupur for funding.

2. 2nd meeting held on 14th March, 2014 at CSR&TI, Berhampore, West Bengal.

- ☞ Preparedness for containment facilities at the Institute for transgenic silkworm testing.
- ☞ Finalization of Action Plan for testing of transgenic "Nistari" and "CSR2" silkworm hybrids.

C. Research Council:

(i) 39th meeting held on 30th Sept. and 1st Oct., 2013.

- ☞ For documentation/ financial implication of every prog., Code No. should be obtained.
- ☞ The Divisional Heads of the Institute should regularly update the achievements in the Institute website.
- ☞ The RSRSs should develop their own database and upload the updated information in the respective websites.
- ☞ RSRSs to put efforts for **"Accreditation of ISO 9001:2008 at RSRSs"**, immediately.
- ☞ The concerned PI/ scientist of the project, prog. pilot study should maintain the project, prog., pilot study documents / ledgers properly.

D. Regional Research Advisory Committee (RRAC):

A. RSRS, KALIMPONG:

1. Meeting held on 17th June, 2013 at Siliguri, West Bengal.

- ☞ Regarding selling of Bivoltine cocoons produced in Sikkim to the DoT (Seri), Kalimpong, the AD, DoT (Seri), Kalimpong was suggested to chalk out the programme in consultation with RSRS, Kalimpong and matching with the rearing programme of DoS, Sikkim so that the bivoltine cocoons can be easily used for production of hybrids in plains of West Bengal.
- ☞ RSRS, Kalimpong to take necessary action for preparation of Bio-fertilizers on a small scale at RSRS Kalimpong with the help of NBU, Siliguri.

- ☞ Higher doses of micronutrients being toxic to silkworm, critical limit of micronutrients and thereby individual micronutrient studies are necessary. Zinc sulphate, should be added along with 50% dose of lime to avoid scorching the leaves.
- ☞ Regarding opening of a separate Muga Unit at Sikkim proposal may be sent to CSB, Bangalore.
- ☞ To meet the demand of basic seed of muga, assistance is needed.
- ☞ Emphasis may be given on introducing the intercrops in the Muga plantation.

A.2. Meeting held on 25th Jan., 2014 at Siliguri, West Bengal.

- ☞ Performance of SK6 and SK7 was encouraging in the Darjeeling and Sikkim hills. Therefore, DoT (Seri.), West Bengal and DoS, Sikkim to promote SK6 and SK7 bivoltine silkworm rearing in Darjeeling and Sikkim Hills to meet the demand of bivoltine seed cocoons for the plains of West Bengal.
- ☞ Development of Muga Sericulture in Darjeeling Hills as well as Terai region.
- ☞ CSR&TI, Berhampore to arrange supply of quality muga dfls from P4 Farm under MSSO, Guwahati for seed crop rearing in Kalimpong hills for better performance.
- ☞ Analysis of soil of DoS, Sikkim Farms and Farmers field for better integrated nutrient management of soil to optimize quality leaf production.

B. RSRS, KORAPUT:

1. 14th Meeting held on 4thJuly, 2013 at Conference Hall of RSRS, Koraput (Odisha).

- ☞ To take a prog. on high bush and tree type mulberry plantation under rainfed condition of Odisha at 3-4 State Mulberry Demonstration Farms (MDFs) as there is immediate need to shift to tree cultivation in view of emerging prospects of bivoltine in the state.
- ☞ REC, Deogarh/ RSRS, Koraput was advised to emphasis on mass disinfection and use of bed disinfectants to stabilize the cocoon yield and extend necessary technical guidance to the farmers of Subarnpur Mulberry Park, Sonpur.

2. 15th Meeting of held on 18th Feb., 2014 at Conference Hall of RSRS, Koraput (Odisha).

- ☞ Field applicability, productivity vis-a-vis investment in as unit area should be given due consideration while formulating projects.
- ☞ Yield gap analysis at farmers' level should be done effectively before. developing/ implementation of the technologies and fine tuning there-on.
- ☞ Bio assay studies on the use of sulphatic fertilizer on silk quality.
- ☞ Collection of soil samples of all the sericulture farmers and analysis of the soil samples.

C. RSRS, JORHAT:

1. 15th Meeting held on 27th June, 2013 at Conference Hall of RSRS, Jorhat, Assam.

- ☞ Identify the new core areas of research. Discuss with DOS, Assam regarding quantity of dfls required, technology demonstration programmes and training to the stakeholders/ staff and coordinate with RO, Guwahati for smooth functioning.
- ☞ Hybrids from outside region are to be tested at farm level before releasing to the field. Formulate the collaborative projects on micronutrients.
- ☞ Development model mulberry farms/ demonstration centers to encourage the farmers to take up mulberry sericulture. Assam may identify the place and RSRS can develop MDC.
- ☞ Arrangement of training for the farmers.
- ☞ One year research programme on pruning and rearing schedule (late summer & late autumn) for Mizoram state, in coordination with DOS, Mizoram.
- ☞ Extension & Training programmes should be organized in coordination with Krishi Vigyan Kendras (KVK) at different locations of N.E. region.

2. 16th Meeting of held on 1st March, 2014 at Conference Hall of RSRS, Jorhat, Assam.

- ☞ RSRS, Jorhat to play a pivotal role for mulberry in North -East region and cater to the needs of the region, the productivity gap at farmers and institute level have to be identified and reduced.
- ☞ Provide training to the reelers of the region.
- ☞ Popularization of CRC concept and systematic plantation among the farmers of Nagaland to be taken up with the active technical support of the CSB.
- ☞ College of Sericulture is being established at Titabar in collaboration with AAU & DoS, Assam, RSRS, Jorhat should assist in the development and formulating the course curriculum.
- ☞ New technologies developed should must be disseminated to the field immediately for the benefit of the farmers.
- ☞ The Joint Director (DoS) Nagaland, requested for the supply of dfls locally.

D. RSRS, RANCHI:

1. 15th Meeting held on 29th Aug., 2013 at CTR&TI Conference Hall, Ranchi, Jharkhand.

- ☞ While taking the feedback of field problems, it was suggested the farmers to use Serichlor/ Seritech and Sericilin for high cocoon production.
- ☞ Proposal for CDP project to CSB through the CSR&TI for implementation and CDP provisions should be circulated among the farmers/NGOs. Assistant

Director, RO, CSB, Patna suggested to incorporate disinfection agents in the project submitted by DoS, Jharkhand.

2. 16th Meeting held on 25th Feb., 2013 at CTR&TI Conference Hall, Ranchi, Jharkhand.

- ☞ Intercropping in mulberry plantation should be done for additional income by the farmers.
- ☞ DoS, Jharkhand should take initiative for fixing of cocoon price for mulberry and cocoon produced by the farmers in the state may be purchased by them. Bulk quantity of cocoons produced by the farmers may be sold to the reelers of Malda, West Bengal.

C. EXTENSION OFFICERS' MEETING:

1. E.O. meeting held at RSRS, Kalimpong on 13/12/2013 at RSRS Farm of Kalimpong.

- ☞ It was suggested to collect the rearing data of the dfls (SK6 x SK7) supplied by the station at farmers level.
- ☞ It was suggested to implement MGNREGA scheme immediately.
- ☞ It was suggested to ensure the distribution of chawki worms through DoT (Seri.), Kalimpong.

2. E.O. meeting held at RSRS, Jorhat on 20/09 to 21/09/2013 at RSRS, Jorhat, Assam.

- ☞ A fair amount of technical innovations are available. These interventions need to be placed within the broader social context in order to enhance their social acceptability and implementation.
- ☞ Studies of traditional resource management and production systems are required as a basis for identifying constraints and prioritizing resources.

3. E.O. meeting held at RSRS, Ranchi, Jharkhand 21/12/2013 at Nagri.

- ☞ It was decided to send the lists of actual farmers/ Directory of farmers alongwith their mulberry acreage immediately.
- ☞ It was suggested to report the crop yield with maximum and minimum range at farmers' level with the percentage of failure, if any.
- ☞ The benchmark of crop yield to be standardized.

4. E.O. meeting held at RSRS, Koraput on 07/11/2013 at Bhubaneswar, Odisha.

- ☞ It was suggested to submit one page concept note on project proposal based on the regional problems both for mulberry and silkworm.
- ☞ Cluster Promotion Programme to be implemented in such a way that in mulberry sericulture becomes viable with three crops.

