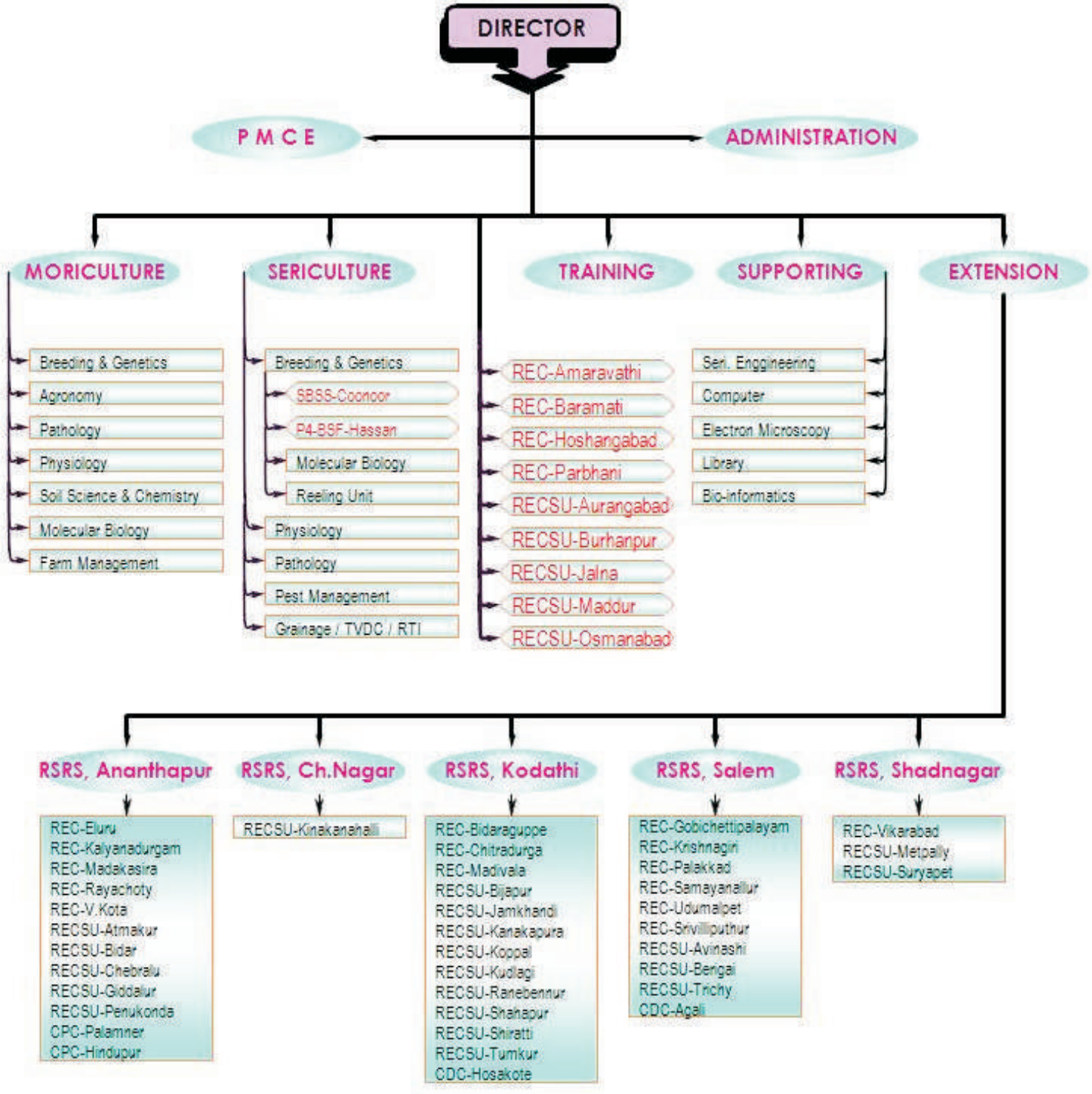
सं./No . 54

के रे अ प्र सं, मैसूरु
CSRTI-Mysuru

वार्षिक प्रतिवेदन
Annual Report
2017-18

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान
केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार, मैसूरु – 570 008

Central Sericultural Research and Training Institute
Central Silk Board, Ministry of Textiles, Government of India, Mysuru – 570 008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वार्षिक प्रतिवेदन
ANNUAL REPORT
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केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान

(आई एस ओ 9001: 2015) प्रामाणित

Central Sericultural Research and Training Institute

(ISO 9001: 2015 Certified)

केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार, मैसूरु – 570 008

Central Silk Board, Ministry of Textiles, Government of India, Mysuru – 570 008

प्रकाशक
डॉ वी. शिवप्रसाद
निदेशक
केंरे अ प्र सं, मैसूरु

संपादकीय समिति
डॉ वी. शिवप्रसाद
डॉ विनीत कुमार
डॉ एल कुसुम
श्री जे. जस्टिन कुमार

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सर्वश्री रेडी प्रिंट, मैसूरु

प्रतियां : 150

दिसंबर, 2018

Published by
Dr. V. Sivaprasad
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Printed by
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No. of Copies: 150

December, 2018

CONTENT

प्रस्तावना

केंरेअप्रसं, मैसूरु का मुख्य अधिदेश समयबद्ध अनुसंधान गतिविधियों के जरिए हितधारकों के समन्वयन से दक्षिण राज्यों तथा महाराष्ट्र, मध्यप्रदेश जैसे अन्य राज्यों के अनुसंधान व विकास संबंधी अपेक्षाओं को पूरा करना है। शहतूत रेशम की उत्पादकता को बढ़ाने तथा हितधारकों की समस्याओं का समाधान करने हेतु क्षेरेअकें, अविकें तथा रेशम उत्पादन विभागों के माध्यम से क्षेत्र विशिष्ट प्रौद्योगिकी का विकास एवं हस्तांतरण लंबे समय से किया जाता रहा है। वर्ष 2017-18 के दौरान केंरेअप्रसं, मैसूरु ने शहतूत रेशम उत्पादन उद्योग की उत्पादकता में सुधार तथा उद्यम क्षमताओं में बढ़ोत्तरी हेतु बहुत से सन्निहित चुनौतियों का समाधान किया है। संस्थान ने शहतूत रेशम उद्योग के विकास हेतु चिर-प्रतीक्षित मानक प्रौद्योगिकी आधारित पैकेज (समग्र पद्धति) को कार्यान्वित करने का कार्य भी किया है।

शहतूत - उत्पादन विकास के क्षेत्र में प्राप्त मुख्य उपलब्धियों में उन्नत शहतूत उपजाति का प्राधिकरण, सिंचित स्थितियों में 65 मेट/हे/वर्ष की उपज क्षमतावाली जी 4 किस्म, विशेष शहतूत जीन प्रारूपों का स्वस्फूर्त प्राधिकरण, मूल विगलन एवं मूलगांठ रोग प्रतिरोधी शहतूत प्रजाति के प्रभेदों/संकरों (32) तथा समतल के लिए अनुकूल छ: संकरों की पहचान तथा मूल विगलन रोग से ग्रस्त पौधों में उल्लेखनीय पुनर्जीवन - दर दर्शाने वाले रॉट फिक्स का सफल क्षेत्र मूल्यांकन, 12000 मृदा स्वास्थ्य कार्ड वितरण, शहतूत पत्ती एवं कोसा उपज बढ़ाने वाले "अंकुर" (जैव एवं अजैव पोषण आधारित) का विकास, बीज बागानों की संस्थापना द्वारा उन्नत शहतूत उपजातियों (जी 2, जी 4, एम.एस.जी. 2, एजीबी 8) का प्रचार - प्रसार कार्य आदि शामिल है।

उत्पादकता बढाने के उद्देश्य से संचालित रेशमकीट विकास कार्यक्रम केंरेअप्रसं, मैसूरु की मुख्य गतिविधियों में शामिल है। इस दिशा में उठाए गए प्रमुख कदम हैं:- जी 11xजी 19 का प्राधिकरण, उप अनुकूलतम स्थितियों के लिए एम.ए.एस. एमिलेज़ का उपयोग करते हुए विकसित द्विप्रज द्विसंकर जिसकी उपज क्षमता उत्साहवर्धक है (68 कि.ग्रा./100 रोमुच, 2ए-4ए कच्चा रेशम), उच्च तापमान एवं उच्च आर्द्रता वाले क्षेत्रों के लिए उपयुक्त छ: संकर संयोजनों की पहचान, बल्गेरियन जनन संसाधनों का उपयोग करते हुए (एसएईएस – व्रष्टा) बीएच 1 (24% रेशम प्राप्ति तथा 75 कि.ग्रा./100 रोमुच) का विकास, बीएमएनपीवी सहनशीलता दर्शानेवाला उत्पादक द्विप्रज एफ 1 (सीएसआर 52 एन x सीएसआर 26 एन और सीएसआर 52 एन x सीएसआर 16 एन.सीएसआर 26 एन), वाणिज्यिक उपयोग हेतु उच्च उत्पादकता एवं रेशम गुणवत्तावाले (70 कि.ग्रा./100 रोमुच, 2ए–3ए रेशम) दो उन्नत संकर नस्ल (आईसीबी 17 x एस 8 एवं आईसीबी 14 x एन 23) का विकास आदि है। इस संबंध में किए गए अन्य पहल में मूल बीज क्षेत्र में कड़ाई से किए गए रोग अनुवीक्षण के फलस्वरूप रेशमकीट रोगों के प्रकोप में कमी एवं शहतूत पत्ती रोलर नियंत्रण तथा ऊजी मक्खी के खतरों से निबटने हेतु अपनाई गई सेक्स फेरमोन आधारित ट्रैप विधि (यूजी ल्योर) शामिल है।

सात राज्यों में स्थित 106 क्लस्टरों में 352.28 लाख रोमुचकत्तों की सहायता से 1.785 लाख फसल का उपयोग करते हुए 3905 मे.ट. द्विप्रज कच्चे रेशम का उत्पादन किया गया। औसतन कोसा उपज 72.15 कि.ग्रा./100 रोमुच रही। विशिष्ट प्रौद्योगिकियों (14.56 लाख रोग मुक्त बीज चकत्ते, उन्नत कोसा उपज क्षमता - 18.40%) को अपनाकर सेरि-आदर्श ग्राम कार्यक्रमों (IVLP) से भी 129.16 मे.ट. द्विप्रज कच्चे रेशम का उत्पादन किया गया।

द्विप्रज रेशम उत्पादन में केंरेअप्रसं, मैसूरु का योगदान महत्वपूर्ण है क्योंकि क्लस्टर और गैर क्लस्टर क्षेत्रों का उत्पादन 86% (5260 मे.ट.) रहा। मिशन के तौर पर प्रौद्योगिकी स्थानांतरण कार्यक्रमों के संचालन के फलस्वरूप उत्पादकता में बढ़ोत्तरी तथा परिणामत: हितधारकों के आर्थिक लाभ में पर्याप्त वृद्धि हुई। उत्तर कर्नाटक में क्लस्टर

उन्नयन कार्यक्रम कार्यान्वित किए जाने के परिणामस्वरूप कोसा उपज में औसतन 27% और कच्चा रेशम उत्पादन में रिकार्ड 50% वृद्धि दर्ज की गई। प्रौद्योगिकी अपनाने का स्तर (23.20% से 63.40% तक) अर्थात 40.20% बढ़ गया और उपज अंतराल - में 9.38 से 12.90% तक की कमी दर्ज की गई। आंध्र प्रदेश और तेलंगाना राज्यों में उपज अंतराल में महत्वपूर्ण कमी आई जिससे (26 -35% से मात्र 12%) उच्च कोसा उपज प्राप्त करने में सहायक सिद्ध हुआ। इसी प्रकार तमिलनाडु में प्रौद्योगिकी अपनाने से कच्चा रेशम उत्पादन में काफी वृद्धि (75 से 92% तक) हुई। साथ ही उत्पादकता में 69.70 कि.ग्रा. (2012-13) से 78 कि.ग्रा./100 रोमुच (2017-18) तक की वृद्धि हुई।

इसके अलावा तमिलनाडु में कच्चा रेशम उत्पादन में रिकार्ड वृद्धि हुई (वर्ष 2012-13 में 603 मे.ट. की अपेक्षा वर्ष 2017-18 में 1627 मे.ट.)। केंरेबो और रेशम उत्पादन विभाग के प्रभावी समन्वित प्रयास एवं विभिन्न राज्यों में सीपीपी के कार्यान्वयन के कारण उच्च उत्पादन, उत्पादकता एवं सामाजिक आर्थिक स्थिति में सुधार आदि के कारण रेशम उत्पादन से होने वाली आय में उच्चतर वृद्धि हुई।

केंरेअप्रसं, मैसूरु ने उद्यमी विकास कार्यक्रमों में हमेशा ही महत्वपूर्ण भूमिका अदा की है। रिपोर्ट की अवधि के दौरान शहतूत नर्सरियों एवं चॉकी कीटपालन केन्द्रों में नियमित कार्यक्रम आयोजित करने के अलावा लाभार्थियों को ट्रे धुलाई सह विसंक्रमण मशीन की आपूर्ति की गई। पिछले कुछ सालों में हितधारकों के लिए विकसित कुछ नए उत्पादों को विस्तार संचार कार्यक्रमों (ई.सी.पी) एवं प्रौद्योगिकी हस्तांतरण कार्यक्रमों (1.22 लाख कृषकों के लिए 1652) के जरिए लोकप्रिय बनाया गया। निर्दिष्ट एवं विशिष्ट कार्यक्रमों तथा रेशम उत्पादन संसाधन केन्द्रों के माध्यम से क्षमता - निर्माण कार्यक्रम आयोजित करके 4000 लाभार्थियों में कुशलता विकसित की गई।

भारत के अग्रणी रेशम उत्पादन अनुसंधान व विकास संस्थान के रूप में केंरेअप्रसं, मैसूरु कोसा पूर्व क्षेत्र में समस्त रेशम मूल्य श्रृंखला में कच्चा रेशम उत्पादन करने के संबंध में गुणवत्ता मानक निर्धारित करता है। संस्थान मांग व आवश्यकतानुसार अनुसंधान व विकास परियोजनाओं (राष्ट्रीय/अंतर्राष्ट्रीय स्तर पर संयुक्त सहयोग से), समुचित प्रौद्योगिकी के अनुप्रयोग एवं विकास कार्यक्रमों के जरिए देशी रेशम उत्पादित करने के लिए हितधारकों को सशक्त बनाने हेतु कटिबद्ध है। केंरेअप्रसं, मैसूरु निकट भविष्य में अंतर्राष्ट्रीय स्तर के रेशम की गुणवत्ता को प्राप्त करने में कृषकों को आवश्यक तकनीकी सहयोग प्रदान करने के लिए पूर्णत: प्रयासरत है।

FOREWORD

CSRTI-Mysuru has the mandate to meet the R&D needs of southern states and other states like Maharashtra and Madhya Pradesh co-ordinating with all the stakeholders in providing solutions through implementation of time-bound research activities. The region-specific technology discovery and interventions are made through RSRSs, RECs, and DoSs for addressing stakeholders' issues for achieving enhanced productivity in mulberry sericulture since long. CSRTI-Mysuru during 2017-2018 has addressed many a challenges with regard to productivity improvement and augmenting entrepreneurship potential of sericulture. The institution provided much needed impetus in implementing standard technology based practices for the improvement of mulberry sericulture industry.

The salient achievements in mulberry productivity improvement include authorization of improved mulberry variety, G-4 for irrigated conditions with yield potential of 65 MT/ha/year; *suo moto* authorization of specific mulberry genotypes; identification of several mulberry accessions/hybrids resistant to root rot and root knot (32) and six hybrids exhibiting horizontal resistance; successful field evaluation of `Root-fix' with remarkable rate of revival of root rot infected plants; issual of 12000 soil health cards; development of 'Ankur' (organic and inorganic nutrient based) for improving mulberry leaf and cocoon yield; popularisation of improved mulberry varieties (G2, G4, MSG2, AGB-8) by establishing the seed gardens.

Silkworm improvement programmes aimed to enhance productivity are major activities of CSRTI-Mysuru. The significant steps in this direction include authorization of G11 x G19, bivoltine double hybrid for sub-optimal conditions developed by utilizing MAS-Amylase with promising yield potential (68 kg/100 dfls; 2A-4A raw silk); identification of six hybrid combinations suitable rearing under high temperature and high humidity regions; development of new bivoltine double hybrid, BH1 (24% silk content with a cocoon yield of 75kg /100 dfls utilizing Bulgarian genetic resources (SAES - Vratsa); productive bivoltine F1s (CSR52N x CSR26N and CSR52N x CSR16N.CSR26N) exhibiting BmNPV tolerance; evolution of two ICBs (ICB17 x S8 and ICB14 x N23) for commercial exploitation with improved productivity and silk quality (70 kg/100 dfls; 2A-3A silk). Few other initiatives include stringent disease monitoring of basic seed area resulted in less incidence of silkworm diseases and evaluation of sex pheromone based trapping methods to contain the menace of uzi (UZI lure) and mulberry leaf roller.

A formidable quantity of 3905 MT bivoltine raw silk was produced through 106 clusters spread across seven states utilizing 352.28 lakh dfls and 1.785 lakh crops with an average cocoon yield of 72.15 kg/100 dfls. Seri Model Village (IVLP) programmes also recorded 129.16 MT bivoltine raw silk production by adopting specified technologies (14.56 lakh dfls with an improved cocoon yield of 18.40%). The contribution of CSRTI-Mysuru in bivoltine silk production in the

country is quite impressive as 86% (5260MT) produced in cluster and non-cluster areas. The transfer of technology programmes driven in a mission mode approach resulted in significant improvement in improving productivity and economic returns to the stakeholders. The implementation of Cluster Promotion Programme (CPP) in North Karnataka improved the average cocoon yield by 27% and increased raw silk production up to a record 50%. The technology adoption levels increased (from 23.20% to 63.40%) by 40.20% and registered significant reduction in yield gap by 9.38-12.90%. The yield gap reduction in Andhra Pradesh and Telangana states too was significant (to 12% from 26-35%) thereby improving in obtaining higher cocoon yields. Similarly, raw silk production in Tamil Nadu registered significant improvement due to enhanced technology adoption (from 75 to 92%) resulting in productivity improvement from 69.70 kg (2012-13) to 78 kg/100 dfls (2017-18). Besides, Tamil Nadu witnessed record raw silk production (from 603 MT in 2012-13 to 1627 MT in 2017-18). Sericulture income has registered highest growth due to the implementation of CPP in different states guaranteeing improved production, productivity, socio-economic conditions through effective co-ordination of CSB and DoS.

CSRTI-Mysuru always played active role in promoting the Entrepreneurial Development Programmes and during this year, Tray washing cum Disinfection machines were supplied to beneficiaries along with regular programmes such as mulberry nursery and chawki rearing centres. Several new products which were developed during the previous years were popularized through ECPs and ToT programmes (1652 for 1.22 lakh farmers) for the benefit of stakeholders. Capacity building programmes skilled 4000 beneficiaries through designated and special programmes and sericulture resource centres.

As the premier Sericulture R&D Institute in India, CSRTI-Mysuru sets quality standards for raw silk production across the silk value chain in the pre-cocoon sector. The Institute is committed to empower all the stakeholders in producing Indian Silk through demand-driven R&D projects (national and international collaborations), appropriate technology interventions and developmental programmes for improving raw silk production.

CSRTI-Mysuru endeavours to provide necessary technical guidance to sericulture farmers in meeting the international quality silk in the near future.

कें रे अ प्र सं, मैसूरु के बारे में

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार के नियंत्रणाधीन संस्थापित हुआ । पूर्व मैसूर राज्य में स्थापित रेशम उत्पादन अनुसंधान संस्थान के कार्यों को लेकर वर्ष 1961 में संस्थान ने चन्नपट्टणा में कार्य प्रारंभ किया और बाद में 1963 में इसे मैसूरु स्थानांतरित किया गया । प्रशिक्षण घटक को सम्मिलित करने के बाद इस संस्थान का वर्ष 1965 में केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु (केंरेअप्रसं) के रूप में पुनर्नामाकरण किया गया । यह संस्थान देश में रेशम उद्योग के विकास के लिए पिछले 60 सालों से प्रतिबद्धता के साथ कार्यरत है । संस्थान आई एस ओ 9001:2008 प्रमाणित (2013) है जो रेशम उत्पादन उद्योग के विकास हेतु गुणवत्ता प्रबंधन अनुसंधान व विकास प्रशिक्षण एवं अनुषंगी सेवाओं में उत्कृष्टता का प्रमाण है ।

आज यह संस्थान अनुभवी वैज्ञानिकों, समस्त आधुनिक सुविधाओं एवं अवसंरचनायुक्त रेशम उत्पादन अनुसंधान के एक उत्कृष्ट संस्थान के रूप में विख्यात है । इस संस्थान ने देश तथा विदेश में उष्णकटिबंधीय रेशम उत्पादन में अग्रणी अनुसंधान व विकास संस्थान के रूप में ख्याति प्राप्त की है और यह उच्च अध्ययन एवं उन्नत प्रशिक्षण केंद्र के रूप में सुविख्यात है । यह संस्थान कर्नाटक, आंध्रप्रदेश, तमिलनाडु, तेलांगाना, केरल, महाराष्ट्र एवं मध्यप्रदेश में शहतूत रेशम उद्योग संबंधी आवश्यकताओं की पूर्ति करने हेतु रेशम उत्पादन अनुसंधान व विकास संबंधी समस्त कार्यकलापों में संलग्न है । अभी तक इस संस्थान ने रेशम उत्पादन प्रौद्योगिकी के विभिन्न पहलुओं में 800 विदेशियों सहित करीब 50,000 व्यक्तियों को प्रशिक्षित किया है । यह संस्थान अनुसंधान, प्रशिक्षण एवं विस्तार कार्य संचालित करने के अलावा राष्ट्रीय एवं अंतर्राष्ट्रीय अभिकरणों को परामर्श एवं सलाहकारी सेवाएं भी प्रदान करता है ।

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द्विप्रज रेशम उत्पादन में उत्कृष्ट अंतर्रराष्ट्रीय रेशम उत्पादन संस्थान
के रूप में प्रतिस्थापित होना ।</td></tr>
<tr><td>लक्ष्या

भारतीय रेशम उत्पादन उद्योग को आजीविका स्तर के उत्पादन से प्रतिस्पर्धी वाणिज्यिक उत्पादन आधार संरचना में परिणत करने हेतु अनुप्रयोग आधारित अनुसंधान में श्रेष्ठता हासिल करना|</td><td>उद्देश्य
• भारत में रेशम उत्पादन, उत्पादकता एवं गुणवत्ता बढ़ाने हेतु अनुसंधान।
• शहतूत एवं रेशम कीटपालन के लिए पैकेज (समग्र पद्धति) विकसित करना।
• उत्पादों और प्रौद्योगिकियों का वाणिज्यीकरण ।
• प्रौद्योगिकी स्थानांतरण ।
• प्रौद्योगिकी स्थानांतरण के माध्यम से आयातित रेशम के आनुपातिक रेशम उत्पादन बढाना।
• प्रशिक्षण ।
• अनुसंधान कार्यक्रमों को बल देने हेतु संस्थान के ढाँचे को मज़बूत बनाना।
• प्रजनक स्टॉक का अनुरक्षण ।
• रोग पूर्वानुमान एवं पूर्वसूचना ।
• अनुसंधान एवं विकास नवोन्मेष और पैकेज (समग्र पद्धति) का प्रकाशन ।
• भारत और विदेश में अन्य अनुसंधान व विकास संगठनों के साथ सहयोगी अनुसंधान।</td></tr>
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संगठनात्मक रचना

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु, देश में रेशम उत्पादन अनुसंधान विकास कार्य में संलग्न सबसे बड़ा और सर्वाधिक वैविध्यपूर्ण संस्थान है जिससे कृषि इंजीनियरों, समाजशास्त्रियों एवं अर्थशास्त्रियों सहित करीब 150 वैज्ञानिकों जुडे हैं । ये कार्मिक कर्नाटक, तमिलनाडु, आंध्रप्रदेश, तेलंगाना, केरल, महाराष्ट्र और मध्यप्रदेश राज्यों के मुख्य संस्थानों और संबद्ध एककों के माध्यम से समुचित प्रौद्यौ्गिकियों के विकास और उनके स्थानांतरण हेतु समन्वय कार्य कर रहे हैं । अनुसंधान व विकास कार्यकलाप और प्रौद्योगिकी विकास कार्य चार प्रमुख प्रभागों यथा पर-पोषी पादप, रेशमकीट, विस्तार एवं प्रशिक्षण संभाग के विभिन्न अनुभागों में किए जा रहे हैं । कें रे अ प्र सं, मैसूरु अधिदेशात्मक कार्य निपटाने हेतु कई योग्य तकनीकी एवं प्रशासनिक कर्मचारियों की सेवाओं का भी उपयोग करता है । योजना, अनुवीक्षण, समन्वयन एवं मूल्यांकन कक्ष की सहायता से निदेशक, संस्थान और इसकी संबद्ध इकाइयों के अनुसंधान व विकास कार्यकलापों की प्रगति का अनुवीक्षण करते हैं । राष्ट्रीय एवं अंतर्राष्ट्रीय पत्रिकाओं में प्रकाशित तकनीकी एवं अनुसंधान शोध-पत्रों के अलावा संस्थान के द्वारा 71 पुस्तकें भी प्रकाशित की गई है । संस्थान को अंतर्राष्ट्रीय ख्याति की द्विवार्षिक पत्रिका इंडियन जर्नल ऑफ सेरिकल्चर और रेशम उत्पादन विज्ञान पर दस्तावेज़ी सहित्य सेरिडॉक प्रकाशित करने की प्रतिष्ठा भी प्राप्त है ।

विस्तार कार्य-तंत्र (नेटवर्क)

प्रयोगशाला की उपलब्धियों के मान्यकरण एवं उन्हें क्षेत्र में प्रभावी ढंग से स्थानांतरित करने की प्रक्रिया को सुगम बनाने हेतु इस संस्थान के तीन स्तरीय विस्तार कार्य-तंत्र हैं - क्षेत्रीय रेशम उत्पादन अनुसंधान केंद्र (क्षे रे अ कें), अनुसंधान विस्तारण केंद्र (अ वि कें) और उपएकक । दक्षिणी राज्यों के मुख्य रेशम उत्पादन अंचलों में स्थित क्षेत्रीय रेशम उत्पादन अनुसंधान केंद्र क्षेत्र विशेष के अनुकूल एवं प्रायोगिक अनुसंधान संचालित करते हैं । विस्तार कार्य में संलग्न कर्मचारियों एवं कृषकों को प्रशिक्षित करने के अतिरिक्त क्षेत्रीय आवश्यकताओं के अनुसार उपर्युक्त प्रौद्योगिकियों की सिफारिश करने हेतु प्रौद्योगिकी परीक्षण किया जाता है । लाभार्थियों को प्रौद्योगिकी का स्थानांतरण करना और उनकी सहायता के लिए सभी प्रौद्योगिकी निवेश / तकनीकी जानकारी देने का उत्तरदायित्व अनुसंधान विस्तारण केंद्र एवं उप-एककों का है । महाराष्ट्र एवं मध्यप्रदेश के अलावा दक्षिण राज्यों में भी द्विप्रज रेशम उत्पादन को बढ़ावा देने हेतु कें रे अ प्र सं, मैसूरु, 106 समूहों (समूह संवर्धन कार्यक्रम) और ग्यारह सं.ग्रा.सं.का. (आई.वी.एल.पी.) केंद्रों का समन्वयन करता है । राज्य रेशम विभागों के तकनीकी कार्मिकों के समन्वयन से प्रौद्योगिकियों का प्रभावी स्थानांतरण किया गया है ।

प्रशिक्षण केंद्र

इस संस्थान को उष्णकटिबंधीय रेशम - उत्पादन के क्षेत्र में प्रशिक्षित मानव संसाधन विकसित करने हेतु उत्कृष्ट केंद्र के रूप में मान्यता प्राप्त है जिसमें राष्ट्रीय एवं अंतर्राष्ट्रीय स्तर पर उष्णकटिबंधीय रेशम उत्पादन में प्रशिक्षण प्रदान किया जाता है । यह संस्थान रेशम उत्पादन प्रौद्योगिकी एवं जैव सूचना विज्ञान में अनुसंधान एवं रेशम - उत्पादन में पीएच डी कार्यक्रम संचालित करने हेतु मैसूर विश्वविद्यालय से संबद्ध है । इसे संस्थान के द्वारा ग्रामीण गरीब लोगों, कमज़ोर वर्गों और महिला रेशम - उत्पादकों के सामाजिक-आर्थिक विकास एवं प्रौद्योगिकी सशक्तिकरण हेतु जैव प्रौद्योगिकी विभाग एवं विज्ञान व प्रौद्योगिकी विभाग, भारत सरकार द्वारा प्रायोजित विभिन्न प्रशिक्षण कार्यक्रम संचालित किए जाते हैं। यह संस्थान राज्य रेशम उत्पादन विभागों की मानव संसाधन विकास आवश्यकताओं को पूरा करने के अलावा जापान अंतर्राष्ट्रीय रेशम उत्पादन प्रशिक्षण (जीका) कार्यक्रम भी संचालित करता है । प्रशिक्षण स्कंध

में दृश्य-श्रव्य शिक्षण उपस्करों से सुसज्जित कक्षाएं हैं और योग्य संकाय सदस्यों द्वारा कार्यक्रम संचालित किए जाते हैं । करीब 125 व्यक्तियों के ठहरने हेतु छात्रावास सुविधाएं भी उपलब्ध हैं ।

अवसंरचना सुविधाएं

- रेशम उत्पादन विज्ञान में उन्नत अनुसंधान संचालित करने हेतु सुसज्जित प्रयोगशालाएं, शहतूत बाग़ और कीटपालनगृह ।
- प्रौद्योगिकी मान्यकरण एवं किसानों को प्रशिक्षण देने हेतु बड़े पैमाने पर कीटपालन गृह ।
- चॉकी कीटपालन केंद्र संकल्पना को बढ़ावा देने हेतु आदर्श चॉकी कीटपालन केंद्र ।
- यंत्रों/उपस्करों के अभिकल्प एवं विकास तथा संरचना को समर्थित करने हेतु सभी सुविधाओं से युक्त रेशम उत्पादन अभियांत्रिकी प्रभाग ।
- संबद्ध एककों, रेशम उत्पादन विभागों और अन्य संगठनों के साथ प्रभावी पारस्परिक संपर्क के लिए कें रे अ प्र सं, मैसूरु में संस्थापित विडियो सम्मेलन स्टुडियो प्रौद्योगिकी का तेजी से संप्रेषण एवं प्रभावी स्थानांतरण किया जाना सुनिश्चित करता है ।
- कंप्यूटर सेन्टर द्वारा लेन के माध्यम से प्रिंट / फाइल शेयर / समर्थन सहित सभी को इन्टरनेट कनेक्शन दिया गया है ।
- जैव सूचना विज्ञान केंद्र अखाड़े संचयन की पुन: प्राप्ति सेवा प्रदान करता है ।
- पुस्तकालय सेवाएं (11148 पुस्तकें, 7753 वैज्ञानिक पत्रिकाओं का बंध खंड, 59 जर्नल, शोध पत्र 308, प्रबंध-49 तकनीकी रिपोर्ट एवं सीडी रॉम डेटा बेस-एग्रिस।

ABOUT CSRTI-MYSURU

The Central Sericultural Research & Training Institute (CSRTI), Mysuru was established under the aegis of Central Silk Board, Ministry of Textiles: Govt. of India. The institute started functioning at Channapattana in the year 1961 after taking over the Sericulture Research Institute of erstwhile Mysore province and later shifted to Mysore in the year 1963. With the inclusion of training component, the Institute was renamed as 'Central Sericultural Research & Training Institute (CSRTI); Mysore in the year 1965. The Institute has completed >60 years of dedicated service for the development of sericultural industry in the country. The Institute is accredited with ISO 9001: 2015 certification (2013) as a testimony of excellence in quality management in R&D, training and service support to sericulture Industry.

The Institute has the distinction of being premier institution for sericulture research *par excellence* with all modern facilities and infrastructure including experienced scientific personnel. CSRTI has made mark as the leading R&D institution for quality research and services on tropical sericulture in the country and abroad and is well recognized as center for higher learning and advanced training. CSRTI caters to the need of on-farm sector of mulberry sericulture in Karnataka, Andhra Pradesh, Tamil Nadu, Telangana, Kerala, Maharashtra and Madhya Pradesh. To date CSRTI trained about 50,000 persons including 800 foreign nationals in various aspects of sericulture technology. The institute besides conducting research, training and extension activities, also offers consultancy and advisory services to national and international agencies.

<table>
<tr><td colspan="2">Vision

To become an International Sericulture Institute par-excellence in Bivoltine Sericulture</td></tr>
<tr><td>Mission</td><td>Objectives</td></tr>
<tr><td>To achieve excellence in application oriented research to transform Indian Sericulture industry from the subsistence level of production to a vibrant competitive commercial production base</td><td>• Research to enhance production, productivity and quality of Indian silk
• Development of package of practices for mulberry and silkworm rearing
• Commercialization of products and technologies
• Transfer of technology
• Enhance production of import substitute silk through transfer of technology
• Training
• Strengthening institutional framework to support research programmes
• Maintenance of breeders' stock
• Disease forecasting and forewarning
• Publication of R&D innovations and package of practices
• Collaborative research with other R&D organizations in India and abroad</td></tr>
</table>

Organization Setup

CSRTI-Mysuru is the largest and most diversified institution engaged in sericulture R&D in the country, supported by about 150 scientists of various disciplines including agricultural engineers, sociologists and economists. These personnel working in close coordination for the development of appropriate technologies and their transfer through the main institute and its nested units spread in the states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh. R&D activities and technology development are carried out in four major divisions: Host Plant Production & Protection, Silkworm Production & Protection, Extension and Training. CSRTI-Mysuru also utilizes the services of several able technical and administrative staff in undertaking the mandated activities. The Director monitors the progress of R&D activities of Institute and nested units with the support of Planning, Monitoring, Coordination and Evaluation cell. CSRTI-Mysuru regularly publishes books, bulletins, leaflets and technical pamphlets. Over 71 books have been brought out so far in addition to large number

of technical and research papers published in leading national and international journals. The institute has the distinction of publishing Indian Journal of Sericulture, a biannual journal of international repute and Seridoc - documenting literature on sericultural sciences.

Extension Network

CSRTI-Mysuru has a three-tier system of extension network: Regional Sericultural Research Stations (RSRS), Research Extension Centres (REC) and Sub-Units (REC-SU) to facilitate validation and translation of laboratory findings effectively to the field. RSRSs are located in major sericultural zones of southern states carryout region-specific adaptive and applied research. Technology trials are also conducted to suit the regional requirements besides providing training to farmers and grassroot level extension staff. RECs and sub-units share the major responsibility of technology transfer to the beneficiaries and also provide technological inputs and support services. CSRTI-Mysuru coordinates 106 clusters (Cluster Promotion Programme) and eleven IVLP centers for the promotion of bivoltine sericulture in Southern States along with Maharashtra and Madhya Pradesh. Effective transfer of technologies is undertaken in close coordination with technical personnel of State Departments of Sericulture.

Training Centre

CSRTI-Mysuru is recognized as flagship centre for generation of trained human resource in tropical sericulture at national and international level. The Institute is affiliated to University of Mysuru for conducting research including Ph.D. programmes. CSRTI-Mysuru also conducts training programmes sponsored by DBT, DST and Ministry of Textiles: Govt. of India for socio-economic and technological empowerment of the rural poor, weaker sections and women sericulturists. Besides catering to the HRD needs of the state departments of sericulture in the country, CSRTI-Mysuru also conducts sericulture training programmes for international students/personnel through various organizations such as JICA and Ministry of External Affairs: Govt. of India (ITEC). The training hub houses well-equipped classrooms and the programmes are managed by qualified faculty. The attached hostels can accommodate about 125 persons.

Infrastructure Facilities

- Well-equipped laboratories, mulberry gardens and rearing houses to carry out advanced research
- Large scale rearing houses for technology validation and farmers' training
- Model chawki rearing centre (CRC) to promote the concept of CRC
- Engineering Division with excellent facilities to support designing, development and fabrication of machines/equipments
- Video Conference Studio @ CSRTI-Mysuru ensures faster communication and efficient transfer of technology for effective interactions with nested units, DOSs and other organizations
- Computer center provides internet connectivity to all sections/labs through LAN with print/file share support
- Bioinformatics Center (NBN Sub-DIC: DBT) provides database retrieval services
- Library Services (11148 books; 7753 bound volumes of scientific journals; 59 journals; dissertations - 308; theses-49; technical reports and CD-ROM database-AGRIS).

केंरेअप्रसं, मैसूरु

2017 - 18 की मुख्य उपलब्धियां

शहतूत और रेशमकीट प्रजनन, फसल उत्पादन और संरक्षण, तकनीकी हस्तांतरण, विस्तार और प्रशिक्षण गतिविधियों पर अनुसंधान और विकास कार्यक्रम आरंभ किए जाने के परिणाम स्वरूप आंध्र प्रदेश, कर्नाटक, केरल, तमिलनाडु, तेलंगाना, महाराष्ट्र और मध्य प्रदेश के शहतूत रेशम उत्पादन किसानों की आवश्यकताओं के अनुरूप तकनीकी विकसित की गई हैं । केंरेअप्रसं, मैसूरु की उपलब्धियों की मुख्य बातें निम्नवत हैं :-

शहतूत फसल सुधार, उत्पा4दन एवं संरक्षण:-

- केंरेबो शहतूत उपजाति अनुमोदन समिति (ए.आई.सी.ई.एम फेज-III) ने सिंचित स्थितियों में जी 4 शहतूत उपजाति को अधिकृत किया है और इसकी फसल उत्पादन क्षमता 65 मी.ट. प्रति वर्ष हैं । (डीयूएस विशिष्टता, एकरूपता, स्वामित्व)
- केंरेअप्रसं, मैसूरु को केन्द्रीय अभिकरण परीक्षण केन्द्र और केंरेअप्रसं, बरहमपुर को सह केन्द्रीय अभिकरण परीक्षण केन्द्र के रूप में कार्य करने हेतु नामित किया गया है ।
- शहतूत के 17 एवं 24 संकरों को क्रमश: मूल विगलन रोग कारक और मूल विगलन कृमिसूत्र के विरुद्ध और छ: संकर (क्रम संख्या 2, 7, 9, 16, 17 और 21) दोनों प्रकार के संक्रमण के खिलाफ सहिष्णु पाए गए ।
- 32 शहतूत जननद्रव्य प्रभेद कृत्रिम संरोपण स्थितियों में मूल गांठ रोग से अप्रभावित रहते हैं ।
- कर्नाटक, आंध्र प्रदेश, तेलंगाना, महाराष्ट्रा, मध्य प्रदेश और तमिलनाडु के 12000 रेशम उत्पादक किसानों को मृदा स्वास्थ्य परीक्षण कार्ड जारी किया गया ।
- मूल गांठ के प्रबंधन के लिए रॉटफिक्स का निर्धारण किसानों के सहयोग से किया गया और मूल गांठ रोग से संक्रमित औसतन 68-74% पौधों को पुनर्जीवित किया गया ।
- मेसर्स सिरिकोन टेक्नॉलाजी प्रा. लि., बेंगलूर के साथ शुरु की गई एक सलाहकारी परियोजना के अंतर्गत शहतूत की खेती के लिए कार्बनिक और अकार्बनिक पोषण युक्त उत्पादन अंकुर मूल्यांकन कर इसकी अनुशंसा की गयी । इसके प्रयोग से शहतूत पत्तियों के उत्पादन में 14% की वृद्धि और कोसा उत्पादन में 11% से अधिक वृद्धि पाई गई ।
- जी 2, जी 4, एमएसजी 2 एवं एजीबी 8 उपजातियों को लोकप्रिय बनाने हेतु बीज बागानों को संस्थापित किया गया ।

रेशमकीट फसल सुधार, उत्पादन एवं सुरक्षा

- महाराष्ट्र सहित दक्षिण भारतीय राज्यों में उप इष्टतम स्थितियों में वाणिज्यिक दोहन हेतु द्विसंकर G11 x G19 को एमाइलेज मार्कर के आधार पर केंरेबो संकर नस्ल अनुमोदन समिति , बेंगलूर द्वारा अधिकृत किया गया । संकर का परिणाम काफी उत्साहवर्धक रहा (5.01 लाख रोमुच, औसतन कोसा उपज : 68.0 कि.ग्रा. /100 रोमुच, 2ए – 4ए कच्चा रेशम, अच्छी मात्रा में अंडे की प्राप्ति, बीज फसल का सरलतापूर्वक रोपण)
- एस.एस.आर. मार्कर के आधार पर विकसित N21 x N56 उष्मारोधी द्विप्रजी द्वि संकर से गर्मी के महीनों में सीमित क्षेत्र परीक्षण में (6000 रोमुच / 12 किसान) 72 कि.ग्रा. /100 रोमुच की उपज की प्राप्ति हुई ।
- बहु विषाणु प्रतिरोधी नस्लों/संकरों के विकास के लिए रेशमकीट वायरस (बीएमडीएनपी1, बीएमएनवी एवं बीएमएलएफवी) प्रतिरोधी द्विप्रजी नस्ल/वंशक्रम जनसंख्या ओवल 6 बी एपीएसएसएचटी 05, एस 8, ची ओवल, एपीएस 5, एन आर 2, एच1 एम, डम्बबेल; 5 एन, पाम 117, एसके 6, ची डंब, ईएच 1, 63 एन) का चयन किया गया ।
- कीटपालन और धागाकरण के कार्य निष्पादन के आधार पर उत्पादक द्विप्रजी एफ 1 संकर ; सीएसआर 52 एन x सीएसआर 26 एन और द्वि संकर (सीएसआर 52 एन.एस. 8 एन) x (सीएसआर 16 एन.सीएसआर 26 एन) की पहचान वीएमएनपीवी सहिष्णुता को प्रदर्शित करने वाले सबसे आशाजनक संकर के रूप में की गई ।
- उच्च तापमान एवं अधिक आर्द्रता के लिए अनुकूल सशक्त द्विप्रज रेशमकीट संकरों की पहचान हेतु 88 संकरों सहित अन्य रेशमकीट का पालन प्रमुख गर्म प्रदेशों (आंध्र प्रदेश, तमिल नाडु और कर्नाटक) में किया गया । वर्ष 2018 में गर्मी के मौसम में मूल्यांकन करने हेतु छ: उत्तम संकरों का चयन किया गया ।
- कर्नाटक, आंध्र प्रदेश, तेलंगाना और तमिल नाडु में एस 8 x सीएसआर 16 जो एक उच्च उत्पादक द्विप्रजी एकल संकर है, (उच्च कवच मात्रा : >23.0%; कमतर रेंडिटा : 5.0-5.5) पर औसतन कोसा उत्पादन 74.1 कि.ग्रा. /100 रोमुच (1.59 लाख रोमुच/755 किसान) रिकार्ड किया गया ।
- उरेप्रकें – कूनूर में विकसित उच्च उत्पादक द्विप्रज संकर संयोजन एसएसबीएस 5 x एसएसबीएस 6 का कृषक स्तर पर (33450 रोमुच/146 कृषक) मूल्यांकन किया गया और 72.78 कि.ग्रा. /100 रोमुच की औसतन कोसा उपज दर्ज की गई ।
- बल्गेरिया के आनुवंशिक स्रोतों का उपयोग करते हुए विकसित नए द्विप्रज द्विसंकर (बीएच 1 जिसकी उच्च रेशम मात्रा (24%) और 75 कि.ग्रा. कोसा उपज/100 रोमुच है) को आगे के केन्द्र परीक्षण और क्षेत्र परीक्षण हेतु अनुकूल पाया गया ।
- उन्नत उत्पादकता और रेशम उत्पादकता हेतु प्रत्यक्ष चयन विधि द्वारा दो उन्नत शुद्ध मैसूरु वंशों (तंतु लंबाई : 480-600-800 मी.) का चयन किया गया । कच्चा रेशम गुणवत्ता परीक्षण और संकर मूल्यांकन (x सीएसआर 2) की प्रगति जारी है ।
- वाणिज्यिक उपयोग के लिए नई उन्नत संकर नस्लों को विकसित करने हेतु उन्नत उत्पादकता एवं रेशम गुणवत्ता वाले 6 बहुप्रज वंशों को विकसित किया गया । आईसीबी 17 x एस 8 और आईसीबी 14 x एन 23 को अधिक आशाजनक पाया गया जिसकी उपज क्षमता 70 किग्रा /100 रोमुच और रेशम की कोटि 2ए-3ए है ।

- कर्नाटक, तमिलनाडु और आंध्र प्रदेश में उच्च उत्पादकता हेतु विकसित कावेरी गोल्ड (एमवी 1 x एस 8) का क्षेत्र परीक्षण करने पर 70 कि.ग्रा. / 100 रोमुच (95275 रोमुच: 493 कृषक) की औसतन कोसा उपज दर्ज की गई ।
- नोसेमा बाम्बिसिस की पहचान के लिए संशोधित लैंप तकनीक की अभिपुष्टि मूल बीज भंडार संग्रह (सीएसआरटीआई, मैसूरु : प्रजनक लॉट : पी4, पी 3 एवं पी 2 बीज फसल (1399 नमूने का विश्लेषण ; बिना किसी अयथार्थ संकरात्मक/गुणात्मक परिणाम) के साथ की गई । संशोधित लैंप तकनीक से पेब्रीन संक्रमण के कमतर स्तर की पहचान विकासशील अवस्थाओं में भी किया जा सकता है । यह तकनीक प्रयोग में आसान है एवं इसका उपयोग मूल बीज प्रक्षेत्र तथा बीज उत्पादन इकाइयों में किया जा सकता है ।
- संशोधित लैम्प तकनीक से मूंगा रेशम कीट नमूनों में भी पेब्रीन संक्रमण की पहचान की गई ।

  पीसीआर अनुक्रमण से यह ज्ञात हुआ कि एन. एस्सामेन्सिस, एन बोम्बिसिस (एनसीबीआई में पंजीकृत) से भिन्न है । एकल न्यूक्लियोटाइड पोलिमोर्फिसम (एसएनपी) के आधार पर विशिष्ट प्राइमरों की डिजाइन की जा रही है।
- रेशमकीट प्यूपा आहार से संपूरित पशु प्रोटीनयुक्त आहार में इन विट्रो फरमेन्टेशन और खर-पतवार पाचन शक्ति में प्रतिकूल प्रभाव दर्ज नहीं किया गया ।

प्रौद्योगिकी स्थानांतरण

- आंध्र प्रदेश, कर्नाटक, केरल, तमिलनाडु, तेलंगाना, महाराष्ट्र और मध्य प्रदेश में द्विप्रज क्लस्टर संवर्धन कार्यक्रम (106 क्लस्टर) के माध्यम से रिकार्ड 3905 मी.ट. द्विप्रज कच्चा रेशम उत्पादित किया गया (352.28 लाख रो.मु.च. से 1.765 लाख फसलों में 72.15 कि.ग्रा. / 100 रोमुच की औसतन कोसा उपज प्राप्त हुई) ।
- कर्नाटक, तमिलनाडु, आंध्र प्रदेश, तेलंगाना, मध्य प्रदेश और महाराष्ट्र में (14.56 लाख रोमुच, ककून की उत्पादकता में 18.40% सुधार) में आईवीएलपी (रेशम आदर्श ग्राम) के अन्तर्गत विशिष्ट तकनीकों को अपनाकर 129.16 मी.ट. द्विप्रज रेशम कीट बीज उत्पादन किया गया ।
- 1652 विस्तार संचार कार्यक्रम के माध्यम से 1.22 लाख रेशम उत्पादकों को नई प्रौद्योगिकी से परिचित कराया गया ।
- रेशम उत्पादन प्रौद्योगिकी पर आकाशवाणी मैसूर (मार्च 2017; नवंबर 2017) से रेशमे वाहिनी नामक 39 सप्ताह का प्रायोजित कार्यक्रम प्रसारित किया गया ।
- उत्तर कर्नाटक में सी.पी.पी. के कार्यान्वयन (2012-2017) के परिणामस्वरूप संकर नस्लों के स्थान पर द्विप्रज का उपयोग किया जाने लगा । (संकर नस्लों की ब्रशिंग 87% तक कम हो गई और द्विप्रज की ब्रशिंग में 276% की वृद्धि हुई) कोसा की औसत उपज में 22% वृद्धि हुई और कुल कच्चे रेशम का उत्पादन 50% तक बढ़ गया । प्रौद्योगिकी को अपनाने की दर 23.2% से बढ़कर 63.4% हो गयी । सामाजिक आर्थिक परिप्रेक्ष्य में परिसंपत्ति की स्थिति में 23.62% की बढ़ोत्तरी हुई जबकि परिदेयता की स्थिति 6.3% घट गई, उच्च उत्पादन, उत्पादकता एवं उच्च बाजार भाव के कारण रेशम उत्पादन से प्राप्त आय में 47.2% वृद्धि हुई । पशु पालन, रेशम उत्पादन / कृषि उपस्करों एवं घरेलू सामग्री की खरीद में पर्याप्त वृद्धि हुई । रेशम उत्पादकों की

सामाजिक स्थिति में 15.86% तक सुधार हुई । उच्च श्रमिक उपयोग क्षमता और गोबर खाद के अनुप्रयोग के कारण तकनीकी प्रभाविता की क्षमता में 15.27% वृद्धि हुई और प्रौद्योगिकी अप्रभाविता की क्षमता में 22.35% तक की बढ़ोत्तरी हुई ।

- आंध्र प्रदेश और तेलंगाना में सीपीपी के प्रभाव से शहतूत पत्ती उत्पादन और रेशम कोसा उत्पादकता में उपज अंतराल 1 को उपज अंतराल 11 से कम किया गया । क्लस्टरों की अवधारणा के पहले तेलंगाना में शहतूत पत्ती उत्पादन में 29.84% और कोसा उत्पादन में 40.06% उपज अंतराल दर्ज किया गया जिससे उपज अंतराल में यथाक्रम 12.90% एवं 9.38% की कमी हुई । आंध्र प्रदेश में शहतूत उत्पादन और कोसा उत्पादन में यथाक्रम 26.052% और 35.24% उपज अंतराल दर्ज किया गया जबकि उपज अंतराल में सीपीपी के पश्चात क्रमश: 11.21% एवं 12.48% कमी आई । सामाजिक आर्थिक विश्लेषणों से साबित हुआ कि युवा लोग ही (30-40 वर्ष के) सर्वाधिक सक्रिय हैं, जो शिक्षित है और रेशम उत्पादन कृषि में कम अनुभव रखते हैं । सीपीपी में चालू उन्नत रेशम उत्पादन प्रौद्योगिकियों की जानकारी सह कृषकों से ही प्राप्त होती है । (तेलंगाना 45.30% आंध्र प्रदेश में 49.5%)
- तमिलनाडु में सीपीपी कार्यान्वयन के फलस्वरूप प्रौद्योगिकी अपनाने का स्तर 75% से 92% तक बढ़ गया । उत्पादकता में 69.7 कि.ग्रा. (2012-13) से 78 कि.ग्रा. / 100 रोमुच (2016-17) तक की वृद्धि हुई और ब्रशिंग क्षमता 38.34 लाख (2013-14) से 73.68 लाख तक (2016-17) बढ़ गई । महत्वपूर्ण प्रौद्योगिकियों / पद्धतियों को अपनाने से उत्पादकता बढ़ जाती है । कच्चा रेशम उत्पादन 603 मी.ट. (वर्ष 2012-13) से 1627 मी.ट. (2016-17) तक बढ़ गया । रेशम उत्पादन से प्राप्त आमदनी को नलकूप खोदने, बच्चों की उच्च शिक्षा, वाहनों की खरीदी और विवाह में होने वाले खर्च पर की जाती है । एक एकड़ शहतूत बागान से रु. 0.977 लाख से रु. 1.575 लाख तक की आय प्राप्त हुई, जबकि कोसा उत्पादन रु. 245-275 तक रहा । प्रौद्योगिकियों को अपनाने की वाधाओं के बारे में जानकारी प्राप्त कर विश्लेषण किया गया । उच्च उत्पादन, उत्पादकता एवं सामाजिक आर्थिक स्थिति सुधारने के प्रमुख कारक रेशम उत्पादन से प्राप्त होने वाली बेहतर आय, विसंक्रमण एवं साफ-सफाई का प्रभावी अनुपालन सुस्थापित सी.आर.सी. (चॉकी कीटपालन केन्द्र), पर्याप्त सुविधाओं से युक्तकीटपालन गृह, नवीनतम प्रौद्योगिकियों का उपयोग, केंरेबो एवं राज्य रेविकें कर्मचारियों एवं कृषक समूह द्वारा समय समय पर फसल की देख-रेख हेतु प्रभावी समन्वयन हैं ।
- शहतूत नर्सरी (पौधशाला) एवं चॉकी कीटपालन केन्द्रों का व्यावसायिक नमूना तैयार किया गया है ।
- रेशम उत्पादन विभाग, कर्नाटक के समन्वयन से सेरि एफपीओ (रेशम उत्पादन कृषक संगठन कोप्पल, मद्दूर, कर्नाटक) को तकनीकी जानकारी प्रदान की गई ।
- एम किसान के माध्यम से 60,600 कृषकों को 97 संदेश (तमिल, कन्नड, तेलुगु एवं हिन्दी) भेजे गए ।
- राष्ट्रीय अनुसंधान विकास निगम (एनआरडीसी) भारत सरकार के तत्वावधान में उद्यमी विकास कार्यक्रम कार्यान्वित किया गया जिसके अंतर्गत 10 लाभार्थियों को ट्रे धुलाई सह विसंक्रमण मशीन वितरित की गई ।
- कृषकों को उन्नत शहतूत रेशम उत्पादन प्रौद्योगिकियों से अवगत कराने हेतु हासन (कर्नाटक), चेब्रोलु (आंध्र प्रदेश), सिद्दिपेट (तेलंगाना), बारामती, महाराष्ट्र एवं कृष्णगिरि में रेशम उत्पादन कृषकों के लिए कार्यशाला आयोजित की गई ।

- दक्षिण भारत में शहतूत रेशम उत्पादन पर लिखित पुस्तक "टेक्नॉलजी डिस्क्रिप्टर" को विभिन्न भाषाओं (तमिल, कन्नड़, तेलुगु, अंग्रेज़ी और हिन्दी) में प्रकाशित करके केंरेबो / रे.उ.वि. के कर्मचारियों के बीच वितरित किया गया ।
- ओटोमेटड डिसिन्फेक्शन टेक्नॉलजी, ट्री मलबरी कल्टिवेशन और डिज़ाइनिंग ऑफ सिल्कवर्म रियरिंग हाउस (कन्नड व अंग्रेजी) आदि पुस्तकें प्रकाशित की गई ।
- नर ऊजी मक्खी को पकड़ने तथा मारने हेतु ऊजील्योर नामक सेक्स फेरोमोन विकसित किया गया और इसे क्षेत्र मूल्यांकन हेतु जारी किया गया ।
- पीड़क प्रबंधन हेतु फेरोमोन ट्रैप की (डिज़ाइन) अभिकल्पना करने के लिए डयफेनिया पल्वेरुन्टालिस शहतूत पत्ती रॉलर की मुख्य फेरोमोन (जेड ॥ हेक्साडिसिनल) और छ: लघु यौगिक (ज़ेड ॥-औक्टोडिसिनल, जेड 13 ओक्टाडिसिनिल एसेटेट, मीथाइल पैलमिटेट ट्राइडिकेन, मिथाइल सिन्नमेट, एथनोन) की पहचान की गई ।
- शुष्क चूर्ण से शहतूत रेशमकीट प्यूपीय तेल निकालने के लिए लागत प्रभावी विलायक निष्कर्षण प्रक्रिया को अनुकूलतम बनाया गया । रेशमकीट प्यूपीय तेल से अधिकतम लिनोलिक एसिड निकालने की प्रक्रिया विकासित की गई ।
- शहतूत / रेशमकीट पीड़कों के प्रभावी प्रबंधन हेतु जैव नियंत्रण कारकों (ऊजी मक्खी के लिए नेसोलिंक्स थाइमस, मिली बग के लिए सिम्मस कोक्सिवोरा भ्रमर, और थ्रिप्स के लिए क्राइसा परला जेस्ट्रोवि एवं बाकन ब्रेविकोनिस) को बड़े पैमाने पर उत्पादित करके कृषकों के बीच वितरित किया गया ।

क्षमता निर्माण एवं प्रशिक्षण

- क्षमता निर्माण व प्रशिक्षण कार्यक्रम के अंतर्गत प्रौद्योगिकी अभिमुखीकरण कार्यक्रम एवं कृषक कौशल प्रशिक्षण के ज़रिए 2885 अभ्यर्थियों को प्रशिक्षित कराया गया ।
- चार रेशम उत्पादन संसाधन केन्द्रों द्वारा (कर्नाटक 2 व तमिलनाडु 2) 36 बैचों में 661 रेशम उत्पादन कृषकों को प्रशिक्षण दिया ।
- 454 लाभार्थियों (कृषक, उद्यमी व कर्मचारियों के लिए) गहन द्विप्रज प्रौद्योगिकी, चॉकी कीटपालन जैव नियंत्रण कारक उत्पादन, एकीकृत पीड़क व रोग प्रबंधन पर आवश्यकता आधारित प्रशिक्षण कार्यक्रम संचालित किए गए ।
- आदर्श चॉकी कीटपालन केन्द्र द्वारा भावी उद्यमियों / कृषकों को चॉकी कीटपालन में प्रशिक्षण दिया गया । 578 कृषकों को वितरित किए गए चॉकी कीटों के 83600 रोमुच से 81.00 कि.ग्रा. / 100 रोमुच की औसतन उपज दर्ज की गई ।
- तेरह स्नातकोत्तर और साठ स्नातक छात्रों ने पाठ्यक्रम के अनुरूप निर्दिष्ट शोधकार्य पूरा किया ।
- कर्नाटक एवं तमिलनाडु राज्य के रेशम उत्पादन विभाग के पदधारियों के लिए नई रेशम उत्पादन प्रौद्योगिकियों तथा शीतोष्ण रेशम उत्पादन अनुसंधान संस्थान, एस के ए यू एस टी जम्मू व कश्मीर के सहायक प्रोफेसरों के लिए शहतूत व रेशमकीट प्रजनन एवं आनुवंशिकी पर विशेष कार्यक्रम की संरचना कर उसे आयोजित किया गया ।

पेटेन्ट (एकस्व) एवं वाणिज्यीकरण

पेटेन्ट प्रस्तुत पेटेन्ट रॉटफिक्स – शहतूत में मूल विगलन, रोग नियंत्रण हेतु पारिअनुकूल ब्रोड स्पेक्ट्रम सूत्रीकरण	रा.अ.वि.प., नई दिल्ली
वाणिज्यीकरण अंकुर मृदा उर्वरता एवं स्वास्थ्य के लिए जैव एवं अजैव पूरक पोषक	मेसर्स सेरिकॉन टेक्नॉलजिस, बेंगलूरु (28.03.2018)
अंकुश पारि अनुकूल एवं उपभोक्ता अनुकूल रेशमकीट शरीर एवं कीटपालन शय्या विसंक्रामक	सर्वश्री प्योर केमिकल्स लैबोरेटरी, बेंगलूरु (10.11.2017) की अनुज्ञप्ति का नवीकरण
रॉटफिक्स – शहतूत में मूल विगलन रोग नियंत्रण हेतु पारि अनुकूल ब्रोड स्पेक्ट्रम सूत्रीकरण	सर्वश्री कामत, क्लोरोटेक, बेंगलूरु (18.12.2017)
समृद्धि कोसा उत्पादन बढ़ाने हेतु (किशोर होर्मोन अनुरूप) जे.एच.ए.	सर्वश्री सेरि ग्रो प्रोडक्ट्स, बेंगलूरु की अनुज्ञप्ति का नवीकरण (05.10.2016-4.10.2019)
सेरिमोर रेशमकीट वृद्धि सुधारक	सर्वश्री हेल्थलाइन प्राइवेट लिमिटेड, बेंगलूरु की अनुज्ञप्ति का नवीकरण (3/2018-08.03.2021)
सुपर सैनिटेक – 40,000 पीपीएम सामान्य विसंक्रामक	सर्वश्री हेल्थलाइन प्राइवेट लिमिटेड, बेंगलूरु की अनुज्ञप्ति का नवीकरण (03/2018-08.03.2021)
विकसित उत्पाद अंकुर रॉटफिक्स	परामर्शी परियोजना केंरेबो परियोजना

HIGHLIGHTS OF RESEARCH, TRAINING AND EXTENSION DIVISION

Highlights of Achievements

The R&D programmes undertaken in mulberry and silkworm breeding, crop production and protection; transfer of technology; extension and training activities resulted in developing technologies suitable for the needs of mulberry sericulture farmers in the states of Karnataka, Andhra Pradesh, Kerala, Tamil Nadu, Telangana, Maharashtra and Madhya Pradesh. The salient achievements of CSRTI-Mysuru are as follows:

Mulberry Crop Improvement, Production and Protection

- G4 mulberry variety was authorized by Mulberry Variety Authorization Committee-CSB (AICEM Phase-III) for irrigated conditions and its yield potential is 65 MT/ha/year.
- CSRTI-Mysuru is designated as nodal DUS (Distinctiveness, Uniformity, Stability)-test centre and CSRTI-Berhampore would function as co-nodal test centre.
- Isolated 17 and 24 mulberry hybrids exhibiting disease resistance to root rot pathogens and root knot nematodes, respectively. Six hybrids (Nos. 2, 7, 9, 16, 17 & 21) showed resistance to both the infections.
- 32 mulberry germplasm accessions were found immune to root knot disease under artificial inoculated conditions.
- Soil Health Cards were issued to 12000 sericulture farmers in Karnataka, Andhra Pradesh, Telangana, Maharashtra, Madhya Pradesh and Tamil Nadu.
- Rot-*fix*, formulation for the management of root rot was evaluated with farmers and an average 68-74% revival of root rot infected plants was observed.
- Ankur, a product with organic and inorganic nutrients was evaluated and recommended for mulberry cultivation under consultancy project with M/s. Seri-Con technologies Pvt. Ltd., Bengaluru. Its application increased mulberry leaf yield by 14% and cocoon yield by 11% over control.
- Seed gardens of G2, G4, MSG2 and AGB8 varieties were established for popularization.

Silkworm Crop Improvement, Production and Protection

- G11 X G19, a double hybrid developed for sub-optimal conditions based on amylase marker was authorized by the Hybrid Authorization Committee-CSB, Bengaluru for commercial exploitation in the South Indian states including Maharashtra. The hybrid performance was highly promising (5.01 lakhs dfls; average cocoon yield: 68.0 kg/100 dfls; 2A-4A raw silk; very good egg recovery; easy seed crop rearing).
- N21 x N56, a thermo-tolerant bivoltine double hybrid developed based on SSR marker yielded 72 kg/100 dfls with 21.5% shell in limited field trials during summer months (6000 dfls/12 farmers).
- Bivoltine breeds/line populations (oval: 6B, APSHTO5, S8, Chi Oval, APS5, NR2, H1M; dumbbell: 5N, PAM117, SK6, Chi. Dumb, EH1, 63N) resistant to silkworm viruses (BmDNV1, BmNPV & BmIFV) were shortlisted for developing multi-viral resistant breeds/hybrids.
- Based on rearing and reeling performance, productive bivoltine F1 hybrid: CSR52N x CSR26N and double hybrid: (CSR52N.S8N) x (CSR16N.CSR26N) were identified as most promising, exhibiting BmNPV tolerance.
- To identify robust bivoltine silkworm hybrids suitable for high temperature and high humidity conditions, silkworm rearings were conducted at hotspots (AP, Tamil Nadu & Karnataka) with 88 hybrids. Six best performing combinations were short-listed for further evaluation during summer 2018.

- Field trials of S8 x CSR16, a highly productive bivoltine single hybrid (higher shell content: >23.0%; lower renditta: 5.0–5.5) recorded an average cocoon yield of 74.1 kg/100 dfls (1.59 lakh dfls/ 755 farmers) in Karnataka, Andhra Pradesh, Telangana and Tamil Nadu.
- SSBS5 x SSBS6, a highly productive bivoltine double hybrid combination developed at SSBS-Coonoor was evaluated with farmers (33450 dfls/146 farmers) and recorded an average cocoon yield of 72.78kg/100 dfls.
- A new bivoltine double hybrid (BH1 with high silk content (24%) with 75kg cocoon yield/100 dfls utilizing Bulgarian genetic resources (SAES-Vratza) was found most promising for further OST and OFT.
- Two improved Pure Mysuru lines (filament length: 480-600-800m) were identified for improved productivity and silk quality employing directional selection. Raw silk quality testing and hybrid evaluation (x CSR2) is under progress.
- 6 multivoltine lines with improved productivity and silk quality were developed to evolve new ICBs for commercial exploitation. ICB17 x S8 and ICB 14 x N23 were most promising ICBs with a yield potential of 70kg/100 dfls and 2A-3A silk.
- Field trials of Cauvery Gold (MV1 x S8), an ICB for high productivity (6.5-7.0 renditta) and silk quality (2A) recorded an average cocoon yield of 70kg/100 dfls (95275 dfls; 493 farmers) in Karnataka, Tamil Nadu and Andhra Pradesh.
- Modified LAMP technology for the detection of *Nosema bombycis* was validated with basic seed stocks (Breeders lots @ CSRTI-Mysuru; P4, P3 & P2 seed crops (1399 samples; without any false negatives and positive). Modified LAMP could detect low level of pebrine infections even under developmental stages. The technology is user friendly and can be used in the BSFs and seed production units.
- Modified LAMP also detected pebrine in Muga silkworm samples. The sequencing of PCR products revealed that *N. assamensis* varies from *N. bombycis* (submitted to NCBI). Specific primers are being designed based on single nucleotide polymorphism (SNPs).
- No adverse effects with regard to *in vitro* fermentation and straw digestibility were recorded in cattle feed protein supplementation with silkworm pupal meal.

Transfer of Technology

- A record quantity of 3905MT bivoltine raw silk was produced through Bivoltine Cluster Promotion Programme (106 clusters) in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana, Maharashtra and Madhya Pradesh (352.28 lakh dfls covering 1.785 lakh crops with an average cocoon yield of 72.15 kg/100 dfls).
- 129.16 MT bivoltine raw silk was produced by adopting specified technologies under IVLP (Seri Model Village) in Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Madhya Pradesh and Maharashtra (14.56 lakh dfls with an improvement in cocoon yield by 18.40%).
- 1.22 lakh sericulturists were sensitized with new technologies through 1652 extension communication programmes.
- Reshme Vaahini, a 39-week sponsored programme on Sericulture Technologies was conducted through All India Radio, Mysuru (Mar. 2017-Nov. 2017).
- Implementation of CPP in North Karnataka (2012-2017) resulted in the shift from CB to Bivoltine (CB brushings came down drastically by 87% and BV brushings increased by 276%). The average cocoon yield (kg/100 dfls) increased by 22% and total raw silk production increased by 50%. The technology adoption increased from 23.2% to 63.4%. With regard to socio-economic impact, the asset position (discounted) increased by 23.62%; liability position came down by 6.3%; sericulture income increased by 47.2% due to higher production, productivity and market prices; considerable improvement in animal husbandry,

purchase of sericulture/agriculture equipments and household assets; social status improvement by 15.86% was observed with the sericulture farmers. The non-neutral technological efficiency increased by 15.27% and neutral technological efficiency recorded upto 22.35% mainly due to high labour use efficiency and FYM application.

- The impact of CPP in Andhra Pradesh and Telangana resulted in lowering the yield gap I than yield gap II in case of mulberry leaf production and silkworm cocoon productivity. Before cluster approach, the yield gap recorded in Telangana was 29.84% in case of mulberry leaf production and 40.06% in cocoon production; while the yield gaps reduced to 12.90% & 9.38% respectively after the CPP. With regard to Andhra Pradesh, 26.05% and 35.24% yield gaps were recorded in mulberry leaf production and cocoon production, respectively; while the yield gaps reduced to 11.21% & 12.48%, respectively following CPP. Socio-economic characteristics revealed that most of the respondents were in the active age group (30-40 years), educated and small farmers with few years of experience in sericulture farming. Fellow farmers (45.30 % in Telangana; 49.5 % in Andhra Pradesh) were major source of information on improved sericultural technologies in the CPP.
- Implementation of CPP in Tamil Nadu revealed that technology adoption level ranged from 75 to 92%; productivity improvement from 69.7kg (2012-13) to 78kg/100 dfls (2016-17); and increased brushing capacity, 38.34 lakhs (2013-14) to 73.68 lakhs (2016-17). Higher levels (80-100%) of adoption of critical technologies/practices are attributed for achieving the improved productivity. Raw silk production improved from 603 MT (2012-13) to 1627MT (2016-17). Sericulture income was invested in digging bore well, children's higher education, purchase of vehicles, marriage arrangements. The net returns from one acre of mulberry ranged from Rs.0.997 lakhs to Rs. 1.575 lakhs, whereas the cost of cocoon production ranged from Rs.245-275. Constraints in non-adoption of technologies were recorded and are being analyzed. The contributory factors for improved production, productivity and socio-economic improvement include good returns from sericulture, effective adoption of disinfection/hygiene measures; well established CRCs; suitable rearing houses with adequate facilities; higher adoption of latest technologies; effective coordination in timely crop monitoring by CSB & DOS staff and farming communities.
- Business models for mulberry nursery and chawki rearing centres have been prepared.
- Technical hand-holding was provided to a Seri-FPO (Sericulture Farmers' Producers Organization; Koppa, Maddur, Karnataka) in coordination with DoS-Karnataka.
- 97 messages (Tamil, Kannada, Telugu & Hindi) were communicated to 60600 farmers through m-Kisan.
- Entrepreneurial development programme sponsored by the National Research Development Corporation (NRDC), Govt. of India was implemented and tray washing cum disinfection machines were supplied to ten beneficiaries.
- Sericulture Farmers' Workshops were organized in Hassan (Karnataka), Chebrolu (Andhra Pradesh), Siddipet (Telangana), Baramati (Maharashtra) and Krishnagiri (Tamil Nadu) for enlightening farmers with improved mulberry sericulture technologies.
- Technology Descriptor for Mulberry Sericulture in South India in various languages (Tamil, Kannada, Telugu, English & Hindi) was published and distributed for the benefit of CSB/DoS officials.
- Handbooks on Automated Disinfection Technology, Tree Mulberry Cultivation and Designs of Silkworm Rearing Houses (Kannada & English) were published.
- Uzi-lure, a sex pheromone to trap & kill male uzi flies was developed and released for field evaluation.
- One major compound (Z-11-hexadecenal) and six minor compounds (Z-11-Octadecenal, Z-13-Octadecenyl acetate, methyl palmitate, tridecane, methyl cinnamate, ethanone) of mulberry leaf roller, *Diaphania pulverulentalis* were identified to design pheromone trap for the management of pest.

- Cost-effective solvent-extraction method was optimized for mulberry silkworm pupal oil from dried powder. A process for maximum recovery of α-linolenic acid from silkworm pupae oil was also developed.
- Mass production of bio-control agents (*Nesolynx thymus* for uzifly, *Scymnus coccivora* beetles for mealybugs, *Chrysoperla zastrowi* for thrips and *Bracon brevicornis* for leaf roller) was continued and distributed to the farmers for effective management of mulberry/silkworm pests.

Capacity Building & Training

- 2885 beneficiaries were trained under Capacity Building & Training (CBT) programme through Technology Orientation Programme (TOP) & Farmer Skill Training (FST).
- Four Sericulture Resource Centres (Karnataka: 2 & Tamil Nadu: 2) trained 661 sericulture farmers in 36 batches.
- Need-based training programmes were conducted for 454 beneficiaries (farmers, entrepreneurs and officials) in Intensive Bivoltine Technology, Chawki Rearing, Bio-Control Agent Production, Integrated Pest & Disease Management.
- Model CRC unit trained prospective entrepreneurs/farmers in chawki rearing. 83600 dfls of chawki worms distributed to 578 farmers recorded an average cocoon yield of 81.00 kg/100 dfls.
- Thirteen post graduate and sixty eight under graduate students completed dissertation works for three months as a part of partial course fulfilment.
- Special programmes were designed and conducted for the officials of DoS-K, DoS-TN on new sericulture technologies and Asst. Professors of the Temperate Sericulture Research Institute, SKAUST, J&K on Mulberry & Silkworm breeding and Genetics.

Patents and Commercialization

PATENTS Patent Submitted Rot fix – A Broad Spectrum Eco-Friendly Formulation for Control of Root Rot Disease in Mulberry	NRDC, New Delhi (23.06.2017)
COMMERCIALIZATION ANKUR An organic and inorganic Nutrient Supplement for Soil Fertility and Health	M/s. Seri-Con Technologies, Bengaluru (28.03.2018)
ANKUSH an eco & user friendly silkworm body and rearing seat disinfectant	License renewal to M/s. Pure chemicals Laboratory, Bengaluru (10.11.2017)
Rot fix A Broad Spectrum Eco-Friendly Formulation for Control of Root Rot Disease in Mulberry	M/s. Kamath Chlorotech, Bengaluru (18.12.2017)
Samruddhi (Juvenile hormone Analogue) JHA for enhancing cocoon production	License renewal to M/s. Seri-Gro Products, Bengaluru. (05.10.2016-04.10.2019)
Serimore Silkworm growth promoter	License renewal to M/s. Healthline Pvt. Ltd. [SERICARE], Bengaluru (03/2018 - 8.03.2021)
SANITECH SUPER–40000ppm General disinfectant	License renewal to M/s. Healthline Pvt. Ltd. [SERICARE], Bengaluru (08.03.2021)
PRODUCTS DEVELOPED Ankur Rot fix	Consultancy Project CSB Project

राजभाषा कार्यान्वयन संबंधी गतिविधियाँ

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु में वर्ष 2017-18 के दौरान राजभाषा नीति का सफलतापूर्वक अनुपालन किया गया। राजभाषा के महत्वपूर्ण प्रावधान यथा राजभाषा अधिनियम की धारा 3(3), राजभाषा नियम 5 आदि का भी शत प्रतिशत अनुपालन सुनिश्चित किया गया । संस्थान में हर तिमाही में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगति के बारे में समीक्षा की गई एवं हिन्दी कार्यशाला का आयोजन नियमित रूप से किया गया । निर्धारित लक्ष्य के अनुसार हिन्दी टिप्पण-आलेखन के अलावा महत्वपूर्ण वैज्ञानिक एवं तकनीकी साहित्य को भी हिन्दी में प्रकाशित करने का कार्य किया गया ।

संस्थान द्वारा उक्त अवधि के दौरान राजभाषा कार्यान्वयन के विभिन्न बिन्दुओं पर की गई कार्रवाई का विवरण निम्नानुसार है:

- **धारा 3(3) का अनुपालन:** राजभाषा अधिनियम 1963 की धारा 3(3) के अधीन आने वाले सभी कागज़ात द्विभाषी में जारी किए गए।
- **नियम 11 का अनुपालन:** सभी फार्म, पत्रशीर्ष, रबड़ मोहरें, सूचनापट्ट, नाम पट्ट, लिफाफे, पहचान-पत्र, परिचय-पत्र आदि द्विभाषी है । इन्हें सुनिश्चित करने हेतु जाँचबिंदु (भंडार अनुभाग, प्रेषण कक्ष और संबंधित अधिकारी के स्तर पर बनाए गए हैं ।
- **हिंदी पत्राचार:** वर्ष के दौरान क, ख तथा ग क्षेत्र स्थित केंद्रीय सरकारी कार्यालयों को क्रमश: 90%, 73 % और 76% तथा क व ख क्षेत्र स्थित राज्य सरकार के कार्यालयों/व्यक्तियों को 100% पत्र हिंदी में भेज कर लक्ष्य से अधिक पत्राचार किया गया है ।
- **राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन:** संस्थान में हर तिमाही में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा के प्रगामी प्रयोग के बारे में समीक्षा की गई । वर्ष 2016-17 के अंतर्गत दिनांक 30.05.2017, 30.08.2017, 12.12.2017 एवं 23.03.2018 को राजभाषा कार्यान्वयन समिति की बैठकें आयोजित की गई तथा बैठकों में लिए गए निर्णय पर अनुवर्ती कार्रवाई की गई।
- **हिंदी कार्यशालाओं का आयोजन :** संस्थान के पदधारियों को सरकारी काम-काज में हिंदी का प्रयोग करने और साथ-साथ राजभाषा नीति की जानकारी देने के लिए प्रत्येक तिमाही में हिंदी कार्यशाला का आयोजन किया गया। तकनीकी तथा प्रशासनिक पदधारियों के साथ-साथ वैज्ञानिकों के लिए भी इस वर्ष के दौरान दिनांक 18.05.2017, 22.08.2017, 20.12.2017 और 22.03.2018 को अलग-अलग एक दिवसीय हिंदी कार्यशाला का आयोजन कर कुल 33 अधिकारियों व 36 कर्मचारियों को प्रशिक्षित किया गया ।
- **हिंदी टिप्पण-आलेखन प्रोत्साहन योजना का कार्यान्वयन:** संस्थान एवं इसके अधीनस्थ केंद्रों में कार्यरत अधिकारियों तथा कर्मचारियों को हिंदी में मूल रूप से काम करने को प्रोत्साहित करने के लिए निर्धारित शब्द लिखने पर नकद पुरस्कार दिया जाता है। इस वर्ष के दौरान इस योजना के अंतर्गत संस्थान तथा अधीनस्थ कार्यालयों के 10 पदधारियों को इस योजना के अंतर्गत पुरस्कार प्रदान किया गया ।
- **हिंदी प्रकाशन:** संस्थान की वार्षिक रिपोर्ट अंशत: द्विभाषी में प्रकाशित की गई । वर्ष के दौरान अर्धवार्षिक गृह पत्रिका "रेशम किरण" का भी प्रकाशन किया गया ।

- **राजभाषा नियम 10(4) के अंतर्गत अधीनस्थ कार्यालयों को अधिसूचित किया जाना :** जिन कार्यालयों में हिंदी में कार्यसाधक ज्ञान रखने वालों का प्रतिशत 80 हो जाता है उन कार्यालयों को मंत्रालय द्वारा राजभाषा नियम10(4) के अधीन अधिसूचित किया जाता है ।
- **हिंदी प्रतियोगिताओं का आयोजन :** संस्थान में दिनांक 01.09.2017 से 15.09.2017 तक राजभाषा पखवाड़ा मनाया गया । इस दौरान 8 विभिन्न हिंदी प्रतियोगिताओं यथा सहीलेखन, श्रुतलेखन, स्मृति परीक्षण, सामूहिक चर्चा, वाक् प्रतियोगिता, टिप्पण-आलेखन एवं प्रशासनिक शब्दावली, तकनीकी शब्दावली, गीत, तस्वीर क्या बोलती है? आदि प्रतियोगिताओं का आयोजन किया गया । प्रत्येक प्रतियोगिता के विजेताओं को प्रथम, द्वितीय, तृतीय एवं सांत्वना पुरस्कार प्रदान किया गया।
- **कंप्यूटर पर हिंदी में कार्य :** धारा 3(3) का अनुपालन, फार्म/प्रपत्र,मानक मसौदे, तिमाही रिपोर्ट तथा मूल्यांकन रिपोर्ट, बैठकों की कार्रवाई संबंधी कार्य कंप्यूटर पर सुचारू रूप से किया जा रहा है। संस्थान में सभी अभिकलित्रों में यूनिकोड की संस्थापना की गई है जिससे हिंदी,अंग्रेजी तथा अन्य भारतीय भाषाओं में काम करने में सुविधा प्राप्त हो गई है ।
- **निरीक्षण:** राजाभाषा नीति के कार्यान्वयन मे हुई प्रगति की समीक्षा करने तथा तदनुसार आवश्यक सुझाव एवं मार्गदर्शन देने हेतु अदिनस्था कार्यालयों का निरीक्षण किया गया|

ACTIVITIES REGARDING OFFICIAL LANGUAGE IMPLEMENTATION

During 2017-18 Official Language policy has been implemented succesfully at Central Sericultural Research and Training Institute, Mysuru. Cent percent compliance of Official Language provisions i.e. section 3(3) of Official Language Act, Official Language Rule 5 etc have been ensured. The progress in implementation of Hindi was reviewed by conducting quarterly meeting of the Official Language Implementation Committee. According to the prescribed target, in important scientific and technical literature has been published in Hindi apart from doing Hindi noting and drafting.

Organisation of Hindi workshops, Hindi day, Hindi fortnight, Publication of Hindi magazine have been done and Hindi Noting-drafting Incentive Scheme has been implemented.

Action taken on various items of Official Language Implementation during the period is as follows:

- **Compliance of Section 3(3)** : All the documents specified coming under section 3(3) of the Official Language Act 1963 have been issued in bilingual.
- **Compliance of Rule 11** : All types of forms, letter heads, Rubber Stamps, Sign Boards, Name plates, Envelopes, Identity Cards, Visiting cards etc are bilingual. Check points (at Xerox Cell, Stores Section, Despatch Section and the concerned officer) have been devised to ensure the same bilingual.
- **Hindi Correspondence** : During the year the prescribed targets for correspondence of Hindi were achieved by sending 90%, 93% and 76% letters in Hindi to Central Govt. Offices of A, B and C regions respectively and 100% letters in Hindi to State Govt. Offices and individuals of A & B regions.
- **Organisation of meetings of the Official Language Implementation Committee** : The progress of implementation of the Official Language was reviewed from time to time by conducting OLIC meeting in every quarter. During the year 2017-18 Official Language Implementation Committee meetings were organised on 30.05.2017, 30.08.2017, 12.12.2017 and 23.03.2018 and follow up action was taken on the decisions of the meeting.
- **Organisation of Hindi Workshops** : Hindi workshop was organised in every quarter for the officials of the Institute to provide information related to use of Hindi in the Official work and extend information about Official Language Policy. During the year, 33 Officers and 36 Staff have been trained in Hindi workshops organised on 18.05.2017, 22.08.2017, 20.12.2017 and 22.03.2018 seperately for technical and administrative officials and scientists.
- **Implementation of noting-drafting incentive scheme** : To encourage the officers and staff of this Institute and its subordinate offices to do their work originally in Hindi. noting-drafting incentive scheme was implemented in which cash awards are given for writing prescribed words in Hindi. During the year cash awards were given to 10 officials of the institute and of subordinate offices.
- **Publications in Hindi** : Annual report of the Institute was published partly in bilingual. Half yearly house magazine “Resham Kiran” was released.
- **Notification of the sub-ordinate offices under 10(4) of the Official Languages rules** : The Offices in which 80% of the staff are having working knowledge in Hindi are notified under 10(4) of the official languages rules. In this direction, apart from this office, 6 sub-ordinate offices have also been notified.

- **Organisation of Hindi competitions** : Official Language Fortnight was organised from 01.09.2017 to 15.09.2017 during which 10 different Hindi competitions viz. 1. Correct writing 2. Dictation, 3. Memory test, 4. Elocution, 5. Noting-drafting and administrative glossary. 6. Technical glossary, 7. Songs, 8. what does the picture speak ? competitions were organised. The winners of the competitions were awarded with first, second, third and consolation prizes.
- **Work on computers in Hindi** : Compliance of Section 3(3), forms, standard drafts, quarterly progress report and evaluation report, work related to meetings carried out smoothly on computers. Unicode system installed in all computers which facilitates to do work in Hindi, English and other Indian languages.
- **Inspection** : Sub-ordinate offices are inspected for reviewing the progress made regarding implementation of Official Language Policy and extending necessary suggestions & guidance accordingly.

MULBERRY BREEDING AND GENETICS LABORATORY

Concluded Research Projects

PIB 3457: Development of disease resistant and productive mulberry genotypes with special reference to root rot and root knot diseases suitable for seri-zones of south India (Jan. 2012 - Dec. 2017)

S. Gandhi Doss, Mala V. Rajan (upto 31.10.2012), M. K. Prithvi Raje Urs (upto 09.06.2014), Rajashekar, K., D. D. Sharma (upto 28.02.2014), N. B. Chowdhary (upto 31.05.2013), V. Nishitha Naik (upto 31.05.2016), Pratheesh Kumar, P. M., T. Mogili, Tanmoy Sarkar, T. Gayathri and V. Sivaprasad

Objective: To identify and select hybrids resistant to root rot and root-knot diseases through hybridization, selection and evaluation in progeny row trial

Mulberry crop has been affected by root rot and root knot diseases causing 15 to 25% crop loss due to sporadic dying of mulberry plants resulting in yield loss pockets in farmers' field and affects silkworm rearing and silk productivity. In an effort to develop varieties resistant to these major root diseases, systematic breeding work involving resistant mulberry accessions and high yielding varieties/genotypes were taken up. Evaluation and selection of resistant germplasm accessions and crossing with high yielding genotypes are the prerequisite to develop resistant varieties to these root diseases. Hence, 35 mulberry accessions, selected based on the previous reports from the Institute and reports elsewhere were considered for this study.