13. PARTICIPATION OF SCIENTISTS IN WORKSHOP / SEMINAR/ SYMPOSIUM/ CONFERENCE

13.A. International

13.A.1. Abroad: NIL

13. A.2.In the country

Sl. No.	Workshop/Seminar/Symposium/ Conference	Period	Scientists
1.	"XXXIII International Congress on Integrated Decentralized Planning: Geospatial Thinking, ICT and Good Governance", Regional Remote Sensing Centre, Jodhpur, Rajasthan.	19-21th Sept., 2013	Monica Chaudhuri, Sci-C
2.	"International Conference on Harmony with Nature in Context to Ecotechnological Intervention and Climate change" (Harmony-2013), D. D. U. Gorakhpur University, Gorakhpur, Uttar Pradesh.	11-13th Nov., 2013	M. D. Maji, Sci-C
3.	"International Conference on Biodiversity, Bioresources and Biotechnology" Mysore, Karnataka.	30-31st Jan., 2014	R.Banerjee, Sci-D and S.Chattopa-dhyay, Sci-D

13.B.1. National

1.	"National Conference on Recent trends in Life Sciences with reference to biotechnology and applied Zoology", Yashwantrao Chavan College of Science, Karad, Maharashtra.	27- 28th Sept., 2013	M. V. Santha Kumar, Sci-D
2.	"Recent Advances in Modern Biology & Sericulture for women and empowerment and rural development", KSSRDI, Bangalore, Karnataka.	24-26th Oct., 2013	M. V. Santha Kumar, Sci-D, T. Datta (Biswas), Sci-D, S. Chakrabarty, Sci-C, S. Sreekumar, Sci-D, Subhra Chanda, Sci-D and B. N. Choudhury, Sci-D.
3.	"National Symposium on application of Clay Science in Agriculture, Environment and Industry", Regional Centre, NBSS & LUP, Delhi.	27-28th Sept., 2013	R. L.Ram, Sci-B

Sl. No.	Workshop/Seminar/Symposium/ Conference	Period	Scientists
4.	"National Symposium on Crop pathosystem interactions under aberrant weather and perspectives for crop health management", Central Rainfed Upland Rice Research Station, ICAR, Hazaribag, Jharkhand.	24-25th Oct., 2013	M. D. Maji, Sci-C
5.	"National seminar on Recent Advances in Natural Products Research", Pachhunga University College. Aizawl.	29th Nov -1st Dec., 2013	L. Pachuau, Sci.--B
6.	"National Conference on Sericulture for Livelihood Security", College of Sericulture, Chintamani, Karnataka.	29- 31st Jan., 2014	D. Das, Sci.-C and N. Suresh Kumar, Sci-D.
7.	"National Conference on Bio-diversity and Ecological Sustainability", Puri, Odisha.	15-16th Feb., 2014	P. K. Tewary, Sci-D &A. M. Babu, Sci-D
8.	"National seminar on Management of Natural Resources for Sustainable Development: Challenge and opportunities", Mizoram University, Aizawl, Mizoram.	6-7th Mar., 2014	B. N. Choudhury, Sci-D
9.	"National seminar cum workshop on sericulture industry and its role in socio-economic upliftment in rural society", BTC, Kokrajhar. Assam.	10-11th Aug., 2013	B. N. Choudhury, Sci-D
10.	"National Seminar on Emergent Conservation of Bio-diversity Void of Sustainable Vision is a Threat to Mankind", Department of Zoology, Nabajyoti, College, Kalgachia, Assam.	22- 23rd May, 2013	B. N. Choudhury, Sci-D
11.	Workshop "**Paharma Resham Khetiko Bikas Sambandhi Songosthi Ebong Karyasala**" under CDP (2013-14) organized by DoT (Seri.), Govt. of West Bengal at Kalimpong.	26.02.2014	Scientists, RSRS, Kalimpong.

Sl. No.	Workshop/Seminar/Symposium/ Conference	Period	Scientists
12.	Participated in the **JICA** Krishi Utsab held at the compound of Dr. Grahams Home, Kalimpong, Darjeeling, West Bengal.	02.05.2013	-do-
13.	Participated with an Exhibition stall in the SILK MARK EXPO organized by Silk Mark Organization of India, Corporate Office, Bangalore at City Garden Hall, Siliguri, West Bengal.	05.06.2013 to 10.06.2013	-do-
14.	**A Resource Development Programe** was organized at Agartala from Twenty five Trainees participated in the prog.	5^{th} to 11^{th} Feb., 2014	Scientist of REC, CSB, Agartala.

14. WORKSHOPS / SEMINARS / SUMMER INSTITUTES/ RKM AND FARMERS'DAYS ORGANIZED

14.1. INSTITUTIONAL BIOSAFETY COMMITTEE (IBSC) organized by CSR&TI, Berhampore:

The Institutional Biosafety Committee (IBSC) of the Institute organized its 2nd meeting at the Institute on 14th March, 2014. Dr. S. Nirmal Kumar, Director and Chairman, IBSC, CSR&TI, Berhampore in his introductory remarks informed that containment facilities have been made available at the Institute and testing of transgenic silkworms will be taken up in two phases i.e., first phase at the Institute and second at the farmer's field. The members discussed on the preparedness for containment facilities at the Institute for transgenic silkworm testing and finalization of action plan for testing of transgenic "*Nistari x (SK6 x SK7)*" silkworm hybrids. The IBSC members and Dr. Raju, Director, APSSRDI, Hindupur, special invitee expressed their heartiest cooperation for successful testing of transgenic silkworms at the Institute. Dr. R. K. Bhadra, DBT nominee & Senior Principal Scientist, Infectious Diseases and Immunology Division, IICB, Kolkata, West Bengal, Dr. R. K. Sanyal, Bio-safety Officer & Asst. Chief Medical Officer of Health, Murshidabad, Govt. of West Bengal, Dr. R. Banerjee, Sci-D, Dr. G. K. Chattopadhyay, Sci-C, internal expert members, IBSC, and Dr. P. J. Raju, Director, APSSRDI, Hindupur and Dr. V. Sathyavathi, Scientist, CDFD, Hyderabad as special invitees were the other participants of the meeting.

14.2. Resham Krishi Mela organized by CSR&TI, Berhampore at Rampurhat, Birbhum (W.B.)

A Resham Krishi Mela was organized by CSR&TI, Berhampore at Municipal Ground, Rampurhat (Birbhum) on 21st January, 2014. Sri Ashis Banerjee, Parliamentary Secretary, Govt. of West Bengal was the Chief guest of the event. Sri Ratneswar Roy, SDO Rampurhat as representative of the district Magistrate, Sri Aninda Kumar Saha, Vice-Chairman Rampurhat Municipality, Dr. K. Mandal, Scientist-D, ZSSO Malda, Dr. S. Kole, DD, DoT(Seri) Birbhum,

Mr. S. Das, DD, DoT(Seri) Malda and Mrs. Kaveri Mitra, AD-DoT(Seri) Rampurhat and Dr. S. Nirmal Kumar, Director, CSR&TI, Berhampore & Convenor of the Resham Krishi Mela, 2014 were among the other dignitaries present in the occasion. Highlighting the progress achieved in sericulture as well as live demonstration on reeling, an exhibition was also displayed over there. An *Impact Assessment of the Resham Krishi Mela* was done for the first time through intricate discussion with the farmers and filling up of structured questionnaire. The data generated were later analyzed to schematize future course of action, for extension of scientific - sericulture in a major way. A total of 1006 participants from different districts of West Bengal and Jharkhand took part in the Mela and made the program a grand success.

14.3. Resham Krishi Mela organized by RSRS, Kalimpong

A Resham Krishi Mela was organized on 24th January, 2014 at Rabindra Bhanu Mancha, North Bengal University Campus, Siliguri, Darjeeling with a view to disseminate new technologies to the seri farmers of Darjeeling and Sikkim hills and Terai region. Prof. S. K. Das, Vice Chancellor of North Bengal University, Siliguri was the Chief Guest of the function. Prof. B. N. Chakraborty, Dept. of Botany, North Bengal University, Siliguri, Sri B. K. Mukherjee, Addl. Director, DoT (Seri), West Bengal, Sri H. P. Rai, Addl. Director, DoS, Sikkim and Dr. S. Nirmal Kumar, Director, CSR&TI, Berhampore were the other dignitaries participated the function. Dr. S. Nirmal Kumar, Director, CSR&TI, Berhampore emphasized for rearing of SK6 X SK7 at Darjeeling and Sikkim hills to increase cocoon productivity and also income of the stake holders. He also advised to develop community chawki rearing centre to ensure better productivity of bivoltine cocoon. On this occasion, two pamphlets "*Package of practices of mulberry plantation for subtropical hills*" (English & Nepali version) and "*Root mealy bug and its management*" (English & Nepali version) were released. A total number of 132 farmers participated in the mela.