Prior to involving the selected accessions in breeding programme, they were evaluated under artificial inoculated conditions to assess their response to pathogens of root rot (*Fusarium solani*, *Botydiplodia theobromae*; *Rhyzoctonia bataticola*) and root knot nematode (*Meloidogyne incognita*) in pots. Each accession had 9 treatments and one control and separate set of potted plants were kept for each disease. Each potted plant was treated with specific pathogen load of root rot [@ 6.25% /pot (w/w) having a spore load of 2.0 - 2.6 × 10^7/g near the root zone (15 cm deep)] and J2 juveniles [@3 J2 juveniles/g of soil] of root knot

Response of selected germplasm accessions to root rot and root knot diseases under artificial inoculated conditions

Name of the Accession	Root rot			Root knot		
	Disease severity (%)	Root rot index	Disease reaction	Knots/ 25g root (no.)	Root knot index	Disease reaction
M. Multicaulis	16.13	10.12	R	2.50	1.33	MR
C776	16.33	12.22	R	3.33	1.33	MR
Almora local	19.44	19.33	R	2.22	1.33	MR
Punjab local	24.34	18.21	R	4.33	1.33	MR
Mysuru local	23.42	13.32	R	4.33	1.33	MR
Himachal local	24.50	15.33	R	1.33	1.33	MR
China white	25.34	43.22	MR	4.33	1.33	MR
S-36	26.22	43.21	MR	4.00	1.33	MR
English Black	28.15	29.22	MR	3.50	1.33	MR
Assambola	25.71	26.33	MR	4.20	2.33	S
Belidevalaya	26.13	32.33	MR	5.80	1.33	MR
S-30	28.54	30.66	MR	8.91	2.00	MR
K2	28.76	35.33	MR	4.50	2.00	MR
RFS-175	29.12	30.22	MR	9.50	2.00	MR
Roso	38.35	26.23	MR	8.80	2.00	MR
Moulai	52.81	72.33	S	15.2	2.33	S
S-13	48.12	42.12	MR	8.20	2.00	MR
AR-12	41.36	45.15	MR	7.50	2.00	MR
S-146	71.35	76.26	S	18.20	2.67	S
V1	63.18	79.12	S	15.20	2.67	S
S-34	29.14	32.31	MR	9.20	2.00	MR
MR-2	32.15	31.20	MR	29.80	2.33	S
C-763	33.16	35.33	MR	30.10	2.67	S
Anantha	70.18	73.20	S	35.10	2.67	S
Ber-20	42.69	49.20	MR	15.20	2.67	S
Cuckpilla	36.17	38.50	MR	18.20	2.00	MR
OPH-1	74.32	85.44	S	42.20	2.67	S
M. Rotundiloba	49.15	43.76	MR	23.80	2.00	MR
OPH-3	84.16	76.12	S	25.10	2.67	S
Shrim-8	52.15	56.15	S	29.10	1.33	MR
S-14	55.30	54.25	S	40.10	2.67	S
Shrim-5	69.18	58.21	S	32.10	3.33	S
S-54	51.50	59.18	S	23.10	3.67	S
Acc-107	58.90	63.62	S	30.10	9.33	S
Hungarian	60.1	65.81	S	32.50	9.00	S

nematode. After 120 days of inoculation, the disease response was evaluated based on 5 point disease scoring scale. Out of 35 accessions, 6 and 8 accessions showing resistant (R) and moderately resistant (MR) response to root rot and root knot diseases, respectively, were short-listed for breeding programme.

Grading scale for root rot disease incidence			
Grade	Code	Disease severity	
		Leaf wilting (%)	Root rotting (%)
Immune (I)	0	No wilting	No rotting
Highly Resistant (HR)	1	0–15%	0–15%
Resistant (R)	2	15.1–25%	15.1–25%
Moderately resistant (MR)	3	25.1–50%	25.1–50%
Susceptible (S)	4	50.1–75%	50.1–75%

$$\text{Root Rot Index} = \frac{\text{Root wt. in control} - \text{Root wt. in treatment}}{\text{Root wt. in control}} \times 100$$

Grading scale for root knot disease incidence				
Disease severity	Code	No. of knots/25 g root	Disease resistance	Root Knot Index
Disease free	0	Nil	Immune	Nil
Very mild	1	1–2	Highly resistant	0.0–0.05
Mild	2	3–10	Resistant	0.051–1.0
Moderate	3	11–30	Moderately resistant	1.1–2.0
Severe	4	31–100	Susceptible	2.1–3.0
Very severe	5	100.1 and above	Highly susceptible	3.1 and above

$$\text{Root Knot Index} = \frac{\text{No. of egg masses in test plant} \times \text{Maximum egg mass index}\left(i.e., 5\right)}{\text{No. of egg masses in standard variety}}$$

The short-listed R/MR accession were used in crossing with either resistant/MR or high yielding genotypes, as per the sex of the accessions. A total of 17,284 hybrids developed from 16 different crosses were maintained in seed beds. The 150 days old seedlings were treated with pathogens of root rot in seed beds itself and the surviving seedlings after 120 days were isolated and transplanted to pathogen free nursery beds.

Seedling evaluation

Maintenance of surviving seedlings

Based on the seedling vigour of the hybrids, 1019 hybrids were short-listed and transplanted in the field in 60 x 150 cm spacing to evaluate their yield potential in PRT (progeny row trial) experiment. After establishment of hybrids in PRT, in the first stage of selection, 107 hybrids short-listed based on AGB (>2.25 kg/plant) over population mean + 1.25 SD were planted in nursery to raise saplings for artificial inoculation study. In the second stage of selection, 60 hybrids short-listed based on higher rooting ability (>60%). In the third stage of selection, 43 hybrids yielding higher (1171–760 g leaf per plant) over the population mean + 2SD, short-listed based on leaf yield performance in PRT. The average yield potential of the test hybrids ranged from 53 to 1170 g/plant.

Selection of promising mulberry hybrids at different stages of selection					
Cross	Progeny raised	Number of progeny selected			
		PRT	AGB (> 2.25 kg/plant)	Rooting (>60%)	Leaf yield (> 760 g/plant)
Punjab local × V1	1250				
Himachal local × C-776	534	150	12	7	10
English black × V1	484	65	13	3	
RC-2 × V1	17	4	3	2	2
S-36 × V1	1051	20	4	4	2
S-30 × Mysuru local	1518	13	1	1	1
Roso × V1	2292	95	12	6	11
M. multicaulis × Mysuru local	1330	87	13	12	3
K2 (4n) × Chinawhite	455	42	2	1	2
M. multicaulis × C-776	1728	244	23	10	7
G-2 × C-776	229	15	3	2	1
S-36 (4n) × Almora local	128	7			
Punjab local × Mysuru local	1280	99			2
Punjab local × C-776	920	22			
Punjab local × Almora local	2987	26			
S-36 × Mysuru local	1051	13	2	1	1
Total	17284	1019	107	60	43

Growth and yield data of 43 promising hybrids in PRT (average of 8 crops)						
Cross	Leaf yield (g/ plant)	Above ground biomass (g/plant)	Leaf: shoot ratio	shoots/plant (No.)	Longest shoot Length (cm)	Total shoot Length (cm)
HL × C776	1170.63	2145.0	0.61	12.25	179.88	1604.0
HL × C776	1100.94	2213.1	0.57	16.75	198.63	2157.5
PL × ML	1051.25	1760.0	0.61	14.44	161.88	1830.5
Roso × V1	1045.63	1840.0	0.66	13.13	171.63	1564.3
Multi × C776	1033.13	1903.1	0.60	18.88	171.38	2208.3
HL × C776	1026.88	2000.0	0.57	17.94	191.88	2254.9
Multi × C776	1021.25	1858.1	0.62	16.88	160.63	2025.7
S36 × V1	1015.94	1684.3	0.73	13.38	148.13	1511.6
Roso × V1	1010.00	1751.2	0.88	18.13	156.50	2038.0
HL × C776	992.50	2200.0	0.50	26.63	216.63	3091.6
RC2 × V1	955.00	1999.3	0.55	19.00	189.63	2354.8
Multi × ML	947.19	1791.5	0.62	18.00	167.63	2056.3
Multi × C776	940.94	1771.8	0.61	16.63	161.13	1871.3
Roso × V1	940.00	1643.1	0.66	15.38	161.63	1777.3
K24N × CW	932.50	1844.3	0.58	14.25	162.00	1744.5
S36 × V1	923.75	1555.0	0.70	16.00	159.50	1717.0
Roso × V1	915.00	1759.3	0.59	19.25	167.38	2117.6
HL × C776	910.00	1665.0	0.65	16.38	141.38	1725.0
S30 × ML	903.13	1705.0	0.58	23.81	159.13	2481.6
Roso × V1	903.13	1457.5	0.73	13.56	138.44	1362.8
S36 × ML	901.25	1800.6	0.54	17.75	179.00	2122.3
HL × C776	901.25	1653.7	0.63	11.69	170.00	1501.7
ML × C776	895.63	1512.5	0.69	16.50	134.00	1599.3
Roso × V1	882.50	1578.1	0.63	15.13	169.75	1756.3
Multi × ML	855.94	1628.4	0.59	19.25	157.75	2180.3
Roso × V1	836.88	1546.8	0.61	19.38	152.63	2080.7

Multi × C776	834.38	1496.2	0.65	13.25	153.88	1509.1
Multi × C776	831.25	1771.8	0.53	17.56	194.56	1986.6
Roso × V1	827.81	1540.0	0.61	12.25	183.75	1581.0
PL × V1	822.50	1800.0	0.54	21.69	211.50	2606.8
Multi × C776	822.50	1482.5	0.64	13.38	149.25	1490.0
Roso × V1	818.13	1408.7	0.67	13.63	132.50	1399.5
Roso × V1	816.25	1536.2	0.61	17.00	163.06	1841.7
HL × C776	813.13	1605.6	0.59	17.38	182.38	2118.5
K24N × CW	805.00	1630.0	0.55	12.81	166.19	1495.1
HL × C776	795.63	1709.3	0.52	20.38	197.25	2528.2
PL × ML	788.75	1460.6	0.64	16.38	149.25	1601.6
Multi × ML	788.13	1357.5	0.68	15.00	147.13	1617.0
HL × C776	786.88	1465.0	0.61	15.88	149.13	1770.5
RC2 × V1	783.75	1360.0	0.67	15.38	150.63	1575.5
HL × C776	772.50	1712.5	0.52	17.63	177.94	2041.0
G2 × C776	766.88	1428.7	0.61	15.75	160.88	1699.6
Roso × V1	760.00	1360.6	0.62	13.75	153.00	1490.5
Mean (μ)	403.75	769.90	0.60	9.22	146.84	1001.4
SD	178.06	356.55	0.07	3.49	23.06	417.8
Mean (μ) +SD	759.87 (μ+2SD)	1482.99 (μ+2SD)	0.64 (μ+0.5SD)	16.19 (μ+0.5SD)	169.90 (μ+1SD)	1419.2 (μ+1SD)

In parallel to yield evaluation in PRT, the short-listed 60 hybrids with high rooting ability were subjected to artificial inoculation study to root rot pathogens (*Fusarium solani*, *Fusarium oxysporum, Botydiplodia theobromae*; *Rhyzoctonia bataticola*) and root knot nematode (*Meloidogyne incognita*) and identified 25 & 46 hybrids exhibiting resistant response to root rot and root knot diseases, respectively, 22 hybrids exhibited resistant response to both the diseases out of which 7 hybrids possessed higher leaf productivity over population mean.

Response of short-listed 60 hybrids to artificial inoculation of root rot pathogens and root knotnematodes												
Cross	Number of progeny selected											
	Root rot					Root knot					Resistant to both root rot/ knot	Resistant and productive hybrids
	HR	R	MR	S	HS	HR	R	MR	S	HS		
Punjab local x V1	3	3	5			1	8	1	1		5	
Himachal local x C-776	1	4	2			2	4			1	4	3
English black x V1	1	1	1				3				2	
RC-2 x V1		1	1				2				1	1
S-36 x V1	2	1	1			1	2	1			3	
S-30 x Mysuru local		1					1				1	
Roso x V1	1	1	3	1		3	3				2	2
M. multicaulis x Mysuru local	1	2	6	3		6	2	2		2	3	
K2 (4n) x Chinawhite	1						1				1	1
M. multicaulis x C-776		1	6	3		1	3	1	3	2		
G-2 x C-776			2				2					
S-36 (4n) x Almora local												
Punjab local x Mysuru local												
Punjab local x C-776												
Punjab local x Almora local												
S-36 x Mysuru local			1				1					
Total	10	15	28	7		14	32	5	4	5	22	7

Mulberry hynrid progeny in PRT experiement (A) and evaluation of short-listed hybrids under artificial inoculated conditions (B).

A

B

Saplings of hybrid showing resistance and susceptible response to root rot (A) and root knot (B and C) pathogens under artificial inoculated conditions.

A

B

C

The short-listed 43 high productive hybrids including hybrids showing resistant response to both root diseases (22) and disease resistant productive hybrids (7) will be considered for evaluation under PYE experiment in a separate research project.

Ongoing Research Projects

PIP 3592: Identification of indices for abiotic stress tolerance in mulberry with special reference to moisture and alkalinity stress (Oct. 2016 - Sept. 2019)

T. Gayathri, S Gandhi Doss and Tanmoy Sarkar

Objective: To identify physiological and biochemical indices of abiotic stress tolerance in mulberry

Physiological (relative water content and photosynthetic efficiency) and biochemical (antioxidants and osmolytes) parameters were analyzed in different mulberry genotypes under optimal input conditions. All these parameters significantly varied among the genotypes. Mean data were used to calculate the index value based on Mano's Evaluation Index (EI) (Mano *et al.,* 1993) and score value of particular parameter above 50 was considered to be the desired varieties.

Evaluation Index value was used to score biochemical parameters and RC1 ranked first among the 15 genotypes studied, followed by S1635, Mysuru local, RFS 175, S34 and RC2. The results of this study reported the high antioxidant potential of resource constraint variety; RC1 among different mulberry varieties and this data was used for short-listing of varieties for further screening under stress conditions. Saplings of short-listed varieties (EI value 50) were raised in nursery beds and transplanted to pots for conducting moisture stress experiments.

Photosynthetic and leaf gas exchange parameters in mulberry genotypes							
Variety	P_N (µmol $m^{-2}s^{-1}$)	Gs (mol $m^{-2}s^{-1}$)	E (mmol $m^{-2}s^{-1}$)	WUE (P_N/E)	CO_2i (µmol $m^{-2}s^{-1}$)	Ci/Ca	RWC (%)
RC1	21.1±0.50	0.60±0.11	3.23±0.55	7.06±1.59	339.56±8.2	0.83±0.03	70.51±2.3
S1635	19.7±0.38	0.57±0.05	3.69±0.27	5.42±0.45	339.82±5.5	0.84±0.01	69.15±2.5
M.Local	21.7±0.78	0.61±0.06	3.77±0.24	5.80±0.18	353.69±4.8	0.84±0.01	68.1±1.69
S 34	23.4±0.77	0.63±0.10	3.71±0.55	6.6±0.99	336.89±10.5	0.82±0.02	68.35±0.45
RC2	22.3±0.66	0.54±0.08	2.95±0.51	8.04±1.4	333.65±5.48	0.81±0.02	67.05±1.8
S13	23.8±1.15	0.56±0.10	3.06±0.72	8.71±2.12	332.23±10.2	0.80±0.02	67.05±1.08
G4	22.7±1.48	0.57±0.08	3.20±0.41	7.22±0.43	344.23±3.7	0.82±0.01	76.61±1.36
MG2	24.5±0.81	0.64±0.13	2.55±0.27	9.89±1.33	338.22±10.4	0.82±0.02	69.11±2.54
AR12	19.1±0.64	0.60±0.05	3.96±0.25	4.90±0.47	352.20±10.2	0.85±0.01	66.62±1.34
Sahana	17.2±0.40	0.73±0.04	4.22±0.57	4.23±0.61	350.55±12.8	0.86±0.03	67.09±0.64
AR11	23.3±0.89	0.62±0.09	4.07±0.35	5.84±0.62	344.10±7.58	0.82±0.02	73.88±2.68
V1	21.04±1.9	0.71±0.03	3.81±0.19	5.48±0.31	356.13±6.92	0.86±0.007	71.97±1.4
K2	23.8±0.50	0.59±0.05	3.51±0.35	6.89±0.58	352.04±8.07	0.83±0.007	73.81±4.9

Biochemical analysis of antioxidants, osmolytes and Evaluation Index of different mulberry genotypes									
Variety	SOD Total activity (units/g)	POX Total activity (Units/g)	Phenols (mg/g)	Ascorbic acid mg/g)	Reduced glutathione (mg/g)	Proline (µmole/g)	Soluble sugar (mg/g)	EI value	Rank
RC1	110.9±6.0	441.3±19	6.0±0.06	2.9±0.07	0.35±0.009	4.57±0.23	42.6±0.2	54.24	1
S1635	27.9±4.5	444.7±11	4.0±0.05	3.6±0.09	0.56±0.011	5.19±0.27	34.4±0.2	53.40	2
M.Local	81.3±1.5	195±0.8	8.0±0.04	3.54±0.1	0.46±0.03	6.16±0.37	42.7±0.4	52.87	3
RFS175	78.1±2.4	375±2.9	3.8±0.02	3±0.03	0.6±0.006	8.57±0.32	39.9±0.1	52.01	4
S34	8.4±2.2	418.3±7	3.5±0.09	4.02±0.03	0.49±0.004	6.51±0.27	33.87±0.30	50.11	5
RC2	108.5±2.7	211±11.5	6.5±0.06	2.49±0.1	0.34±0.008	5.28±0.18	41.7±0.43	49.86	6
S13	81.3±0.98	419.4±5.7	4.1±0.03	3.52±0.06	0.54±0.008	5.14±0.17	21.66±0.11	49.86	7
G4	72.9±2.12	325.6±3.9	4.5±0.05	2.8±0.02	0.33±0.007	6.5±0.35	24.89±0.15	48.91	8
MSG2	73.6±2.6	372.7±5.08	3.6±0.03	2.6±0.02	0.32±0.005	6.35±0.42	35.82±0.15	48.87	9
AR12	48.7±4.09	255.5±4.5	4.4±0.02	2.44±0.08	0.57±0.009	6.17±0.22	33.5±0.11	48.86	10
Sahana	79.6 ±1.4	334.3±21.1	4.8±0.18	2.24±0.07	0.43±0.01	6.88±0.24	33.8±0.42	48.69	11
AR11	26.6±0.68	405.6±33.7	4.1±0.03	2.86±0.04	0.54±0.01	6.34±0.13	34.16±0.13	48.52	12
V1	87.7±3.9	227.3±27.1	2.2±0.13	2.93±0.02	0.54±0.01	6.73±0.27	37.85±0.26	48.42	13
RFS135	30.2±2.6	414.9±8.3	4.5±0.03	2.8± 0.04	0.51±0.006	7.08±0.36	32.3±0.19	47.61	14
K2	17.5±0.71	224.8±0.7	3.7±0.06	3.43±0.02	0.57±0.005	4.45±0.23	33.6±0.29	44.82	15

PIE 3575: Evaluation of mulberry genetic resources for functional traits associated with resilience to climate change (Aug. 2016 - Jul. 2019; In collaboration with CSGRC-Hosur)

S. Gandhi Doss, T. Gayathri, Arunakumar, G. S., Jhansi Laxmi, K. (CSGRC-Hosur) and V. Sivaprasad

Objectives

- To estimate variability in different functional traits associated with N use efficiency and drought tolerance in mulberry germplasm
- To identify donor parents for specific traits having adaptive significance
- To standardize the assessment method for different functional traits to identify desired mulberry genotypes

Thirty nine mulberry germplasm accessions, short-listed for the study, planted in Augmented design in 3 blocks along with 4 check varieties on 17-06-2017. After completion of establishment period, the experimental plants were pruned during March 2018 and data on number of days taken to sprout after pruning was recorded. The number of days taken to sprout after

pruning was ranged from 6.0 (MI-686) to 14.3 (MI-670). The Check varieties viz., V1, S-13, Vishala & Anantha took 10.5, 11.3, 11.1 and 9.7 days to sprout after pruning, respectively. Eleven accessions, *viz*., ME-125, ME-244, ME-107, MI-768, ME-173, MI-686, MI-685, MI-226, ME-253 sprouted quicker (<9.7 days) than the check varieties, while the other 30 accessions took more number of days to sprout, than the check varieties.

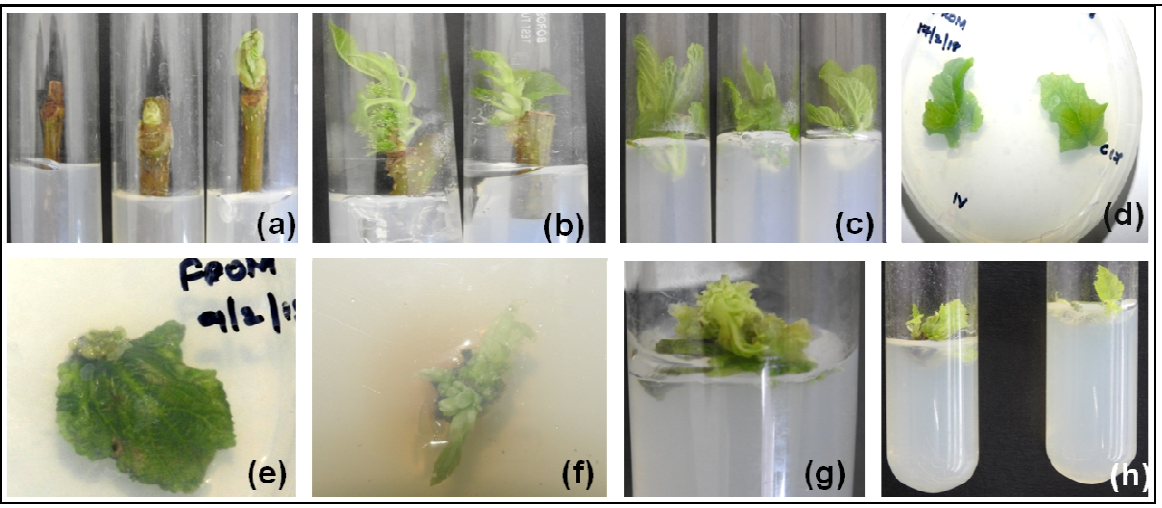
PIC 3620: Engineering photosynthesis in mulberry for resilience to climate change: A C4 approach (Aug. 2017 - Jul. 2021)

Tanmoy Sarkar, Prof. A. S. Raghavendra, (Univ. of Hyderabad), T. Mogili (upto 28.02.2018), S. Gandhi Doss, T. Gayathri and Arunakumar, G. S.

As per the decision of 60th RCC, held during 23rd & 24th October 2017, a meeting of the researchers of the project at Mysuru and Hyderabad, including RAC Chairman and Director, CSRTI, and a few experts and RCC members was held on 19th March 2018 at Department of Crop Physiology, GKVK-UAS, Bengaluru, to discuss the preparedness and feasibility of the programme. The recommendations of the meeting are given below:

- Model plants *Arabidopsis* and tobacco need to be used for validation of gene constructs at UoH and CSRTI-Mysuru, respectively.
- Genetic transformation need to be attempted in mulberry along with tobacco at CSRTI-Mysuru.
- GLDPB2 promoter of *Flaveria pringlei* need to be utilized to induce the tissue-specific expression of heterologus genes in model plants and mulberry.
- Instead of multi-gene constructs proposed earlier, three gene constructs viz., PEPC, CA and PEPC+CA need to be used individually to transform model plants and mulberry. These constructs need to be used for genetic transformation in *Arabidopsis* at University of Hyderabad, and in tobacco and mulberry simultaneously at CSRTI-Mysuru. Later, PPDK gene can be introduced in transgenic mulberry in a sequential manner.
- Herbicide resistance gene need to be used as marker gene in the transformation studies.
- Genetic transformation will be carried out in model plants with individual gene constructs and engineered C_4 feature need to be assessed by Δ^{13}C-isotope discrimination assay in the first two years step by step.
- These suggestions may need fine-tuning of yearly plans. These need to be discussed after first year review.
- Prof. Raghavendra's group would also exploit cloning of PEPC gene from mulberry, if feasible.
- The results obtained in the experiments would be reviewed periodically once in a year by the collaborating investigators and Prof. S.R. Bhat for any modifications in the strategies to be adopted.

In vitro shoot regeneration in mulberry is genotype dependent. In this study, an initial attempt has been made to develop protocol for mass production of *in vitro* grown leaves of commercially released mulberry cultivar G4 and for its micropropagation. Murashige and Scoog (MS) medium in combination with various concentration of BAP (0.5-2.0 mg/L), with and without putrescine (0.5 mg/L) has been used to regenerate shoots from axillary bud culture. MS medium amended with BAP (1.0 mg/L) and putrescine (0.5 mg/L) showed maximum shoot regeneration as compared to other BAP concentration and hormonal combination. Subsequently, the *in vitro* grown leaf explants were used to induce regeneration of multiple shoots. MS medium containing TDZ (1.0 mg/L), IAA (2.0 mg/L), Putrescine (0.5 mg/L), $AgNO_3$ (2.0 mg/L) showed around 45% shoot bud regeneration from leaf explants. MS medium amended with the above said hormonal combination without putrescine did not show shoot bud regeneration. The regenerated shoot buds were inoculated on MS medium containing BAP (1.0 mg/L), Gibberellic acid (GA3) (2.0 mg/L), $AgNO_3$ (2.0 mg/L) for elongation. Field grown tender leaves were cultured on MS medium in combination with putrescine and various hormonal combinations, only elongation and rosette appearance of leaf explant were observed and no sign of shoot regeneration was visible. Further study in this direction is required to enhance frequency of shoot regeneration and whole plants from *in vitro* grown leaf explants.



Regeneration of multiple shoots from *in vitro* grown leaf explant. Shoot buds induction, regeneration and *in vitro* production of leaves from axillary bud cultures (a-c); culture of *in vitro* grown leaves (d), shoot bud induction (e), development of multiple shoot buds (f), elongation of multiple shoots from leaf explants (g-h)

PIB 3631: Primary yield evaluation for identification of superior mulberry hybrids with drought adaptive traits under sub-optimal irrigated conditions (Mar. 2018 - Feb. 2022)

Tanmoy Sarkar, T. Mogili, V. Girish Naik and V. Sivaprasad

Out of 1000 (approx.) hybrids developed for raising drought adaptive trait specific mapping population and introgression lines (V1 x Mysuru Local, G4 x MS-3, Himachal Local x MS-3, Muki x S-34, Dudia White x MS-3), raised in the previous experiments, 48 hybrids were short-listed based on biomass, vigor and shoot number and planted in nursery beds for raising of saplings to plant and initiate the PYE experiment.

PIB 3632: Evaluation of superior triploid genotypes for yield and adaptability under varied agro-climatic conditions (Mar. 2018 - Feb. 2024)

S. Gandhi Doss, Jalaja S. Kumar, Arunakumar, G. S., B. Vijaya Naidu, S. Kamaraj and V. Sivaprasad

Objectives

- Evaluation of identified triploid genotypes for development of superior variety with high yield and quality for optimal input conditions
- Evaluation of identified triploid genotypes for development of superior variety with high yield and quality for sub-optimal input condition

Stem cuttings of promising triploid genotypes, short-listed for the study *viz*., 1, 5, 6, 8, 9 and 10, were planted in nursery beds for raising of saplings to plant in the experimental plot at 4 different test centres (RSRS-Kodathi, RSRS-Ananthapur and RSRS-Salem) including CSRTI-Mysuru.

Continuous/Other activities

Maintenance of mulberry germplasm, mother culture and demonstration plot

T. Mogili (upto 28-02-2018), S. Gandhi Doss, Tanmoy Sarkar and T. Gayathri

A working germplasm with 28 accessions was maintained for carrying out hybridization programmes. Nineteen elite varieties were also maintained in the demonstration plot for the benefit of Sericulturists, students and other stakeholders. Breeders seed plots of four newly evolved varieties *i.e*., G4 (late age silkworm rearing), G2 (young age silkworm rearing), MSG2 (soil moisture stress environments) AGB8 (sub-optimal irrigated conditions) and AR-12 (alkaline resistant) maintained for seed supply. Eleven transgenic lines of K2 OPH (open-pollinated hybrid) with *HVA1* gene and a transgenic line of V1 with *DREB2A* and *SHN1* genes were maintained under net-house containment facility.

MULBERRY MOLECULAR BIOLOGY LABORATORY

Ongoing Research Projects

PRP 3591: Identification of resistance in mulberry germplasm for root knot nematode disease (Oct. 2016 - Sept. 2019)

G. S. Arunakumar and T. Mogili (upto February, 2018)

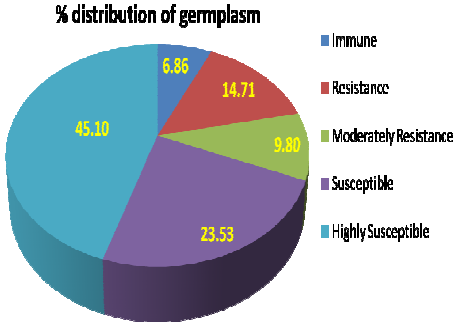
Objective: Identification of mulberry genetic resources for root knot nematode resistance

Number of germplasm accessions categorized under different reaction grades against RKN		
Reaction	No. of galls/ plant	No. of Germplasm
Immune	Nil	14
Resistance	1-10	30
Moderately Resistance	11-30	20
Susceptible	31-100	50
Highly Susceptible	>100	101
Total		215

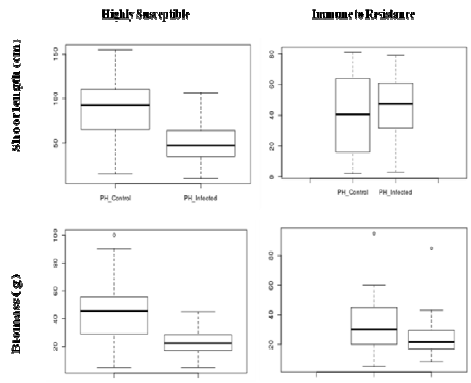
Root-knot nematode (RKN) disease of mulberry caused by *Meloidogyne incognita* is the most devastating soil-borne disease as infected root can become disease complexes with other root rot causing pathogens. The project envisages evaluating about 400 mulberry germplasm accessions in four different batches. In the first and second batch, four months old saplings of 215 mulberry germplasm were evaluated in earthen pots (RKN inoculation) under glass house condition and controls without RKN inoculums were also maintained for each accession in four replications. The RKN inoculation was done at three different intervals to maintain sufficient inoculum load (three J2 nematodes/g soil). Four months after the inoculation, the accessions were uprooted and data was recorded on biomass (g), longest shoot length (cm) and number of galls/5g root mass.

The results indicated that fourteen germplasm accessions exhibited immune reaction and thirty exhibited resistance reaction. However, twenty accessions showed moderate resistance to RKN. Remaining 151 germplasm accessions exhibited susceptible and highly susceptible reaction to RKN. The accessions which exhibited resistance to RKN were replanted for further confirmation. A third set of 165 accessions including exotic and indigenous origin were collected from CSGRC-Hosur are under evaluation at glass house condition. Fourth set of germplasm including identified resistant germplasm were planted in raised nursery beds for further evaluation against RKN.

Among 215 germplasm accessions 6.86 and 14.71% germplasm were identified as immune and resistance to RKN respectively. However, 9.80% germplasm were identified as moderately resistance to RKN. Whereas, 23.53 and 45.10% germplasm showed susceptible and highly susceptible reaction to RKN respectively.



Percent distribution of germplasm accessions for different reaction grades against RKN



Effect of biomass and shoot length of germplasm accessions under RKN inoculated and uninoculated condition

A total of 215 germplasm accessions were evaluated in two consecutive batches and categorized into five groups based on the number of galls per 5g root weight of each germplasm. All the reaction groups were subjected for data analysis using 'R' statistical software. The results indicated that there was a significant decrease in biomass (g) and shoot length (cm) among highly susceptible germplasm under inoculated condition as compared to control (without RKN inoculation).There was no significant difference in the RKN inoculated and uninoculated condition of immune to resistance group of germplasm. The representative resistance (MI-0298 & MI-0290) and highly susceptible (MI-0037) germplasm against RKN inoculated and uninoculated conditions are shown in Figures.

Roots of mulberry germplasm free from root galls (MI-0290)

RKN-Inoculated and Uninoculated

Reduction of plant height and vigour of the plant under RKN-Inoculated condition.

RKN-Inoculated and Uninoculated

Root system under inoculated condition produced the root knots (MI-0037).

Highly susceptible mulberry germplasm showing severe galling of roots

Resistance observed in mulberry germplasm (MI-0298)

Continuous/Other activities

In vitro evaluation of bio-agents, botanicals and recent fungicides against root rot, leaf spot and leaf rust causing fungi in mulberry.

***In vitro* evaluation of bio-agents:** The antagonistic effects of four bio-agents *viz., Trichoderma viride*, *Pseudomonas fluorescens*, *Bacillus subtilis* and *Paecilomyces lilacinus* on growth of *F. solani*, *F. oxysporum* and *M. phaseolina* was studied *in vitro* by dual culture method. The results revealed that the antagonists significantly reduced the growth of all three pathogens either by competition or by antibiosis.

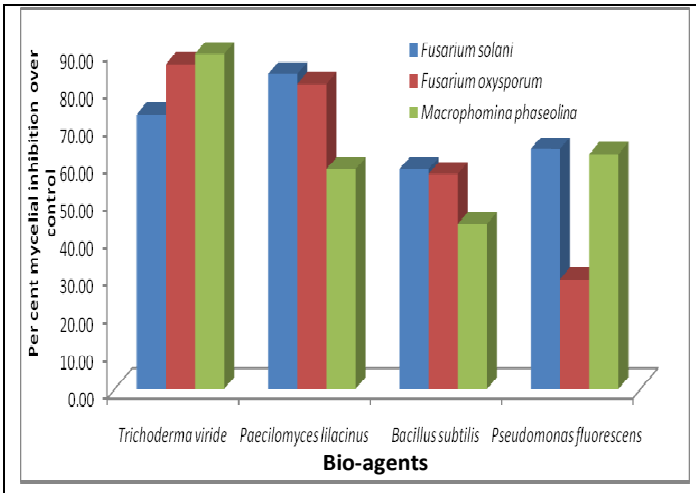
***Fusarium solani*:** It was noticed that maximum reduction in colony growth of *F. solani* was observed in *P. lilacinus* (84%) which was significantly superior over all other bio-agents tested. Next best was *T. viride* (73.33%) and was on par with *P. lilacinus*. Least inhibition was noticed in *B. subtilis* (58.67%) followed by *P. fluorescens* (64%).

Fusarium oxysporum: The maximum reduction in colony growth of *F. oxysporum* was observed in *T. viride* (86.67%) which was significantly superior over all other bio-agents tested and next best was *P. lilacinus* (81.33%) and was on par with *T. viride.* Least inhibition was noticed in *P. fluorescens* (29.33%) followed by *B. subtilis* (57.33%).

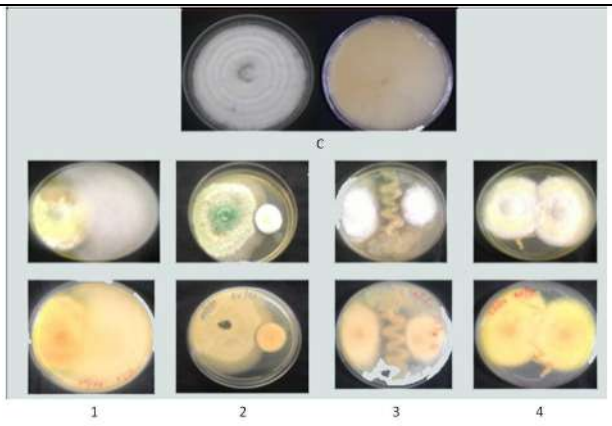
***Macrophomina phaseolina*:** The experimental results showed that maximum reduction in colony growth of *M. phaseolina* was observed in *T. viride* (89.33%) which was significantly superior over all other bio-agents tested and next best was *P. fluorescens* (62.67%) and was on par with *P. lilacinus* (58.67%). Least inhibition was noticed in *B. subtilis* (44.00%).

Efficacy of different bio-agents in inhibiting mycelial growth of root rot causing pathogens of mulberry

Root Rot Pathogens	*Fusarium solani*	*Fusarium oxysporum*	*Macrophomina phaseolina*	Mean
Bio-agents	Per cent inhibition over control			
Trichoderma viride	73.33	86.67	89.33	83.11
Paecilomyces lilacinus	84.00	81.33	58.67	74.67
Bacillus subtilis	58.67	57.33	44.00	53.33
Pseudomonas fluorescens	64.00	29.33	62.67	52.00
Mean	70.00	63.67	63.67	
	S. Em +		CD at 5%	
Bioagents (A)	3.95		11.65	
Pathogens (B)	3.42		N/A	
A × B	6.84	20.19		

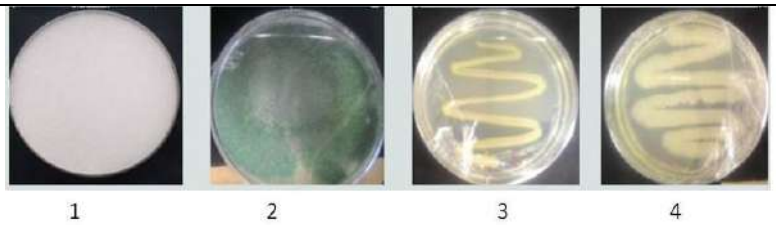


Graphical representation of efficacy of different bio-agents in inhibiting mycelial growth of root rot causing pathogens of mulberry



C - Control 1. *Paecilomyces lilacinus*, 2. *Trichoderma viride*, 3. *Pseudomonas fluorescens*, 4. *Bacillus subtillis*

In vitro evaluation of bio-agents against *F. solani*

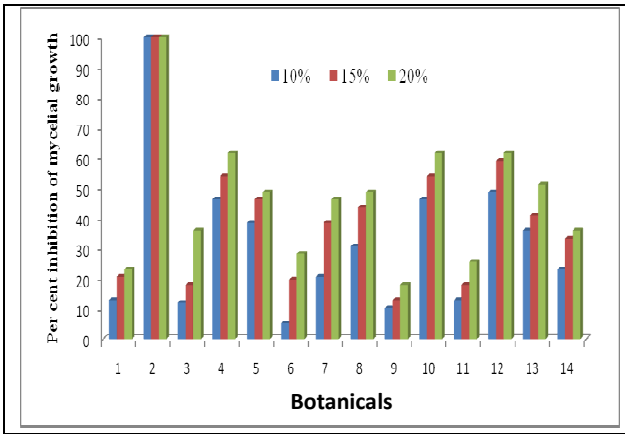


1. *Paecilomyces lilacinus*, 2. *Trichoderma viride*, 3. *Pseudomonas fluorescens* and 4. *Bacillus subtillis*

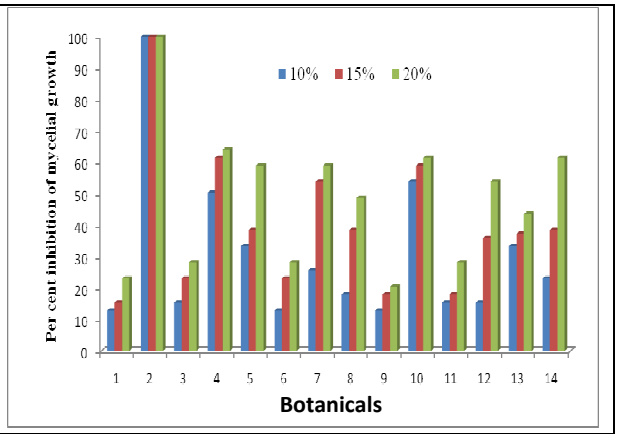
Pure cultures of different bio-agents

Compatibility study between bio-agents: The combination of *Trichoderma viride* + *Paecilomyces lilacinus* + *Bacillus subtilis* recorded the highest degree of compatibility among ten different combinations. The bacterial antagonist *Pseudomonas fluorescens* was not compatible with the other fungal bio-agents (*Trichoderma viride* & *Paecilomyces lilacinus*). This study unveiled the best combination of two fungal and one bacterial bio-agent for development of microbial consortium effective in management of soil-borne diseases in mulberry.

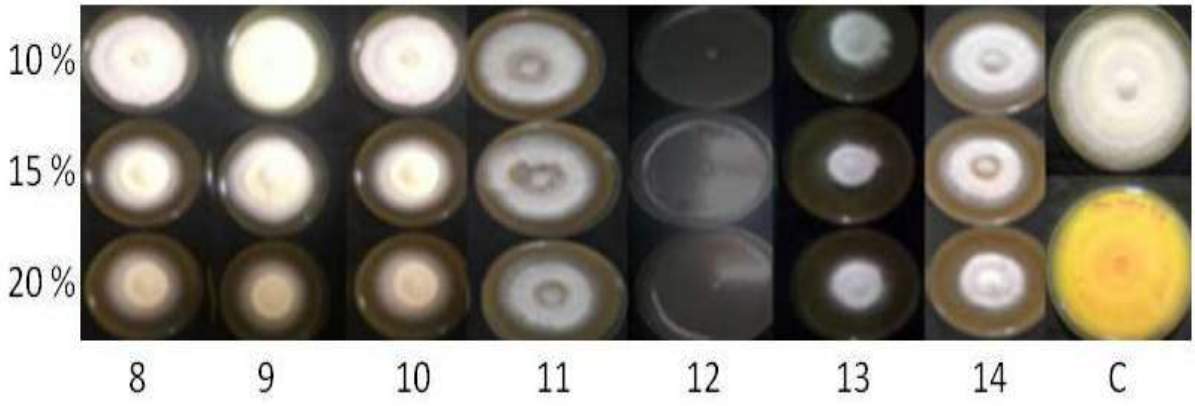
***In vitro* evaluation of botanicals:** Fourteen different plant extracts were evaluated with different concentrations (10, 15 and 20%). Among them *Azadirachta indica* A. (Neem), *Parthenium hysterophorus* (Parthenium), *Carica papaya* (Papaya), *Centella asiatica* (Centella) showed highest inhibition of the dry root rot with 20 per cent concentration. Garlic extracts showed complete inhibition of fungus in all the concentration. The study also proves that application of garlic botanical formulations can be very effective in the management of dry root rot of mulberry and this has to be tested in field.