14.4. Vichar Gosthi organized by RSRS, Kalimpong:

RSRS, Kalimpong jointly with the DoT(Seri.), W.B. at Kalimpong organized a Vichar Gosthi on 26.02.2014 with 75 farmers from 17 villages of Kalimpong with a view to disseminate the latest technologies on sericulture for the development of the farming community. The Vichar Gosthi was inaugurated by Col. Ramesh Aloy, Deputy Chief Executive, GTA. The other participants of the occasion were Prof. Kalyan Dewan, Executive Sabhasad, GTA, Sri. B.T. Lepcha, Deputy Magistrate, W.B., Sri Gopal Ruchel, Sabhasad, GTA, N. Rizal, Asst Director,. DoT (Seri). Kalimpong, W.B., Smt. C. Maji, Sci-D, RSRS, Kalimpong and the other scientists of RSRS, Kalimpong.

14.5. Resham Krishi Mela was organized by RSRS Ranchi, Jharkhand.

A Resham Krishi Mela was also organized by RSRS Ranchi, Jharkhand on 20th December, 2013 at CTR&TI campus, Nagri, Jharkhand. Ram Krishna mission also attended the mela and a total of 713 farmers were educated on mulberry sericulture.

14.6. Resham Krishi Mela organized by RSRS Jorhat, Assam.

A Resham Krishi Mela on mulberry sericulture was organized by RSRS Jorhat, Assam at its own premises on 28th March, 2014. The function was graced by Prof. Pranab Talukdar, AAU, Jorhat as chief guest, Dr. Utpal Baruah, Principal Scientist, NBSS & LUP, ICAR, Rowriah, as guest of honour, Dr D. P. Khanikar, Prof. & Head, Sericulture, Assam Agriculture University, Jorhat & Sri Probin Das, Joint Director, DoS, Upper Assam, Jorhat as special guest and presided over by Sri T. K. Biswas, Sci-D. About 210 mulberry sericulture farmers from the Jorhat, Golaghat and Sivasagar district of Assam participated in the mela. An exhibition on evolved technologies on mulberry sericulture was also organized.

15. LIST OF VISITORS/ DIGNITARIES WHO VISITED THE MAIN INSTITUTE

15.A. MAIN INSTITUTE

Sl. No.	Visitors / dignitaries	Department	Date of visit
1.	Shri T. K. Dutta	I.R.S., Commissioner of Income Tax	23.05.13
2.	Mr. Magan	Asst. Commandant, BSF, Jalangi Camp, Murshidabad.	06.07.13
3.	Dr. Ramesh K. Aggarwal	Chief Scientist (Director grade scientist) of CCMB, Hyderabad, A.P.	12-14.01.14
4.	Dr. P. J. Raju	Director, APSSRDI, Hindupur	14.03.14
5.	Dr. Humayun Kabir, IPS	Superintendent of Police, Murshidabad, West Bengal	12.11.2013

Dr. Ramesh K. Aggarwal, Chief Scientist (Director grade scientist) of CCMB, Hyderabad and Dr. A. Veer Bhadra Rao visited the Institute on 12th to 14th January, 2014 related to project works.

Dr. P. J. Raju, Director, APSSRDI, Hindupur and Dr. V. Sathyavathi, Scientist, CDFD, Hyderabad visited the institute during IBSC meeting.

15.B. RSRS, JORHAT, ASSAM

1. Scientists & Business persons from Japan visited Mizoram.

Prof. Dr. Hiromu Akai, Tokyo University of Agriculture and President of International Society for Wild Silk moths and Japanese Society for Wild Silk moths, Dr. Motoyuki Sumida, Former Professor of Insect Physiology, Biochemistry and Sericology, Centre for Bioresources Field Science, Kyoto Institute of Technology, Kyoto, Japan with 3(three) business personnel Mr. Tanaka Parva, Miss. Yoshie Nagata and Keiko Hiyama visited Aizawl, Mizoram on 7th Feb., 2014 and a meeting

was conducted with the Director's office chamber of Department of Sericulture, Govt. of Mizoram which was attended by different DOS officers and the Scientists of REC, CSB, Aizawl regarding present Sericulture Status of Mizoram and also future strategy for development of the Industry. They also visited Basic Mulberry Seed Farm, Rangvamual and REC, Aizawl.

Japanese delegates arrived at Lengpuii Airport, Aizawl, Mizoram on 7th Feb., 2014.

Meeting with Director's chamber, DoS, Mizoram .

15. C. REC, SHILLONG, MEGHALAYA:

Official of Ministry of Textiles visited on 28th May, 2013

Team of GIZ Project from Germany visited on 12th August, 2013

Official of Ancient Heritage and Research Society, W. B. visited on 1st July, 2013

राजभाषा अनुभाग की गतिविधियाँ (वर्ष 2013- 2014)

Raj Bhasha Anubhag Ki Gatibidhian

केन्द्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, बहरमपुर (प.बं.) में वर्ष 2013-14 के दौरान संघ की राजभाषा नीति का सम्यक अनुपालन किया गया। राजभाषा अधिनियम की धारा -3(3) एवं राजभाषा नियम -5 जैसे अनिवार्य प्रावधानों का शत-प्रतिशत अनुपालन सुनिश्चित किया गया है। राजभाषा हिन्दी के अन्य महत्वपूर्ण कार्यान्वयन बिन्दुओं / प्रावधानों पर भी कार्रवाई की गई। संस्थान में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगति / कमियों की समय-समय पर समीक्षा, हिन्दी कार्यशाला का आयोजन हिन्दी पखवाड़ा /दिवस का आयोजन, हिन्दी भाषा प्रशिक्षण, हिन्दी पुस्तक /पुस्तिकाओं का संपादन, हिन्दी प्रतियोगिता का आयोजन एवं प्रोत्साहन योजनाओं का कार्यान्वयन किया गया।

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

1. धारा-3(3) का अनुपालन:

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

2. हिन्दी पत्राचार:

वर्ष के दौरान 'क', 'ख' एवं 'ग' क्षेत्र में स्थित केन्द्र / राज्य सरकार को क्रमश : 92.58%, 86.66% तथा 'ग' क्षेत्र में स्थित केन्द्रीय सरकार के कार्यालयों को 81.83% 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 11 पदधारी हिंदी परीक्षा में उत्तीर्ण हुए है। अब तक संस्थान के कुल 92.80% अधिकारी/कर्मचारी इस योजना के अन्तर्गत प्रशिक्षित हो चुके है तथा वर्तमान सत्र (जुलाई, 2013 - मई, 2014) के दौरान 07 पदधारी उक्त योजना के अधीन विभिन्न पाठ्यक्रम के अंतर्गत प्रशिक्षणाधीन है।

4. राजभाषा कार्यान्वयन समिति की बैठको का आयोजन

राजभाषा नियम /अधिनियम के प्रावधानों के सम्यक अनुपालन एवं समय-समय पर राजभाषा कार्यो 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 कठितनाइयों का निदान किया जाता है। वर्तमान वर्ष 2013-14 के अंतर्गत राजभाषा कार्यान्वयन समिति की चार बैठकों का नियमित आयोजन क्रमश: दिनांक 14/06/2013, 30/09/2013, 30/12/2013 एवं 25/03/2014 को किया गया तथा बैठक में लिए गए निणयों 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 के लिए दिनांक 22/06/2013 तथा राजभाषा के विविध पहलुओं पर तकनीकी तथा प्रशासनिक संवर्ग के कर्मचारियों के लिए क्रमशः, 22/23.08.2013, 19/20.11.2013 तथा 14.02.2014 को हिंदी कार्यशाला आयोजित कर संस्थान के कुल 88 पदधारीगण राजभाषा हिन्दी में प्रशिक्षित किए गए तथा आगे भी यह क्रम जारी है।

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

संस्थान की संबद्व इकाइयों में भी संघ की राजभाषा नीति के सफल कार्यान्वयन हेतु हिन्दी कार्यशालाओं का आयोजन किया जाता है। इस क्रम में क्षेत्रीय रेशम उत्पादन अनुसंधान केन्द्र, कलिम्पोंग, रांची, जोरहाट तथा अनुसंधान प्रसार केन्द्र, महेशपुर राज, मोथाबाड़ी, इम्फ़ाल, शिलांग, दीमापुर के अतिरिक्त क्षेत्रीय कार्यालय, कोलकाता में भी पूर्ण दिवसीय हिन्दी कार्यशालाओं का आयोजन किया गया।

7. राजभाषा प्रोत्साहन योजना का कार्यान्वयन:

संस्थान एवं इसके संबद्व/अधीनस्थ केन्द्रों में कार्यरत अधिकारियों तथा कर्मचारियों में राजभाषा हिन्दी के प्रति अभिरूचि जगाने हेतु समय समय पर विभिन्न राजभाषा कार्यक्रम /प्रतियोगिता का आयोजन किया जाता है। इन कार्यक्रमों द्वारा कर्मचारियों को प्रोत्साहित /पुरस्कृत करने के अलावा हिन्दी में मूल रूप से टिप्पण आलेखन करने वाले अधिकारियों /कर्मचारियों के लिए केन्द्रीय रेशम बोर्ड की उदारीकृत प्रोत्साहन योजना को भी लागू किया गया है जिसके अन्तर्गत निर्धारित शब्द संख्या हिन्दी में लिखने पर अनुपातत : नगद प्रोत्साहन राशि (महत्तम रू 1000.00) प्रदान की जाती है। हिन्दी दिवस/पखवाड़ा, 2013 के अवसर पर वर्ष 2012-13 के दौरान मूल रूप से हिन्दी में कामकाज करने हेतु कुल 08 अधिकारियों/कमचारियों को पुरस्कृत किया गया।

8. हिन्दी पुस्तक/ पुस्तिकाओं का प्रकाशन:

संघ की राजभाषा नीति के अनुसार संस्थान में अंग्रेजी प्रकाशनों के अनुरूप वैज्ञानिक एवं तकनीकी /प्रशासनिक प्रकाशनों का हिन्दी रूपांतरण तथा मूल रुप से हिंदी में लिखित पुस्तकें आवश्यकतानुसार प्रकाशित की जाती है। वर्तमान वर्ष के अंर्तगत संस्थान की वार्षिक वैज्ञानिक एवं प्रशासनिक रिपोर्ट वर्ष 2012-13 के सारांश प्रकाशित करने के अतिरिक्त राजभाषा हिंदी को समर्पित पत्रिका "रेशम दर्शन", जून, 2013 तथा न्यूज एंड व्यूज (दिसम्बर अंक,

2012), हिन्दी संस्करण समेत **"रेशमकीट एवं रेशम अनुसंधान बढ़ते कदम गांव की ओर"** का प्रकाशन आलोच्य अवधि के दौरान किया गया ।

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 को अध्यक्ष के रूप 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 28वीं बैठक दिनांक 05/08/2013 तथा दिनांक 12/03/2014 को 29वीं 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, संगोष्टी कार्यशाला एवं बैठकों का आयोजन कर रहे है। समिति की उक्त गतिविधियों के संचालन से संस्थान में राजभाषा कार्यान्वयन संबंधी कार्यमात्रा में भी अत्याधिक वृद्वि हुई है।

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

संस्थान के सम्बद्व / 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 10 संबद्ध कार्यालयों को अधिसूचित कराया जा चुका है।

11. हिन्दी प्रतियोगिता का आयोजन:

वर्ष 2013-14 के दौरान दिनांक 02.09.13 से 16.09.13 तक आयोजित हिन्दी पखवाड़ा के अन्तर्गत विभिन्न हिन्दी प्रतियोगिता का आयोजन किया गया। इन प्रतियोगिता में संस्थान के अधिकारियो / कर्मचारियों ने उत्साह से भाग लिया। इस दौरान कुल 08 हिन्दी प्रतियोगिताओं क्रमश : हिंदी टिप्पण व आलेखन 02/09/13, शब्दावली 03/09/13, निबन्ध 04/09/13, वाद विवाद 05/09/13, सुलेख व श्रुतलेख 06/09/13, राजभाषा प्रश्नोत्तरी 07/09/13, अंत्याक्षरी 09/09/13, तात्क्षणिक भाषण 10/09/13 का आयोजन किया गया। प्रत्येक प्रतियोगिता के सर्वश्रेष्ठ प्रतिभागियों को प्रथम, द्वितीय, तृतीय एवं सांत्वना पुरस्कार से पुरस्कृत किए गए।

12. कम्प्यूटर पर हिन्दी में कार्य:

राजभाषा अधिनियम-1963 की धारा 3(3) का अनुपालन, फार्म/प्रपत्र का द्विभाषीकरण, सम्बद्व/ अधीनस्थ केन्द्रों की तिमाही रिपार्ट 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 कम्प्यूटर पर सुचारू रूप से किया जा रहा है। राजभाषा कार्यान्वयन के विभिन्न पहलुओं में कम्प्यूटर 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" तथा "माइक्रोसॉफ़्ट इंडिक लैंग्वेज इनपुट टूल्स" का संस्थापन कम्प्यूटर पर किया गया है जिससे शब्द प्रक्रमण के अलावा आकड़ों के प्रक्रमण, आरेखीय निरूपण, आंकड़ों के समेकीकरण में सहुलियत एवं गति आई है।

16. SCIENTIFIC & ADMINISTRATIVE PERSONNEL OF CSR&TI AND ITS CONSTITUENT UNITS

Dr. S. Nirmal Kumar, Director

Scientist-E (R&S):

Shri M. K. Majumdar	Divisional head, Reeling & Spinning

Scientists D:

Dr. A. K. Saha	Divisional head, Sericulture
Dr. M. K. Ghosh	Divisional head, Moriculture
Dr. S. Roy Chowdhuri	Divisional head, PMCE
Dr. S. K. Mukhopadhyay	Divisional head, Extension
Dr. (Mrs.) Jalaja S. Kumar	Divisional head, Training

Scientists-D/C:

SERICULTURE DIVISION

Silkworm Breeding & Genetics :
Dr. N. Suresh Kumar, Sci.–D
Dr. S. Sreekumar, Sci.-D (upto 25-08-13)
Dr. G.K. Chattopadhyay, Sci.-C
Dr. A.K.Verma, Sci-C.

Biotechnology Section:
Dr. S. Sree kumar, Sci-D(fr.26-8-13 to 10-3-14)
Dr. (Mrs.) Rita Banerjee, Sci.-D
Dr. S Chattopadhyay, Sci.-D
Mrs. N. Lalitha, Sci.-C (upto 04-06-13)

SW Physiology & RTI :
Dr. (Mrs.) T. Dutta (Biswas), Sci.- D

Entomology :
Dr. M. V. Santha Kr., Sci. – D
Dr. (Mrs.) M. Patnaik, Sci.-C (upto 23.05.2013)
Mrs. N. Lalitha, Scientist-C (fr. 05-06-13)

Silkworm Pathology Section:
Dr. S. Sree kumar, Sci-D(fr. 11.03.14)
Dr. S. Chakrabarty, Sci.-C
Shri Z. Hossain, Sci.-C (upto 01.07.13)

MORICULTURE DIVISION

Mulberry Breeding & Genetics:
Dr. P. K. Ghosh, Sci. – C
Dr. (Mrs) M. Chaudhuri, Sci.-C (up to 10.07.13)

Mulberry Pathology :
Dr. S. K. Dutta, Sci-D

Soil Science and Chemistry:
Dr. R. Kar, Sci.-C

Mulberry Physiology:
Dr. P. K. Tewary, Sci. - D
Dr. A. K. Misra, Sci. - C (upto 30.09.13)

TRAINING DIVISION

Dr. L. M. Saha, Sci-D (upto 31.05.2013)
Shri Ram Kumar Saha, Sci-C (upto 31.05.2013)
Dr. (Mrs.) Subhra Chanda, Sci-D (from 04.06.2013)
Shri Zakir Hossain, Sci-C (from 02.07.13)

EXTENSION DIVISION

Shri G.C.Das, Sci.-C (from 01.07.13)
Dr. M.S. Rahaman, Sci-C (from 11.06.13)
Dr. Subhra Chanda, Sci.-D (upto 03.06.2013)
Shri Debojit Das, Sci. – C

PMCE DIVISION

Dr. S. K. Mukhopadhyay, Sci.- D (fr.24.11.13 to 14.03.14)
Dr. M. K. Singh, Sci. - D
Shri D. Chakravarty, Sci.-C

Agronomy :
Dr. S. Rajaram, Sci.- D
Dr. M.S. Rahaman, Sci-C (upto 11.06.13)
Dr. (Mrs) M. Chaudhuri, Sci.-C (fr.11.07.13)

Farm Management:
Dr. S. K. Mondal, Sci.- D

Computer:
Shri N.K.Das, Asst. Director (Statistics)
Shri P. K. Mahapatra, A. D.(Comp) (fr. 22.11.13)

REELING & SPINNING DIVISION		
Shri S. S. Manna, Sci. – D Shri N.B.Kar, Sci. – D		
ADMINISTRATION		**OFFICIAL LANGUAGE**
Shri M.K.Roy, D.D. (A &A) Shri P. D. Mishra, A. D. (A & A) (from 01.07.13) Shri Manas Roy, A.D. (A & A) (from 03.09.13) Shri G.R.V. Reddy, Asst. Eng. (from 03.06.13)		Shri Ram Briksh Choudhary, A.D.