Percent inhibition of *F. solani* mycelial growth by different botanicals at three levels of concentrations



Percent inhibition of *F. oxysporum* mycelial growth by different botanicals at three levels of concentrations



8. Papaya, 9. Centella, 10. Parthenium, 11. Datura, 12. Garlic, 13. Tulsi, 14. Beetal leaves, C-control (*F. solani*)

In vitro evaluation of different botanical against *F. solani* @ three concentrations

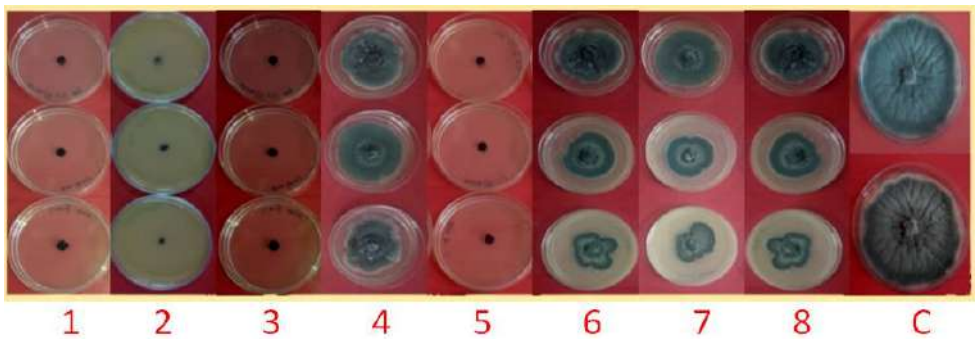
Percent inhibition of mycelial growth by different botanical extracts										
#	Botanical Name	Common Name	*F. solani*				*F. oxysporum*			
			Concentrations (%)			Mean	Concentrations (%)			Mean
			10.0	15.0	20.0		10.0	15.0	20.0	
1	*Aegle marmelas*	Belva patra	12.82	20.51	23.08	18.80	12.82	15.38	23.08	17.09
2	*Allium sativum*	Garlic	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
3	*Aloe barbadensis*	Aloe vera	11.97	17.95	35.90	21.94	15.38	23.08	28.21	22.22
4	*Azadirachta indica*	Neem	46.15	53.85	61.54	53.85	50.43	61.54	64.10	58.69
5	*Bougainvillea*	*Bougainvillea*	38.46	46.15	48.72	44.44	33.33	38.46	58.97	43.59

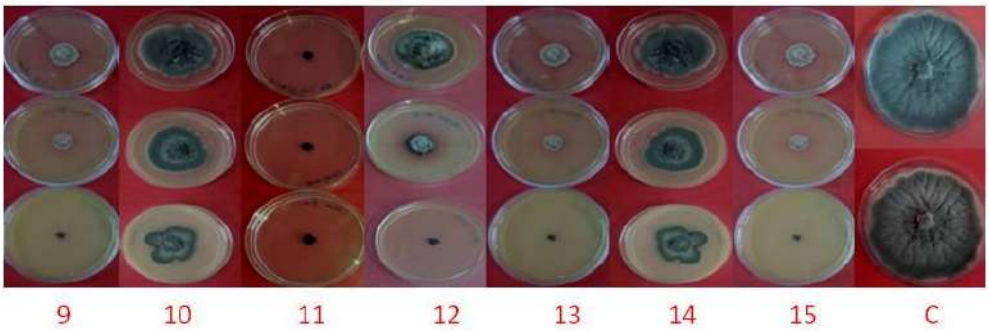
	spectabilis									
6	*Catharanthus roseus*	Vinca rosea	5.13	19.66	28.21	17.66	12.82	23.08	28.21	21.37
7	*Carica papaya*	Papaya	20.51	38.46	46.15	35.04	25.64	53.85	58.97	46.15
8	*Centella asiatica*	Centella	30.77	43.59	48.72	41.03	17.95	38.46	48.72	35.04
9	*Datura metes*	Datura	10.26	12.82	17.95	13.68	12.82	17.95	20.51	17.09
10	*Ocimum tenuiflorum*	Tulasi	46.15	53.85	61.54	53.85	53.85	58.97	61.54	58.12
11	*Piper betel*	Beetle leaves	12.82	17.95	25.64	18.80	15.38	17.95	28.21	20.51
12	*Ricinus communis*	Castor	48.72	58.97	61.54	56.41	15.38	35.90	53.85	35.04
13	*Sarasa asoca*	Ashoka	35.90	41.03	51.28	42.74	33.33	37.35	43.59	38.09
14	*Tanacetum parthenium*	Parthenium	23.08	33.33	35.90	30.77	23.08	38.46	61.54	41.03
		Mean	31.62	39.87	46.15		30.16	39.32	48.53	
		S. Em+	1.580	0.914	0.685		0.852	1.599	0.685	
		CD @ 1%	6.240	3.591	2.693		3.349	6.284	2.693	

***In vitro* evaluation of fungicides:** The systemic fungicide carbendazim is not effective against *Setosphaeria rostrata*. Whereas, Ametoctradin + dimethomorph SC, Fenamidone 10% + Mancozeb 50%, Tricyclazole and Tricyclazole 18% + Mancozeb 60% showed 100% inhibition of mycelia growth at 0.2% concentration.

In vitro evaluation of recent fungicides against leaf spot pathogen

#	Treatments	Per cent Inhibition of mycilial growth (%)			
		0.05%	0.10%	0.20%	Mean
1	Propiconazole	100.00	100.00	100.00	100.00
2	Hexaconozole	100.00	100.00	100.00	100.00
3	Tebuconazole	100.00	100.00	100.00	100.00
4	Carbendazim	20.29	32.61	42.03	31.64
5	Tebuconazole45%+Hexaconozole 10%	100.00	100.00	100.00	100.00
6	Pyroclostrobin	30.43	68.84	80.43	59.90
7	Azoxystrobin	30.43	44.93	78.26	51.21
8	Thiophanate methyl	28.26	40.58	64.49	44.44
9	Ametoctradin +di methomorph sc	71.74	81.88	100.00	84.54
10	Cymoxanil 8% +Mancozeb 64%	65.22	76.09	84.78	75.36
11	Hexaconozole 4% +Zineb 68%WP	100.00	100.00	100.00	100.00
12	Fenamidone10% +Mancozeb50%	76.09	83.33	100.00	86.47
13	Tricyclazole	54.35	89.85	100.00	81.40
14	Chlorothalonil	39.13	61.59	78.26	59.66
15	Tricyclazole 18% + Mancozeb60%	68.12	83.33	100.00	83.82
		65.60	77.54	88.55	
	Comparing the means of		**SEm±**		**CD at 5%**
	Treatment (A)		0.765		2.153
	Concentration (B)		0.342		0.963
	A X B		1.325		3.729





In vitro evaluation of different fungicides against *Setosphaeria rostrata*

***In vitro* evaluation of fungicides against *Cerotelium fici*:** Out of fourteen fungicides evaluated, two combi-products, one systemic fungicide and one non-systemic fungicide showed least leaf rust uredospore spore germination over other fungicides and control. The results revealed that novel fungicide compound and combi-products Ametoctradin + Dimethomorph SC found highly effective at all the concentrations tested and showed least spore germination at 0.1% (0.62%) can be used in the disease management system after evaluation in field condition and bio-assay studies on silkworm. Similarly, existing non-systemic fungicide in the management of leaf rust of mulberry chlorothalonil at 0.3% showed least percent spore germination (2.06%). This can be continued in the chemical management of the disease.

In vitro evaluation novel fungicides against *Cerotelium fici*

#	Treatments	Uredospores germination (%)			
		0.05%	0.10%	0.20%	Mean
1	Propiconazole	22.20	12.28	9.02	14.50
2	Hexaconozole	39.22	26.37	26.57	30.72
3	Tebuconazole	17.03	5.23	1.53	7.93
4	Zineb68%+ Hexaconozole 4%	16.49	9.00	6.15	10.54
5	Tebuconazole 45% + Hexaconozole 10%	15.40	10.83	9.89	12.04
6	Pyroclostrobin	25.51	19.84	19.88	21.75
7	Azoxystrobin	22.37	12.62	9.63	14.87
8	Thiophanate methyl	11.74	10.03	8.92	10.23
9	Ametoctradin + dimethomorph sc	2.01	0.62	1.27	1.30
10	Cymoxanil8% + Mancozeb 64%	2.55	4.38	1.04	2.66
11	Hexaconozole 4% + Zineb 68%WP	8.23	5.02	4.30	5.85
12	Fenamidone10%+ Mancozeb50%	9.63	5.88	1.06	5.52
13	Tricyclazole	8.81	2.91	0.00	3.91
14	Control	95.71	96.15	95.64	95.83
	Concentrations	0.10	0.20	0.30	
15	Chlorothalonil	19.41	12.32	2.06	11.26
	Mean	21.09	15.57	13.13	16.59
	Comparing the means of		SEm±	CD@ 5%	
	Treatment (A)		1.21	3.39	
	Concentration (B)		0.54	1.52	
	A x B		2.09	5.88	

First report of leaf spot causing fungal organism *Setosphaeria rostrata* in mulberry

Proving Koch's postulates of *Setosphaeria rostrata* on highly susceptible mulberry varieties

Culture of leaf spot causing fungal pathogen *Setosphaeria rostrata*

Isolation: Leaf spot symptom appeared as small specks initially and later advanced into irregular shaped leaf spots with brownish center, surrounded by yellow halo. The spot size ranged from 0.4 to 1.5 cm. These spots are inter-veinal in nature and few starts from the leaf margins after 15 to 20 days these spots becomes bigger and after 30 day spots coalesce leading to blightened appearance and finally leads to defoliation. Mulberry leaves with leaf spot symptoms were collected from S13 variety during February 2017. The standard tissue isolation procedure was followed to isolate the pathogen. The infected leaf bits were surface sterilized with 1:1000 mercuric chloride ($HgCl_2$) solution for 30 seconds and repeatedly washed separately in sterilized distilled water to remove the traces of mercury if any and then transferred to sterilized Petri plates (1-2 leaf bits per Petri dish) containing potato dextrose agar (PDA). The Petri plates were incubated at room temperature (27±1°C) and observed periodically for the growth of the fungus. Bit of fungal growth developed from the infected tissue was transferred to PDA slants and incubated at 27±1°C for 12 days. Then such slants with pure culture were used for further studies.

Single spore isolation: Ten ml of clear, sterilized water agar of two per cent strength was poured into Petri plates and was allowed to solidify. Dilute spore suspension was prepared using sterile distilled water from 12 days old culture. One ml of such suspension was spread uniformly on two per cent water agar plates. The plates were incubated at 27±1°C for eight hours. Then, such plates were examined under microscope to locate germinated conidia. Single isolated and germinated conidia were then marked under the microscopic field with ink on the surface of the plate. These marked agar areas were cut and transferred to PDA slants with the help of cork borer under aseptic conditions and incubated at a temperature of 27±1°C. The growth of fungus in slants was used to study the morphological characters. As single spore isolates were identical and hence they were multiplied further. Pure culture derived from such slants was used for further studies.

Identification: Morphological, microscopic and molecular characteristics were used for the identification of the fungal isolate. The mycelia were white, which turned to gray or dark gray after 3 to 4 days. The conidiophores were cylindrical, dark brown or olivaceous but paler toward the apex, septate, simple, and geniculate types. The conidia were 10 to 12 distoseptate, with a darker and thicker wall at the basal end.

Pathogenicity: It was confirmed by following Koch's postulates using glass house-grown five mulberry varieties (V1, *M. multicalis*, RC2, Mysuru local & Punjab local) were inoculated with a conidial suspension (98 spores/ml) prepared in sterile distilled water with a hand sprayer during evening hours and then covered with plastic bags for 24 h. Control plants were sprayed with sterile distilled water and covered with plastic bags. Plants were incubated for one week in a glass house. Disease severity on inoculated leaves were estimated 30 days after inoculation using a 0 to 5 severity scale (0 = healthy plants and 5 = severely diseased plants). Results indicated that Mysuru local and Punjab local are highly susceptible and showed the faster development of leaf spots on leave. V1 and RC2 showed the moderately susceptible and *M. multicallis* showed the resistance to leaf spot organism. Similar symptoms as found in S13 mulberry variety were observed on susceptible mulberry plants after 15 days, whereas no symptoms appeared on the control plants. The pathogen re-isolated from susceptible inoculated leaves was identical in all respects to the isolates used to inoculate the plants, which confirmed Koch's postulates. Molecular identification was accomplished of the isolate by amplifying the rDNA ITS region using ITS1 and ITS4 primers and then determining the sequence. An NCBI-BLAST search showed greatest identity (96% similarity) with the ITS sequences of *Setosphaeria rostrata* (GenBank Accession No. HE664048). The sequence was deposited in NCBI GenBank with accession no. MH244432.1. Based on microscopic, morphological, and molecular characteristics, the fungal isolates was identified as *S. rostrata* (Wakker) Boedijin (syn. *Exserohilum rostratum*).

Continuous/Other Activities

- Maintenance and extension of Panel of Diverse Germplasm (PDG), mulberry germplasm nursery & mapping resources
- Yield and yield contributing traits (Mysuru Local x V1 progeny - 350 Nos)
- Water use efficiency (WUE) trait (Himachal Local x MS-3 progeny - 200 Nos;
  Muki x S34 progeny - 432 Nos; G4 x MS-3 progeny - 182 Nos)
- Root trait (Dudhia White x UP progeny - 560 Nos; Punjab Local x Thai male progeny - 35 Nos)
- Alkaline tolerance (Sujanpur5 x V1progeny - 169 Nos)
- Introgressed lines for WUE and root traits (20 Nos)

- Panel of Diverse Germplasm (~260)
- New set of Panel of Diverse Germplasm (56)

Mapping population for root rot disease trait under glass house nursery beds

Development of mapping populations for root rot disease trait in mulberry

Seeds of three crosses were raised in nursery beds under glass house condition and after four months around 400 F1 seedlings were transplanted to main field by followed spacing of (150+90) cm x 60cm.

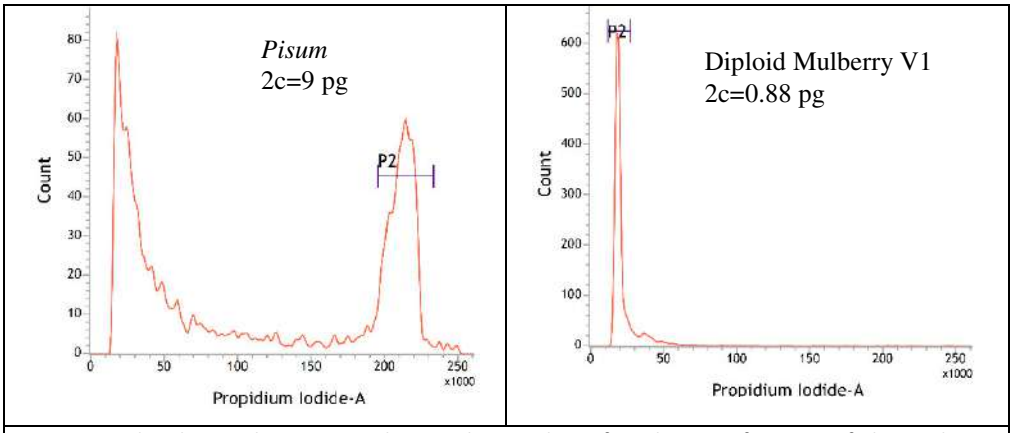
Fund Code 9551: (DST-Ramanujan Fellowship): Genomic tools for mulberry improvement (May 2016 - March 2021)

B.N. Gnanesh

Objective: To develop genomic resources using NGS to facilitate gene discovery, population genomics and molecular breeding in mulberry (*Morus* spp).

Genome size and relative ploidy level estimation for Mulberry sequencing

In the age of high-throughput sequencing technologies, C-values provide, critical data for sequencing projects. With this objective, flow cytometry analysis was performed on 146 germplasm accessions of mulberry with different ploidy to estimate the genome content and variation at ploidy level. Total of 21 accessions were chosen for mulberry genome sequencing and resequencing. *Pisum sativum* (2C=9.0 pg) was used as a reference standard. The mulberry accessions with different ploidy level showed substantial genome size variation, with the 2C-value ranging between 0.52 and 3.33 pg. Haploid (1C) genome size of mulberry accessions ranged from 249.7 to 4342.5Mbp. Estimated relative ploidy level revealed very good variation among the mulberry individual germplasm lines (Fig. 1). Also, this study highlights the necessity of optimizing the flow cytometry methodology prior to obtaining reliable genome size estimates for other mulberry germplasm accessions. This will add more information about the germplasm lines maintained at CSRTI, Mysuru. Results of this study provide useful information on taxonomy of *Morus* and improve breeding programs aiming to advance horticulture and sericulture.



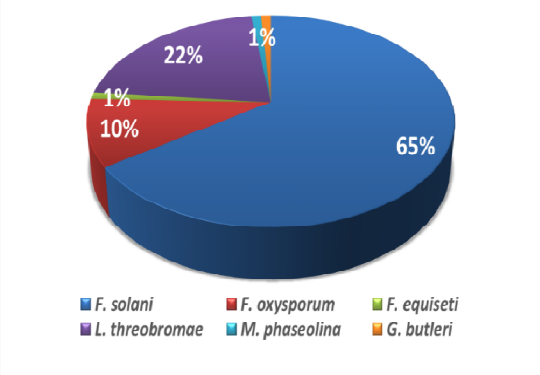
Frequency distribution histograms plotting the number of nuclei as a function of their relative fluorescence intensity, with *Pisum sativum* as the calibration standard and diploid mulberry V1. Nuclear DNA content was analyzed by flow cytometry using nuclei isolated from young mulberry leaves and stained with propidium iodide.

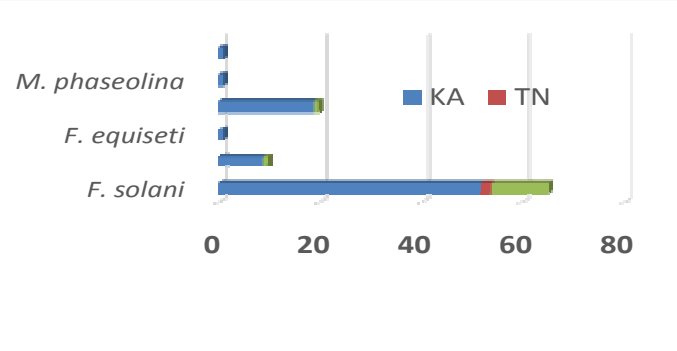
Transcriptome of mulberry in response to root-knot nematode caused by *Meloidogyne incognita*

Root Knot Nematodes (RKN) are one of the major limiting factors in mulberry production and root knot disease caused by *M. incognita* is very serious and chronic in mulberry. Identification of genes responsible for resistance to root knot from gene expression studies can give comprehensive idea for further utilization in disease resistance breeding programmes. Root knot specific transcriptome analysis were carried out using contrasting mulberry accessions from root tissue at specific time points. SCAR markers were used for molecular characterization of RKN and *M. incognita* was selected for inoculation. Two resistant and two susceptible genotypes were selected for RKN inoculation. Total RNA was isolated from whole roots of control and infected mulberry plants at different day's post-infection (dpi) are stored at -80°C and will be sent to transcriptome sequencing. This study will provide insight, at the molecular level, into the mechanisms of the resistance response to root knot disease caused by *M. incognita* and development of specific SNP in mulberry.

Molecular Characterization of Root Rot Causing Fungal Pathogens and Standardization of Inoculation Methods in Mulberry.

Root rot disease is a serious menace in mulberry (*Morus* spp.) and it is prevalent in many states of India. Diseased mulberry root samples were collected from different mulberry cultivation areas of South India based on their wilting symptoms. From these diseased samples, collected from 69 regions of South India, 98 virulent isolates were identified. Among them *Fusarium solani* was most dominating (65%) followed by *Lasiodiplodia theobromae* (22%) and *F. oxysporum* (10%). Thirty five isolates were chosen for species identity using ITS 1 and ITS 4 primers and has been deposited in NCBI data base. Molecular characterization revealed new species of *F. equiseti* associated with mulberry root rot and for the first time *Gongronella butleri* was isolated from root rot infested mulberry garden. Phylogenetic tree based on alignment of ITS gene sequences was used to study the relationships of root rot disease causing organism in mulberry. Three different methods of inoculation (sorghum method, dip method and tooth pick method) were used to standardize the root rot inoculation. Among them dip method of inoculation was found to be effective for screening mulberry genotypes resistant to root rot.



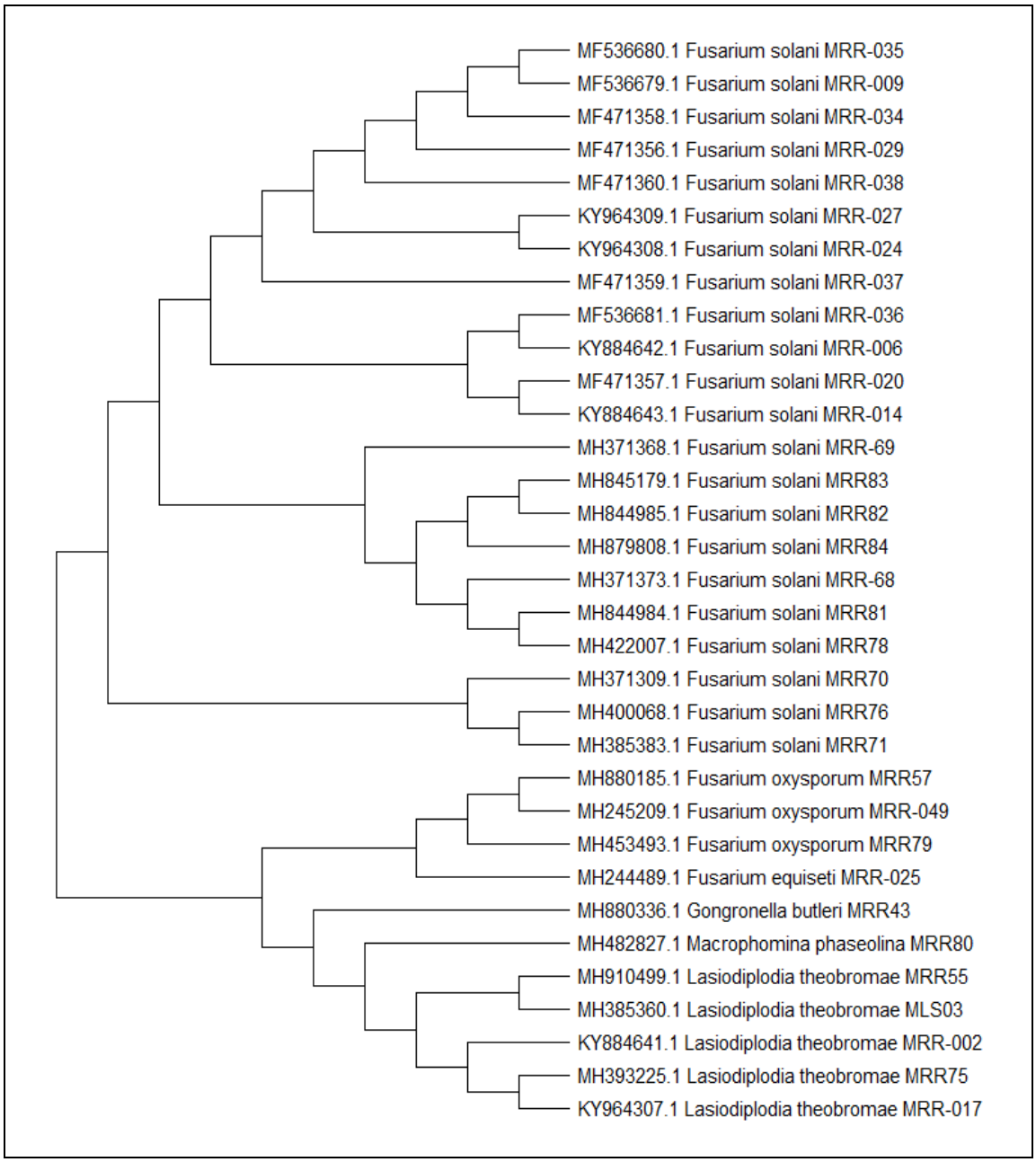


Percentage distribution of root rot causing organism in Southern India

Details of the root rot disease causing isolates in mulberry and GenBank accession numbers of the ITS generated sequences**.**

Sl. No.	Sample Number	Organisms	GeneBank accession No
1	MRR-002	*Lasiodiplodia theobromae*	KY884641
2	MRR-006	*Fusarium solani*	KY884642
3	MRR-009	*F. solani*	MF536679
4	MRR-014	*F. solani*	KY884643
5	MRR-017	*L. theobromae*	KY964307
6	MRR-020	*F. solani*	MF471357
7	MRR-024	*F. solani*	KY964308
8	MRR-025	*Fusarium equiseti*	MH244489
9	MRR-027	*F. solani*	KY964309
10	MRR-029	*F. solani*	MF471356
11	MRR-034	*F. solani*	MF471358
12	MRR-035	*F. solani*	MF536680
13	MRR-036	*F. solani*	MF536681
14	MRR-037	*F. solani*	MF471359
15	MRR-038	*F. solani*	MF471360
16	MRR-043	*Gongronella butleri*	MH880336
17	MRR-049	*F. oxysporum*	MH245209
18	MRR-051	*L. theobromae*	MH881527
19	MRR-055	*L. theobromae*	MH910499
20	MRR-057	*F. oxysporum*	MH880185
21	MRR-068	*F. solani*	MH371373
22	MRR-069	*F. solani*	MH371368
23	MRR-070	*F. solani*	MH371309
24	MRR-071	*F. solani*	MH385383
25	MRR-074	*L. theobromae*	MH400067
26	MRR-075	*L. theobromae*	MH393225

27	MRR-076	*F. solani*	MH400068
28	MRR-078	*F. solani*	MH422007
29	MRR-079	*F. oxysporum*	MH453493
30	MRR-080	*Macrophomina phaseolina*	MH482827
31	MRR-081	*F. solani*	MH844984
32	MRR-082	*F. solani*	MH844985
33	MRR-083	*F. solani*	MH845179
34	MRR-084	*F. solani*	MH879808
35	MLS-003	*L. theobromae*	MH385360



Maximum likelihood phylogenetic tree based on alignment of ITS gene sequences, showing the phylogenetic relationships of root rot disease causing isolates in mulberry from Southern India.

SOIL SCIENCE & CHEMISTRY

Continuous/Other activities

PPA 3580: Soil health cards for sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh (Apr. 2016 - Mar. 2017)

V. Sobhana, S. Sen, M. Munirathnam Reddy (upto Feb. 2017), P. Sudhakar[1], Dahira Beevi[2] and B. Vijay Naidu[3]

[1]RSRS-Kodathi, [2]RSRS-Salem, [3]RSRS-Anantapur

Objective: To make the farmers aware about the importance of soil fertility on the production of quality mulberry leaves by issuance of soil health cards

Quality mulberry leaf production mainly depends on the soil fertility. Site-specific nutrient management involving soil test based application of fertilizers is critical to maintain good soil health. Hence 'Soil Health Card' scheme is rolled out for the benefit of sericulture farmers. Soil testing is conducted to determine the status of soil with respect to pH, EC, OC, N, P, K, S, B, Zn, Fe, Cu and Mn. Based on test results, the fertilizer recommendations and soil amendments to be applied are recommended to farmers. Testing of soil samples that are received are being conducted at the main institute and RSRSs at Anantapur, Kodathi and Salem.

Levels of soil fertility for mulberry crop			
pH	< 6.5 Acidic	6.5 – 7.5 Nor.	> 7.5 Alkaline
Electrical Conductivity (dS/m)	< 1.0 Normal	1.0 – 2.0 High	> 2.0 Harmful
Organic Carbon (%)	< 0.65 Low	0.65 – 1.00 Medium	> 1.00 High
Major Nutrients (kg/ha)	Low	Medium	High
Available Nitrogen	< 280	280 – 560	> 560
Available Phosphorus	< 15	15 – 25	> 25
Available Potassium	< 120	120 – 240	> 240
Other Nutrients (ppm)	Low	Medium	High
Available Sulphur	< 10	10 – 20	> 20
Available Boron	< 0.5	0.5 – 1.0	> 1.0
Available Zinc	< 0.6	0.6 – 1.2	> 1.2
Available Iron	< 4.5	4.5 – 9.0	> 9.0
Available Manganese	< 2.0	2.0 – 4.0	> 4.0
Available Copper	< 0.2	0.2 – 0.4	> 0.4

During 2017-18 total of 12000 soil samples were collected from sericulture farmers of Karnataka, Tamil Nadu, Andhra Pradesh and Maharashtra in coordination with CSB/DOS field units. The state wise number of soil samples collected and analysed during 2016-17 and 2017-18 and cumulative total are shown in table. These soil samples were analyzed for pH, electrical conductivity, organic carbon, major nutrients (available N, P, K, S) and micronutrients (Cu, Fe, Mn, Zn, B).

State wise number of soil samples analysed			
States	Number of soil samples analysed		
	2016-17	2017-18	Total
Karnataka	4197	4398	8595
Tamil Nadu & Kerala	3172	3941	7113
Andhra Pradesh and Telangana	2138	3066	5204
Maharashtra	300	595	895
Madhya Pradesh	200		200
Total	10007	12000	22007

The results show that 14% of the soil samples analysed in Karnataka were alkaline in reaction whereas it is 72% in Tamil Nadu, 28% in Andhra Pradesh and 50% in Maharashtra. Nearly 77% soil samples analysed in Karnataka are neutral in reaction. Most of the samples exhibited normal range with respect to electrical conductivity (EC <1.0 dS/m). The organic carbon content was low in 81% of the soil samples of Karnataka, 55% soil samples of Tamil Nadu, 87% soil samples of Andhra Pradesh and 74% soil samples of Maharashtra.

The available N status shows that most of the soil samples analysed in all the states varied from low to moderate values. More than 50% of the soil samples analysed are having high levels

States	Samples Analyzed	% Soil Samples under different levels of fertility							
		pH			EC		OC		
		Acidic	Normal	Alkaline	Normal	High	Low	Medium	High
KA	4398	9	77	14	100	0	81	18	1
TN	3941	5	23	72	99	1	55	30	15
AP	3066	1	71	28	100	0	87	11	1
MH	595	48	2	50	98	2	74	21	5

of available K content and it ranges from moderate to high values. Soils with high levels of available K are observed maximum in Karnataka (84%), followed by Maharashtra (77%), Andhra Pradesh (69%) and Tamil Nadu (55%). The available sulphur status shows that most of the soil samples from Tamil Nadu are under low category whereas it is medium to high in other states. More than 50% of the soil samples are low in available boron content and deficiency is maximum in Maharashtra followed by Andhra Pradesh, Tamil Nadu and Karnataka.

Percent of soil samples under different levels of fertility															
States	Samples	Available N			Available P			Available K			Available S			Available B		
		L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
KA	4398	90	8	2	29	34	37	1	14	84	3	39	58	52	44	4
TN	3941	40	34	25	1	15	84	10	35	55	64	33	3	59	34	7
AP	3066	60	36	4	37	21	42	3	28	69	14	42	44	89	10	1
MH	595	58	27	15	60	18	22	3	20	77	13	43	44	100	0	0
L : Low, M : Medium, H : High																

The available micro-nutrient status shows that Fe ranged from 0.07-25.14, Mn from 0.19-26.8, Zn from 0.03-4, Cu from 0.03-10 and boron from 0.01-8.29 ppm in mulberry growing areas. More than 40% of the soil samples analysed are deficient in zinc. With respect to available Fe content more than 60% of the samples are under low category. Most of the soil samples analysed have sufficient levels of Cu and Mn.

States	Percent of soil samples under different levels of fertility											
	Available Zn			Available Fe			Available Mn			Available Cu		
	L	M	H	L	M	H	L	M	H	L	M	H
KA	42	39	18	86	8	6	11	17	71	2	5	93
TN	43	44	12	60	37	3	14	49	38	0	37	63
AP	52	22	26	90	7	3	26	28	46	2	14	84
MH	39	31	30	88	4	9	19	10	70	10	19	71

Project No.26/RCS: Validation of "Ankur soil mixture" on mulberry growth, leaf yield and cocoon characters of silkworm, *Bombyx mori*

V. Sivaprasad, M. Munirathnam Reddy (upto Feb.2017), V. Sobhana, S. Sen, E. Bhuvaneswari, Y. Thirupathaiah, H.M. Munikrishnappa.

Objective: Evaluation of Ankur soil mixture for improvement of soil fertility and health, mulberry growth, leaf yield, silkworm growth and cocoon yield

Ankur is a combined organic and inorganic soil application nutrient supplement developed by Seri-Con Technologies, Bangalore for improving soil fertility and health besides improving mulberry leaf production. The product was evaluated at CSRTI-Mysuru farm during 2016-18 for its effect on soil properties, leaf yield and cocoon yield. In the present study, Ankur mixture was applied in 3 different combinations (T1, T2 and T3) and one control (without Ankur). The Ankur mixture was applied @ 10 kg/acre/crop. The chemical fertilizers and FYM were applied as per the general recommended dose.

The application of Ankur increased the growth parameters of mulberry such as number of shoots/plant, length of longest shoot and number of leaves in longest shoot as compared to control. In the present study, the application of Ankur mixture increased the leaf yield from 20 to 22.9 MT/ac/year.

Effect of Ankur on growth and yield parameters of mulberry						
Treatments	shoots /plant(No.)	longest Shoot (lengthcm)	longest shoot (leaves No.)	Leaf yield (kg/plant)	Leaf yield (kg/ac/crop)	Leaf yield (kg/ac/yr)
T1	11.5	160	29.4	0.823	4572	22860
T2	9.5	140	23	0.756	4200	21000
T3	10	145	25	0.725	4027	20135
T4 (C)	9.2	120	21	0.722	4011	20054

The soil chemical properties data on pH of the soil shows that it was slightly reduced by the application of Ankur over control and the value varied from 7.27 to 7.73. Its application recorded organic carbon content (0.72%) and in control it was

0.67%. Available nitrogen, phosphorus, potassium, sulphur and boron were positively influenced by the application of Ankur mixture. The study also shows that the application of Ankur had a positive effect on improving soil micronutrient status.

Effect of Ankur on soil chemical properties												
Treat-ments	pH	EC (dS/m)	OC (%)	Av.N (kg/ha)	Av.P (kg/ha)	Av.K (kg/ha)	Av.S (ppm)	Av.B (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)
T1	7.27	0.11	0.72	460	45	448	42	0.26	1.41	4.93	5.57	1.47
T2	7.65	0.13	0.70	432	30	390	36	0.24	0.92	1.99	3.34	1.28
T3	7.43	0.14	0.70	457	36	460	34	0.23	0.66	4.92	3.38	1.18
T4 (C)	7.73	0.12	0.67	396	35	358	35	0.21	1.20	1.35	3.73	1.19

The commercial characteristics of silkworm (larval weight, survival percentage, cocoon weight, shell weight and silk percentage) improved by feeding Ankur treated (T1) leaves among the four treatments. Maximum cocoon yield was noticed in T1.

Effect of Ankur on the commercial characters of silkworm								
Treatments	Hybrid	Larval wt. (g)	Survival (%)	Cocoon wt (g)	Shell Wt (g)	Pupation rate (%)	Shell ratio (%)	Yield/100 dfls (kg)
T1	FC1 x FC2	43.52	95.81	1.871	0.402	90.02	21.50	72.9
T2	FC1 x FC2	42.58	94.5	1.862	0.379	88.06	20.35	68.5
T3	FC1 x FC2	38.36	94.3	1.826	0.371	88.14	20.31	68.0
T4 (C)	FC1 x FC2	36.26	94.61	1.803	0.362	88.54	20.07	65.5

Based on the study it is concluded that Ankur soil mixture @ 10 kg/acre/crop may be recommended for improving soil fertility and health, mulberry growth, leaf yield and cocoon yield. The product was released in Farmers Workshop conducted at Hassan district during March, 2018.

Continuous/Other activities

Analysis of plant/soil samples, products/inputs and disinfectants used in Sericulture

Objective: To analyse the plant and other samples and assess their suitability in sericulture activities

Products/Inputs	Samples
Mulberry leaf	63
Mulberry stem	20
Irrigation Water	45
Soil	132
Disinfectants etc.	60

Water, plant and soil samples, products and various disinfectants used in sericulture were assessed for respective parameters and certificates given for the benefit of the stakeholders of sericulture industry. In addition to free of cost analysis of samples from different Units/Sections/schemes, an amount of Rs.1,69,137/- was collected towards testing charges for multiple services by the section.

AGRONOMY SECTION

Concluded Project

PPA 3549: Evaluation of modified spacing with special reference to planting geometry for sustainable mulberry leaf production (Jan. 2016 - Dec. 2017)

Vinod Kumar Yadav (PI) and M. Noble Morrison

Objective: Identification of appropriate planting geometry for facilitating mechanization and quality mulberry leaf production

Mulberry planting geometry plays a vital role in crop production and it is decided on the factors such as varieties, branching habit, intercultural operations and harvesting method, magnitude of the growth are influenced edaphic and climatic factors. CSRTI-Mysuru, earlier recommended the plant spacing of 30 cm x 120 cm for the mulberry plants under row system. Subsequently, considering the importance of leaf quality, spacing was revised many times for better growth and rooting pattern of new mulberry varieties developing new package of practices. Various recommendations given by this institute with regard to plant spacing from time to time were 60 cm x 15 cm, 45 cm x 180 cm, 60 cm x 30 cm, 60 cm x 60 cm, 90 cm x 90 cm, 120 cm x 120 cm.

Further, a new system of plantation with a spacing of (90 cm + 90 cm +120 cm) developed at CSRTI-Mysuru has been proved to be more effective in facilitating the mechanized operations by power tiller or tractor, reducing the cultivation cost (Dandin 2004). Though wider spacing is resulting in reduced population, the mechanized cultivation under minimized manpower utilization compensating the same and is most accepted among the Sericulturists. Adoption of new planting geometry combined with improved package with full mechanization results in improving the crop production (Ramakant *et al*., 2001).

Ramakanth *et al*. (2001) developed a suitable spacing required for shoot rearing and reported that frequent harvesting of shoots tends to decrease the plant vigour by reducing the food reserve there by leading to the loss of dry weight of root and stock. Variable spacing for varieties were followed in mulberry cultivation depending upon the varied agro-climatic conditions (Choudhury *et al*., 1991 and Rahaman *et al*., 1999).

Ghosh *et al*. (2009) made an investigation on effect of planting geometry revealed that plant height, number of branches/plant, number of leaves/plant and leaf yield/plant were significantly superior in the chawki leaves of paired row {(150 + 90) cm × 60 cm} plantation in comparison to other spacing. Rahman *et al.* (2009) conducted the studies on mulberry genotypes and spacing on the development and cocoon characters of silkworm (*Bombyx mori*) and observed that the economic characters of silkworm cocoons *viz.,* shell weight, shell ratio, effective rate of rearing, and absolute silk content were superior in close plant spacing compared to the wider spacing.

In recent past, a paired row system (90 + 150) cm x 60 cm was recommended for the highly productive V1 variety, facilitating partial mechanization in cultivation and the distance from plant to plant in a row is close and the leaf canopy develops in a row resulting in poor ventilation leading raising of temperature and humidity (Dandin and Giridhar, 2010). It is an established fact that more number of plants per unit area results in higher leaf production. With this background, a study was carried out to find out a suitable spacing at different farmers' field for the sustainable quality leaf production and its impact on silkworm rearing.

Methodology: It involved identification of thirty farmers in three different district followed by Sampling- survey- collection of data and Analysis.

Survey for data collection on plant geometry: A fixed plot survey was conducted to know the plant geometry of mulberry of three districts of southern Karnataka *viz*., Ramanagara, Kolar and Chikkaballapur during 2016-17 and 2017-18. During the two years investigation, eight crops data were recorded from farmer's field who adopted wider spacing and collected information on mulberry varieties, spacing, input application, irrigation regimes, organic/inorganic fertilizer, leaf yield, number of crop per year, yield per crop and extent of mechanization. Similarly, silkworm rearing data was also collected on number of disease free layings and cocoon yield.

Identification of farmers adapted different wider spacing: A total of 30 farmers were selected based on wider spacing adapted in mulberry cultivation. Five different spacing plant geometry were identified, under each spacing six farmers were selected for collection of data of eight crops.

Effect of different crop geometry on average mulberry leaf yield, rearing capacity and cocoon yield/100 dfls

#	Spacing (cm)	Avg. crop leaf yield per ha/crop (kg)	Rearing capacity dfls/crop/acre	Yield/100 dfls (kg)
1	90 x 90	11732.00	215.67	63.17
2	(150+ 90) x 60	13174.83	245.83	70.83
3	180 x 60	11331.17	191.67	73.67
4	240 x 60	10547.67	187.50	80.00
5	270 x 60	8842.17	166.67	84.83
	SEm±	333.39	17.57	2.14
	CD (p=0.05)	1011.33	53.30	6.49

Growth and yield parameters of mulberry at different plant geometry: The results on growth and yield parameters of mulberry have been analysed statistically and it is observed that highest plant height was recorded in the spacing of 270 cm × 60 cm (215.58 cm) which was significantly superior over all other spacing and it was followed by 240cm × 60cm (185.58cm). Minimum plant height was observed in 90cm × 90cm (135.25cm) spacing followed by paired row {(150 + 90) cm × 60cm} system (163.58cm) of planting. Maximum number of branches per plant was recorded in 270cm × 60cm (13.67) planting which was at par with 240cm × 60cm (11.67) both the spacing were significantly superior over all other spacing. Minimum number of branches per plant was recorded in the 90cm × 90cm (8) spacing followed by paired row system (10.33) of planting. The maximum number of leaves per plant was found in 270cm × 60cm (286.17) planting which was statistically greater over all other spacing followed by 240cm × 60cm (268.83). Further, minimum number of leaves per plant was recorded in the 90cm × 90cm (185.67) spacing followed by paired row system (238.33) of planting.

Effect of different crop geometry on growth parameters and leaf yield

#	Spacing (cm)	Plant height (cm)	No. of branches /plant	No. of leaves /plant	Leaf yield per plant (g)
1	90 x 90	135.25	8.00	185.67	596.33
2	(150+ 90) x 60	163.58	10.33	238.33	784.67
3	180 x 60	175.35	10.83	245.17	895.33
4	240 x 60	185.58	11.67	268.83	1026.17
5	270 x 60	215.58	13.67	286.17	1345.67
	SEm+	4.13	0.68	5.69	32.80
	CD (p=0.05)	12.53	2.07	17.26	99.49

Highest leaf yield per plant was obtained in 270cm × 60cm (1345.67g) planting which was significantly better over all other spacing followed by 240cm × 60cm (1026.17g). Minimum leaf yield per plant was recorded in the 90cm × 90cm (596.33) spacing followed by paired row system (784.67) of planting.