REGIONAL SERICULTURAL RESEARCH STATION:

RSRS, Kalimpong (West Bengal) Smt. C. Maji, Sci. - D Smt. Regina Bhutia, Sci.-D Shri S. Chatterjee, Sci. - C Dr. U. K. Bandyopadhyay, Sci. - D Dr. M. D. Maji, Sci. - C Shri Ram Lakhan Ram, Sci. - B		**RSRS, Jorhat (Assam)** Shri T. K. Biswas, Sci.- D Dr. S. N. Gogoi, Sci. - D Shri M. Sankar, Sci. - C Dr. Y. Debaraj, Sci. - D Smt. M. Pamehgam, Sci. - C
RSRS, Koraput (Odisha) Shri R. Sahu, Sci.- C Dr. N. R. Rao, Sci.- C Shri S. K. Misro, Sci.- C		**RSRS, Ranchi (Jharkhand)** Dr. Ch. Sudhakar Babu, Sci-D (from 18.05.13) Shri M. Alam, Sci.- C Dr. A. H. Naqvi, Sci-C (upto 12.06.13)

RESEARCH EXTENSION CENTRES & SUB UNITS:

REC, Mothabari (West Bengal) Shri A. K. Dutta, Sci. - C Dr. (Mrs.) J. Sarkar, Sci. - C		**REC, Gumla (Jharkhand)** Dr. Ram Kumar, Sci-C Dr. S.P. Sharma, Sci. - C
REC, Kamnagar (West Bengal) Dr. S. P. Chakraborti, Sci. - D		**Sub, REC, Bhandra (Jharkhand)** Dr. G.S.Singh, Sci.-D
Sub-REC, Rampuhat (West Bengal) Dr. (Mrs) M. Patnaik, Sci. - C (from 11.06.13)		**REC, Agartala (Tripura)** Dr. G. B. Singh, Sci. - D
REC, M.P. Raj (Jharkhand) Dr. D. Pandit, Sci. - C		**REC, Dimapur (Nagaland)** Dr. A. K. Bora, Sci. - C
REC, Deogarh (Odisha) Dr. D. P. Dasmohapatra, Sci. - C Dr. K. M. Purohit, Sci. - C		**REC, Aizawl (Mizoram)** Shri B. Chowdhury, Sci. – D Dr. Lalthlamuana Pachuau, Sci. - B
REC, Bademaranga (Chhattisgarh) Smt. Nilima Nag, TA		**REC, Imphal (Manipur)** Dr. L. Somen Singh, Sci. – C
REC, Shillong (Meghalaya) Dr. Collin Z. Renthlei, Sci-C		**Sub-REC, Rajmahal (Jharkhand)** Dr. A. H. Naqvi, Sci-D (from 14.1013)
REC, Rongpo (Sikkim) Shri S.T. Lepcha, Sci. - C		

RESEARCH ADVISORY COMMITTEE

	Chairperson **Prof. M. Muniyamma** (Former *Vice-Chancellor*) Gulbarga University, No.3, First Floor, 11th Cross, 5th Main Jayamahal Extension, Bangalore – 560 045		
	Members		
1.	Dr. H. K. Majumdar, Grade-G & Head, Molecular Parasitology Lab., Coordinator, Infectious Disease & Immunology Group, IICB, 4-Raja S.C. Mullick Rd, Kolkata-700 032	12.	Director of Sericulture, Govt. of Chhattisgarh, Resham Sanchanalaya Kanij Bhawan, Ring Rd, Telibandh Raipur- 492 06, Chhattisgarh
2.	Dr. D. Sen, Ex-Director of Extension, NIRD, ICAR, Hyderabad, EB 1/12, Deshbandhunagar, Baguihati, Kolkata – 700 059	13.	Director (Hand & Seri.), Deptt. of Industries, Govt. of Bihar, Vikas Sachivalaya, Patna- 800 015, Bihar
3.	Prof. S. Maity Department of Agronomy, B-2/221, P.O. Kalyani – 741 235, Dist- Nadia, West Bengal	14.	Director of Industries, Govt. of Jharkhand, III Floor, Nepal House, Doranda, Ranchi - 834 002, Jharkhand
4.	Prof. D. K. Battacharaya Department of Zoology, University of Kalyani, P.O. Kalyani – 741 235 Dist. Nadia, West Bengal	15.	Director of Sericulture & Weaving Govt. of Meghalaya, 3rd Sectt. (Nongkrek building), 2nd Phase, 2nd Floor, Lower lachumiere, Shillong – 793 001, Meghalaya
5.	Prof. P. S. Chattopadhyay Department of Farm & Machinery, BCKV, P.O. Kalyani – 741 235, Dist- Nadia, West Bengal	16.	Director of Sericulture, Govt. of Mizoram, Aizawl – 796 001, Mizoram
6.	Director (Tech) Central Silk Board, P.O. Madiwala, BTM Layout, Bangalore – 560 068	17.	Director of Handlooms, Handicrafts & Sericulture, Govt. of Tripura, Pandit Jawaharlal Nehru Complex, Gorkha Basti,Agartala – 799 006, Tripura
7.	Dr. N. Suryanarayana Ex-Director, CSB, D. No. 11-3-392/2/11/833, Srinivas Nagar Colony, Secunderabad – 500 061	18.	Addl. Director of Sericulture, Deptt. of Forest & Environment, Govt. of Sikkim, Deorali, Gangtok, Sikkim
8.	Director, CSR&TI, Berhampore – 742 101 Murshidabad, West Bengal	19.	Director of Sericulture, Govt. of Assam (Near Research Gate) P.O. Khanapara, Guwahati-781 022, Assam
9.	Director, NSSO, Central Silk Board P.O. Madiwala, BTM Layout, Bangalore – 560 068	20.	Director of Sericulture, Govt. of Nagaland, Kohima – 797 001, Nagaland
10.	Director of Textiles, Govt. of West Bengal, 45, Ganesh Chandra Avenue Kolkata, West Bengal	21	Director of Sericulture, Govt. of Manipur, P.O. Lamphelpat, Imphal –795 004, Manipur
11.	Director of Textiles & Handloom Govt. of Orissa, Sahidnagar, Bhubaneswar - 751 007, Odisha		

17. SPECIAL ACTIVITIES ON WOMEN EMPOWERMENT, DEVELOPMENT OF SC/ST OR PEOPLE FROM BPL

The following human resource development programmes were conducted for empowerment and strengthening of the weaker section of the society.

17. A. MAIN INSTITUTE

17. A. Details of sc/st candidates who participated in various training programmes

#	Name of the prog.	Subject	Period	Dura-tion (Days)	Caste												Grand Total
					Male						Female						
					Gen	SC	ST	OBC	Min ority	Tot al	Ge n	SC	ST	OB C	Min ority	Total	
1.	SUP (farmers)	Spinning Training for women under Natu-ral Fibre Mission (BRGF)	17/6 - 5/7/ 2013	21	-	-	-	-	-	-	-	-	-	-	17	17	17
2.	-Do-	-Do-	19/8- 6/9/ 2013	19	-	-	-	-	-	-	-	-	-	-	16	16	16
3.	-Do-	-Do-	9/9- 27/9/ 2013	19	-	-	-	-	-	-	-	-	-	-	17	17	17
4.	-Do-	-Do-	27/1- 14/2/ 2014	19	-	-	-	-	-	-	-	-	-	-	17	17	17
5.	-Do-	-Do-	17/2- 7/3/ 2014	19	-	-	-	-	-	-	-	-	-	-	15	15	15

6.	-Do-	-Do-	10/3-28/3/2014	19	-	-	-	-	-	-	-	-	-	-	18	18	18
									TOTAL:								**100**
7.	SUP (farmers)	Chawki rearing	17/2-26/2/14	10	5	2	18	2	-	27	4	1	1	-	-	6	33
8.	SUP (farmers)	Mulberry varieties & cultivation techniques	3/3-7/3/2014	5	7	5	14	2	-	28	4	-	1	-	-	5	33
9.	SUP (farmers)	Integrated pest & disease management	17/3-21/3/2014	5	3	4	12	3	-	22	-	-	-	4	-	4	26
									TOTAL:								**92**
10.	MDP (Officials)	Mulberry cultivation and rearing technology	10/3-14/3/2014	5	4	3	7	1	-	15	2	1	2	-	-	5	20
									TOTAL:								**20**
11.	ISDS	Cocoon Handicrafts	3/9-17/9/2013	15	-	-	-	-	-	-	-	-	-	-	20	20	20
		Skill up-dating of extn.agents	17/9. 1/10/2013	15	2	5	-	2	1	10	-	3	-	1	1	5	15
		Commercial silkworm rearing	25/11-9/12/2013	15	7	4	-	4	-	15	-	-	-	-	-	-	15