Highest average leaf yield per crop per hectare (kg) was found in paired row system {(150+90) cm x 60 cm} (13174.83 kg/ha/crop) which was significantly superior over all other plant geometry followed by 90cm x 90cm (11732 kg/ha/crop). Whereas, lowest was obtained in 270cm x 60cm (8842.17 kg/ha/crop) followed by 240cm × 60cm (10547.67 kg/ha/crop). The rearing capacity (dfls/crop/acre) was found statistically non significant among different spacing studied. The cocoon yield per 100 dfls was recorded maximum with spacing 270cm x 60cm (84.83 kg) which was at par with 240cm x 60cm (80 kg). However, minimum cocoon yield per 100 dfls was obtained in 90cm × 90cm (63.17 kg) followed by paired row system (150+90)cm x 60cm (70.83 kg).

Ongoing Research Projects

PPS 3553: Carbon sequestration in mulberry cultivation and strategies to enhance carbon sequestration (Jan. 2016 - Dec. 2018)

V.K. Yadav, K. Vedavyasa, Sibayan Sen and T. Gayathri

Objectives

- Assessment of carbon sequestration efficiency of mulberry cultivated under irrigation conditions
- To develop strategies to enhance carbon sequestration in irrigated mulberry plantation

Carbon sequestration refers to the removal of carbon dioxide from atmosphere into a long lived stable form that does not affect atmosphere. One of the way is to trap carbon di oxide CO_2, through plant. It considered sequestered, if ends in a stable form such as wood or soil organic matter. Mulberry cultivation for silk production is practiced in over two lakh hectare in the country. The packages of practices include extensive tillage, large inputs of inorganic and organic nutrients. The project is initiated with split plot design main plot as irrigation (furrow and drip irrigation) and sub plot (control: NPK 350:140:140 kg/ha/yr in 5 split doses and FYM 25MT/ha/yr in 2 split doses and with reduced tillage (two times in year and mulching of cover crops two times) having six replication. Five mulberry crops were harvested in 2nd year and biomass yield was recorded. There is slight increase in mulberry leaf yield recorded in treatment (13950 kg/ha/crop) than control (13350/ha/crop. Soil analysis has indicated increase in organic carbon, available phosphorous and available potassium and micronutrient like, copper, zinc, iron and manganese also shown higher value in treatment plot compare to control. Similarly, physical and biological parameter also showed improvement in treatment plot. The total carbon sequestered (leaf and stem together) is estimated, it is found higher in treatment 14,846 kg/ha/yr compared to control i.e., 14,204 kg/ha/yr.

Soil Chemical Analysis			
Parameter tested	Treatment (T1)	Control (T2)	Improvement (%)
pH	6.85	7.05	-2.8
EC (mmhos/cm)	0.28	0.40	-30
OC (%)	0.85	0.65	30.7
Available P kg/ha	72.23	56.24	28.4
Available K kg/ha	407.88	356.85	14.1
Cu ppm	1.10	0.95	15.7
Fe ppm	3.25	2.55	24.4
Zn ppm	3.3	2.6	26.9
Mn ppm	1.30	1.20	8.3

PPA 3552: Development of technology for production of organic silk (Jan.2016 - Dec. 2018)

V.K. Yadav (PI), V. Sobhana, Sibayan Sen, Mary Josepha A.V, P.C. Santha, and M. N. Chandrashekar

Objectives:

- To produce the mulberry leaf and cocoon through organic
- To study the reeling parameters in organic silk
- To workout the economics for production of organic silk

The experimental plot were complied with recommended practice as control (T2) which comprised 350:140:100 NPK kg/ha/yr plus 25MT of FYM/ha/yr and organic practice (T1) which included application of 10 MT of FYM and Seri compost/Vermi–compost (8 MT) + Green manure seeds (12 kg) + bio-fertilizers (*Azotobacte*r-10 kg, PSB-2 kg) + Neem cake (400 kg)/acre/yr for production of mulberry. The user–friendly disinfectants/bed disinfectants with permissible limits were used for silkworm disease management in cocoon production. The Silk Reeling/ post cocoon processing were carried out by degumming of raw silk by boiling silk in eco-friendly botanical products solution for 1 hour and wash in hot water

Effect of organic practices on soil chemical properties			
Parameter tested	Treatment (T1)	Control (T2)	Improve-ment (%)
pH	8.11	8.18	-0.86
EC (mmhos/cm)	0.2	0.22	-9.09
OC (%)	0.96	0.80	20.00
Available P kg/ha	44.46	37.66	18.06
Available K kg/ha	478	418.00	14.35
Cu ppm	1.37	1.14	20.18
Fe ppm	1.45	1.33	9.02
Zn ppm	1.5	1.32	13.64
Mn ppm	2.85	2.68	6.34

During the period, project inspection of mulberry gardens for second year (conversion period) and certification was done by identified agency for production of mulberry leaves, cocoons and silk reeling process through organic practices. The mulberry leaf yield of 12689 kg/ha/crop was recorded in organic plot compared to 12859 kg/ha/crop in control.

Mulberry leaf yield data (pool data five crop)					
Treat-ments	Plant height (cm)	Longest shoot length (cm)	Leaf per shoot (No.)	Branches (No.)	Leaf yield kg/ha/ crop (4 crops)
T1	172	179	34	11	11655
T2	175	186	37	12	12156
T1: Organic plot T2: Control plot					

Soil analysis has indicated increase in organic carbon (0.96%), available phosphorous (44.46 kg/ha) and available potassium (478 kg/ha) and micronutrient like copper (1.37 ppm), zinc (1.45 ppm), iron (1.50 ppm) and manganese (2.85 ppm) content has shown higher value in organic plot compared to control. Mulberry leaf, stem, soil physical characterstics and soil microbial populations were analysed for macro and micro nutrients, such as nitrogen, phosphorous contented were recorded higher content in both stem and leaf.

Effect of organic practices on mulberry leaf and stem							
Treat-ments	N	P (kg/ha)	K (kg/ha)	Cu (ppm)	Zu (ppm)	Fe (ppm)	Mn (ppm)
T1	3.66	0.15	1.98	685.25	55.37	218.92	30.29
T2	3.03	0.09	1.67	670.67	52.92	161.25	24.42
Impr. (%)	20.79	66.67	18.56	2.17	4.63	35.76	24.04
Macro and micro nutrients content in mulberry stem							
T1	1.66	0.10	0.92	882.33	47.49	125.50	25.63
T2	1.56	0.08	0.82	875.36	39.85	106.67	24.00
Impr. (%)	6.41	25.00	12.20	0.80	19.17	17.65	6.79
T1: Organic plot T2: Control plot							

Relative impact of different treatments on soil physical characterstics				
#	Treatments	Bulk density (gm/cc)	Porosity (%)	WHC (%)
1	T1	1.21	46.17	37.22
2	T2	1.31	44.89	36.42
% Improvement		-7.63	2.85	2.20
T1: Organic plot T2: Control plot				

Relative impact of organic treatments on soil microbial populations (cfu/gm/soil)				
#	Treatments	Fungi (Cfu X 10^6)	Bacteria (Cfu X 10^7)	Actinomycetes (Cfu X 10^7)
1	T1	30.6	145	167
2	T2	19.77	127	98
% Improvement		54.78	14.17	70.41
T1: Organic plot T2: Control plot				

Two races namely improved multivoltine (MV1) and bivoltine (S8) were used to carry out bio assay studies using organically grown leaf and leaf grown of recommended practice. The cocoon and reeling parameter has shown improvement in all the parameter in organic leaf compared to control.

Rearing data (Average of four crops)							
Race	#	ERR/10k larvae		SCW (g)	SSW (g)	SR%	Yield/100 dfls (kg.)
		No.	Wt. kg				
S8	T1	9622	16.058	1.81	0.391	21.60	74.0
	T2	9214	15.308	1.77	0.371	20.96	61.00
% Improvement		4.43	4.90	2.26	5.39	3.05	21.31
MV1	T1	9545	12.113	1.35	0.24	17.77	74.90
	T2	9179	11.765	1.32	0.23	17.42	60.00
% Improvement		3.99	2.96	2.27	4.35	2.01	24.83

Reeling data (Average of four crops)											
Race	SCW (g)	SSW (g)	SR (%)	Reela-bility (%)	FL (m)	NBFL (m)	Denier	Rendita	Raw silk (%)	Raw silk recovery (%)	Neat-ness (p)
S8	1.516	0.337	22.23	86.30	798.93	689.46	2.53	6.77	14.76	66.41	92%
MV1	1.301	0.201	15.44	83.26	547.40	455.78	2.40	9.82	10.18	64.56	86%

MULBERRY PATHOLOGY

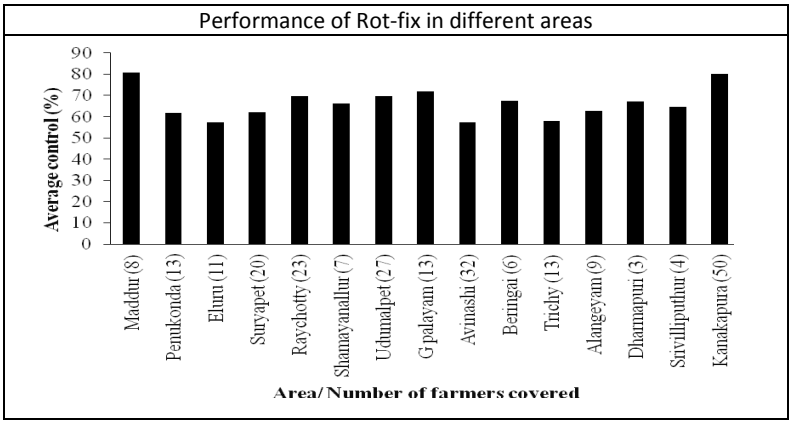
Ongoing Research Projects

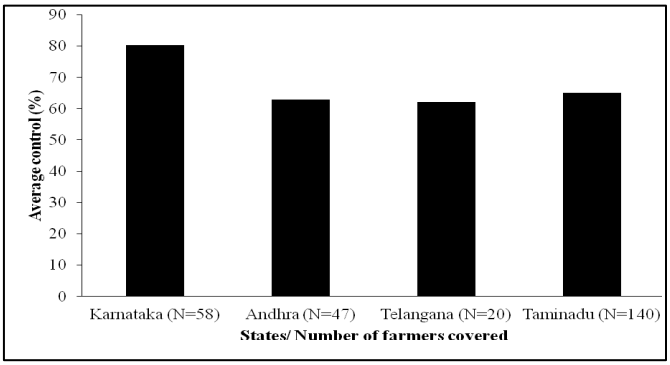
PRP 3816: Popularization of Rot- fix for management of root rot disease of mulberry among sericulture farmers of southern states (Jul. 2017 - Jun. 2019)

Pratheesh Kumar, P.M. (PI), S. Rajakumar., H. Jayaram, T.V. Srinivasarao and A. Venugopal

Objetive: To popularize Rot-fix as a broad spectrum formulation for management of root rot disease of mulberry

About 1200 kg Rot-fix have been prepared and distributed among 239 farmers in various places of Karnataka, Tamil nadu, Andhra Pradesh and Telangana for control of root rot disease of mulberry. Demonstrations were conducted in these areas and the feedback information was collected from the farmers on the performance of Rot-fix for control of root rot disease. The feedback data showed 57.29-80.75% control of the disease due to the application of Rot-fix with an average of 66.39%. Among different areas the Rot-fix performed better in Maddur (80.75%) and Kanakapura (79.97%) of Karnataka with an average of 80.36% control followed by Udumalpet (69.62%), Tamil nadu and Raychotty (69.52%) of Andhra Pradesh and least (57.29%) in Eluru Andhra Pradesh. Among various states, highest control was found in Karnataka with an average of 80.36% followed by Tamil Nadu (65.34%), Andhra Pradesh (62.83%) and Telangana (62.16%).





Patent has been filed through National Research Development Corporation (NRDC), New Delhi for getting Indian Patent for Rot-fix. Commercialized Rot-fix by transferring the technology and licensed to Kamath Chlorotech, Bangalore, through NRDC for commercial production of Rot-fix.

Continuous/Other activities

- Five M.Sc Microbiology students from University of Mysuru and its affiliated colleges worked for project work in different topics in Microbiology and Mulberry Pathology in the laboratory.
- Analyzed 2 samples of Navinya and one sample of Rot-fix through bioassay against different fungal pathogens associated with root rot disease and issued quality certificate.
- Raised 17000 V1 mulberry saplings during the period as a part of revenue generation.
- Extended technical support by field visits and identification of disease samples brought by the farmers and suggested control measures.
- Maintained various fungal pathogen cultures by timely sub-culturing and reviving.

MULBERRY PHYSIOLOGY

Ongoing Projects

PIC 3615: Mapping QTLs for alkalinity tolerance in Mulberry (*Morus* spp.) (Aug. 2017 - Feb. 2021)

P. V. Vaijayanthi[1], T. Mogili[1] (upto Feb. 2018), K. C. Mahalingappa and Y. N. Sanath Kumar

Objectives

- To validate the response of accessions contrasting for alkalinity stress and development of mapping population
- Identification of QTLs controlling alkalinity tolerance in mulberry

In order to validate the response of alkaline stress contrast genotypes, 40 genotypes along with three checks (Ar-12, V1 and S-776) were planted at REC, Koppal & REC Kinkanahalli (identified alkaline hotspots) following RCBD design with 3 replication. The soil and water alkalinity status were analyzed and results are in conformity with the high alkaline nature of both locations. Observations were also made on the survival of genotypes under natural alkaline condition. Results showed around 50% survival and better survival and growth of the genotypes, MR-2, MSG-2 and ME-0006.

Alkaline status of soil and water for REC, Koppal & Kinkanahalli

Location	Soil			Water			
	pH	EC (dS/m)	OC (%)	pH	EC (dS/m)	Hardness(ppm)	SAR (%)
REC, Koppal	10.14	0.88	0.06	8.38	1.10	750	14.16
REC, Kinkanahalli	9.44	0.35	0.06	8.00	1.53	700	25.98

PIN 3563: Evaluation of improved mulberry genotypes for yield potential, nutrient uptake and use efficiency under varied cultivation practices (Feb. 2016 - Mar.2020)

P.V. Vaijayanthi, T. Mogili (upto Feb. 2018), Sibayan Sen, V. Sobhana, E. Bhuvaneshwari and Y. Thirupathaiah

Objectives

- To evaluate yield potential, nutrient use and uptake efficiency of new mulberry genotypes under varied levels of irrigation and fertilizer inputs
- To evaluate new mulberry genotypes cultivated under varied conditions for their efficacy in silkworm rearing
- To determine nitrogen use efficiency from soil to cocoon and workout cost of silk production

An experimental plantation was established by planting four new mulberry varieties (G4, AGB 8, MSG 2 and V1) under 3 fertilizer treatments (100%, 80% and 60%) and 2 irrigation levels (100% and 60%) in split plot design with 3 replication. In order to understand pre-treatment-soil fertility status, soil samples were collected randomly from each subplot and analyzed for physical and chemical properties. Results showed moderately fertile soil with pH ranging from 6.5-6.7.

PIE 3511: Development of Distinctiveness, Uniformity and Stability (DUS) descriptors for mulberry (*Morus* spp.) and their utilization- Phase II (Apr.2017 - Mar.2019)

V. Sivaprasad, V. Girish Naik, T. Mogili (upto Feb. 2018) and P.V. Vaijayanthi

Objectives

- Establishment and maintenance of example and reference varieties
- Development of database for the descriptors of mulberry and add on to INDUS
- Establishment of Co-nodal DUS test centre at CSRTI, Berhampore
- DUS testing of new/ extant varieties and their registration under PPV &FR act, 2001

The example and reference varieties are maintained in PDG plot of CSRTI-Mysuru. The identified example and reference varieties (#45) were multiplied in the nursery towards the establishment of a separate DUS testing plot. CSRTI- Berhampore conveyed approval for establishing Co-nodal DUS test centre. Accordingly, budgetary proposal has been prepared and communicated to PPV&FRA for approval. Further, work has been initiated towards DUS testing of new/extant varieties of mulberry.

BIVOLTINE SILKWORM BREEDING LABORATORY

Ongoing Projects

AIB 3509: Development of productive bivoltine silkworm breeds/hybrids of *Bombyx mori* L. tolerant to nuclear polyhydrosis virus (Jul. 2014 - Dec. 2018)

S. Manthira Moorthy, C.M. Kishor Kumar, Mary Josepha A.V., L. Satish and M.S. Ranjini

Objective: Development of productive bivoltine silkworm breeds/hybrids tolerant to nuclear polyhydrosis virus

Twelve BmNPV tolerant bivoltine breeds (CSR2N, CSR4N, CSRN6, CSR16N, CSR17N, CSR26N, CSR27N, CSR50N, CSR51N, CSR52N, CSR53N and S8N) were developed. Utilizing these breeds, 6 single and 3 double hybrids were prepared and of which, one single hybrid (CSR52N x CSR26N) and one double hybrid (CSR52N x S8N) x (CSR16N x CSR26N) were identified as best hybrids based on rearing and reeling performance. The parents of these hybrids viz., CSR52N, S8N, CSR16N, CSR6N and CSR26N were reared in normal conditions also exposed with BmNPV. In normal condition 90-92% pupation and 22-23% shell was observed. Virus inoculated batches showed 43-56% survival with 21-22.5% shell ratio. The selected single hybrid (S8 x CSR26N) and double hybrid [(CSR52N x S8N) x (CSR16N x CSR26N)], were also reared in different seasons to validate the performance. Presently, the hybrids on station trial at RSRSs is under progress.

Performance of selected parents challenged with *Bm*NPV

Breeds	Pupation%	Yield/ 10000 Larvae		SCW (g)	SSW (g)	SR (%)
		Nos	Wt. kg			
CSR52N	56±1.0	5600±20	8.235±0.17	1.528±0.01	0.324±0.02	21.2±0.60
S8N	52±2.0	5200±97	7.869±0.11	1.554±0.07	0.342±0.01	22.0±1.45
CSR26N	48±2.5	4800±43	7.125±0.12	1.516±0.01	0.312±0.01	20.6±0.10
CSR16N	46±1.5	4600±69	6.756±0.09	1.495±0.01	0.329±0.02	22.0±0.13
CSR6N	43±1.0	4300±79	6.385±0.17	1.447±0.02	0.324±0.02	22.4±0.43

Performance of selected single and double hybrids

Hybrid	Pupa-tion%	Yield (kg)	SCW (g)	SSW (g)	SR (%)	Reel (%)	FL (m)	RS (%)	Denier
CSR52N x CSR26N (SH)	94 ±2.0	17.2± 0.61	1.782± 0.083	0.409± 0.0095	22.9± 1.61	86± 1.00	995± 14.50	18.6± 0.50	2.80± 0.1
CSR2 x CSR4 (Control)	90± 4.5	16.8± 0.56	1.761± 0.065	0.398± 0.011	22.6± 1.44	86± 0.57	969± 11.52	18± 0.96	2.79± 0.08
(CSR52N x S8N) x (CSR16N xCSR26N)-DH	94± 2.08	18.2± 0.35	1.869± 0.0051	0.432± 0.006	23.1± 0.33	88± 1.00	1022± 13.50	18.2± 0.36	2.98± 00.15
(CSR6 x CSR26) x (CSR2 xCSR27) (C)	93± 3.0	18.6± 00.25	1.858± 0.042	0.429± 0.006	23.0± 0.86	87± 0.57	1005± 13	18.9± 0.8	2.97± 0.04

AIB 3537: Improvement of silkworm breeding in India and Bulgaria (Mar. 2015 - Feb. 2020)

V. Sivaprasad and S. Manthira Moorthy

Objectives

- To develop silkworm breeds / hybrids with high silk content
- To identify silkworm hybrids suitable to climatic conditions of India and Bulgaria

Five silkworm genotypes (Kom-2, CV-1071-2, ShV, Vr2012 and JH4) and two hybrid [(H1 x KK) x (G2 x V2)] & Super1 x Hessa2 were received from Sericulture & Agriculture Experiment Station (SAES), Vratza, Bulgaria. After quarantine rearing, these breeds were evaluated in Indian Conditions and maintained by following appropriate procedures. These genetic resources (GRs) were utilized in two kind of approaches; One is GRs are directly put in to hybridization programme with Indian genetic resources

to develop high silk content double hybrids. Another one is development of new silkworm breeds having high silk content & quality silk through conventional breeding programme utilizing Bulgarian and Indian GRs.

In first approach, initially four hybrids were developed and evaluated in laboratory conditions. Promising hybrid *viz*., BH1 was field tested and obtained cocoon yield of 75 kg/100 dfls with 24% shell ratio. Further, 12 oval FC and 6 dumbbell FC were prepared by crossing between Indian and Bulgarian genotypes. Based on performance, five oval and four dumbbell FCs are shortlisted and 20 new double hybrid combinations were prepared and its evaluation is under progress.

In second approach, high silk content Bulgarian genotypes were crossed with adaptive Indian genotypes and three each new oval and dumbbell lines are under development. These lines are in F4-F5 generation. Further segregation of oval & dumbbell lines from the Bulgarian hybrids are also under progress.

Rearing Performance of Bulgarian silkworm genetic resources						
Breeds	Fecundity	Yield/ 10000 Larvae (No)	Yield/ 10000 larvae (Wt) (kg)	SCW (g)	SSW (g)	SR (%)
KOM-2	565	9200	15.125	1.712	0.419	24.47
CV-10712	578	9350	15.324	1.698	0.413	24.32
JH4	606	9200	15.204	1.709	0.42	24.58
ShV	615	9350	15.759	1.712	0.427	24.94
Vr 2012	553	9000	14.856	1.658	0.391	23.58

Rearing Performance of new lines						
Lines / Generation	Fecundity	Yield/ 10000 Larvae (No)	Yield/ 10000 larvae (Wt)	SCW (g)	SSW (g)	SR%
BMO1(F5)	585	9151	14.363	1.653	0.395	23.87
BMO2(F5)	565	8742	13.431	1.624	0.393	24.22
BMO3(F4)	573	9129	14.022	1.601	0.382	23.84
BMD1(F5)	556	8669	13.296	1.603	0.378	23.56
BMD2(F5)	546	8812	13.098	1.520	0.363	23.85
BMD3(F4)	550	8677	13.140	1.569	0.374	23.84

Hybrid	Pupa-tion%	SCW (g)	SR (%)	YLD/100 dfls (kg)	FL (m)	Reel (%)	Denier	RS (%)	Neatness
BH1	90±0.57	1.971±0.005	23.28±0.10	78±2.51	1211±12	84±0.57	2.78±0.04	18.5±0.12	94±0.57
BH2	94±1.52	2.035±0.025	23.18±0.08	84±2.00	1180±5.5	84±1.52	2.8±0.05	19±0.25	95±1.52
BH3	92±2.0	2.041±0.023	23.46±0.2	85±1.52	1225±4.2	86±1.52	2.75±0.01	19±0.3	94±0.57

Inter-Institutional Collaborative Project - (Collaboration with SBRL, Bangalore)

ARP 3605: Validation of the DNA markers in silkworm breed developed by introgression of DNA maker associated with NPV resistance using marker assisted selection breeding and large scale field trial of the breed (Apr. 2017 - Mar. 2020)

S. Manthira Moorthy, B. Mohan and V. Sivaprasad (Coordinator)

Objective: To evaluate the evolved bivoltine lines in various agro climatic conditions and select lines for their suitability in that particular environment at RSRS/REC at Bangalore, Salem, Ananthapur and Chamarajanagar.

Three MASN lines *viz*., MASN4, MASN6, MASN7 were procured from SBRL-Bengaluru and reared at SSBS-Coonoor and CSRTI-Mysuru. Selected cocoons from each line were subjected to SSR marker analysis for NPV tolerance. Based on marker presence, progenies were selected for onward generation. Selected lots were maintained at SSBS-Coonoor and CSRTI-Mysuru for further multiplication and conducting On Station Trial (OST).

10 dfls each of MASN4, MASN6, MASN7 were reared at RSRS-Ananthapur, Kodathi, Salem and Chamarajanagar. Two crops (Summer & favourable) at RSRS-Ananthapur, Salem and Chamarajanagar and three crops at RSRS- Kodathi was conducted. Data collected from all RSRSs were pooled and subjected to ANOVA & t-test. No significant difference was observed between

lines for all characters except yield/ 10000 larvae (wt. kg). To compare the performance of lines, paired t-Test was carried out between groups (MASN4-MASN6, MASN4-MASN7; MASN6-MASN7) and MASN4-MASN7 showed significant difference for only yield/ 10000 larvae (wt. kg). Since no significant difference was observed, to select better line, data on the rearing performance was subjected to Evaluation index (EI). Among the lines, MASN4 was selected based on EI and higher mean value for important characters *viz.*, yield/ 10000 larvae (No), yield/ 10000 larvae (wt. kg) and shell%. The selected line would be crossed with PM and CSR4 and hybrid would be evaluated among farmers.

Performance of MASN lines at RSRS-Ananthapur, Kodathi, Salem and Chamarajanagar under OST (Mean of 9 trials)										
Lines	Fecu-ndity	Hat (%)	Larval period		Yield/ 10000 larvae (No)	Yield/10000 larvae (wt. kg)	SCW (g)	SSW (g)	SR (%)	EI
			Total	V instar						
MASN4	498	95.30	24.06	6.12	8148	10.923	1.529	0.308	20.11	59
MASN6	485	94.41	24.12	7.00	7756	10.268	1.510	0.303	20.06	51
MASN7	482	94.18	24.06	6.12	7251	9.371	1.481	0.289	19.56	40
average	488	94.63	24.08	6.10	7718	10.187	1.507	0.300	19.91	
CD at 5%	0.98	0.974	1.002	0.998	0.232	0.003**	0.750	0.578	0.806	

Comparative analysis of MASN lines through t-test (Two-Sample Assuming Unequal Variances)						
Variable	MASN4 & MASN6		MASN4 & MASN7		MASN6 & MASN7	
	t-value	Sig.	t-value	Sig.	t-value	Sig.
Fecundity	-0.19	0.85	-0.15	0.88	0.019	0.98
Hatching %	-0.22	0.83	-0.09	0.92	0.134	0.89
Larval Period (Total)	0.003	0.99	0.006	0.92	0.002	0.97
Larval Period (V instar)	-0.01	0.99	-0.005	0.95	-0.045	0.96
Yield/10000 Lar. (No)	0.918	0.39	1.79	0.13	0.96	0.37
Yield/10000 Lar. (wt. kg)	3.0	0.057	**3.99	0.01	2.72	0.07
Single Cocoon wt. (g)	-0.21	0.83	0.03	0.97	0.19	0.84
Single Shell wt. (g)	0.26	0.799	0.84	0.42	1.13	0.29
Shell%	0.49	0.63	0.47	0.64	0.38	0.71

AIB 3596: Development of multi-viral disease tolerant (NPV, IFV and DNV) bivoltine silkworm breeds/hybrids of *Bombyx mori* L. through marker-assisted selection (Oct. 2016 – Sep. 2020)

L. Satish, L. Kusuma, S.M. Moorthy and Mary Josepha A.V.

Objectives

- Identification of multi-viral (BmDNV, BmNPV and BmIFV) tolerant bivoltine breeds using molecular markers
- Development of multi-viral disease tolerant bivoltine silkworm breeds/hybrids through pyramiding of resistance
- On station trial of identified hybrids at RSRSs/RECs

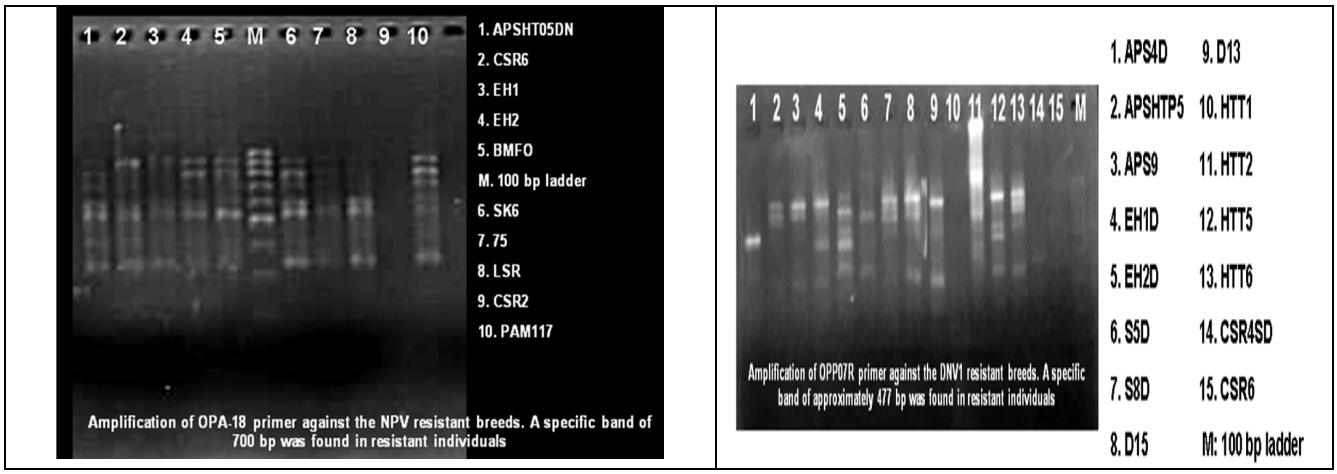
120 bivoltine silkworm breeds were screened from different geographical origin with BmDNV1, BmNPV and BmIFV inoculums at 10^{-2}, $2X10^{6}$, and 10^{-2} respectively, immediately after second moult and reared for four generations. Resistant populations were used for molecular screening by specific markers. The breeds resistant to BmDNV1, BmNPV and BmIFV were further assessed for cocoon parameters. Few promising bivoltine breeds (oval and dumbbell) were shortlisted for pyramiding the resistant genes to develop multi-viral resistant breeds/hybrids. The BmDNV1 and BmNPV resistant populations were subjected to PCR for BmDNV1 and BmNPV specific markers. A specific band of approximately 477bp was found in BmDNV1 resistant populations using OOP7R primer, whereas a specific band of 700bp was found in BmNPV resistant populations using OPA-18 primer.

Breed Geography	Breed Name	Larval Marking	Cocoon Shape	Survival %	Shell %
CSRTI- Mysuru	CSR2	Plain	Oval	24	22.4
	CSR17	Plain	Oval	58	22.8
	CSR27	Marked	Oval	49	22.8
	D7	Marked	Oval	44	21.1
	S5	Plain	Oval	31	22.1
	S8	Plain	Oval	22	22.4
	21	Plain	Oval	8	20.8
	NR2	Plain	Oval	8	20.6
	21X27a	Plain	Oval	31	21.4
	8	Marked	Oval	0	21.1
	101	Plain	Oval	23	22.2
	NB1	Plain	Oval	20	21.9
	N2S6	Plain	Oval	0	21.1
	6B	Plain	Oval	13	21.1
	2C	Plain	Oval	12	22.0
	Gen1	Plain	Oval	18	21.3
	EC1	Plain	Oval	22	21.0
	CSR4	Marked	Dumbbell	33	21.2
	CSR4S	Marked	Dumbbell	39	20.0
	CSR6	Marked	Dumbbell	66	20.9
	CSR16	Marked	Dumbbell	20	20.9
	CSR26	Marked	Dumbbell	15	21.3
	D13	Marked	Dumbbell	7	20.5
	S1	Marked	Dumbbell	14	20.4
	62	Marked	Dumbbell	17	19.4
	87	Marked	Dumbbell	20	21.2
	21X27 b	Plain	Dumbbell	17	20.9
	62X26 a	Marked	Dumbbell	23	20.3
	62X26 b	Marked	Dumbbell	8	20.1
	35	Plain	Dumbbell	11	21.0
	42	Plain	Dumbbell	0	20.1
	51	Marked	Dumbbell	33	19.6
	75	Marked	Dumbbell	68	19.0
	DS6	Plain	Dumbbell	0	17.4
	LSR	Marked	Dumbbell	68	19.4
	5N-IFV	Plain	Dumbbell	43	22.0
	2N	Plain	Dumbbell	8	19.5
	5N	Marked	Dumbbell	15	19.6
	61N	Marked	Dumbbell	24	20.0
	63N	Plain	Dumbbell	44	19.4
	4D	Plain	Dumbbell	23	19.5
	4S	Plain	Dumbbell	21	19.4
SSBS- Coonoor	D1	Plain	Oval	12	21.0
	CNR4	Plain	Oval	26	21.1
	SLD1	Plain	Oval	34	19.9
	D2	Plain	Oval	26	21.5
	SSBS5	Plain	Oval	19	20.8
	SSBS11	Plain	Oval	20	20.8
	SSBS12	Plain	E. Oval	18	21.4
	SSBS2	Plain	Oval	8	20.1

Breed Geography	Breed Name	Larval Marking	Cocoon Shape	Survival %	Shell %
	SSBS3	Plain	Oval	17	19.1
	SSBS4	Plain	Oval	11	19.2
	SSBS9	Plain	Oval	14	20.3
	SSBS10	Plain	Oval	12	20.4
	CNR5	Marked	Dumbbell	22	20.1
	CNR3	Marked	Dumbbell	28	19.2
	CNR15	Plain	Dumbbell	23	19.6
	SLD9	Marked	Dumbbell	38	18.7
	D13	Marked	Dumbbell	22	18.7
	D11	Marked	Dumbbell	18	19.6
	SSBS6	Marked	Dumbbell	17	21.0
	SSBS7	Plain	Dumbbell	15	20.3
	SSBS8	Marked	Dumbbell	14	20.8
	SSBS16	Marked	Dumbbell	22	20.1
	SSBS17	Plain	Dumbbell	24	20.1
China	Chi Oval	Plain	Oval	22	21.3
	Chi Dumb	Marked	Dumbbell	29	19.1
Manipur	C102	Plain	Oval	12	20.8
Egypt	EH1	Marked	Dumbbell	32	21.3
	EH2	Marked	Dumbbell	12	21.1
APSSRDI	APS5	Marked	Oval	20	19.6
	APS9	Plain	Oval	21	20.7
	APSHT05	Plain	Oval	50	20.1
	APS4	Marked	Dumbbell	18	21.1
	APSHTP5	Plain	Dumbbell	36	21.6
Deharadun	Dun17	Marked	Dumbbell	5	20.2
	Dun18	Marked	Oval	17	20.1
Japan	JPN7	Plain	Oval	5	19.1
	JPN8	Plain	Oval	19	18.4
	Bcon1	Marked	Dumbbell	20	20.1
Bulgaria	BMV1	Plain	Oval	40	20.1
	BMV2	Marked	Oval	6	21.1
	BM2E	Plain	Oval	52	19.6
	BM4PA	Plain	Oval	30	19.3
	BM250	Plain	Oval	52	19.4
	HBM10	Marked	Oval	32	20.1
	BMFO	Plain	Oval	44	20.1
	HIM	Marked	Oval	44	19.3
	BM2S0	Marked	Oval	52	20.1
	BMV3	Marked	Oval	12	19.1
	HM1	Plain	Dumbbell	37	20.6
	BMFDD	Marked	Dumbbell	15	18.9
	BM4PBB	Plain	Dumbbell	27	19.4
	BM4M	Marked	Dumbbell	20	19.4
	BM4PBS	Marked	Dumbbell	11	19.2
	BM4PB	Marked	Dumbbell	10	19.8
	BMFD	Marked	Dumbbell	11	19.8
	BM25LMD	Marked	Dumbbell	11	19.6
	BM25MD	Marked	Dumbbell	21	19.4
SBRL	MASN4	Marked	Oval	25	20.1

Breed Geography	Breed Name	Larval Marking	Cocoon Shape	Survival %	Shell %
	MASN6	Marked	Oval	33	20.8
	MASN7	Plain	Oval	43	20.5
	NB4D2	Plain	Oval	32	21.2
CSRTI- Pampore	PAM117	Marked	Dumbbell	66	19.1
CSRTI-Berhampore	SK6	Plain	Dumbbell	32	18.1
	SK7	Plain	Dumbbell	31	17.4

	Primer	Primer sequence (5'-3')	PCR product size
BmNPV	OPA-18	AGGTGACCGT	700bp
	NPV-F NPV-R	GCTACGACCCAGACCTGTACTC GCGTGGCACGTAATGTAACA	
BmDNV1	OPP7R	GTCCATGCCA	477bp
	DNV1-F DNV1-R	GTCCATGCCACCCATGACCGA CATGACCGAACACTGTGGAG	



AIT 3593: Transcriptome analysis of silkworm for identification of molecular markers for improvement of silk quality (Sept. 2016 - Aug. 2019)

L. Kusuma, N. Mal Reddy (upto March 2017), C.M. Kishor Kumar, S. Manthira Moorthy and M. N. Chandrashekar

Objectives

- To carry out transcriptome analysis of silk gland in mulberry silkworm breeds for identification of markers for silk quality
- To analyze important trait-related gene pathways in silkworm and establish gene-gene and gene-protein interaction pathway

Statistics of differentially expressed genes			
Comparison set	Total differentially expressed genes	Total upregulated genes	Total downregulated genes
CSR2 v/s PMxCSR2	225	85	140
CSR2 v/s PM	225	102	123
CSR27 V/s Nistari	254	81	173
PM v/s PMxCSR2	466	199	267

Silk glands from the bivoltine silkworm breeds (CSR2, CSR27) and multivoltine breeds (PM, Nistari) contrasting for silk quality, along with the crossbreed – PMxCSR2 were dissected and total RNA was isolated using TRIZOL method. The quality of the total RNA was assessed on 1% denatured Agarose gel and quantified using Nanodrop8000 Spectrophotometer. The libraries were prepared using 2µg of total RNA by Lexogen SENSE mRNA-Seq Library Prep Kit V2. The amplified libraries were analyzed in Bioanalyzer 2100 (Agilent Technologies) using High Sensitivity (HS) DNA chip as per manufacturer's instructions. The libraries were sequenced using 2 x 150 PE on Illumina platform for generating ~2GB of data per sample.

Total number reads and bases obtained from Illumina 2 x 150 PE transcriptome sequencing along with number of mapped reads and assembled transcripts

	Total Reads	Total Bases	Data (Gb)	No. of mapped reads	No. of assembled transcripts
CSR2	22896032	3158122744	3.16	18994903(82.96%)	14499
CSR27	17818248	2517334553	2.52	15636755(87.76%)	12867
PM	16929188	2453679132	2.45	17545842(90.13%)	21163
NISTARI	19667948	2838315397	2.84	17953817(91.28%)	17526
PMxCSR2	19467554	2801143053	2.80	14930988(88.20%)	22156

These reads were mapped onto the reference genome of *B. mori*, and the mapping statics represented: CSR2 18994903 (82.96%), CSR27 15636755 (87.76%), Pure Mysore 17545842 (90.13%) and Nistari 17953817 (91.28%) and PMxCSR2 14930988(88.20%). The number of assembled transcript included 14499 transcript for CSR2, 12867 for CSR27, 21163 for PM, 17526 for Nistari and 22156 transcripts for PMxCSR2. A total of 4,732 novel isoforms have been identified. Abundances of the merged transcripts were estimated using StringTie. Differential expression analysis of genes for these samples was carried out which indicated a total of 102 genes were upregulated and 123 genes downregulated for a DEG of CSR2 and Pure Mysore; 81 genes upregulated and 173 downregulated genes were present in comparison of CSR27 and Nistari. The mapped genes represented the genes that are involved in metabolism, genetic information processing, environmental information processing and cellular processes. Further, the association of these genes in silk synthesis needs to be evaluated for identification of molecular marker (s) determining silk quality in mulberry silkworm.

AIT 3628: Assessment of SNP Variation in Silkworm (*Bombyx mori* L) by Genotyping by Sequencing and genome-wide association mapping of important commercial traits". (Funded by DBT) - Collaboration with RVCE, Bangalore (Dec. 2017 to Nov. 2020)

S. Manthira Moorthy, L. Kusuma and Vidya Niranjan (RVCE, Bangalore)

Objective: Identification of SNP variation in silkworm genotypes through genotyping by sequencing of diverse silkworm genotypes

100 diverse silkworm genotypes were shortlisted out of 515 genotypes maintained by different Sericulture Research Institutes of CSB & state by Euclidean genetic distance/ clustering. Phenotyping of these breeds for important quantitative & quality traits followed by genotyping for SNP variation employing Genotyping by Sequencing (GBS) method. To carry out above works, procurement of 100 genotypes from different CSB Institutes (CSRTI-Berhampore, Pampore, CSGRC-Hosur,) and State Institutions (APSSRDI-Hindupur & KSSRDI-Thalaghattapura) is under progress.

Development of Hygrotolerant bivoltine breeds/hybrids through molecular marker assisted selection (Pilot project approved by CSB) (Aug. 2017 - Jul. 2018)

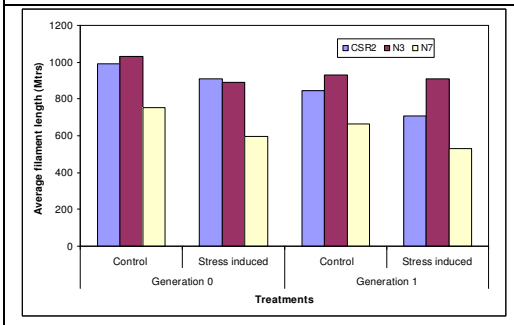
K.N. Madhusudhan, M.S. Ranjini and S. Manthira Moorthy

Objectives

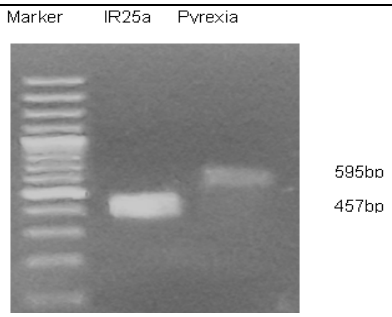
- To identify the relative humidity (RH) sensing genes in silkworm
- To study the expression pattern of RH sensing genes in silkworm

The objective of this project to identify relative humidity (RH) sensing genes in silkworm. The specific dry- and moist-sensing receptors viz., Nanchung (Nan) and Waterwitch (Wtwr) have been identified in the common fruit fly, *Drosophila melanogaster* (Liu et al., 2007). Ionotropic receptors play essential roles by regulating membrane potential, propagation of action potentials, neurotransmitter release, and intercellular communication (Wallach *et al*., 2017).

Comparative study in the variations in avarage filament length in control and stress induced silkworm (in Generation 0 & 1)



Amplification of Pyrexia and Ionotropic Receptor 25a genes from relative humidity exposed silkworm moths



With this background, the sequences of both Nanchung and Waterwitch were retrived from NCBI database and primers were designed for multiplex PCR. The thirty bivoltine breeds/hybrids along with five important multivoltine breeds were screened for the presence of Nanchung and waterwitch genes in silkworm. The results showed non-presence of these two genes in any of the breeds.

Hence, in order to identify RH sensing genes, five silkworm breeds (CSR2, N1, N3, N5 and N7) was screened at two different humidity regimes (95% with 30° C and 98% with 35° C). The larva exposed to 98% RH with 38° C showed high mortality compared to 95% RH with 30° C. Based on the survival%, N3 (Oval) and N7 (Dumbbell) were selected and same progeny was used for subsequent rearing. In the subsequent rearing, the larvae were exposed to 95% RH with 30° C and the cocoons were subjected to post cocoon assessment. The post cocoon assessment results confirmed that, generation 1 showed less filament length in comparison with cocoons obtained in generation 0. The impact of humidity was more noticed in dumbbell shaped cocoons in comparison with oval shaped cocoons.

Further, the primers for two group of receptors (ionotropic receptors and Transient Receptor potential) were synthesized and amplified (TRP and IR25a). Further, expression profile of two genes between control and stress induced condition are under progress.

Nucleotide Sequences of pyrexia and IR25a genes

Pyrexia gene sequence

CCATCCTTGGTGACCTATTAAGGAAAAATCCATTCGTAATTGAAATGCAATGGTGGGTTCTAGCCGGGATCACGATATTTGAGATATTTAGGAAGGTATAC
GGGATCGCTGGATATTCGACCGTCAAACAATATTTGATGCAATCGGAGAACATTATTGAGTGGTTCGTGATAATTAGTGTTTTCCTTATTTCGTATATATACA
CAAACATCACGTATACATGGCAGAACCACGTCGGCGCCTTCGCGGTGCTCGCTGGGTGGACGAACCTCATGATGATGATCGGACAGCTACCCGTTTTCGGC
ACCTACGTCGCGATGTACCAAAAAGTACAAAAGGAATTTGCTAAATTGCTTATGGCCTATTCGTGTATCCTAATCGGTTTCACGATAAGTTTCTGCGTTATCT
TCCCGGACTCGTCCTCGTTCGCGAATCCGTTTATGGGCTTCATAACCGTCTTGACAATGATGATCGGGGAGCTAAATTTAGATTTACTACTCAACGAGCCAG
ATGGAAACGACCCTCCTGTCTTGCTCGAGTTTTCTGCGCAGATAACCTACGTGTTATTCCTAATGTTTGTTACGGTCGTACTGATGA

IR25a gene sequence

CCCAAATCCCTACTGGACTCTGGCAAGTGGCCAAATAACATGAAATATATCACATGCGAC
GATTACGACGGCAAGAATACACCTAACAGGACCTTGGATCTTAAACTGGCTTTTCAAGAG
GTACGTTGACACAATAACATAATTTCTCTGATTCGAAATTATATTTACGTTTAGTGATGT
AAATAATGAGATATATCTAATAATAATTTACACCTCACTGAACTGTAATTTAAATAACAT
TTTAATAATTTTACGGATTCGCACTTTAGTGCTTTGAGCCTTGTGTCCACAGGTGAAAGA
GACTCCAACTTATGCTCCGTTTTATATCCCCGGAGACGACCCTATGAATGGAAGAAGCTA
CATGGAATTTAGTACTGATTTATCGGCAGTTACCGTCAAAGATGGTGCTTCTATAGGTAG
TAAGGCCC

On Station Trial and field testing of thermo tolerant hybrids (2017-2018)

S. Manthira Moorthy, R. Meenal and S.M. Hukkeri

Two double hybrids (TT21 x TT56; TT23x TT67) and one single hybrid (TT2 x TT6) were developed from the concluded project AIT3445. These hybrids along with control were evaluated in RSRSs under OST and total of 15 crops were conducted. Among these hybrids, TT21 x TT56 was found better (61 kg/100 dfls with 21.49% shell ratio) followed by N23 x N67 (58 kg/100 dfls with 21% shell) compared to 42.34 kg/100 dfls and 22.29% shell ratio in control, FC1 x FC2. Further TT21 x TT56 field tested (limited scale) during summer seasons in Andhra Pradesh, Tamil Nadu and Karnataka. An average of 75 kg/100 dfls with 21.6% shell ratio was obtained.

Performance of thermo tolerant hybrids reared at Regional Sericultural Research Stations (Ananthapur; Salem; Chamarajanagar; Kodathi) under On Station Trial (Mean of 15 crops)

Hybrid	Fecun-dity (No.)	Hat%	Yield/10000 Larvae		Yield/100 dfls (kg)	SCW (g)	SSW (g)	SR (%)
			No	Wt. kg				
TT21 x TT56	523±58	96.70±2.2	7920±1245	9.785±3.21	61.19 ±12.25	1.470 ±0.245	0.316 ±0.052	21.49 ±0.91
TT23 x TT67	550 ±29	95.00±1.5	7559±1185	8.854±2.85	58.0 ±10.14	1.472 ±0.230	0.312 ±0.035	21.20 ±0.64
TT2 x TT6	468±45	93.00±2.5	6021±1658	7.102±3.26	49.50 ±8.25	1.436 ±0.134	0.296 ±0.021	20.61 ±0.39
FC1 x FC2 (C)	550±82	96.12±2.6	4552±1375	6.266±2.55	42.34 ±14.45	1.458 ±0.235	0.325 ±0.045	22.29 ±0.59

Temperature and RH during rearing: Salem: 27-34°C & 78-95%; Ananthapur: 26-35°C & 66-92%: Kodathi: 24-30°C & 65-90%; Chamarajanagar: 26-32°C & RH-68-90%

Field performance of TT21 x TT56

State	No of dfls	YLD/100 dfls (kg)	SCW (g)	SSW (g)	SR (%)
Tamil Nadu	2000	72.0	1.84	0.38	20.65
Karnataka	500	84.0	1.767	0.393	22.23
Andhra Pradesh	500	70.0	1.67	0.370	22.15
Total/ Average	3000	75.3	1.759	0.381	21.67

Continuous/ Other activities

Maintenance of bivoltine Genetic Resources

C.M. Kishor Kumar, S. Manthira Moorthy, Anuradha H Jingade, K.N. Madhusudan, M.S. Ranjini, L. Kusuma, L. Satish and S.M Hukkeri

Productive bivoltine breeds (10), robust bivoltine breeds (11), thin denier bivoltine breeds (2) and sex limited breeds (5), amylase marker assisted selection breeds (15), NPV tolerant breeds (14) and morphological mutants (17) were maintained for conservation and evaluation. The values obtained for the traits were in conformity with the original breed characteristics.

Category	Breeds		Fec. (Nos)	Pupation Rate (%)	SCW (g)	SR (%)	FL (m)	SR (%)	Denier
Productive breeds	CSR2 CSR3 CSR4 CSR5 CSR6	CSR12 CSR16 CSR17 CSR26 CSR27	>500	>85	>1.70-1.80	>22-24	>900	>17.0	2.7-3.0
Robust breeds	CSR18 CSR19 CSR46 CSR47 CSR50 CSR51	CSR52 CSR53 S8 D2 NB1	>500	>90	>1.60-1.80	>22-23	>900	>15.0	2.7-3.0

Thin Denier breeds	CSR48 JPN7		>500	>85	>1.60-1.80	>22-23	>1200	>15.0	2.2-2.4
Sex-Limited breeds	CSR2 (SL) CSR4 (SL) CSR8 (SL)	CSR27 (SL) CSR202 (SL)	>400	>85	>1.50-1.70	>20-21	>700	>13.0	2.6-2.9
Amylase Marker assited selection breeds	GEN1 GEN3 2C 2S 2M 3P 3C 3D	3N GEN2 4S 4C 4P 6P 6C	>450	>85	>1.50-1.70	>20-21	>800	>14.0	2.7-3.0
NPV Tolerant breeds	2N 5N 61N 63N 8 21 35	42 51 62 75 87 101 Rudra	>500	>85	>1.40-1.60	>20-21	>700	>13.0	2.6-2.9
Morphological mutant breeds	TMS 01 (White) TMS 01 (Knob) TMS 03 (Plain) TMS 03 (Green) TMS 04 TMS 13 TMS 18	TMS 19 TMS 23 TMS 34 TMS 40 TMS 42 TMS 45 TMS 47 TMS 52 TMS 53 TMS 59	>300	>80	>0.90-1.30	>13-16	>350	>10.0	2.1-2.5

Transfer of Technology (TOT) Programme

Field testing of S8 x CSR16, a new productive bivoltine silkworm hybrid

C. M. Kishor Kumar, R. Meenal and S. M. Hukkeri

Systematic evaluation to determine the yield potentiality of a newly identified productive bivoltine silkworm hybrid S8 x CSR16 is undertaken through ToT programme with the farmers of Karnataka, Tamil Nadu and Andhra Pradesh.

State	Dfls	No.of farmers	Yield/100 dfls
Karnataka	3000	16	78.0
Tamil Nadu	19150	61	79.4
Andhra Pradesh	21600	78	69.0
Total	43750	155	74.2

SATELLITE SILKWORM BREEDING STATION-COONOOR

Maintenance of Bivoltine Silkworm Germplasm Stocks

During the period, rearing of 37 bivoltine germplasm was undertaken during July-August'17. During the rearing, confirmatory charaterisation of larvae and cocoons was done and the germplasm were maintained true to type as per the original data. Rearing performance of the germplasm is given in the Table.

Field testing of newly developed bivoltine double hybrid, SSBS5 x SSBS6

The newly developed SSBS5 x SSBS6 double hybrid, the parental races viz., SSBS3, SSBS5, SSBS6 and CSR51 were reared during April'17 and a total of 5,550 dfls of Foundation Cross were prepared and preserved for further use. The performances of the parental breeds are furnished in the Table.

Breed	Fecundity	Pupation (%)	SCW (g)	SSW (g)	SR (%)
SSBS3	561	93.75	1.481	0.309	20.89
SSBS5	646	92.92	1.468	0.322	21.94
SSBS6	657	95.92	1.785	0.370	20.72
CSR51	613	94.88	1.320	0.260	19.73

Rearing Performance of Bivoltine Germplasm Stocks

Breed	Fec.(No.)	Pupation (%)	SCW (g)	SSW (g)	SR (%)
CNR3	556	93.47	1.33	0.26	19.70
CNR4	563	96.13	1.38	0.31	22.73
CNR5	582	95.87	1.40	0.30	21.63
CNR15	506	96.67	1.38	0.30	21.50
SLD1	609	96.27	1.50	0.31	20.59
SLD4*	503	94.80	1.45	0.29	19.73
SLD8	530	95.60	1.39	0.29	21.14
SLD9	523	56.27	1.04	0.22	20.92
SSBS2	693	96.53	1.37	0.29	21.42
SSBS3	561	78.80	1.23	0.26	21.51
SSBS4	617	90.13	1.37	0.30	22.26
SSBS5	646	96.13	1.39	0.32	23.14
SSBS6	657	90.80	1.28	0.27	20.79
SSBS7	652	96.40	1.35	0.29	21.54
SSBS8	667	91.87	1.37	0.31	22.52
SSBS9	574	96.13	1.40	0.31	21.95
SSBS10	598	82.67	1.31	0.29	22.54
SSBS11	627	93.60	1.40	0.30	21.70
SSBS12	598	88.80	1.51	0.33	21.77
SSBS16	570	95.33	1.29	0.29	22.21
SSBS17	587	95.60	1.34	0.28	20.94
D1	560	91.47	1.44	0.29	20.32
D2	528	89.60	1.40	0.29	20.75
D11	616	95.73	1.29	0.26	20.05
D13	523	94.80	1.41	0.27	19.30
D15	520	91.60	1.22	0.26	21.00
D17	484	93.73	1.33	0.29	21.77
CSR2	601	95.33	1.62	0.35	21.79
CSR4	519	95.33	1.43	0.31	21.53
CSR6	489	92.80	1.77	0.36	20.13
CSR16	414	90.53	1.80	0.37	20.56
CSR17	631	96.13	1.54	0.32	20.85
CSR26	538	95.20	1.63	0.33	19.95
CSR27	531	95.07	1.52	0.34	22.50
CSR51	613	96.53	1.32	0.27	20.32
CSR202	475	89.33	1.30	0.30	23.05
CSR204	484	95.73	1.47	0.34	23.01

* discontinued during cocoon selection

P4 BASIC SEED FARM-HASSAN

Bivoltine Silkworm Race Maintenance and Multiplication

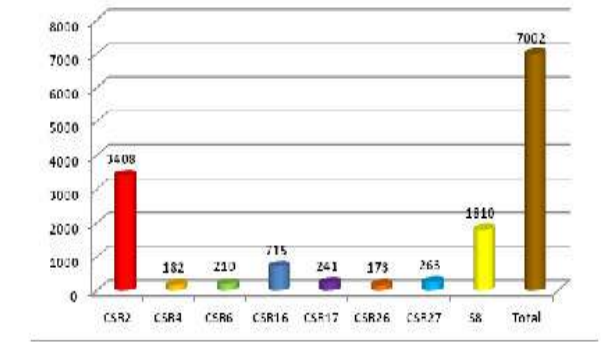
V. Nishitha Naik and Dayananda

Objective: Systematic maintenance of mulberry garden, bivoltine silkworm races and supply of quality bivoltine eggs to downstream multiplication centers

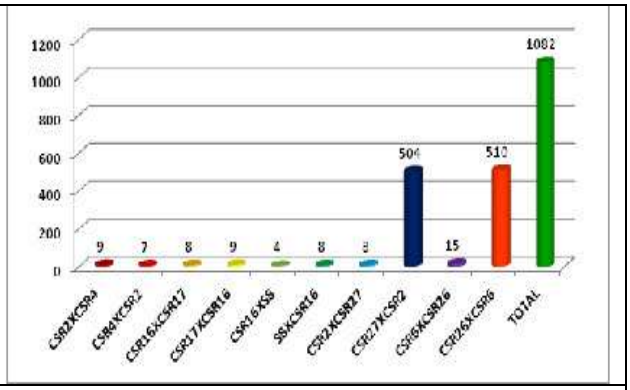
The bivoltine breeds which are commercially exploited for hybrid dfls production in India were reared four times-a-year following the well laid out Silkworm Race Maintenance Procedures. The rearing performance of pure lines was documented and maintained in conformity with the original breed characteristics. The hybrid vigour of commercial hybrid combinations was evaluated once-a-year to determine the stability of breeds and hybrids.

Performance of Bivoltine Breeds					
Breed	Pupation Rate (%)	Yield/10000 Larvae (kg)	SCW (g)	SSW (g)	SR (%)
CSR2	96.38±1.12	16.41±0.25	1.726±0.06	0.402±0.01	23.29±0.51
CSR4	96.51±2.13	15.91±1.35	1.617±0.07	0.360±0.03	22.22±0.74
CSR6	97.07±0.99	16.14±1.90	1.597±0.13	0.330±0.04	21.24±0.57
CSR26	96.18±1.23	15.77±1.33	1.590±0.12	0.340±0.04	21.34±1.18
CSR27	96.34±1.41	15.77±1.45	1.618±0.11	0.383±0.05	23.57±1.22
CSR16	96.46±2.04	15.99±1.63	1.612±0.11	0.346±0.04	21.42±1.19
CSR17	97.23±1.14	17.16±1.25	1.733±0.10	0.377±0.02	21.2±0.71
S8	94.91±1.75	16.82±1.50	1.700±0.12	0.386±0.04	22.68±0.85

A total of 7002 dfls basic seed (P4, P3 & P2) was prepared from the selected beds of seven bivoltine breeds for supply to P3 and P2 multiplication centres of DoS & CSB as per the requirement (1651 dfls). Pebrine monitoring of basic stocks was monitored systematically at pre-designed stages following stringent measures/methods.



Total production of disease free layings (Pure Breeds)



Total production of disease free layings (Hybrids)

Continuous/Other activities

1.5 acres of mulberry garden was maintained with an average leaf yield of 55000 kg/ha.

G4, S13 and V1 tree mulberry plantation

11.5 MT of vermi-compost and 12 MT of compost was produced and utilized.

MULTIVOLTINE BREEDING LABORATORY

Ongoing Projects

AIB 3524: Improvement of Pure Mysore race for productivity and Silk quality (Jan. 2015 - Jun. 2018)

K. B. Chandrashekhar (PI), S.B. Kulkarni, P.V. Soudaminy and M.N. Chandrashekhar

Objective: To develop Pure Mysore lines for improved hybrid vigour and fibre quality

The directional selection was applied for the isolation of improved PM lines based on cold mono-cocoon reeling data Improvement in the Pure Mysuru lines was achieved by selecting four lines with filament length of female cocoon 480-665m and male cocoon 480-619 m. The selected lines were subjected for complete study on silk characters cohesion and tenacity study. The selected lines were used to develop popular crosses with CSR2. During the year 6 generations and upto now a total of 16 generation rearing were completed.

Details of selected isolated Pure Mysore lines by mono-cocoon reeling

Source		Fec. (No.)	Filament length (m)		Average filament length (m)		Pupa-tion (%)	SCW (g)	SSW (g)	SR (%)
Improved line			Female	Male	Female	Male				
PM-MBL	PM-1	470	450-610	480-540	521	505	95.30	1.10	0.204	18.59
PM-CMV	PM-2	408	500-640	500-619	526	439	96.32	1.129	0.183	16.24
PM DOS	PM-3	421	373-441	413-458	411	429	89.71	1.114	0.183	16.42
PM A	PM-4	487	500-625	480-505	564	491	91.10	1.195	0.215	17.85
PM B	PM-5	428	500-665	500-584	571	556	93.60	1.134	0.185	16.32

Details of improved PM lines and their characteristics

Particulars	Basic stock		Improved Pure Mysore lines				
	CSGRC-Hosur		PM-1	PM-2	PM-3	PM-4	PM-5
	PM		(PM MBL)	(PM CMV)	(PM DOS)	(PM A)	(PM B)
Fecundity (No.)	404±25		470±20	460±20	448±20	487±20	453±20
Larval duration D:H	23:18±1		25:06±1	25:06± 1	25:06± 1	25:06±1	25:06±1
5^{th} age D:H	5:20±1		7:10±0:06	7:10±0:06	7:10±0:06	7:10±0:06	7:10±0:06
Pupation (%)	90.75±5		89 ± 5	90 ± 5	90 ± 5	91 ± 5	90 ± 5
SCW (g)	1.0±0.10		1.11±0.15	1.157±0.15	1.122±0.15	1.177±0.15	1.257±0.15
SSW (g)	0.14±0.04		0.196±0.02	0.186±0.02	0.190±0.02	0.198±0.02	0.227±0.02
Shell ratio (%)	14.0±0.10		17.71±0.20	16.13 ±0.20	16.67±0.20	16.82±0.20	17.94±0.20
Reel (%)	70.90±5		67.58 ±2	82.66 ±2	86.57± 2	85.28±2	83.73±2
FL (m)	307±25		496 ±50	532±50	450 ± 25	510± 50	497±50
FS (d)	2.4±0.1		2.27± 0.1	2.31± 0.1	2.77 ± 0.1	2.45± 0.1	2.49± 0.1
RS (%)	12.0±0		12.12 ± 0	13.21±1	12.10± 1	12.52±1	13.57±0
RSR (%)	47.30±5		63.03±5	60.41± 5	60.58±5	58.52±5	63.60±5
Neatness (%)	81±1		84.50±1	83.50±1	87±1	83±1	86±1
Pupal duration (days)	11:00±1		11:00±1	11:00±1	11±1	11:00±1	11:00±1
Tenacity g/d	>3.7		3.1	3.5	3.5	3.3	3.2
Cohesion stroke	Upto 30		70	91	84	89	86
Elongation (%)	>18		17	22	18	22	25

Performance of Pure Mysore Lines over the generations						
Parameter	Gen.- 1			Gen 16		
	Source I (MBL)	Source II (CMV)	Source III (DOS)	Source I (MBL)	Source II (CMV)	Source III (DOS)
Fecundity (No.)	468	464	461	470	489	470
Pupation Rate (%)	84.50	90.5	81.5	95.30	94.89	89.71
SC weight (g)	1.006	1.045	1.036	1.10	1.129	1.114
SS weight (g)	0.152	0.147	0.163	0.204	0.183	0.183
Shell (%)	15.10	14.39	15.73	18.51	16.24	16.42

Performance of Improved PM lines and their cross breeds				
Particulars	PM-1 x CSR2	PM-2 x CSR2	PM-4 x CSR2	PM-3 x CSR2
	PM -MBL x CSR2	PM -CMV x CSR2	PM -ORG x CSR2	PM- DOS x CSR2
Fecundity (No.)	473	510	485	469
Pupation rate%	93.5	96.0	93.0	91.2
SCW (g)	1.78	1.55	1.515	1.475
SSW (g)	0.39	0.33	0.3	0.28
SR%	21.63	21.24	19.965	18.82
Reel (%)	86.11	83.69	78.845	74.73
FL (m)	680.11	650.39	681.73	654.81
NBFL	585.62	551.45	560.865	523.48
Renditta	7.51	7.63	7.245	7.585
FS (d)	3.15	2.89	2.765	2.81
RS (%)	13.32	14.87	15.185	14.78
RSR (%)	61.58	65.56	73.495	70.86
Neatness	88	85.5	85	84.5

AIB 3534: Development of improved cross breeds of silkworm *Bombyx mori* L. suitable for south India (Mar. 2015 - Mar. 2019)

K. B. Chandrashekhar, C. M. Kishor Kumar, S. B. Kulkarni, P. V. Soudaminy and M. N.Chandrashekhar

Objectives: To develop crossbreed with high cocoon productivity and improved silk quality

During the year 6 rearings were conducted and retained 10 crosses based on economic traits and visual appearance. The crosses are in 16th generation. The shortlisted ICBs will be crossed with popular bivoltines and potentiality will be evaluated for further short listing.

Rearing Performance of Improved ICB lines (F-16)						
ICB Line	Parentage	Fec. (Nos)	ERR/ 1000 L (Nos)	SCW (g)	SSW (g)	SR (%)
ICB- 2	L14*NDV6	466	9404	1.56	0.290	18.52
ICB-6	ND7*ND5	486	9002	1.49	0.291	19.46
ICB-7A	NDV6*ND5	395	9183	1.32	0.230	17.42
ICB-13	FVB1*ND7	350	8579	1.56	0.240	15.38
ICB-14	APDR15*MH1	421	8329	1.53	0.270	17.39
ICB-17	FVB1*MH1	464	8564	1.59	0.260	16.09
ICB-19	L14*SARUPAT*L14	404	8602	1.51	0.281	18.54
ICB-29	20A*S8xS8*20A	403	6883	1.41	0.240	17.15
ICB-30	20A*FC4xFC4*20A	402	9180	1.52	0.290	19.08

Reeling parameters of selected ICBs crossed with Bivoltine		
Particulars	ICB17 x S8	ICB17 x CSR2
SCW (g)	1.75	1.570
SSW (g)	0.39	0.190
Shell (%)	22.14	20.31
Reel (%)	82.17	78.94
FL (m)	705.84	648.05
NBFL	551.78	563.27
FS (d)	2.77	2.67
Renditta	8.22	7.72
RS (%)	12.17	18.12
RSR (%)	54.95	75.43
Neatness (%)	86	84

Continuous/Other activities

Field Trial of Improved Crossbreed, Cauvery Gold (MV1 x S8)

S.B. Kulkarni, K.B. Chandrshekar, P.V. Soudaminy, P.C. Santha and V. Sivaprasad

Objective: Generation of MV1 and S8 seed cocoons for F1 production and field testing of new ICB

P1 seed cocoons for ICB, MV1 and S8 were generated (MV1: 139 kg; S8: 91 kg) in 4 batches for the production of MV1 x S8 dfls (Cauvery Gold). Also seed cocoons generated at other section were used to produce a total of 82230 Cauvery gold layings which were distributed to the farmers (431) in Karnataka, AP under ToT throughout the year and yield ranged from 64-74 kg/100 dfls and average yield of 66.30 kg/100 dfls was recorded. The new cross breed, Cauvery Gold, MV1 x S8 has gained popularity as the cocoon fetched higher price by Rs. 30 to 50, per kg in comparison to Kolar gold (PM XCSR2).

Rearing performance of seed crop

Breed	Dfls (No.)	Fec. (No.)	Actual yield	Yield/ 100 dfl	CCN/ kg (No.)	SCW (g)	SSW (g)	SR (%)
MV1 (MV)	245	477	139.00	56.70	685	1.570	0.300	19.12
S8 (BV)	170	505	91.00	53.88	650	1.671	0.370	22.19

Field performance of MV1 x S8 Cauvery Gold

Year	Location	No of dfls	No. farmers	YLD/100 dfls (kg)
2015-16	Karnataka	21525	124	59.65
	Tamil Nadu	1350	8	61.11
	Andhra Pradesh	3100	21	61.70
	Sub-Total/Avg.	25975	153	59.21
2016-17	Karnataka	25320	75	71.54
	Tamil Nadu	4680	24	67.17
	Andhra Pradesh	3450	16	66.31
	Sub-Total/Avg.	26750	115	70.0
2017-18	Karnataka	81230	425	66.37
	Andhra Pradesh	1000	06	65.50
	Sub-Total	82230	431	66.30
	Sub-Total/Avg.	134955	699	65.66

List of All India Coordinated Research Projects highlights/Pre-authorisation/Post-authorization Projects and highlights

Programme	Highlights	Regional Coordinator
Pre authorization field trial of Cauvery Gold (MV1 x S8) - a new improved cross breed for cocoon productivity and silk quality	The field trial of the new cross breed covering 82,230 dfls with 431 farmers recorded an average cocoon yield of 66.30 kg/100dfls with a silk quality suitable to power looms and mechanized hand looms, giving 2A grade silk	Director, CSRTI- Mysuru

Progress of Inter-Institutional Collaborating Projects

AIB 3577: Evaluation of Multivoltine germplasm to identify potential parent for developing cross breeds for Southern and Eastern India (In Collaboration with CSGRC-Hosur) (June 2016 – May 2019)

N. Balachandran[1], M. Muthulakshmi[1], and S. Niveditha[1], K.B. Chandrashekar[2], P.V. Soudaminy[2], M.N. Chandrashekar[2]
[1]CSGRC – Hosur, [2]CSRTI – Mysuru.

Under the project 2 trials of total 20 cross breeds in 3 replications were conducted during the year.

Performance of 20 cross breeds of CSGRC breeds/Accessions												
#	Accession No.	Fec. (No.)	Larva after 3rd moult	Cocoons				ERR No.	ERR (g)	SCW (g)	SSW (g)	SR (%)
				Harvested (Wt.) (g)	Good (No.)	Double (No.)	Total (No.)					
1	001 x 290	505	250	355	229	5	234	9353	14.21	1.400	0.25	18.02
2	007 x 290	470	250	324	225	10	235	9407	12.97	1.422	0.27	18.82
3	017 x 290	427	250	354	237	6	243	9707	14.14	1.426	0.26	18.04
4	022 x 290	473	250	334	227	6	233	9333	13.37	1.488	2.57	17.32
5	025 x 290	464	250	350	233	8	241	9640	13.99	1.500	0.27	18.14
6	026 x 290	432	250	340	238	4	241	9640	13.61	1.460	0.26	18.03
7	030 x 290	496	250	351	238	6	244	9753	14.05	1.452	0.27	18.60
8	048 x 290	469	250	369	238	5	244	9740	14.75	1.462	0.27	18.46
9	054 x 290	451	250	340	230	11	242	9660	13.59	1.461	0.26	17.50
10	055 x 290	461	250	352	234	6	240	9593	14.07	1.508	0.28	18.31
11	068 x 290	460	250	359	231	7	238	9520	14.37	1.586	0.30	18.93
12	069 x290	456	250	358	235	4	239	9553	14.33	1.455	0.27	18.67
13	074 x 290	472	250	332	224	13	237	9467	13.29	1.515	0.30	19.63
14	076 x 290	491	250	301	215	4	218	8720	12.03	1.481	0.29	19.67
15	077 x 290	456	250	360	233	6	238	9527	14.38	1.498	0.29	19.07
16	078 x 290	466	250	324	233	5	237	9493	12.96	1.443	0.28	19.50
17	079 x 290	507	250	358	220	9	229	9153	14.33	1.508	0.30	19.63
18	080 x 290	481	250	335	232	1	234	9340	13.38	1.390	0.26	18.67
19	081 x 290	472	250	373	235	5	240	9580	14.91	1.529	0.31	20.52
20	082 x 290	463	250	327	237	2	239	9567	13.09	1.408	0.26	18.22

Continuous/Other activities

Maintenance of polyvoltine silkworm breeds of *Bombyx mori* L.

K. B. Chandrashekhar, S. B. Kulkarni, P.V. Soudaminy and M. N. Chandrashekhar

Objectives: Maintain the polyvoltine breeds conforming to their original characters

Thirty one polyvoltine breeds were maintained conforming to their original breed character for 5 generations. The average performances of some of the important evolved breeds are as below

Rearing and reeling performance of the germplasm										
#	Breed	Fec. (No.)	Pupation (%)	SCW (g)	SSW (g)	SR (%)	Reel. (%)	FL (m)	RS (%)	Neat. (Points)
1	2000H	451	67.03	1.62	0.280	17.28	71.29	341	13.80	86
2	AGL3	461	92.13	1.294	0.217	16.77	82.40	437	09.82	90
3	AGL5	471	85.71	1.295	0.218	16.83	70.57	420	09.14	86
4	APDR 15	466	79.67	1.321	0.209	15.82	63.89	355	08.11	88
5	BL24	401	80.65	1.25	0.210	16.80	72.87	432.	14.02	85
6	BL65	361	63.44	1.31	0.240	18.32	61.44	516	14.17	88
7	BL68	411	70.67	1.27	0.209	16.42	73.39	513	11.41	87
8	BL 67	370	80.4	1.347	0.230	17.67	53.58	542	11.09	84
9	BM-005	299	67.21	0.88	0.121	13.64	76.28	529	14.44	80
10	BM-078	251	88.67	1.01	0.171	16.83	83.79	647	15.86	86
11	FVB1	401	79.35	1.38	0.220	16.89	74.35	371	8.44	87
12	HB4	466	87.12	1.30	0.234	17.95	71.29	666	11.09	87
13	HB6	425	86.72	1.39	0.250	18.23	63.83	506	10.50	86

14	L1	440	74.52	1.26	0.220	17.28	59.00	521	11.50	86
15	L14	452	95.00	1.30	0.250	19.51	84.12	496	11.2	87
16	L15	485	87.22	1.31	0.250	19.22	74.10	580	11.74	85
17	L3	468	88.75	1.26	0.230	18.29	77.38	580	11.52	86
18	MH1	470	89.50	1.22	0.220	17.98	87.0	458	08.84	85
19	MO6	444	79.68	1.23	0.220	17.89	80.11	452	15.11	85
20	ND10	485	86.68	1.40	0.230	16.43	62.77	535	12.50	83
21	ND2	431	87.94	137	0.260	18.98	77.09	493	11.66	83
22	ND5	412	70.89	1.48	0.260	17.74	81.20	545	11.20	86
23	ND7	435	87.34	1.38	0.260	18.88	72.30	445	10.45	87
24	NDV6	366	83.05	1.33	0.260	19.12	82.98	468	08.30	86
25	Nistari	206	97.54	0.98	0.160	15.85	81.30	523	9.32	85
26	NP1	413	71.33	1.35	0.250	18.47	82.64	341	8.39	85
27	NP4	328	84.31	1.21	0.220	17.74	72.55	514	6.96	84
28	PV1	415	71.20	1.39	0.230	16.55	69.72	548	15.37	88
29	MV1	515	91.50	1.43	0.260	18.09	82.63	496	10.37	87
30	RD1	401	89.04	1.11	0.150	13.51	83.18	332	14.67	84
31	Sarupat	365	85.57	1.13	0.160	14.45	63.28	483	10.35	88

SILKWORM PHYSIOLOGY LABORATORY

Ongoing Project

AIP-3568: Development of value added product from spent pupae of mulberry silkworm *Bombyx mori* L.
(April 2016 – March 2019)

Y. Thirupathaiah, E. Bhuvaneswari and M. Munirathnam Reddy (upto Feb. 2017) and M. Chandrashekaraiah, (NIANP)

Objectives:

- Isolation and characterization of α- linolenic acid acid from pupae oil and establishment of pilot production plant (CSRTI–Mysuru)
- Development of DSWP meal enriching cattle feed as supplement for bypass protein and fat (NIANP, Bangalore)

Isolation and characterization of α- linolenic acid acid from pupae oil and establishment of pilot production plant

Extraction of mulberry silkworm, *Bombyx mori* L., pupae oil from dried pupae powder was evaluated by three different methods i.e soxhlet, maceration and column extraction methods with hexane and petroleum ether as solvents. The scale-up process for pupae oil extraction was established at 5 kg level, and maximum oil content obtained by both spent and fresh silkworm pupae powder (29-34%) by column extraction method when hexane was used as solvent. The qualitative characteristics such as free fatty acid content, saponification value, iodine number and peroxide values of extracted silkworm pupae oil were at considerable level. Fatty acid profiles of spent and fresh pupae oil by gas chromatography analysis revealed the predominance of α-linolenic acid (29 to 32.2%). Further α-linolenic acid separation from extracted pupae oil was carried out with chemical and enzymatic methodologies. HPLC analysis indicated that higher level of α-linolenic acid was recovered by chemical method (92%) followed by enzymatic method (83%) after urea inclusion

Extraction of silkworm pupae oil by column extraction

Recovery of silkworm pupae oil by vacuum evaporation

complexes followed by fractional crystallization. Chromatographic methods are being established for maximum separation of α-linolenic acid from mixture of fatty acids. De-oiled silkworm pupae powder and pupal oil have been sent to NIANP, Banglore for

Amino acid profile of both fresh (Bivoltine) and spent silkworm pupae powder was carried out before and after oil extraction. There was no significant loss of amino acids after oil extraction. However, some of the amino acid contents were found to be less in spent pupae compared with fresh pupae, may be due to the microbial spoilage of spent pupae. Silkworm pupae powder contains all the 9 essential amino acids, out of which four essential amino acids were detected in higher percentage.

Extraction of mulberry silkworm pupae oil by different methods

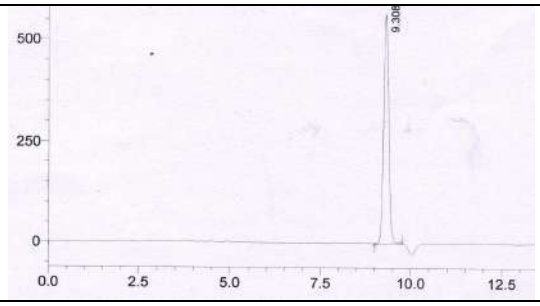
Extraction Method	Solvent	Bivoltine Pupae (g/kg)	Multivoltine Pupae (g/kg)	Spent Pupae (g/kg)
Soxhlet	Petroleum Ether	219.60 ± 4.16	220.50 ± 1.22	203.00 ± 1.63*
	Hexane	224.00 ± 4.58	224.60 ± 2.60	204.16 ± 2.56*
Maceration	Petroleum Ether	212.43 ± 1.18	213.40 ± 3.55	201.93 ± 4.20*
	Hexane	223.10 ± 1.73	224.30 ± 0.93	209.83 ± 2.15*
Column	Petroleum Ether	329.43 ± 3.18*	330.40 ± 2.50*	274.00 ± 3.30*
	Hexane	340.00 ± 2.50**	343.30 ± 2.93**	289.65 ± 2.55*

Values expressed are mean ± SD of three independent replicates. The values statistically significant at <0.001 indicated as **, p<0.05 indicated as *.

Qualitative analysis of mulberry silkworm pupae oil

Parameter	Bivoltine Pupae	Multivoltine Pupae	Spent Pupae
Free fatty acid value	5.6±0.20	5.7±0.14	7.8±0.21*
Peroxide value	2.7±0.12	2.7±0.09	3.0±0.10
Saponification value	199±1.10	201±1.40	210±2.10*
Iodine number	155±2.20	157±1.90	143±1.30*

Values expressed as mean±SD of three replicates;
Statistically significant at p<0.05 indicated as * .



HPLC analysis of ALA

Recovery of α-Linolenic acid (ALA) by enzymatic and chemical method

Fatty acid (%)	Fractional Crystallization		Urea Inclusion Complexes	
	Enzymatic Extraction	Chemical Extraction	Enzymatic Extraction	Chemical Extraction
18:3 (ALA)	74.00 ± 1.72	79.00 ± 2.90*	83.46 ± 1.80	92.00 ± 2.10*
18:2 (Linoleic acid)	12.34 ± 0.50	16.90 ± 1.30	13.34 ± 0.60	7.9 ± 0.40*
18:1 (Oleic acid)	10.61 ± 0.30	1.12 ± 0.23*	1.31 ± 0.10	0.10*

Values expressed as mean±SD of three replicates. The values statistically significant at p<0.05 indicated as *.

Amino acid profile of mulberry silkworm *Bombyx mori* pupae

Amino acid (g/100g) of protein	Fresh pupae powder	Deoiled pupae powder	Spent pupae powder	Deoiled spent pupae powder
Glu	12.9 ± 0.20	12.87 ± 0.90	10.2 ± 0.20	10.6 ± 0.16
Asp	9.65 ± 0.13	9.76 ± 0.15	10.18 ± 0.06	9.26 ± 0.09
Lue *	6.91 ± 0.04	6.85 ± 0.09	6.11 ± 0.12	6.34 ± 0.05
Lys *	6.60 ± 0.59	6.75 ± 0.54	6.23 ± 0.23	6.41 ± 0.09
Phe *	6.58 ± 0.13	6.59 ± 0.14	6.34 ± 0.35	6.70 ± 0.23
Ala	6.13 ± 0.15	5.73 ± 0.05	4.66 ± 0.19	4.80 ± 0.26
Tyr	5.86 ± 0.11	5.87 ± 0.10	5.16 ± 0.13	4.76 ± 0.09
Val *	5.53 ± 0.28	5.37 ± 0.11	4.55 ± 0.20	4.78 ± 0.34
Gly	5.52 ± 0.15	5.55 ± 0.27	4.50 ± 0.30	3.55 ± 0.21
Ser	5.50 ± 0.17	5.35 ± 0.08	4.13 ± 0.01	4.03 ± 0.03
Pro	4.85 ± 0.21	4.43 ± 0.26	2.97 ± 0.05	3.53 ± 0.18
Arg	4.85 ± 0.12	5.24 ± 0.08	5.65 ± 0.22	4.59 ± 0.11
Thr *	4.83 ± 0.08	4.89 ± 0.01	4.03 ± 0.03	3.88 ± 0.10
Ile *	4.20 ± 0.17	4.13 ± 0.14	3.64 ± 0.11	3.78 ± 0.09

His *	3.79 ± 0.20	4.00 ± 0.20	2.03 ± 0.10	2.31 ± 0.26
Met-S *	3.21 ± 0.03	3.52 ± 0.08	2.33 ± 0.03	2.65 ± 0.04
Cys	1.65 ± 0.18	2.04 ± 0.04	1.09 ± 0.01	1.27 ± 0.02
Try *	1.15 ± 0.01	0.91 ± 0.03	0.87 ± 0.02	1.02± 0.02
Values expressed as mean±SD of three replicates;* Essential amino acids				

Development of DSWP meal enriching cattle feed: Studies were conducted in 2 phases to evaluate the feeding value of byproducts of SWP in crossbred cattle. In the first phase, the *in vitro* experiment was conducted to study the effect of supplementation of different inclusion levels of silkworm pupae meal (DSWP) by replacing (0, 10, 20 ….100%) soybean meal (SBM) in the concentrate mixture on Finger millet straw (FMS) based diets on *in vitro* rumen fermentation. The *in vitro* total gas production (IVTGP), pH, ammonia nitrogen (NH_3-N), total volatile fatty acids (TVFA), partitioning factor (PF), microbial biomass production (MBB), metabolizable energy (ME), were determined. No significant ($p>0.05$) difference was observed in pH, NH_3-N, TVFA, PF, MBB, ME, IVDMD and IVOMD among treatments (T0 to T10).

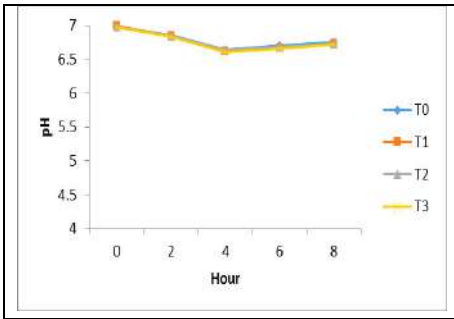
In the 2nd phase experiments were conducted to evaluate the effect of different inclusion levels of defatted silkworm pupae meal (DSWP) on rumen fermentation in cattle fed on Finger millet straw (FMS) based diet. Four nitrogenous concentrate mixtures were prepared with DSWP replacing soybean meal (SBM) at 0, 10, 20 and 30% (T_0, T_1, T_2, T_3). Rumen fermentation experiment was conducted in a 4×4 Latin switch over design using four crossbred steers to study the effect of different levels of DSWP (0,10, 20 and 30%) on rumen fermentation. All the animals were fed with FMS as sole source of roughage. No significant difference ($p>0.05$) was observed in intakes of feed rumen fermentation parameters such as pH, NH_3-N, TVFA among the experimental groups in phase II. In the second phase, the digestibility trial was conducted in 20 crossbred cattle which were divided into four experimental groups of five animals each in a complete randomized design to study the effect of different rations (T_0, T_1, T_2 and T_3) on nutrient utilization. The data processing is under progress.

Salient findings

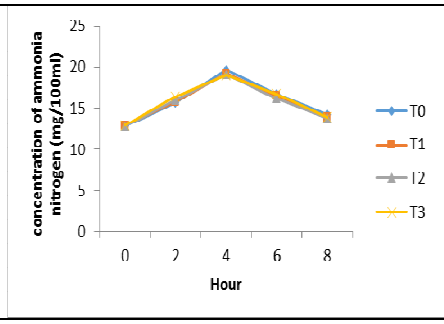
- Supplementation of DSWP up to 100% had no significant effect on *in vitro* rumen fermentation on FMS based ration.
- DSWP can be incorporated in the ration of cattle up to 30% by replacing SBM without compromising the rumen fermentation.