		Cocoon Handicrafts	25/11-9/12/2013	15	-	-	-	-	-	-	12	7	-	1	-	20	20
		Cocoon Reeling & Spinning	27/11-11/12/2013	15	9	5	-	5	-	19	-	-	-	-	-	-	19
		Mulberry Cultivation	9/12-23/12/2013	15	10	4	-	1	-	15	-	-	-	-	-	-	15
		Mulberry Cultivation	10/12-24/12/2013	15	7	6	-	1	-	14	-	-	-	-	-	-	14
		Cocoon Reeling & Spinning	10/12-24/12/2013	15	7	1	-	9	-	17	4	-	-	-	-	4	21
		Commercial silkworm rearing	6/1-20/1/2014	15	10	4	-	5	-	19	-	1	-	-	-	1	20
		Cocoon reeling & spinning	15/1-29/1/2014	15	11	2	-	6	-	19	1	-	-	-	-	1	20
TOTAL ISDS (Under CSRTI, Berhampore):																	**179**
	ISDS at RSRS, Jorhat	Mulberry Cultivation	22/11-6/12/2013	15	-	-	5	2	-	7	-	-	-	8	-	-	15
		Skill Up-dating of extn. agents	10/12 24/12/2013	15	-	-	15	-	-	15	-	-	-	-	-	-	15
		Commercial silkworm rearing	3/03-17/3/2014	15	-	-	3	3	-	6	-	-	6	3	-	9	15
TOTAL ISDS (Under RSRS, Jorhat):																	**45**

	ISDS at RSRS, Koraput	Mulberry cultivation	25/11-9/12/ 2013	15	-	-	9	6	-	15	-	-	-	-	-	-	15
		Commercial Silkworm Rearing	10/12-24/12/ 2013	15	-	-	7	8	-	15	-	-	-	-	-	-	15
		Skill Up-dating of extn. agents	13/1-27/1/ 2014	15	-	-	10	5	-	15	-	-	-	-	-	-	15
		Commercial silkworm rearing	21/2-7/3/ 2014	15	9	-	6	-	-	15	-	-	-	-	-	-	15
TOTAL ISDS (Under RSRS, Koraput):																	**60**
	ISDS at RSRS, Kalim pong	Skill Up-dating of Extension Agents	2/12-16/12/ 2013	15	2	-	-	-	-	2	-	-	2	11	-	13	15
		Mulberry Cultivation	24/2-10/3/ 2014	15	2	-	1	-	-	3	7	1	4	-	-	12	15
		Commercial silkworm rearing	4/03-18/3/ 2014	15	3	-	2	-	-	5	9	-	-	1	-	10	15
TOTAL ISDS (Under RSRS, Kalimpong):																	45
	ISDS at RSRS, Ranchi	Commercial silkworm rearing	12/12-26/12/ 2013	15	1	-	1	-	-	2	-	-	5	8	-	13	15
		Mulberry cultivation	23/12-6/1/ 2014	15	-	-	6	8	-	14	-	-	2	-	-	2	16
		Mulberry cultivation	13/2-27/2/	15	2	1	9	2	-	14	-	-	-	-	-	-	14

			2014														
		Commercial silkworm rearing	11/3-25/3/2014	15	-	-	-	-	-	-	-	1	15	1	-	17	17
TOTAL ISDS (Under RSRS, Ranchi):																	**62**
TOTAL ISDS:																	**391**
12.	BEP	Exposure visit for farmers of Assam	3/9-6/9/2013	4	11	3	2	5	-	21	4	6	11	6	-	27	48
		Exposure visit for farmers of Kishanganj	2/9-7/9/2013	4	16	1	-	-	12	29	-	-	-	-	-	-	29
		Exposure visit for farmers of Assam	24/9-27/9/2013	4	5	9	10	10	2	36	-	-	-	-	-	-	36
		Exposure visit for farmers of Assam	29/9-30/9/2013	2	3	1	5	11	-	20	2	2	10	17	-	31	50
		Exposure visit for farmers of Assam	17/11-19/11/2013	3	13	5	4	5	-	27	6	6	6	7	-	25	52
TOTAL:																	**215**
13.	Ad Hoc (Official)	Computer Training	3/6-11/6/2013	2	12	6	-	4	-	22	6	1	-	-	-	7	29
		-do-	26/6-29/06/	2	8	8	1	4	-	21	2	-	-	-	-	2	23

			2013														
TOTAL:																	**52**
		Bivoltine rearing	14/11-28/11/2013	11	1	1	-	-	-	2	2	-	-	-	-	2	4
		Bivoltine rearing	20/11-28/11/2013	9	1	2	2	1	-	6	-	-	1	-	-	1	7
TOTAL:																	**11**
		Orientation for CDFs	26/8-28/8/2013	3	9	10	-	1	-	20	1	-	-	-	-	1	21
		Extension Manage-ment appro-aches in collaboratio n with MANAGE	28/1-31/1/2014	4	7	6	1	-	-	14	2	-	1	-	-	3	17
		Focussed Training on store purchase procedure	12/3-14/3/2014	3	19	7	1	1	-	28	1	-	-	-	-	1	29
TOTAL Ad Hoc:																	**130**
GRAND TOTAL:																	**948**

17. A. 2. INTEGRATED SKILL DEVELOPMENT SCHEME (ISDS):

At this Institute, the ISDS envisages to train youth/women in the fields of mulberry cultivation, commercial silkworm rearing, cocoon handicrafts, cocoon reeling and spinning skill updating of extension agents. The trainees were identified and selected from an exhaustive list prepared course wise in coordination with the DoS. While selecting a candidate, many eligibility criteria were taken into consideration viz., educational qualification, age, category etc. The programme was conducted at free of cost and accordingly all the selected candidates were provided free boarding and lodging. They were also paid their actual travel expenses and wage compensation during training period. The duration of the training period was 15 days.

Details of ISDS courses conducted

Sl. No.	Name of the course	Duration (Days)	Persons trained
1.	Skill updating of Extension Agents	15	60
2.	Cocoon handicraft	15	40
3.	Mulberry cultivation	15	104
4.	Commercial Silkworm rearing	15	127
5.	Cocoon reeling & spinning	15	60
Total:		**-**	**391**

Training on cocoon handicrafts is under progress

Dr.S.Nirmal Kumar, Director distributing prize to the winner among ISDS trainees

Dr. M. Banerjee, DD, DoT(Seri.), Murshidabad taking class of ISDS trainees

ISDS trainee is preparing polythene bags for kisan nursery after training

17. A. 3. AD HOC TRAINING PROGRAMME CONDUCTED

Sl. No	Course	Dura-tion (Days)	Sponsoring authority	Persons trained	Objective
1.	Spinning Training Program me for women under Natural Fibre Mission (BRGF).	21	DoT (Seri), Murshi dabad	100	To impart practical training to the Matka spinners of Murshidabad district in motorized spinning machine to upgrade the operational skill of the spinners, with the improved technologies, to improve the quality of yarn and production efficiency and to facilitate enhancement in earning.
2.	Orienta-tion prog. for CDF.	03	C.O., CSB, B'lore	21	To orient the knowledge and deliver guidelines for creating and managing the bivoltine sericulture clusters in the eastern region of India.

Expert of Reeling & Spinning Section, CSRTI, Berhampore imparting practical training to women spinners.

Participants of bivoltine practical training programme are with Director, CSRTI Berhampore and other scientists.

Fig.5. One of the participants is showing the Action Plan of his centre on CDF.

17.B. RSRS, Kalimpong:

A total No. of 25 women farmers from 9 villages of Kalimpong area and 10 women farmers from 6 villages of East Sikkim were trained under ISDS on the improved technologies suitable for the region viz., raising of seedling with black polythene cover, reclamation of acidic soil, pruning schedule, package for bivoltine silkworm rearing etc.

17.C. RSRS, Ranchi:

Altogether 4 batches of ISDS Training programme was conducted with 61 farmers which includes 30 men & 31 women. Under HRD training programme 40 women farmers were trained for 5 days in silkworm rearing and mulberry cultivation.

17. D. RSRS, Koraput:

17. D. 1. Trainers' Training Programme

A Trainers' Training Programme was organized at the premises of RSRS, Koraput on 31st May 2013 to impart training to the technical personnel of DoS, Odisha on Soil Testing & its reclamation, Integrated Package of Practices for Mulberry cultivation, Disinfectants and disinfection procedure for a successful rearing and Latest Technologies of Silkworm Rearing & Management.

17. D. 2. Farmers' Training Programme

A total of 37 farmers were trained in **t**hree Farmers Training Programmes at the premises of RSRS, Koraput on 31.05.2013 (12 Farmers), 25.10.2013 (15 farmers) & 12.03.2014 (10 farmers) of Lamtaput, Musulipadara and Sunabeda villages of Koraput & Rayagada district of Odisha.