Effect of incorporation of graded levels of defatted silkworm pupae meal (DSWP) by replacing soybean meal (SBM) on *in vitro* rumen fermentation

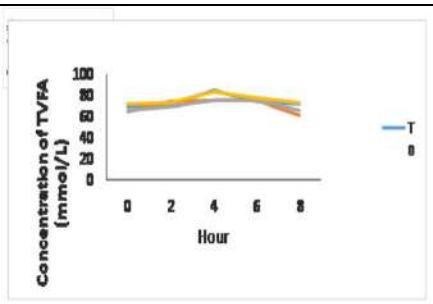
Diets	Gas production (ml/0.2g DM)	pH	NH_3-N (mg/ 100ml)	TVFA (mM/l)	A:P	PF	MBB (mg)	ME (MJ/kg DM)
T0	37.0	6.72	19.58^{ab}	45.05	3.45	2.69	17.87	8.23
T1	36.5	6.72	19.50^{ab}	44.64	3.49	2.73	19.13	8.17
T2	37.11	6.73	19.59^{ab}	45.21	3.48	2.69	17.94	8.25
T3	36.33	6.74	19.36^{ab}	44.43	3.42	2.72	18.75	8.14
T4	36.33	6.74	19.68^{a}	44.47	3.44	2.73	19.35	8.14
T5	36.56	6.75	18.99^{ab}	44.82	3.5	2.71	18.42	8.18
T6	36.78	6.76	19.21^{ab}	44.85	3.36	2.74	19.57	8.21
T7	36.25	6.76	18.81^{bc}	44.4	3.37	2.74	19.79	8.14
T8	36.33	6.77	18.64^{c}	44.58	3.41	2.74	19.38	8.15
T9	36.11	6.78	18.59^{c}	44.23	3.41	2.76	19.89	8.12
T10	36.33	6.79	18.65^{c}	44.62	3.37	2.70	18.25	8.15
Mean	36.52	6.75	19.14	44.66	3.43	2.72	18.93	8.17
SEM	0.09	0.016	0.07	0.41	0.01	0.01	0.27	0.01
Linear	0.29	0.683	0.00	0.979	0.121	0.36	0.44	0.34
Quadratic	0.71	0.094	0.419	0.722	0.213	0.56	0.54	0.72
a, b, c, values with different superscripts differs significantly.								



Rumen pH in cattle as affected by different experimental rations



Rumen ammonia nitrogen (mg/100ml) in cattle asaffected by different experimental rations



Total volatile fatty acid (TVFA) concentration (mM/l) in cattle as influenced by different experimental rations

AIP 3594: Feed supplementation studies for improving young age silkworm rearing in Chawki rearing centres (Oct. 2016 - Sept. 2018)

E. Bhuvaneswari, Y.Thirupathaiah and M. Munirathnam Reddy (upto February 2017)

Objective: To enhance feed response, growth and survival of chawki silkworms through feed supplementation and correlate chawki larval growth to cocoon productivity

The objective of this study is screening, evaluation of feed supplements and development of chawki feed supplement formulations through mulberry leaf for improving chawki performance. The minimum effective concentration of different feed supplements like Vitamin- Ascorbic acid, Minerals- Sodium chloride, Potassium chloride, Potassium sulphate; Anti-microbial substance- Sorbic acid, Honey, Sericin, leaf powder of *Sesbania grandiflora*; Immune enhancers and modulators Caffeic acid, Curcumin, organic acids (Crotonic acid and Quinic acid, Shikimic acid), leaf powder of Asparagus and Aloevera, α-Linolenic acid; Growth promoters- Choline chloride, β-sitosterol, Amino acid mixture, Sea weed extracts (*Kappaphycus alvarezi* and *Sargassum cristae folium*); Antibiotic- Amoxycillin and Feed attractants- Morin and Guar (cluster bean) powder were evaluated individually on mulberry leaf as well as on artificial diet with bivoltine double hybrid FC1 x FC2 silkworms. The larval survival, feed response and growth over and above the control were identified. To improve the uniformity and the

Effect of different Chawki feed supplement formulations (CFSFs) on G2 leaf fed chawki silkworm's (*bivoltine* double hybrid FC1 x FC2)

Treatments	Hatching percentage	Survival Percentage upto II instar	Feed response Percentage upto II instar	Larval growth (Weight of 100 larvae in gm- II moult)	Absolute growth index
CFSF-1	97.31 ±1.502 (0.436)	95.13 ±0.665 (5.360)	94.24 ±0.910 (8.123)	3.652 ±0.029 (5.426)	3.520 ±0.111 (16.685)
CFSF-2	97.01 ±0.452 (0.052)	96.33 ±0.493 (6.686)	93.75 ±1.149 (7.565)	3.798 ±0.123 (9.621)	3.556 ±0.142 (17.901)
CFSF-3	96.64 ±0.517 (0.440)	95.62 ±0.891 (5.903)	93.91 ±1.029 (7.748)	3.698 ±0.064 (6.475)	3.460 ±0.070 (14.696)
G2 Leaf	97.29 ±0.357 (0.230)	92.96 ±0.593 (2.953)	89.33 ±0.378 (2.493)	3.641 ±0.019 (5.109)	3.246 ±0.005 (7.624)
V1 leaf (Control)	97.06 ±1.125	90.29 ±3.059	87.16 ±2.856	3.464 ±0.023	3.010 ±0.102
Significance of F Ratio between treatments	NS	**	***	**	**

Each value is the mean±SD of three separate observations,
Percent change over control values in parentheses,
*Significant at 5% level;
** Significant at 1% level;
***Significant at 0.1% level; NS- Non Significant
CFSF-1: CFS*, Aloevera and Asparagus leaf powder
CFSF-2: CFS*, Asparagus leaf powder and Crotonic acid
CFSF-3: CFS*, Aloevera, Asparagus and *Sesbania grandiflora* leaf powder
Note: *CFS-Sodium chloride, Potassium sulphate, Potassium chloride, Ascorbic acid, Choline chloride, Sorbic acid, Caffeic acid, Amoxycillin, Morin, β-Sitosterol, Guar powder

robustness in chawki worms, different combinations of formulations were prepared with the supplements and evaluated on the chawki worms. The results shows that chawki worms treated with some novel formulations showed improved survival, feed response percentage and uniformity than the untreated batch. The application of formulation treatment during first instar (every day one feeding, total 3 feeding), spraying on the recommended quantity of mulberry leaves improved the performance of chawki worms and the results are represented in the table.

Continuous / Other activities

Mother culture maintenance of *Cordyceps* and production of fruiting bodies

Objective: To maintain and culturing of *Cordyceps* species for the *in-vitro* and *in-vivo* fruiting body formation on mulberry silkworm pupae.

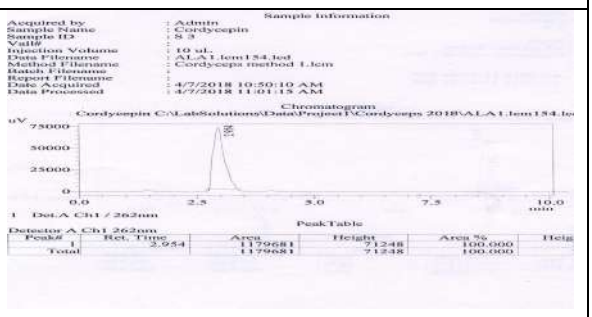
Y. Thirupathaiah, E. Bhuvaneswari and Vineet Kumar

Nine species of *Cordyceps* are being regularly cultivated and maintained on potato dextrose agar (PDA) as well as on sabouraud dextrose agar yeast (SDAY) by providing required incubation conditions. All the *Cordyceps* spp. were screened for its fruiting body formation in *in-vitro* (culture media) and *in-vivo* (on silkworm pupae). Optimization of *Cordyceps* fruiting body formation was carried out by studying different concentrations of inoculum levels, incubation temperature, humidity, light intensity and duration. Results indicated that out of nine species *Cordyceps takaomontana anamorph (isaria tenuipies) 91 (IS 91*), *Cordyceps militaris* and *Cordyceps sinensis* were able to produce fruiting body formation on silkworm pupae but not on *in vitro* culture media (PDA). The biologically active compounds such as cordycepin, cordycepic acid and adenosine present in *Cordyceps* fruiting body and their mycelia are being carried out.

Cordyceps takaomontana anamorph **(**IS 91)

Cordyceps militaris

Cordyceps sinensis



HPLC detection of Cordycepin in IS-91 fruiting body

Bacterial profiling of mulberry silkworm *Bombyx mori* L. mid gut through metagenomic approach

Y. Thirupathaiah, V. Sivaprasad and R. Sumathy

The bacterial communities present in the silkworm *Bombyx mori* mid gut of multivoltine (PM), bivoltine (CSR 2) and Hybrid (PM X CSR2). Larvae were enumerated through metagenomic approach. In PM, *Enterococcus* (30.30%) followed by *Bacillus* (16.96%) species, where as in CSR2 *Lactobacillus* (56.56%) followed by *Enterococcus* (10.58%) species were the predominant bacteria. Interestingly, mid gut of PM X CSR2 had combination of both PM and CSR2 bacterial communities *i.e*., *Lactobacillus* (36.21%) followed by *Bacillus* (25.94%), uncultured bacteria (18.37%) and *Enterococcus* species (8.1%). The metagenomic profile indicate that gut bacterial changes in the multivoltine, bivoltine and hybrid, might influence the changes in silkworm physiological activities. This dominant population could be screened for developing probiotic consortium for improved nutrient absorption, disease prevention and syngenical development of climate resilient breeds with improved silk productivity in the mulberry silkworm. The genus *Lactobacillus, Enterococcus, Bacillus* found in silkworm race CSR2 were significantly different from PM and PM x CSR2 (>0.05) according to Fisher's exact test for categorical data.

Bacterial genus	Percent (%) of bacterial genus in each silkworm race		
	PM	CSR2	PM x CSR2
Bacillus	15.15 *	8.30*	25.94*
Lactobacillus	16.96 *	56.56*	36.21*
Enterococcus	30.30 *	10.58*	08.10*
Uncultured	14.54	10.21	18.37
Klebsiella	09.69	-	02.10
Enterobacter	-	-	02.70
Lysinibacillus	09.09	2.55	-
Bifidobacterium	03.03	-	02.70
Staphylococcus	-	9.12	-
Micrococcus	-	1.45	-
Eschirichia Coli	-	1.09	-
Veillonella	01.21	-	-
Clostridium	-	-	03.78

REARING TECHNOLOGY & INNOVATION

Ongoing Research Projects

AIB 3561: Identification of robust bivoltine silkworm hybrids suitable for different regions of high temperature and high humidity conditions (Mar. 2016 - Mar. 2018)

S. Purushotham, D.S. Somaprakash, N. Mal Reddy, Vineet Kumar, Kariyappa, S. Rajakumar, Santhan Babu and T.V.S. Rao

Objectives

- To evaluate silkworm breeds/hybrids under high temperature and high humidity
- To determine factors influencing the post-cocoon parameters under high temperature and humidity

The project has been initiated during March-16 and the main objective of the project is to findout the effect of different adverse agro climatical conditions on productive breeds/hybrids.

Rearing/reeling performance of Double hybrids at Peddageddada, AP B/o 19.04.17											
Hybrid	Pupation (%)	SCW (g)	SSW (g)	SR (%)	Reela-bility (%)	FL (m)	NBFL (m)	Denier	RS (%)	RS Rec. (%)	Neatness (point)
DH1	79.3	1.128	0.25	22.1	78.4	799.27	626.6	2.2	17.3	78.6	97.0
DH9	87.3	1.033	0.203	19.7	79.7	600.7	479.0	2.3	14.6	74.2	96.0
DH10	81.3	1.077	0.257	23.9	80.6	638.4	514.4	2.9	18.8	78.9	97.0
DH13	83.3	1.106	0.228	20.6	88.6	591.8	524.3	3.0	17.7	85.9	95.0
DH17	72.3	1.071	0.21	19.6	67.4	712.5	480.1	2.6	19.3	78.2	95.0
DH19	72.0	1.133	0.235	20.7	86.4	621.6	536.9	3.1	18.7	81.1	95.0
DH21	80.0	1.268	0.278	21.9	79.0	672.9	531.8	2.3	13.3	60.5	95.0
DH24	72.7	1.112	0.257	23.1	81.3	656.0	533.6	2.5	16.2	69.9	97.0
DH33	82.6	1.091	0.245	22.5	77.1	637.4	491.6	2.5	16.1	71.8	96.0
DH34	66.0	1.133	0.244	21.5	77.1	693.8	534.6	2.5	17.1	79.3	97.0

Screening of the parental breeds were completed and 82 double hybrids were prepared based on the performance of the breeds. Out of 82 double hybrids evaluated under high temperature and high humdity (Peddageddata in AP,Tamil Nadu and in RSRS, Kodathi) during summer season i.e., (April to June 2017) 10 double hybrids were shortlisted based on the rearing performance and the performance of the selected hybrids are further to be evaluated at farmers level.

Rearing/reeling performance of Double hybrids at RSRS,Kodathi, Karnataka DoB: 31.05.17											
Hybrid	Pupation (%)	SCW (g)	SSW (g)	SR (%)	Reela-bility (%)	FL (m)	NBFL (m)	Denier	RS (%)	RS Rec. (%)	Neatness (point)
DH1	96.4	1.590	0.340	21.3	82.7	734.3	607.1	3.5	17.4	82.1	94.0
DH4	95.2	1.650	0.344	20.8	78.1	690.1	539.0	2.9	13.1	62.8	95.0
DH10	96.8	1.740	0.356	20.4	83.6	694.9	580.8	2.8	12.8	63.0	94.0
DH11	92.8	1.690	0.340	20.6	80.1	763.9	611.9	2.3	12.0	58.2	97.0
DH17	91.2	1.720	0.356	20.6	81.2	829.9	674.3	3.0	15.8	77.0	94.0
DH20	92.0	1.520	0.330	21.6	80.9	714.5	577.9	3.0	17.6	81.0	97.0
DH24	96.0	1.580	0.340	21.5	75.1	804.0	603.8	2.6	14.4	66.9	96.0
DH27	96.0	1.760	0.348	19.7	81.2	698.3	567.3	3.4	14.7	74.3	95.0
DH28	96.8	1.560	0.334	21.4	81.2	734.5	596.5	2.5	12.7	59.5	96.0
DH31	95.2	1.780	0.380	21.3	84.4	705.4	595.6	2.9	12.7	59.3	95.0

Rearing/reeling performance of Double hybrids at RSRS, Salem, TN DoB: 03.05.17											
Hybrid	Pupation (%)	SCW (g)	SSW (g)	SR (%)	Reela-bility (%)	FL (m)	NBFL (m)	Denier	RS (%)	RS Rec. (%)	Neatness (point)
DH4	19.1	1.260	0.280	22.20	81.4	601.3	486.0	3.2	17.0	61.1	93.0
DH5	19.9	1.330	0.320	24.12	82.8	663.1	542.4	2.7	14.5	60.2	96.0
DH13	58.3	1.400	0.330	23.31	82.7	639.8	522.2	3.0	16.2	68.2	96.0
DH25	48.6	1.210	0.280	23.35	82.7	661.2	531.9	2.9	14.7	61.2	96.0
DH17	30.6	1.370	0.270	19.43	85.8	660.0	580.6	2.9	19.9	71.1	96.0
DH19	31.5	1.470	0.280	18.75	81.0	842.2	682.4	3.1	19.3	62.0	94.0
DH22	83.0	1.270	0.250	19.89	82.8	803.3	665.4	3.2	18.4	79.4	94.0
DH24	62.7	1.390	0.280	19.9	81.0	842.2	682.4	3.1	16.8	69.3	94.0
DH33	70.5	1.250	0.210	17.03	84.3	652.5	536.5	2.9	14.2	71.7	96.0
DH34	41.8	1.190	0.260	17.67	85.9	604.9	516.5	2.9	17.8	65.7	95.0

Rearing performance of Double hybrids at RTI-CSRTI DoB: 07.04.17				
Hybrid	Pupation (%)	SCW (g)	SSW (g)	SR (%)
DH1	85.6	1.256	0.284	22.61
DH6	84.3	1.468	0.291	19.82
DH9	83.0	1.368	0.322	23.54
DH11	96.0	1.396	0.298	21.40
DH13	80.0	1.288	0.274	21.27
DH14	88.3	1.286	0.304	23.64
DH16	79.6	1.416	0.311	21.96
DH20	85.0	1.550	0.356	22.97
DH24	94.3	1.538	0.344	22.37
DH34	83.6	1.278	0.264	20.66

Rearing performance of Double hybrids at REC-Rayachoti, A.P. DoB: 06.05.17				
Hybrid	Pupation (%)	SCW (g)	SSW (g)	SR (%)
DH2	84.6	1.989	0.389	19.56
DH5	80.6	1.864	0.284	15.24
DH8	94.6	1.753	0.295	16.83
DH09	45.3	0.752	0.140	18.62
DH22	91.6	0.925	0.190	20.54
DH20	96.6	0.838	0.140	16.71
DH25	94.6	0.753	0.170	22.58
DH29	94.3	0.770	0.140	18.18
DH33	95.6	0.674	0.174	25.82
DH34	97.3	0.722	0.152	.21.05

Rearing performance of robust bivoltine hybrids reared at farmers field of Villupuram district under AIB-3561 RSRS, Salem DoB: 07.04.2017 - S/O: 28/29-04-2014													
Hybrid	Fecun-dity	Hatch %	Lar. brushed (No.)	Lar. Dur. V age (D:H)	Total Days (D:H)	Actual Yield by		ERR by		SCW (g)	SSW (g)	SR (%)	Trimoulters (No.)
						No.	Wt. kg	No.	Wt. kg				
TDH1	502	91.35	2291	05:04	20:12:00	372	0.462	1624	2.017	1.241	0.260	20.95	
TDH2	696	96.87	3369	05:04	20:13:00	659	0.756	1956	2.244	1.260	0.303	24.05	2
TDH3	631	95.06	3002	05:00	20:08:00	597	0.750	1989	2.498	1.337	0.281	21.02	
TDH4	599	95.33	2857	04:22	20:06:00	546	0.673	1911	2.356	1.257	0.279	22.20	
TDH5	603	95.49	2879	05:05	20:13:00	574	0.781	1994	2.713	1.331	0.321	24.12	
TDH6	525	87.81	2303	04:22	20:06:00	2203	3.094	9566	13.435	1.332	0.255	19.14	
TDH7	544	99.08	2697	05:05	20:13:00	1397	1.867	5180	6.923	1.335	0.268	20.07	31
TDH8	465	92.47	2150	05:01	20:09:00	1190	1.488	5535	6.920	1.344	0.290	21.58	
TDH9	699	85.12	2975	04:23	20:07:00	907	1.213	3049	4.077	1.192	0.300	25.17	
TDH10	627	96.65	3032	05:01	20:09:00	1052	1.247	3470	4.113	1.434	0.280	19.53	
TDH11	511	85.52	2184	04:22	20:06:00	349	0.438	1598	2.005	1.260	0.305	24.21	
TDH12	489	91.00	2227	04:22	20:06:00	1421	1.963	6381	8.815	1.308	0.283	21.64	28
TDH13	501	89.62	2245	05:03	20:12:00	1309	1.808	5831	8.053	1.403	0.327	23.31	
TDH14	412	92.48	1905	05:00	20:08:00	762	1.053	4000	5.528	1.382	0.315	22.79	30
TDH15	432	83.1	1795	04:21	20:06:00	1060	1.541	5905	8.585	1.427	0.317	22.21	
TDH16	367	86.6	1589	04:22	20:06:00	591	0.778	3719	4.896	1.453	0.282	19.41	28
TDH17	653	98.56	3220	05:00	20:08:00	988	1.235	3068	3.835	1.374	0.267	19.43	
TDH18	335	95.6	1601	05:02	20:09:00	1307	1.650	8164	10.306	1.250	0.250	20.00	
TDH19	545	98.82	2695	05:05	20:13:00	849	1.241	3150	4.605	1.472	0.276	18.75	
TDH20	543	93.51	2540	05:23	20:07:00	1605	2.192	6319	8.630	1.322	0.308	23.30	6
TDH21	379	86.5	1366	05:18	21:00:00	1013	1.224	7416	8.960	1.245	0.255	20.48	
TDH22	234	89	1042	05:18	21:00:00	872	1.034	8369	9.923	1.267	0.252	19.89	
TDH23	362	87.2	1579	05:22	21:04:00	820	1.000	5193	6.333	1.233	0.236	19.14	10
TDH24	282	72.7	1027	05:19	21:01:00	644	0.844	6271	8.218	1.392	0.277	19.90	
TDH25	327	87.4	1431	06:00	21:06:00	696	0.916	4864	6.401	1.212	0.283	23.35	1
TDH26	500	93.1	1864	05:23	21:05:00	1106	1.503	5933	8.063	1.342	0.291	21.68	
TDH27	661	99.18	3280	05:21	21:03:00	1470	1.894	4482	5.774	1.273	0.242	19.01	5
TDH28	590	98.61	2910	05:23	21:05:00	1476	1.670	5072	5.739	1.150	0.211	18.35	
TDH29	578	93.29	2698	05:19	21:01:00	647	0.760	2398	2.817	1.001	0.229	22.88	
TDH30	525	98.89	2595	05:18	21:00:00	1053	1.438	4058	5.541	1.361	0.258	18.96	4
TDH31	448	93.83	2101	05:17	20:23:00	1299	1.746	6183	8.310	1.282	0.305	23.79	
TDH32	352	85.3	1500	05:18	21:00:00	639	0.731	4260	4.873	1.214	0.230	18.95	
TDH33	227	93.1	1055	05:22	21:04:00	744	0.894	7052	8.474	1.245	0.212	17.03	13
TDH34	494	91.13	2252	05:16	19:22:00	942	1.208	4183	5.364	1.488	0.263	17.67	
TDH35	246	91.9	1242	05:18	21:00:00	1214	1.678	9775	13.510	1.372	0.262	19.10	

Continuous activities: Large scale evaluation of new silkworm breeds/hybrids

S. Purushotham

Objective: To multiply new breeds/hybrids for production of hybrid dfls

Conducted rearing of bivoltine Pure race viz., S8, CSR16, N-14, N-56 NS & NS hybrids and supplied seed cocoons for preparation of F1 hybrid dfls under different programmes.

Rearing performance of the different breeds								
Season	Race	Dfls (No.)	Cocoons generated (No.)	ERR (No.)	SCW (g)	SSW (g)	SR (%)	Pupation (%)
Aug.	S8	10	4039	8935	1.68	0.37	21.97	90
	CSR16	10	4136	9400	1.66	0.37	22.02	92
Oct.-Nov	N-14	50	13896	6745	1.53	0.29	18.71	89
	N-56	50	14076	6412	1.63	0.32	19.18	91
Jan.- Feb.	G-11	50	5760	2837	1.53	0.32	21.05	77
	G-19	50	13524	6662	1.63	0.36	22.07	82

TECHNOLOGY VALIDATION & DEMONSTRATION CENTRE

Continuous/Other activities

Large scale evaluation and muliplication of Silkworm breeds/hybrids

P.C. Santha and V. Sivaprasad

Objective: To evaluate silkworm breeds/hybrids and multiply the stocks for seed production

Technology Validation and Demonstration Centre conducts large scale in-house evaluation of promising silkworm breeds and hybrids and validates them before recommending for further field testing and adoption. This exercise ensures a proper feed-back from the independent evaluation under simulated conditions resembling farmers conditions and facilities to the breeders enabling them to make correct and modify. MV1 breed and its hybrids are found to be an excellent alternative with superior qualities for traditional multivoltine races. MV1 breed and its hybrids are superior both quantitatively and qualitatively and characterized by superior fiber quality.

Rearing performance of MV1 breed: Under the large scale in house evaluation and multiplication, six trials of silkworm rearing crops with MV1 & S8 breeds with a total quantity of 725 dfls were conducted during the period under report. Generated a total of 447.0 kg (314875 Nos.) of cocoons. Evaluated the rearing performance of S8 & MV1 breeds. Results indicated an Avg. ERR by No. 9383, Av. ERR by wt. 14.0 kg., Avg. SCW 1.937 g., Avg. SSW 0.406g. & Avg. SR% 21.1% for S8 race and an Avg. ERR by No. 9286, Avg. ERR by wt. 13.3 kg., Avg. SCW 1.788 g., Avg. SSW 0.316 g & Avg. SR% 17.7% for MV1 race. The silkworm rearing performance of MV1 & S8 breeds were conforming to their original breed characteristics.

Rearing performance of silkworm breeds at TVDC during 2017-2018												
Crop No.	Race	Dfls (No.)	Fec. (No.)	Actual yield		ERR/10,000 larvae		SCW (g)	SSW (g)	SR (%)	Coc/ kg	YLD/ 100 dfls (kg)
				No.	Wt. (kg)	No.	Wt. kg					
1	S8	50	490	21300	30.0	9181	12.931	1.704	0.402	23.60	710	60.0
	MV1	100	503	45000	60.0	9298	12.400	1.702	0.307	18.04	750	60.0
2	S8	50	505	21828	34.0	9574	14.912	2.010	0.412	20.50	642	68.0
	MV1	100	502	42525	63.0	9265	13.726	1.760	0.303	17.22	675	63.0
3	S8	50	506	21080	31.0	9246	13.600	2.057	0.417	20.27	680	62.0
	MV1	100	504	41400	60.0	9059	13.130	2.059	0.363	17.60	690	60.0
4	S8	20	512	8992	16.0	9669	17.204	2.019	0.406	20.11	562	80.0
	MV1	30	530	14638	26.0	9824	17.500	1.807	0.319	17.65	563	86.7
5	S8	50	502	21000	30.0	9292	13.270	1.920	0.401	20.90	700	60.0
	MV1	75	530	34300	45.0	9147	12.000	1.701	0.301	17.70	763	60.0
6	S8	40	525	17732	22.0	9333	11.580	1.910	0.400	20.94	806	55.0
	MV1	60	502	25080	30.0	9120	10.910	1.700	0.302	17.77	836	50.0
Total/Avg		725		314875	447.0							

Production details of seed cocoons: Total quantity of 289.0 kg (1,92,735 Nos.) cocoons were supplied to SSPC, NSSO, Ramanagaram and generated Rs.1,39,139/- as per the Bill No. 174 Dt. 1.8.17, Bill No. 175 Dt.3.10.17, Bill No.001 Dt. 22.11.17, Bill No.002 Dt. 6.1.18 and Bill No.003 Dt. 24.2.18. The target assigned for the period has been achieved.

PEST MANAGEMENT LABORATORY

Concluded Research Projects

PRE 3546: Identification, characterization, synthesis and field evaluation of sex pheromone of the mulberry leaf roller, *Diaphania pulverulentalis* (Lepidoptera: Pyralidae) (In collaboration with NBAIR-Bangalore)

J.B. Narendra Kumar, N. Bakthavatsalam[2] (PI), N. Morrison[1] and Subhaharan[2]

[1]REC-Madivala, [2]NBAIR-Bengaluru

Objectives

- To isolate and identify the sex pheromones of the leaf roller, *D. pulverulentalis*
- To determine the bio-efficacy of sex pheromones against leaf roller
- To develop suitable pheromone based trap for the leaf roller

The mulberry leaf roller, *Diaphania pulverulentalis* (Lepidoptera : Pyralidae) is considered to be a serious threat to mulberry in southern sericultural states of India. The average incidence of this pest on mulberry is recorded to be 15 to 25%. The infestation is observed in mulberry plantations from 15 days to 70 days after pruning or leaf harvest. Its occurrence coincides with the onset of monsoon (June-July), with a peak incidence from September to December and from January onwards–downward trend in the population size is observed.

Presently, an IPM package comprising of cultural (deep ploughing to expose pupae present in the soil), chemical (spraying 0.076% DDVP 12-15 days after pruning) and biological (release of *Trichogramma chilonis* egg parasitoids) strategies is being recommended to control the leaf roller. But still, the damage due to this pest is on the increasing trend year by year as the farmers are not taking up the control measure simultaneously in an area and hence the package need to be strengthened by including other effective, economical and eco-friendly strategies such as exploitation of sex pheromones. Also, alternative pest management strategies are warranted to reduce the misuse of chemical pesticides in mulberry.

In the field of agriculture, the use of pheromone based trap is very common and employed for detection, monitoring, mating disruption and mass trapping of pests. Commercially pheromone lures are available for about 20 important insect pests which include cotton, bollworm, sugarcane early shoot borer, sugarcane internode borer, brinjal fruit borer, diamond back moth, cut worm, coffee white borer, etc. These pheromone lures are mostly species specific, non-hazardous and safe to environment. However, sex pheromone based trap is so far not evolved for management of mulberry leaf roller, *Diaphania pulverulentalis.*

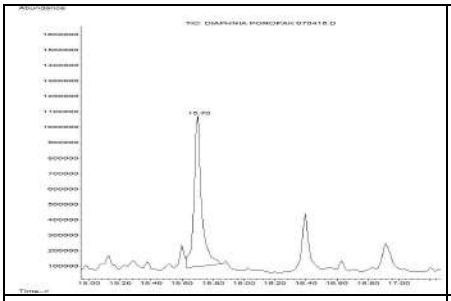
Hence, the present investigation was taken up to isolate and characterize sex pheromones of leaf roller for further utilization towards formulation of a suitable trap for effective management of the pest.

Collection of pupae of *Diaphania pulverulentalis:* Regular field trips were made to collect the larvae of *Diaphania pulverulentalis* and reared on the mulberry leaves in the laboratory to get the pupae, which were used for further studies.

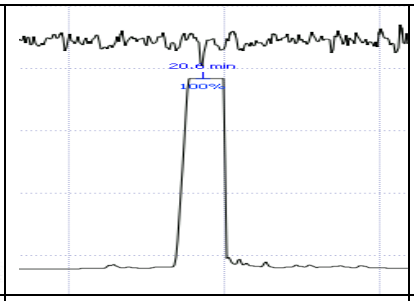
Leaf roller adult female abdomen extract: The adults on emergence were collected, sexes were separated and kept in cages. The abdomen of virgin female was cut and kept in eppendorf tube along with 2 ml of hexane. The tube was shaken in a vortex shaker for 20 minutes. Then it was filtered through Whatmann filter and membrane filter. The extract was used for the electrophysiological and analytical studies.

Pheromone Analysis: Solid Phase Micro Extraction (SPME) technique was followed for the collection of pheromone. The SPME was kept in an active mode with the extruded fiber to trap the volatiles in glass chamber with virgin females of *D. pulverulentalis* for around 24 hours after which the SPME was directly injected into GC-MS and the peaks were analyzed using Wiley software.

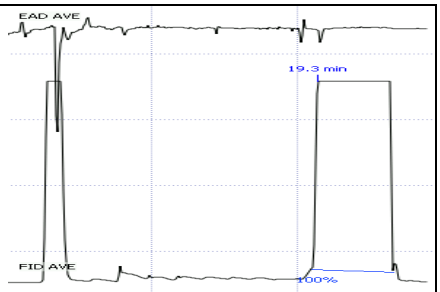
The male moth's antenna was fixed in electro antennogram detector and was exposed to the female abdomen extract. The antennal and GC traces were recorded and the coinciding peaks were identified.



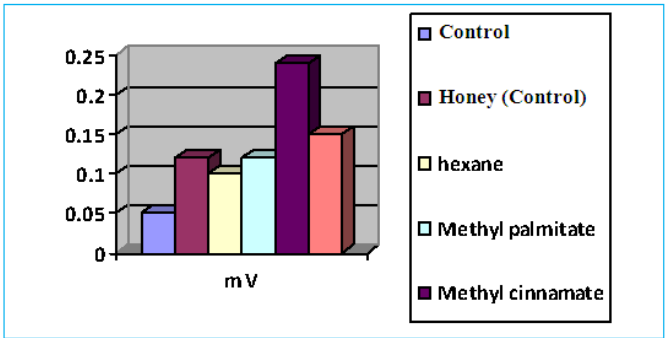
Total ion chromatogram of abdominal gland extracts *Diaphania pulverulentalis* showing Z-11-hexadecenal



GC-EAD traces of *Diaphania pulverulentalis* to Z-11 hexadecenal



GC-EAD traces of *Diaphania pulverulentalis* to Octadecane



Electro-physiological study with identified minor compounds

Electrophysiological responses of the new minor compounds were conducted as per the earlier procedures. The results indicated that methyl palmitate showed more response followed by tridecane and methyl cinnamate, which were on par with honey as shown in the graph.

The volatiles from the abdominal extract were identified using the gas chromatography coupled mass spectral detector. Kovat retention index and mass spectra were used for the identification of volatiles

The volatiles from females were collected using entrapment method and the volatiles were identified using Wiley library. The main component was identified as Z-9-hexadecenal in GCMS and the minor compound as Octadecane.

Synthesis: As the identified compounds were readily available in the market and to reduce the cost of synthesis, it was purchased from the chemical companies in the market. However, some of the isomers were synthesized through known chemists.

Field trials: Based on the identified major and minor compounds, two field trials were conducted during July 2017 (at Kanakapura) and November 2017 (at Kolar). In the first trial Z-11-hexadecenal (major) alone @1 mg, 3 mg and 5 mg per dispenser (2 traps each), along with Z-11-octadecenal @1 mg, 3 mg and 5 mg per trap and Z-13-Octadecenyl acetate (minor) @1 mg, 3 mg, and 5 mg per trap, and mixture of Z-13 octadecenal and z-13 octadecenyl acetate @1 mg, 3 mg, and 5 mg per trap.

Field trial with yellow sticky trap and sleeve trap

In the second trial Z-11-hexadecenal and other compounds such as ethanone, tridecane, methyl cinnamate, methyl palmitate @ 2 mg per septa, and Z-11-hexadecenal, methyl palmitate and methyl cinnamate @ 2 mg per septa, Z-11-hexadecenal, methyl palmitate and tridecanone @ 2 mg per septa were kept. However, no catches were recorded in both the trials. Hence the identified pheromone compounds will be field tested again at different concentrations when once the pest incidence starts.

Inference

- Identified one major pheromone compound of the mulberry leaf roller, *Diaphania pulverulentalis viz.,* Z-11-hexadecenal and six minor compounds namely Z-11-Octadecenal, Z-13-Octadecenyl acetate, methyl palmitate, tridecane, methyl cinnamate, and ethanone.
- The electroantennogram studies indicated that Z-11-hexadecenal elicited good electrophysiological response.
- However other than the above, there are also other minor compounds most probably z-11-tetradecenal or z-9-tetradecenal with pheromonal functionalities.

Future course of action: The results indicated that there may be structural isomerism in the minor pheromone compounds or the concentrations were not optimum in field conditions and need to be verified in the field. Since it is a seasonal pest and occurs only from July to December, the identified pheromone compounds will be again field tested at different concentrations when once the pest incidence starts.

Continuous /Other activities

Maintenance of mother culture for production of recommended bio-control agents and mass release of recommended bio-control agents of sericultural pests in CSRTI-Campus

J. B. Narendra Kumar, K. Sathya Prasad (upto Jan. 2018), N. Morrison[1], S. Mahiba Helen[2] and B. Vijaya Naidu[3]

[1]REC-Madivala, [2]RSRS-Salem, [3]RSRS-Anantapur

Objective: To maintain mother culture of bio-control agents for mass production, release and supply to stake-holders

At main institute, nucleus cultures of four pupal parasitoids of uzi fly *viz., Nesolynx thymus*, *Trichomalopsis uziae*, *Trichopria* sp. and *Dirhinus anthracia* and two predators of mealy bug (*Cryptolemous montrouzieri* & *Scymnus coccivora*) besides host culture of Housefly and pink mealy bug were maintained throughout the year. Besides main institute, the nested units are also involved in the production of bio-control agents and distributing to stake-holders in the respective command areas. The release of bio-control agents in the field was effective in keeping the tukra and uzi fly incidence below ETL.

Details of production of bio-control agents at CSRTI-Mysuru and its nested units (2017-18) and impact of IPM practice against mealybug

Centre	BCA	Quantity produced	Sale to stakeholder	States	Tukra incidence (%)	
					2016	2017
CSRTI- Mysuru	NT	2,497	943	KA	2.75±2.96	3.89±2.39
	Beetles	485	225	TN	6.98±5.02	8.07±1.51
REC - Madivala	NT	845	845	AP	13.40±0.47	13.28±4.25
RSRS - Salem	AP	1186	1186			
	CZ	250	250			
	Tc	569	569			
	Bb	1271	1271			
RSRS- Anantapur	NT	791	791			

NT: *Nesolynx thymus* (No. of pouches; 1 pouch=50 ml or 10,000 parasitoids)
Beetles: Scymnus coccivora (No. of boxes; 1 box=250 adults)
Cryptolaenus montrouzieri (No. of boxes; 1 box= 125 adults)
AP: *Acerophagus papayae* (1 unit=250 adults)
CZ: *Chrysoperla zastrowi* (I unit= 1000 eggs)
Tc: *Trichogramma chilonis* (1 unit= 1 cc/1 card)
Bb: *Bracon brevicornis* (1 unit= 100 Nos.)

Forewarning and forecasting of mulberry pests

J.B. Narendra Kumar (PI), RSRS-Chamarajanagar, REC-Madivala, RSRS-Salem, REC-Samayanallur, RSRS- Anantapur and REC-Eluru

Objective: To know the status of mulberry pest incidence in southern India

Place	Seasons	Mealybug (%)	Thrips No./Leaf	White fly No./Leaf	Leaf Roller (%)	Papaya mealybug (%)
Mysuru	Summer	4.53±0.92	0.91±1.31		0.65±0.75	
	Rainy	4.90±4.75	0.54±0.67		2.13±1.56	
	Winter	2.25±1.51	0.42±0.44		5.20±5.23	
Salem	Summer	8.51±0.87	19.39±2.86			1.00±2.00
	Rainy	7.32±1.43	10.73±11.82		3.38±6.75	3.53±7.05
	Winter	8.38±2.23	2.13±4.25		7.98±5.57	0.91±1.83
Samayanallur	Summer	0.66±0.47	12.24±2.63		0.39±0.35	
	Rainy	1.99±1.79	10.89±6.29		9.11±10.16	
	Winter	0.14±0.28	6.18±2.4		12.37±7.28	0.91±1.83
Eluru	Summer	14.95±7.32	7.81±4.84	1.49±1.13	5.61±1.28	
	Rainy	8.34±1.15	9.05±2.85		6.49±2.32	
	Winter	16.56±4.28	20.54±5.46		9.64±1.42	

Pest Calendar for the selected places during the year 2017-18

PEST CALENDAR										Incidence levels	<5	5.1 - 10	>10	
Place	Pest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mysuru	Mealybug													
	Thrips													
	Leaf roller													
Salem	Mealybug													
	Thrips													
	Leaf roller													
Samayanallur	Mealybug													
	Thrips													
	Leaf roller													
Eluru	Mealybug													
	Thrips													
	Leaf roller													

Note: For thrips, the figures indicate the population/leaf; for other pests%

SILKWORM PATHOLOGY SECTION

Concluded Research Projects

ARP 3519: Silkworm Disease Monitoring of Seed and Commercial Crop Rearings of South Indian States (Oct. 2014 - Mar. 2018)

M. Balavenkatasubbaiah (upto Dec. 2016), A.V. Mary Josepha, Ramesh Babu (NSSO, upto Dec. 2015), Raghavendra Rao (NSSO, Bangalore, upto Apr. 2017), H.M. Shanbogue (NSSO, Bangalore)

Objectives:

- To estimate the prevalence of silkworm diseases at selected Basic Seed Farms and Commercial Crop rearings (CPP Clusters) in the South Indian states
- To suggest remedial measures on spot to the farms/farmers to manage the silkworm diseases and to prevent disease outbreak

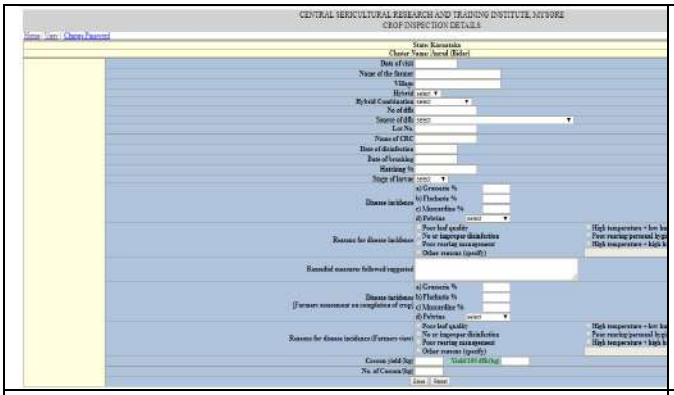
Silkworm Disease Monitoring has been conducted in every crop of selected BSFs of Karnataka, Tamil Nadu and Andhra Pradesh and also in the selected clusters of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala and Maharashtra from Jan. 2015 to Dec. 2017. In the clusters 10 farmers' crops were monitored in every month and the data was uploaded in web site created for Silkworm Disease Monitoring. Three years disease incidence data were compiled and the incidence in each state during the different seasons were noted.

BSFs covered in Karnataka includes two P4 stations, Bivoltine P4 Hassan, CSRTI (BV) and multivoltine P4 Kunigal (DoS). Five P3 stations (P3 BSF, NSSO, Mysuru; P3 BSF, Kumbarahalli (DoS); P3 BSF, Kudige (DoS), P3 BSF, Kaggundi (DoS), P3 BSF, Chikkonahalli (DoS). Six P2 stations, (P2, NSSO, Gavimata, P2 NSSO Nagamangala, P2 DoS Sira, P2 BSF K.P.Doddi, P2 DoS Rudrapatna, P2 DoS Ambuga). In Andhra Pradesh Two P3 stations (P3 BSF, Horsley hills (BV) (DoS), P3 BSF, (DoS) Thadakalapalli (MV) (DoS)) and one P2 station (P2 BSF, NSSO, Horsley hills) and in Tamil Nadu two P3 stations (P3 BSF, Avalapalli (DoS), P3 BSF,

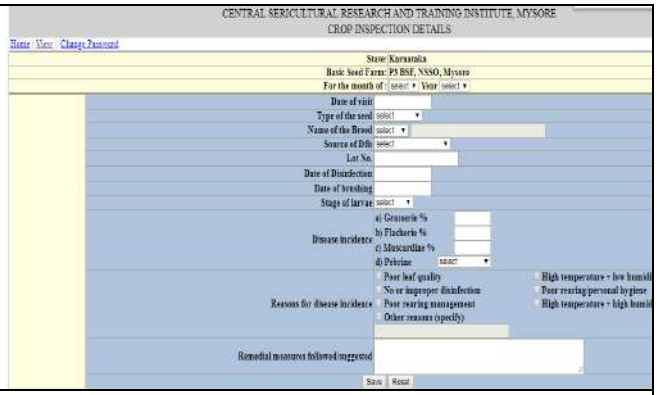
Berigai (DoS)) and one P2 BSF NSSO Yelagiri Hills (BV) were covered. All the batches in all the BSFs were covered during the project period.

36 clusters from Karnataka, 27 clusters from Tamil Nadu, 13 clusters from Andhra Pradesh, 4 clusters from Telangana, 1 cluster from Kerala and 9 clusters from Maharashtra were monitored every month during the project period. 10 farmers /clusters were surveyed every month. The data collection was done in the 5th instar in between 4th day and 6th day. In the case of clusters after harvesting disease incidence data were collected from the farmer too which gives the total disease incidence percentage.The data were uploaded in the web pages made for BSFs and clusters.