17.D. 3. Farmers Field School

ISDS Training programmes with 60 trainees from 6 villages of Koraput district and 13 villages of Kashipur district was conducted on mulberry cultivation, commercial silkworm rearing and skill updating for extension agents for 15 days.

17.E. RSRS, Jorhat:

Conducted ISDS training program on latest technologies in mulberry cultivation and silkworm rearing, disease & pest management, extension communication programmes and training needs.

Sl. NO.	Name of the training Prog.	No of women trained					Income before training (Rs)	Income after training (Rs)
		SC	ST	OBC	BPL	Total		
1	ISDS	4	14	3	10	31	3500/- 4500/-	8000/- 8500/-

18. MISCELLANEOUS EVENTS / ACTIVITIES

18. A. PATENT / COMMERCIALIZATION

- **Technology filed for Patenting:** Patent application for "Sericillin- a synergistic composition for disinfecting silkworm body and silkworm bed" filed to NRDC, New Delhi [Ref: NRDC, New Delhi: IPR /110-L /2012 dated 18.05.12) through R.K. Dewan & Co., Kolkata (Ref No. 650/KOL/2012 dated 11.06.12), published in Indian Patent Journal on 13.12.2013.

18. B. Technologies Transferred during the year:

I.. RSRS, Kalimpong:

The following technologies were popularized at farmers' level through Transfer of Technology and disseminated in some pockets of Kalimpong and Sikkim region.

- Introduced a new pruning schedule for the subtropical hills to increase leaf productivity during autumn crop.
- Eco-friendly management of Leaf webber with 1% neem oil (with azadirachtin 1500 ppm).
- Forewarning of mulberry diseases to take up timely preventive measures.

II. RSRS, Koraput:

- **Use of Bio fertilizer:** Supplying Bio fertilizer, Nitrofert, Phosphofert and Morizyme-B, to the farmers and its application in the mulberry plants.
- **Use of Disinfectants:** Utilizing disinfectants lime, Bleaching powder, 2.5% Sanitech for disinfection of the rearing houses recorded a cocoon yield gain of 11.6% against control.
- **Use of Bed disinfectants:** Utilizing Bed disinfectants Labex, lime, Vijetha and vijetha supplement recorded a cocoon yield gain was 11.6%.
- **Use of harmones:** A cocoon yield gain of 11.65% was recorded by application of Sampoorne for uniform ripening silkworm.

III. RSRS, Ranchi:

Technologies were transferred to the farmers through various extension tools like Resham Kisan Mela, Field days, Exhibitions, Audio-Visual Programme, Awareness Programme, Field days, Group discussion & Technology Demonstration etc. organized by the centre. Different technologies transferred during the year are as follows:-

- **Mulberry Cultivation :-** (i) Selection of popular variety S1635 for mulberry cultivation (ii) Spacing 3'×3' (iii) use of vermicompost @ 10 mt/ha/yr (iv) use of Nitrofert @ 10 kg/ha/yr (iv) Application of phosphofert @ 40 kg/ha/yr (v) Application of reduced dose of N:P:K @ 75:10:50

- **Silkform rearing:** (i) Disinfection of "Rearing house" and "Appliances" with 5% Bleaching Powder solution. (ii)Rearing of Improved hybrids like PM × CSR2, SK6 × SK7, FC1 × FC2, P5 × NB18 &Gen2xGen3. (iii) Chawki rearing upto 3rd instar and supply of chawki worms to farmers. (iv) Use of Labex @ 3.5 k.g/100 Dfls as bed disinfectant.

IV. RSRS, Jorhat:

During the year 2013-14 the following technologies were disseminated to the farmer's field through different programme by the RSRS & its REC's as follows: -

1. Improved mulberry varieties like S1635
2. Mulberry spacing 3'×3' feet
3. Use of Bio-fertilizer (Nitrofert & Phosphofert)
4. Use of Vermicompost
5. Reduced dose of chemical fertilizer like N:P:K
6. Use of Morizyme-B as plant growth regulator
7. Integrated pest & disease management
8. Techniques on disinfection of rearing house & appliances by Bleaching Powder and slaked lime
9. Chawki rearing techniques
10. Incubation of Dfls
11. Late age rearing
12. Use of bed disinfectant as Labex
13. Use of plastic mountage and harvesting
14. Rearing techniques of new MXBi and BixBi hybrids.
15. Popularization of botanical pesticides for the management of major mulberry pests

16) Popularization of Thiamethoxam for whitefly management

C. Conducted Training Programme

I.RSRS, Kalimpong

i) Trainers Training Programme (TTP):

Target groups: DoT (Seri) officials.
No. of persons trained: 5Nos.

Name of the Course	Duration (Days)	Persons trained (Nos)			
		CSB	DoT (Seri)	NGO	Total
Trainers Training Programme	**1**	**---**	**05**	**--**	**01**

ii) Farmers Training Programme (FTP) :

Target groups: Farmers of hilly region

No. of persons trained: 41 Nos.

Duration (Days)	Venue	Subject	No of persons trained
01 days (26.12.2013)	Village - Dalapchand	Use of Secature and pruning saw for pruning of mulberry bushes	22
01 days (27.12.2013)	Village - Primtam	Use of black polythene sheet for mulberry sapling raising	19

iii) Integrated Skill Development Scheme (ISDS) Programme:

Target groups: Rural youth/women

No. of persons trained: 30 Nos.

The main objective of this programme is to train the youth / women in the fields of "Skill updating for extension agents, mulberry cultivation and commercial silkworm rearing". The trainees was identified and nominated by the DoT (Seri), Kalimpong, W.B. and DoS, Sikkim. The programme was conducted under the sponsorship of Ministry of Textiles, Govt. of India at Regional Sericultural Research Station, Kalimpong. The duration of the training period was 15 days.

Details of ISDS conducted:

Sl. No.	Name of the course	Duration (Days)	Sponsoring authority	No of persons trained
1.	Skill updation for extension agents	02.12 - 16.12.2013 (15 days)	Farmers nominated by DoT (Seri), Kalimpong	15
2.	Mulberry cultivation	24.02 - 10.03.2014 (15 days)	Farmers nominated by DoT (Seri), Kalimpong	15
			Total	**30**

Sri B.K. Chhetri, Secretary, KKS, NABARD, Kalimpong delivering lecture to the trainees.

Participants and faculties of First batch training on Skill updation for extension agents under ISDS prog.

iv) AD–HOC TRAINING PROGRAMMES CONDUCTED ON THE REQUEST OF DIFFERENT AGENCIES

Sl. No.	Course	Duration (Days)	Sponsoring Authority	Persons trained
1.	Short Term Internship	15 days (06.05.2013 to 24.05.2013)	Head of the Department, Department of Biotechnology, Chirst University, Bangalore	01

II.RSRS, JORHAT

i) Trainer's Training Programme:

Target groups: DOS Officials
No. of persons trained: 8 Nos.

Sponsoring Agency	Target	Apr - Sept	Oct - March	Achievement
DOS, Assam (Participants)	1	--	1 (8)	1 (8)

ii) Farmers Training Programme:

Target groups: Farmers of N.E. States
No. of persons trained: 1027 Nos.

Unit	Target	Apr. – Sept.	Oct. – Mar.	Achievement
RSRS, Jorhat	03 programme	1	2	03 (38)
REC, Agartala No. of beneficiary	03 programme	1	4	5 (152)
REC, Aizawl No. of beneficiary	03 programme	3	2	5 (233)
REC, Dimapur No. of beneficiary	03 programme	3	2	5 (106)
REC, Imphal No. of beneficiary	03 programme	4	1	5 (141)
REC, Shillong No. of beneficiary	03 programme	2	3	5 (357)

iii) ISDS Training Programme:

Target groups: Stake holders beneficiaries involved in sericulture activities.

No. of persons trained: 45 Nos.

Sl. No.	Title	Period	No. of persons	Target groups
01	Mulberry cultivation	15 days	15	Stake holders (beneficiaries involved in sericulture activities)
02	Skill Updation of Extn. Agents	15 days	15	Stake holders (beneficiaries involved in sericulture activities)
03.	Commercial silkworm rearing	15 days	15	Stake holders (beneficiaries involved in sericulture activities)

III. RSRS, KORAPUT

12.a Trainers' Training Programme:

A Trainers' Training Programme was organized at the premises of RSRS, Koraput on 31st May, 2013 to impart training to the technical personnel of DOS, Odisha on Soil Testing & its reclamation, Integrated Package of Practices for Mulberry cultivation, Disinfectants and disinfection procedure for a successful rearing and new Technologies of Silkworm Rearing & management.

12.b. Farmers' Training Programme:

A total of 37 farmers were trained in **t**hree Farmers Training Programmes at the premises of RSRS, Koraput on 31.05.2013 (12 Farmers), 25.10.2013 (15 farmers) & 12.03.2014 (10 farmers) of Lamtaput, Musulipadara and Sunabeda villages of Koraput & Rayagada district of Odisha.

12.c. Farmers Field School:

With two lead farmers in Kashipur Block, Rayagada district (Odisha) 8 sittings have been conducted and total of 108 farmers attended the programme.

12.d. Integrated Skill Development Programme

A total number of sixty trainees were trained (15 farmers per batch for 15 days in a schedule from 6 villages of Koraput district and 13 villages of Kashipur district) with the following curriculum viz. Mulberry Cultivation, Commercial Silkworm Rearing, Skill Updating for Extension Agents and Commercial Silkworm Rearing.

IV. RSRS, RANCHI

A total number of sixty two persons were trained under ISDS programme on Mulberry Cultivation, Commercial Silkworm Rearing, Skill Updating for Extension Agents and Commercial Silkworm Rearing.

19. METEOROLOGICAL DATA

I. CSR&TI, BERHAMPORE (Latitude 24°6´N, Longitude 88°15´E, Altitude 19 M above MSL)

Month	Temperature °(°C)		Relative Humidity %)		Rain-fall (mm)	Rainy days (No)	Wind velocity (kmph)	BSS (hrs)	Eva. (mm/ h)
	Max	Min	Max	Min					
April, 2013	35.65	23.41	67.47	47.60	21	3	3.41	7.35	0.17
May, 2013	33.09	25.38	83.87	70.84	256	10	4.97	4.40	0.17
June, 2013	33.51	26.49	85.33	74.63	146	12	3.30	5.47	0.14
July, 2013	32.63	26.66	82.55	75.48	97	13	4.40	6.27	0.16
August, 2013	32.02	26.24	87.81	80.35	296	20	1.30	5.56	0.13
Sept., 2013	32.43	26.33	87.10	74.53	252	14	0.42	5.52	5.09
October, 2013	30.32	29.94	88.32	75.19	204	9	0.32	5.37	0.09
Nov., 2013	28.16	17.36	76.57	63.27	0	0	0.26	8.00	1.10
Dec., 2013	24.05	13.32	87.68	66.03	0	0	0.12	3.87	0.06
Jan., 2014	22.48	11.75	87.55	60.16	0.3	1	0.31	4.89	0.06
Feb., 2014	25.00	13.47	82.57	52.96	35	4	0.45	6.26	0.10
March, 2014	31.20	18.52	68.00	44.03	8	2	0.10	7.34	0.15

Installation of Surface Observatory by IMD, Kolkata

India Meteorological Department/ Regional Meteorological Centre, Kolkata-700 027 installed surface Meteorological observatory 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).

II. REGIONAL SERICULTURAL RESEARCH STATION:

A. KALIMPONG, WEST BENGAL

Month	Temperature (ºC)			Relative Humidity (%)			Rain fall (mm)	Rainy days (no.)
	Max	Min	Mean	Max	Min	Mean		
April,2013	27.13	15.90	21.52	89.27	46.07	66.97	89.60	13
May, 2013	27.81	18.39	23.10	96.16	58.35	76.23	259.60	19
June,2013	29.70	21.10	25.40	97.23	61.03	77.82	257.10	22
July, 2013	28.71	21.32	25.02	99.23	67.76	82.36	412.10	29
Aug., 2013	29.45	20.74	25.10	99.10	62.61	80.85	431.30	26
Sept., 2013	30.00	20.53	25.26	96.70	57.77	77.23	107.40	16
Oct., 2013	26.74	17.13	21.94	95.90	55.61	75.76	79.90	11
Nov., 2013	25.63	12.60	19.12	84.57	36.17	59.48	0.00	0
Dec., 2013	20.74	10.16	15.45	94.61	48.16	71.39	2.25	02
Jan., 2014	21.16	9.39	15.27	88.52	45.13	66.32	0.00	0
Feb., 2014	21.39	10.21	15.80	87.18	42.29	64.00	7.00	02
Mar.,2014	25.42	13.29	19.35	86.87	39.16	63.01	58.00	07

B. KORAPUT, ODISHA

Month & Year	Temperature (^{0}C)		Relative Humidity (%)		Rainfall mm/No. of days	
	Min.	Max.	Min.	Max.	mm	days
April, 2013	17.1	40.2	23.6	80.2	73.3	06
May, 2013	19.8	40.7	24.6	72.2	33.7	07
June, 2013	20.8	37.6	61.6	94.8	454.6	23
July, 2013	21.3	32.1	75.1	97.8	329.5	24
August, 2013	19.4	32.1	67.9	97.9	376.4	23
September, 2013	20.1	34.2	55.6	96.7	233.7	15
October, 2013	17.1	33.0	59.2	97.7	165.5	14
November, 2013	12.0	31.8	43.2	95.5	6.6	01
December, 2013	10.1	28.1	27.5	98.4	--	0
January, 2014	11.9	30.1	25.2	96.7	--	0
February, 2014	12.1	32.6	20.2	87.4	9.7	01
March, 2014	16.9	38.3	21.0	75.8	40.9	04
Average/ Total	**16.6**	**34.2**	**42.1**	**90.9**	**1723.9**	**118**

C. RANCHI, JHARKHAND

Month	Temp. ^{0}C		R.H. %		Rainfall (mm.)
	Max.	Min.	Max.	Min.	
April, 2013	30.27	24.37	51.50	41.23	4.0
May, 2013	34.65	26.94	56.13	39.84	34.4
June, 2013	28.00	24.40	85.17	77.63	225.8
July, 2013	27.06	24.03	89.52	83.84	97.2
August, 2013	26.26	23.10	91.94	90.00	228.6
September, 2013	27.20	22.67	93.80	89.80	49.8
October, 2013	26.09	20.58	91.67	85.80	353.0
November, 2013	25.40	13.13	90.80	85.23	–
December, 2013	24.35	8.90	90.09	83.77	–
January, 2014	23.13	9.26	80.29	69.61	9.2
February, 2014	25.54	12.18	68.61	59.36	5.3
March, 2014	28.45	15.68	63.03	53.16	23.1

D.JORHAT, ASSAM

Location: 26°45′N 94°13′E / 26.75°N 94.22°E at 116 meters (381 feet) ASL.

Month	Temp ^{0}C		R.H. %		Rainfall (mm)	Rainy Days
	Max	Min	Max	Min		
April, 2013	34.0	18.0	99	53	55	12
May, 2013	33.2	23.0	99	43	132.6	13
June, 2013	38.0	23.0	99	47	54	20
July, 2013	38.0	23.0	99	53	96.0	13
August, 2013	36.8	24.0	99	42	209.0	23
September,2013	36.7	25.7	99	64	54.0	19
October, 2013	33.3	20.7	99	58	28.0	14
November,2013	29.1	13.4	99	47	-	-
December,2013	28.2	6.3	99	28	-	-
January, 2014	27.3	6.3	99	51	-	-
February, 2014	29.2	7.5	93	41	-	-
March, 2014	34.0	11.0	100	18	34.6	10

20. ADMINISTRATIVE REPORT

Central Sericultural Research & Training Institute, Berhampore (West Bengal) and its allied units are as follows:

A. STAFF POSITION : MAIN INSTITUTE

Category	Sanctioned	Filled	Vacant
Director	1	1	-
Scientific	49	27	22
Technical	58	46	12
Administrative	68	56	12
Supporting	35	20	15
Total	**211**	**150**	**61**

B. OFFICERS & STAFF RETIRED:

Sl. No.	Name of the employees	Designation	Date of retirement
1.	Sri Ram Kr. Saha	Sci-C	31.5.2013
2.	Dr. A.K.Misra	Sci-C	30.9.2013
3.	Sri S.K.Datta	AD(A&A)	30.6.2013
4.	Smt. Ira Chowdhury	Assistant	08.10.2013(VR)
5.	Sri G. K. Roy	Supdt.	31.1.2014
6.	Sri P.S.Mukhopadhyay	Tech. Asst.	30.4.2013
7.	Sri Santosh Kr.Karmakar	Attender	30.4.2013
8.	Sri Banamali Hazra	Safaiwala	31.12.2013
9.	Sri Bhanu Roy	Chowkider	31.12.2013
10.	Sri Nil Kr. Pal	Sr. Tech. Asst.	28.2.2014
11.	Sri A.K.Baisya	Sr. Tech. Asst.	28.2.2014
12.	Sri Arjun Kr. Das	Driver	28.2.2014
OFFICERS & STAFF EXPIRED:			
1.	Late Mrityunjoy Biswas	Asst. Technician	10.10.2013

C. BUDGET (Rs. in lakh):

Non-Plan	Plan-Gen	Plan-Cap	NE		Total
			Gen	Cap	
2313.545	**408.718**	**170.229**	**145.760**	**4.900**	**3043.152**