The average incidence of grasserie disease during summer in Andhra Pradesh BSFs was 0-0.24%, flacherie was 0 -2.0% and muscardine 0-0.32%. During rainy season the incidence of grasserie was 0-14.17%, that of flacherie 0-5.17% and muscardine 0-0.32%. In winter 0-1.02% grasserie, 0-2.50% flacherie and 0-1.05% muscardine was reported. In BSFs of Karnataka during summer the grasserie incidence was 0 to 0.04%, flacherie incidence was 0 to 0.25% and muscardine was 0 to 1.0%. During rainy season grasserie incidence was 0-1.02%, flacherie was 0-0.31% and muscardine was 0-0.06%. In winter the incidence of grasserie was 0-0.04%, flacherie 0-0.14% and muscardine 0-0.25%. From P4 BSF Hassan 1.0% pebrine incidence was reported during December 2016 rearing and from P3 BSF Mysuru 1.0% of pebrine was reported in August and November 2017 rearings. In Tamil Nadu BSFs during summer 0-0.67% grasserie, 0- 4.0% flacherie and 0 – 1.0% muscardine was reported. In rainy season grasserie incidence was 0-3.0%, 0-5.0% flacherie and 0 to 1.0% muscardine was reported. In winter grasserie incidence was 0 to 1.02%, flacherie incidence was nil and muscardine was 0 to 2.0%.



Web page for the data entry for clusters



Web page for the data entry for BSFs

In Andhra Pradesh clusters as per the survey during summer the point prevalence of grasserie was 0.57 - 3.83%, flacherie was 0.71-2.52% and muscardine was 0 - 0.88%. According to the farmer during summer the grasserie incidence is 0.64-2.54%, flacherie incidence 0.85-1.75% and muscardine 0-0.88%. During rainy season grasserie incidence was 1.08-3.75%, flacherie incidence was 0.70- 3.22% and muscardine 0-1.54%. As per the farmers, the grasserie incidence was 0.54-2.53% flacherie incidence was 0.7 -3.22% and muscardine 0-0.01%. Whereas in winter grasserie incidence was 0.73-5.4% flacherie incidence was 0.79- 5.24% and muscardine 0-4.71%. Average of the incidence percentage as per the farmer was grasserie 0 to 2.03%, flacherie 0 to 2.01% and muscardine 0 to 0.15%. In Karnataka clusters during summer grasserie incidence was 0.01-4.41%, flacherie incidence was 1.64-3.82% and muscardine incidence was 0-1.40%. As per the farmers opinion the grasserie incidence was 1.17-4.04%, flacherie incidence was 1.51-3.82% and muscardine incidence was 0-1.40%. During rainy season grasserie incidence was 0.92-6.06%, flacherie incidence was 1.32-3.54% and muscardine incidence was 0-0.39%. According to the farmer grasserie incidence was 1.01- 4. 08%, flacherie incidence was 1.32-2.96% and muscardine incidence was 0-0.50%. During the winter season grasserie incidence was 0-.53-9.60%, flacherie incidence was 0.90- 7.80% and muscardine incidence was 0-1.20%. According to farmer grasserie incidence was 0.75-5.60%, flacherie incidenc was 0.90-5.20% and muscardine incidence was 0-2.90%.

In Kerala the average incidence of grasserie during summer was 0 to 0.52%, flacherie was 1.05-3.82% there was no incidence of muscardine reported. According to the farmers opinion the grasserie occurrence was 0 to 0.52% and flacherie was 1.69 -12.19% and no incidence of muscardine. During rainy season grasserie incidence was 0-0.54% flacherie incidence was

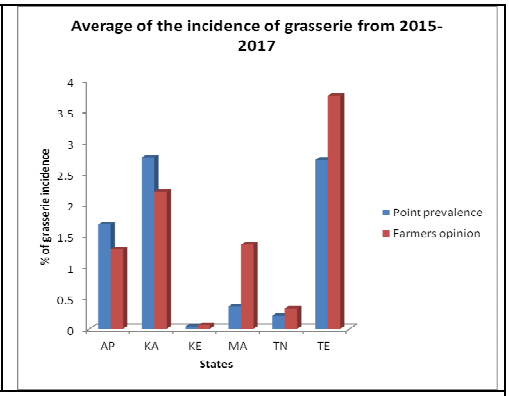
0.55-3.34% and no muscardine disease. According to farmer grasserie incidence was 0-0.54%, flacherie incidence was 0.76-3.34% and there was no muscardine incidence. During winter the grasserie incidence was 0 flacherie incidence was 0-2.24% and 0-1.56%. According to farmer the grasserie incidence during winter was 0, flacherie incidence was 0-2.81% and muscardine 0-0.156%.

In Maharashtra grasserie incidence during summer was 0-1.76%, flacherie incidence was to 0-1.17% and muscardine was 0 to 0.12%. According to farmers grasserie was 0 to 2.75%, flacherie was 0-1.17% and muscardine was 0-0.90%. During the rainy season grasserie incidence was 0-2.78%, flacherie incidence was 0-2.41% and muscardine 0- 0.31%. According to the farmer grasserie incidence was 0-3.07% flacherie incidence was 0-2.41% and muscardine was 0-1.77%. During winter season grasserie incidence was 0-0.99%, flacherie incidence was 0-1.73% and muscardine was 0-0.31%. According to farmers the grasserie incidence was 0-2.56% flacherie incidence was 0-1.55% and muscardine was 0-1.31%.

In Tamil Nadu during summer average incidence of grasserie was 0.02-0.16%, flacherie was 0.17-3.27% and muscardine was 0-0.12% and the occurrence according to the farmer was grasserie 0.01-0.76%, flacherie 0.18-3.27% and muscdine 0-0.12%. During rainy season grasserie was 0.01-1.48%flacherie was 0.21%-1.88% and muscardine 0-0.12%. According to the farmer grasserie incidence was 0 - 2.78%, flacherie was 0-1.92% and muscardine was 0-0.01%. During winter grasserie was 0.01-0.54%, flacherie was 0.69-5.10% and muscardine was 0-1.07%. According to the farmers grasserie incidence was 0-0.79% flacherie was 0.20- 0.73%, and muscardine was 0-0.31%.

In Telangana clusters during summer the grasserie incidence was 0-7.63%, flacherie incidence was 1.37-5.1%., muscardine was 0-0.45%. According to farmers' opinion grasserie incidence was 1.97-14.0%, flacherie incidence was 2.43 to 5.1% and muscardine incidence was 0- 3.08%. During rainy season the grasserie incidence was 1.36-8.57% flacherie incidence was 1.52-4.11% and muscardine incidence was 0-0.05%. According to the farmers' view the grasserie incidence was 2.50-9.77%, flacherie incidence was 1.17-3.63% and muscardine was 0-1.44%. During winter season grasserie incidence was 0.51-9.6%, flacherie incidence was 0.69-5.1% and muscardine incidence was 0-1.07%. According to the farmer, the grasserie incidence was 0.63- 4.68%, flacherie incidence was 1.65- 5.1% and muscardine was 0-1.03%.

Percentage of disease	Yield /100 dfls kg
1-2	75-80
2.1-5	60-75
5.1-6	50-60
6.1-8	40-50
8.1-10	30-50
10 and above	Below 30



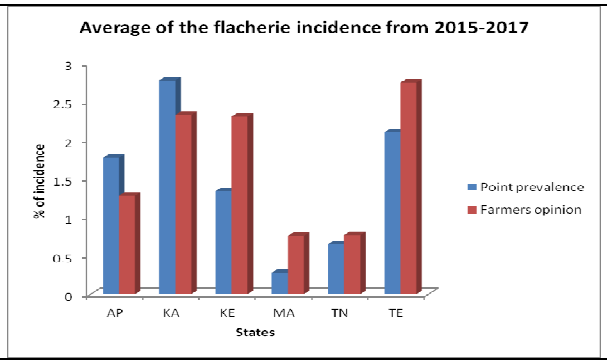
Comparison of the average % of point prevalence of grasserie disease in farmers' rearing in different states and data collected from farmers

Range percentage of point incidence of diseases during different seasons in BSFs in three southern states

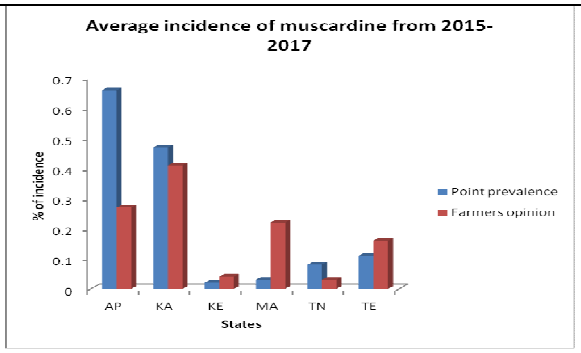
Year	State	Summer			Rainy			Winter		
		NPV (%)	Flacherie (%)	Muscardine (%)	NPV (%)	Flacherie (%)	Muscardine (%)	NPV (%)	Flacherie (%)	Muscardine (%)
2015	AP		0-2.0		0-14.17	0-5.17		0.18-1.02	0-2.5	0-1.1
	KA		0.08-0.25	0-0.04	0-0.12	0.10-0.31	0-0.06		0-0.14	0.07-0.25
	TN		0-3.0	0-1.0	0-3.0					
2016	AP	0-0.24	0.40-1.99	0-0.32	0-0.24	0.26-0.48	0-0.24		0-0.56	
	KA		0.03-0.25	0-0.01	0-1.02	0.1-0.31	0-0.11	0-0.08	0-0.14	0-0.01
	TN	0-0.67	0-4.0			0-5.0				
2017	AP	0-0.17	0-0.69	0-0.05	0-0.25	0-0.73				
	KA	0- 0.04	0.01- 0.06		0-0.29	0-0.16	0-0.01	0-0.04	0.03-0.14	
	TN		0-2.5		0-3.0	0-1.0				0-2.0

Range percentage of point incidence of diseases during different seasons during the project period in clusters in six southern states										
Year	State	Summer			Rainy			Winter		
		NPV (%)	Flacherie (%)	Muscardine (%)	NPV (%)	Flacherie (%)	Muscardine (%)	NPV (%)	Flacherie (%)	Muscardine (%)
2015	AP	0.57-1.19	1.32-1.75	0-0.880	1.08-1.81	1.4-3.22	0-0.01	0.73-1.54	0.81-2.01	0.09-1.5
	KA	1.01-1.95	1.72-3.82	0-1.4	0.92-1.60	1.98-3.28	0-0.09	0.81-1.49	1.90-2.49	0.30-0.94
	MH		1.05-3.26		0-0.29	1.25-3.34			1.27-2.81	
	KE	0-0.48	0-1.15	0-0.06	0.37-1.46	0-2.41	0-0.01	0.15-0.69	0-1.12	0-0.31
	TN	0.11-0.16	0.34-3.27	0-0.06	0.21-1.48	0.35-1.88	0-0.01	0.06-0.54	0.34-0.73	0-0.59
	TEL	2.06-7.32	1.37-4.92		1.36-8.57	1.92-4.11	0-0.05	0.51-1.66	2.44-4.65	0-0.39
2016	AP	0.97-3.83	0.71-2.52	0-0.65	2.3-3.75	1.01-2.97	0-0.78	0.68-0.84	0.79-1.74	0.02-1.26
	KA	1.03-3.03	1.64-2.78	0-0.26	1.87-2.65	1.32-2.47	0-0.06	0.53-2.4	0.93-2.02	0.04-1.20
	MH		2.03-3.68			0.55-2.19			0.7-2.24	0-1.56
	KE	0-1.76		0-0.12	0-2.42	0-1.03		0.08-0.99	0.03-1.73	0-0.25
	TN	0.20-0.58	0.26-1.74	0-0.12	0.20-0.34	0.52-0.79		0.01-0.20	0.28-0.42	0-0.25
	TEL	1.60-7.63	1.93-3.33	0-0.07	2.0-3.46	1.52-3.3	0-0.05	0.47-3.40	0.69-5.1	0-1.07
2017	AP	0.97-1.79	0.85-1.71	0-0.33	1.67-2.80	0.70-2.89	0-1.54	0.78-5.40	0.42-5.24	0-4.71
	KA	2.97-4.41	1.78-3.64	0-0.02	4.12-6.06	2.19-3.54	0-0.39	1.71-9.60	0.90-7.80	0-3.4
	MH	0-0.52	1.24-2.13		0-0.54	0.66-2.44			0-1.96	
	KE	0-0.31	0-1.17		0-2.78	0-1.92	0-0.03	0-0.51	0-1.29	0-0.08
	TN	0.02-0.06	0.17-0.61		0.01-0.30	0.21-1.0	0-0.03	0-0.08	2.02-0.41	0-0.08
	TEL	0-0.31	1.90-5.10	0-0.45				0-1.03		0-0.83

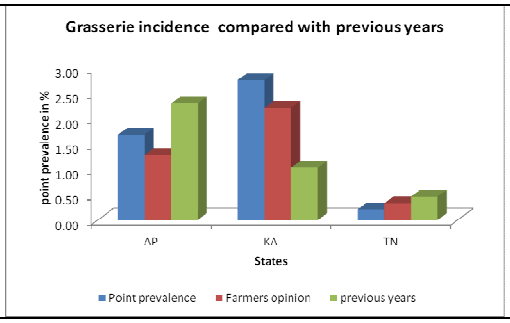
Disease incidence in the 6 southern states collected after completion of the crop										
Year	State	Summer			Rainy			Winter		
		NPV (%)	Flacherie (%)	Muscardine (%)	NPV (%)	Flacherie (%)	Muscardine (%)	NPV (%)	Flacherie (%)	Muscardine (%)
2015	AP	0.64-1.39	1.42-1.75	0-0.88	1.36-2.2	1.68-3.22	0-0.01	1.04-2.03	0.98-2.01	0.13-1.5
	KA	1.65-2.72	1.96-3.82	0-1.4	1.01-1.56	1.98-2.9	0.01-0.09	0.75-1.74	1.9-2.45	0.3-0.94
	MH		2.18-12.19		0-0.47	1.73-3.34			2.39-2.81	
	KE	0-2.75	0-1.15	0-0.90	0-3.07	0-2.41	0-1.77	0.72-1.96	0.09-1.12	0-1.31
	TN	0.16-0.24	0.43-3.27	0-0.06	0.57-2.77	0.44-1.88	0-0.01	0.11-0.79	0.17-0.73	0-0.31
	TEL	2.75-9.02	2.43-4.92		2.50-9.77	2.53-3.63	0-0.05	0.63-2.63	3.08-4.65	0-0.39
2016	AP	1.26-2.54	0.87-1.56	0-0.65	0.54-2.53	1.01-1.58	0	0.48-0.99	0.92-1.33	0.02-0.52
	KA	1.17-2.56	1.81-2.64	0-0.26	1.45-1.96	1.32-1.7	0-0.06	0.56-2.79	0.93-1.74	0.04-1.2
	MH		2.6-3.68			0.76-2.23			1.16-2.24	0-1.56
	KE	0-1.76			0-2.42	0-1.4	0-0.74	0.46-2.1	0.2-1.08	0-0.53
	TN	0.25-0.76	0.26-1.74	0-0.12	0.30-0.52	0.67-0.79		0-0.27	0.29-0.42	0-0.25
	TEL	2.86-9.30	2.82-3.54	0-07	3.56-6.07	1.17-3.3	0-1.44	1.2-4.68	1.05-5.1	0.23-1.03
2017	AP	1.08-1.55	0.85-1.11	0-0.20	1.0-1.56	0.7-1.48		0-0.46	0-0.61	0-0.74
	KA	2.11-4.04	1.51-3.7		1.88-4.08	2.19-2.96	0-0.50	1.17-5.60	0.9-5.2	0-2.90
	MH	0-0.52	1.69-2.24		0-0.54	1.12-2.44			0-1.96	
	KE	0-2.41	0-1.17	0-0.32	0-2.78	0-1.92		0-2.56	0-1.55	
	TN	0.01-0.07	0.18-0.61		0.04-0.32	0.48-1.1		0.01-0.11	0.2-0.41	0-0.02
	TEL	1.97-14.0	2.57-5.1	0-0.47					0-6.13	0-0.83



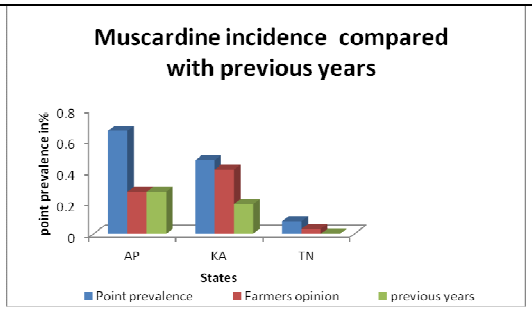
Comparison of the average % of point prevalence of flacherie disease in farmers' rearing in different states



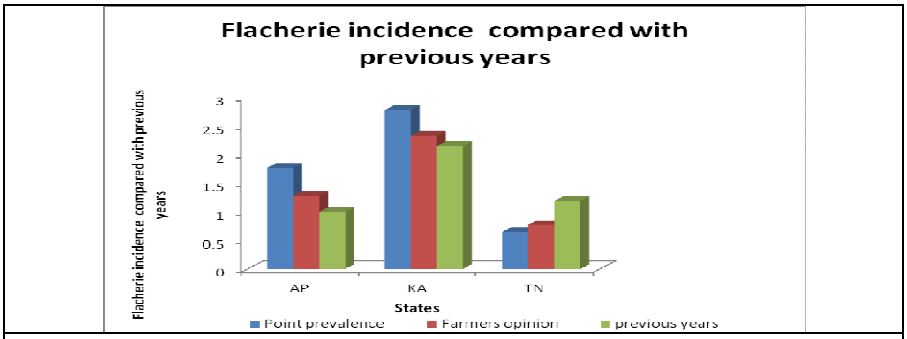
Comparison of Avg. % of point prevalence of muscardine disease in farmers' rearing in different states



Comparison of the average % of point prevalence of grasserie disease with previous years



Comparison of the average % of point prevalence of muscardine disease with previous years



Comparison of the average % of point prevalence of flacherie disease with previous years

Conclusion and Inference: The average of the disease incidence in AP was grasserie 1.68, flacherie was 1.77 and muscardine 0.66% with average yield 67.18 kg/100dfls. According to the farmers opinion the grasserie incidence was 1.28, flacherie 1.28 and muscardine 0.27%. During the period from October 2012 to September 2014 the disease incidence in Andhra Pradesh was 2.3% grasserie, 1.0% flacherie and 0.27% muscardine with an average yield of 63.96 kg /100dfls. In Karnataka the incidence was 2.76, 2.78 and 0.47% grasserie, flacherie and muscardine respectively. As per the farmers it was 2.21, 2.33 and 0.41% grasserie, flacherie and muscardine respectively. The average yield/100dfls was 64.83 kg/100 dfls in Karnataka. During the period from October 2012 to September 2014 the disease incidence in Karnataka was 1.03% grasserie, 2.15% flacherie and 0.19% muscardine with an average yield of 71.35kg/ 100dfls. In Kerala the average of the point prevalence was 0.04, 1.34 and 0.02% and as per the farmers opinion it was 0.06, 2.31 and 0.04% grasserie, flacherie and muscardine respectively. The average yield in Kerala was 83.46 kg/100 dfls. In Maharashtra the point prevalence was 0.36, 0.28 and 0.08% and as per the farmers opinion 1.36, 0.76 and 0.22% grasserie, flacherie and muscardine respectively. The average yield was 62.64 kg/100 dfls in Maharashtra. In Tamil Nadu the point prevalence was 0.21, 0.65 and 0.08 and as per the farmers opinion 0.33, 0.77 and 0.03% grasserie, flacherie and muscardine respectively with an average yield of 76.46 kg/100 dfls. During the period from October 2012 to September 2014 the disease incidence in Karnataka was 1.03% grasserie, 2.15% flacherie and 0.19% muscardine with an average yield of 67.50/ kg. In Telangana the point prevalence was 2.72, 2.10% & 0.11% and as per the farmers opinion 3.75, 2.75 and 0.165% grasserie, flacherie and muscardine with an average yield of 75. 03 kg/100 dfls. The data collected gives a clear picture of the disease prevalence in the field. The scientists have helped the farmers by giving suggestions for the disease management on the spot. Flacherie is the more prevalent disease in the field. The disease is negatively correlated with the crop yield.

Average of the point prevalence of diseases during the survey period							
State	Grasserie		Flacherie		Muscardine		Y/100 dfls
	Point prevalence	Farmer opinion	Point prevalence	Farmers opinion	Point prevalence	Farmer opinion	
AP	1.68	1.28	1.77	1.28	0.66	0.27	67.18
KA	2.76	2.21	2.78	2.33	0.47	0.41	64.83
KER	0.04	0.06	1.34	2.31	0.02	0.04	83.46
MH	0.36	1.36	0.28	0.76	0.03	0.22	62.64
TN	0.21	0.33	0.65	0.77	0.08	0.03	76.46
TG	2.72	3.75	2.10	2.75	0.11	0.16	75.03

ARP 3597: Standardization and Validation of LAMP (Loop mediated isothermal amplification reaction) technique for the detection of *Nosema bombycis* infection in silkworm (Oct. 2016 - Sept. 2017)

V. Sivaprasad, G. Mallikarjuna, L. Satish, S. Manthira Moorthy and A. V. Mary Josepha

Objectives:

- Standardization and Validation of LAMP based technique
- For specificity and sensitivity in detection of *Nosema bombycis* infection in silkworm and silkworm eggs
- Fine tuning LAMP based techniques for specificity and sensitivity in early detection of *N. bombycis*.

To validate the M-LAMP assay using developmental stages and different levels of infection five batches of Silkworms were inoculated with different concentrations of *N. bombycis* spores (10^1 to 10^8) immediately after brushing and after each moult respectively. The inoculated silkworm samples have been collected every 24 hrs intervals including larval stages from 1st instar 2nd day to moth and egg. Samples were stored at -20 ˚C for further use.

Primers sequences used for the M-LAMP assay. The first four primers are SSU 278 primers targetting SSU rRNA and the last two are loop primers.

Primers	Sequence
FIP-(5'-3')	GCCATGCACCACTATCATGATCGCGGGGTAATTTACCAG
BIP-(5'-3')	GTTTCCAATGGATGCTGTGAAGTTCATATGTATCACTACATCTGTCT
F3- (5'-3')	GCGGCTTAATTTGACTCAA
B3- (5'-3')	ACCTGTTTTAATCCTCTCCT
FP- (5'-3')	CGCGGGGTAATTTACCAG
BP- (5'-3')	GTTTCCAATGGATGCTGTGAAGT

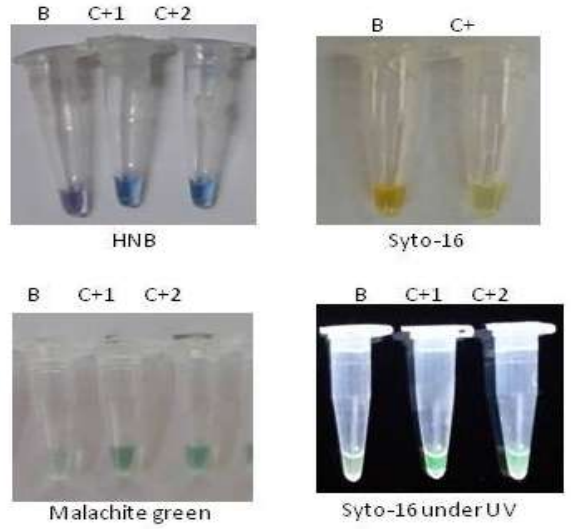
N. bombycis DNA were used as positive control and silkworm DNA as negative control in the reaction. Four primers targeting smaller subunit RNA were used for the reaction (Yan *et al.,* 2014). Using primer explorer software designed and synthesized specific loop primers for more sensitivity. It helped in reducing the assay time from 90 min to 45 min and increased the color intensity. Inner primers FIP and BIP, outer primers F3 and B3 along with the loop primers FP and BP gives the desired contrast effect for the reaction.

Properties of different dyes used in M-LAMP assay

Dye	Safety	Colour		Visibility	Stability	Contami-nation	Dye added
		-Ve	+Ve				
HNB	Safe	Violet	Sky blue	Normal spectrum	2-3 weeks	Nil	Before Amplification
Malachite Green	Safe	No color	Bluish green	Normal spectrum	1-2 day	Nil	Before Amplification
Syto-16	Safe	Orange	Yellow	UV	1-3 days	Nil	Before Amplification

Tested different indicator dyes viz., HNB (Hydroxy Naphthol Blue), Cresol Green, Eosin Green, Malachite Green, Orange G, Phenol Red, Calcien, SYBr Green and Syto-16 for contrast colour. HNB was showing more contrast between positive and negative samples and giving consistent results compared to other dyes used. HNB at pH 8.8, at the start of the reaction violet in color will turn to sky blue in positive reaction showing *N. bombycis* infection. Apart from HNB, Malachite green and Syto-16 has given promising results which has to be further validated. Syto-16 indicator dye required UV illumination to detect the colour change.

Performance of different dyes in the M-LAMP assay

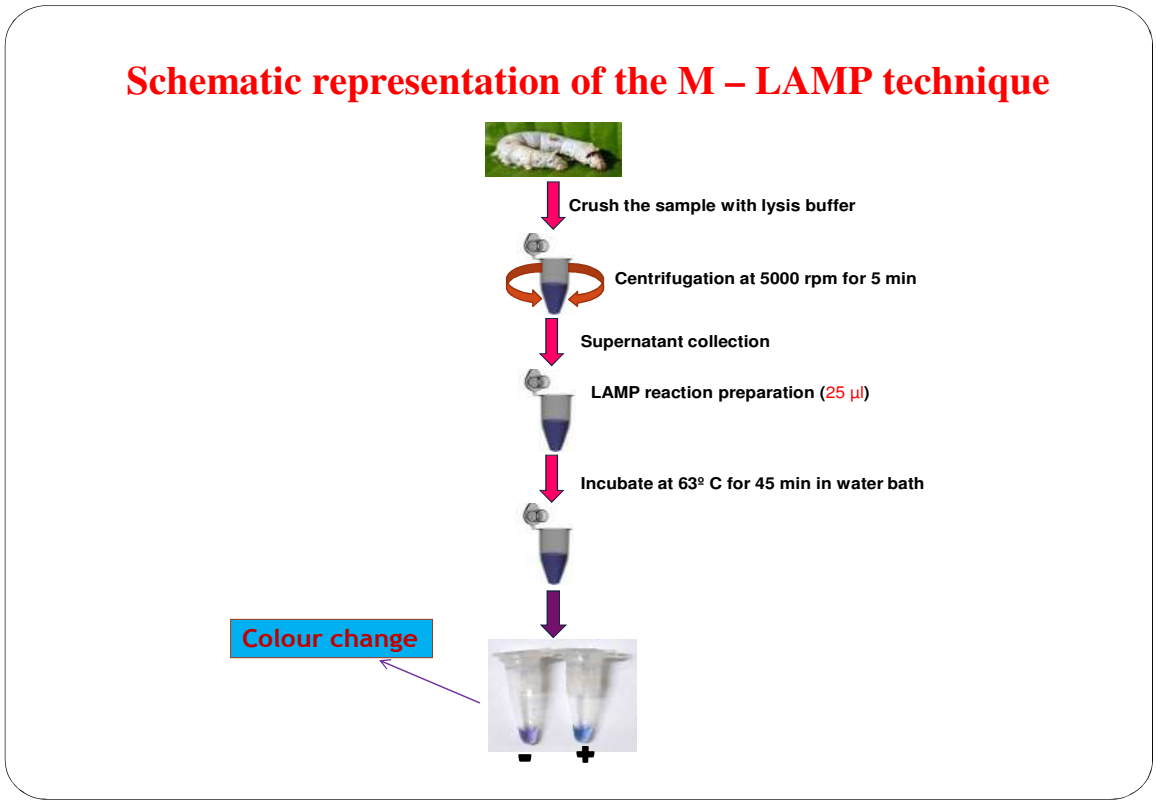


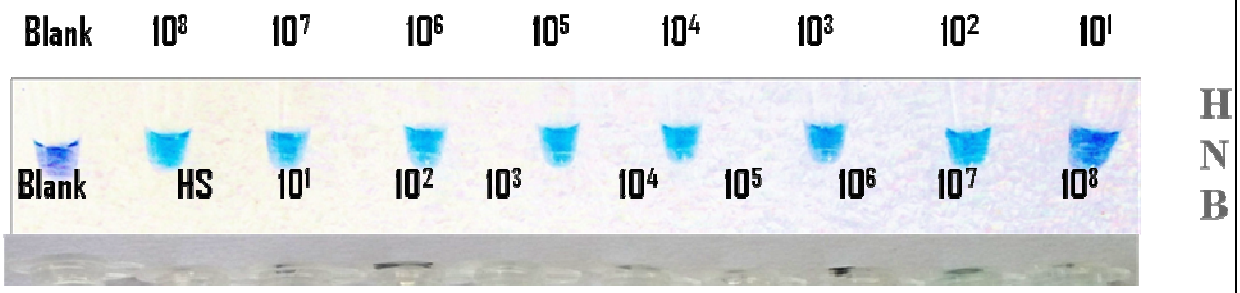
The tissue samples (egg, larvae, pupae & moth) were homogenized in specially designed lysis buffer boiled at 100° C for 10 min and centrifuged at 5000 RPM for 5 min at room temperature and the supernatant collected and used for the M-LAMP assay in plates (96 well) or PCR tubes (0.2ml). 25 µL of the reaction mixture contains 20

mM Tris–HCl (pH 8.8), 10 mM KCl, 5 mM $MgSO_4$, 10 mM $(NH_4)_2SO_4$, 0.1% Triton

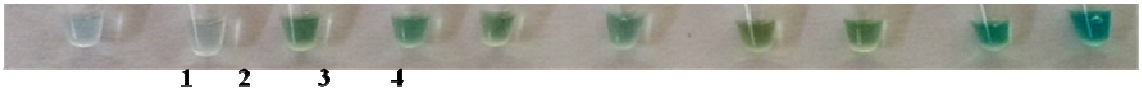
X-100, 1.6 M Betaine, Deoxy nucleotide triphosphates (2.8 mM), 1.6 µM (each) FIP and BIP primers, 0.2 µM (each) F3 and B3 primers, FP and BP 0.2 µM (each), 8 U *Bst* DNA polymerase, template DNA and distilled water. The mixture was kept at 63˚C for 45 min in a hot water bath for thermocycling. Step used for arresting the reaction in LAMP reactions by transferring the mixture to 75˚C for 2 min. is not done in this method. *N. bombycis* infection in silkworms was detected using M-LAMP assay after 12h, after inoculation. Samples inoculated with different concentrations 10^1 to 10^8 were tested on the 7^{th} day using M-LAMP assay and got positive reaction in all samples. Whereas in microscopical examination spores were observed only in the samples inoculated with 10^8 and 10^7 and sporoblasts were observed in the samples inoculated with 10^6, 10^5 and 10^3. *N. bombycis* DNA and Silkworm DNA was used in the LAMP method as positive control and negative control respectively.

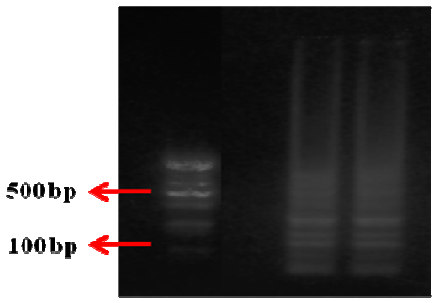
DNA isolated from *N. bombycis* spore was utilized to check the efficiency of the selected primers (F3 & B3) using PCR and obtained amplification product of ~180bp size. Different concentrations of $MgCl_2$ (1mM to 6 mM) were used in the reaction mixture and got same result with all. The MgCl2 concentration is very crucial for the colour change in the colorimetric reaction taking place in M-LAMP assay. Different annealing temperatures were also tested.





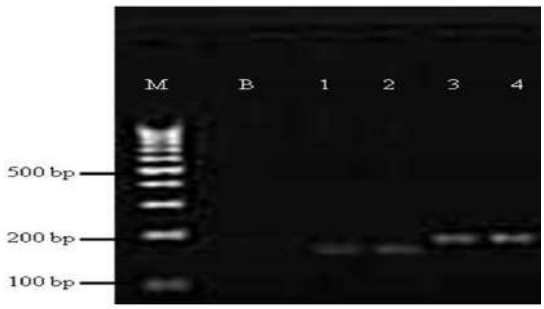
Different spores concentration of *N. bombycis* used for M-LAMP assay by using HNB and Malachite Green



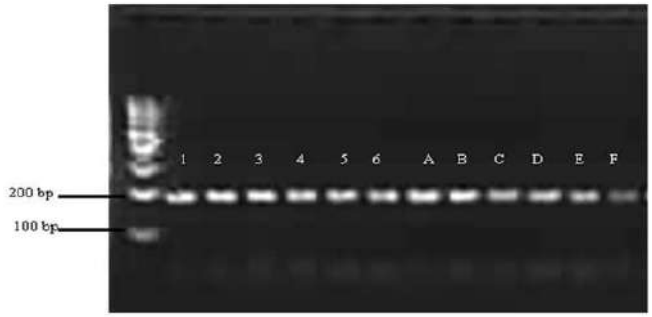


Lane 1: Marker
Lane 2: Control Negative
Lane 3: DAI -1
Lane 4: DAI -2

Gel electrophoresis of the products of LAMP assay M: marker, lane 2: healthy silkworm sample and lane 3 & 4 inoculated silkworm samples1st -DAI and 2nd DAI



Agarose gel electrophoresis of PCR products. *M* 100bp ladder, *B* blank, lane 1 & 2 healthy silkworm DNA, lane 3 & 4 *Nosema bombycis* DNA



Optimization of PCR condition for detection of *Nosema bombycis* using F3 and B3 primers. *M* 100 bp ladder, *lane 1-6* 1mM to 6mM $MgCl_2$, Annealing temperature 45° C, lane A-F 1mM to 6mM $MgCl_2$, Annealing temperature 47° C

After the reaction, the positive samples were run in agarose gel and confirmed the DNA amplification. Non specific bands were present in the gel. The sequencing of the amplified PCR product obtained from the *N. bombycis* spore was done. Nucleotide BLAST result has shown 100% identity with *Nosema*, sp. whereas the sequenced product of non-specific bands did not give any result in the nucleotide BLAST. The sequence was submitted to NCBI GenBank and obtained accession number MG 831719. The nucleotide sequence obtained from the amplified product which is submitted to NCBI is given below:

1 tcatgatagt ggtgcatggcc gtttccaatggatgctgtg aagtaatgatt aatttcaac
61 aagatgtgag accctcatta gacagatgtagtgatacatat gaaggagag gattaaaac
121 aggt

The validation trials of the M-LAMP assay were done at breeding labs at CSRTI-Mysuru, SSBS Coonoor, P4 BSF-Hassan, P3 BSF-Mysuru and P2 BSFs (NSSO). Egg shells and the moths were tested. The positive samples in M-LAMP assay were reared for two successive generations and the presence of spores were tested both microscopically and using M-LAMP assay. No false positives were recorded so far. The cost of the M-LAMP assay was calculated and the details are given in the table.

Validation of field samples. B: Blank C: Control Positive S1 to S5: Negative Samples from P2 BSF Palakkad

Cost of the chemicals M-LAMP assay reaction for 1000 samples			
#	Items	Product make	Rate/1000 samples (Rs.)
1	Primers	Proteogen	9,694
2	Bst Enzyme	NEB	23,678
3	dNTP	Chromous	15,694
4	Chemicals	Sigma	6,000
5	Plates	Tarsons	2,000
Total			57,063

Cost of the equipment for M-LAMP assay reaction			
Item		Product make	Amount (Rs.)
1	Water bath Digital (one time investment)	Sd-fine	10,000
		Total	10,000

Cost comparison of the M-LAMP assay kit with the commercially available LAMP assay kits		
	Disease diagonised	Cost/Reaction (Rs.)
TB-LAMP	TB	975.00
Omni Amp LAMP	Any DNA/RNA	150.00
M-LAMP	*N . bombycis*	57.06

Conclusion and Inference: The M-LAMP assay can detect the developmental stages of the *N. bombycis* 12h post infection even in batches inoculated with 101 concentration.. This will help in the erly detection of the disease and also in the detecton of low level of infection. The cost of the reaction is very low when compared to commercially available LAMP Kits. It can be also used for the detection of microsporidian infection in other silkworms *viz.,* tasar, eri and muga. Large scale validation of the technology will be done through one ToT project.

Modified-Loop mediated isothermal amplification (M-LAMP) for the early detection of *Nosema bombycis* Testing report format		
1	Name of the centre	
2	Letter No. date	
3	Crop Number	
4	Race	
5	Lot No	
6	Source	
7	Brushed on	
8	No of Samples	
9	Sample stage	
10	Tested on	
11	M-LAMP Results	
12	Light Microscopy Results	

M-LAMP protocol

Crush the sample with specific lysis buffer (cell lysis)

↓

Boil the mixture @100°C for 10 min.(Denaturation of protein)

↓

Centrifuge the crude sample at 5000 RPM for 5 min(@ room temp.) (removal of the tissue debris)

↓

Collect the supernatant

↓

Prepare the reaction mixture and take 23µl in 0.2 ml tube/ 96 well plates

↓

Add 2µl of supernatant

↓

Incubate the samples in water bath reaction for 45 min at 63 °C(Thermo cycling)

↓

Remove tube / 96 well plate from water bath(Check for color change)

↓

Violet indicates negative and sky blue indicates positive reaction

Validation of modified-Loop mediated isothermal amplification (M-LAMP)							
CSB/DoS Units	Crop Number	Samples Tested	No. of Samples	Microscopic Observation	M-LAMP Results	Bioassay	Remarks
P4-Hassan	01/2017-18 02/2017-18 03/2017-18	Egg shell & Eggs	451	Nil 8 +ve	4 +ve 8 +ve	4 +ve	Moth Exam. (12 +ve)
P3-Mysuru	02/2017-18 03/2017-18 03/2017-18	Egg shell Butterflies Egg shell larvae	607	Nil Nil Nil 1 +ve	2 +ve 2 +ve Nil 1 +ve	2 +ve (1+31) +ve	III instar larvae (2+ve) 68 dfls
SSPC-Mysuru	DH	Egg shell	02	Nil	Nil		
SSPC- KR Nagar	14 & 15	Egg shell	04	Nil	Nil		
SSPC-Dharmapuri	3, 3A	Moths	143	Nil	1 +ve		Male moth
SSBSCoonoor	2017-18	Egg shell & Larvae	96	Nil	Nil		
P2 BSF-Ambuga	1,2,3,4,5	Egg shell	5	Nil	Nil		
P2-BSF-Dharmapura	7, 21	Egg shell	2	Nil	Nil		
P2-BSFs-Horsley hills	1A, 1B, A, 2B, 3A, 3B	Egg shell	6	Nil	Nil		
P2-BSF Krishnagiri	3, 3A, 4, A, 5,5A, 6, 6A, 8, 8A, 9, 9A	Egg shell	28	Nil	1 +ve		NT
P2-BSF Madakasira	2, 6A, 6B	Egg shell	4	Nil	Nil		
P2-BSF Palakkad	P2 M13, 2, M14, P1, 73PM3P2, M4P2, M13, M14	Egg shell	14	Nil	Nil		
Farmers (Tumkur)		Egg shell	25	Nil	Nil		
SW Physiology		Larvae	12	12 +ve	12 +ve		AD lines
Total	1399	21+ve	31 +ve	(7+31) +ve			

Ongoing Research Projects

ARP 3607: Development of antibody based biosensor for early and rapid detection of silkworm viruses at Chawki Rearing Centres (Mar. 2017 - Feb. 2020) (In Collaboration with CSRTI - Pampore)

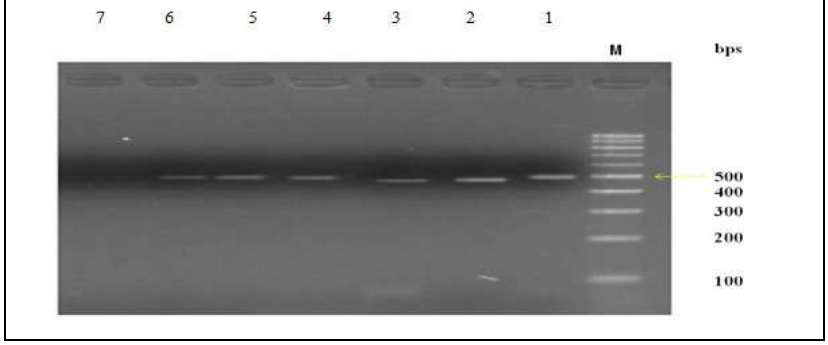
Mudasir Gani (CSRTI-Pampore), Sahadev Chouhan (CSRTI-Berhampore), A.V. Mary Josepha and L. Satish

Objectives

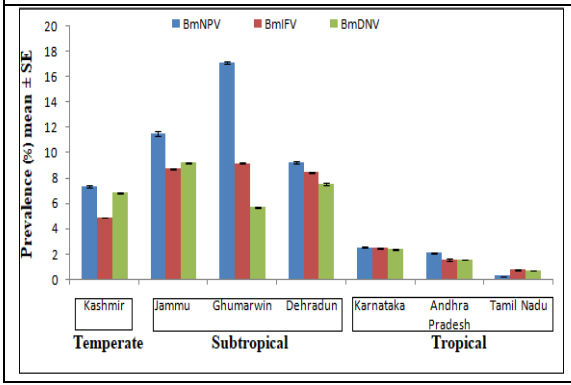
- Production of polyclonal antibodies specific to BmNPV, BmIFV and BmDNV1
- Development of polyclonal antibody based biosensor for early and rapid detection of BmNPV, BmIFV and BmDNV infection in Silkworms at CRCs

During the intensive exploratory surveys, silkworm larvae with typical symptoms of BmNPV, BmIFV and BmDNV were collected from seven locations of India including North India [Kashmir (temperate), Jammu, Ghumarwin in Himachal Pradesh (H.P.), Dehradun in Uttarakhand (subtropical)] and South India [Karnataka, Andhra Pradesh and Tamil Nadu (tropical)]. The viruses were isolated and identified through PCR amplification of highly conserved genes. The results revealed that BmNPV, BmIFV and BmDNV1 are prevalent across India. The incidence of BmNPV, BmIFV and BmDNV1 in North India was significantly higher than South India. The BmNPV was found as the most serious and dominant viral pathogen with the maximum prevalence of 17.32% in Ghumarwin, H.P. The prevalence of these viruses was found maximum in subtropical climate followed by temperate and tropical climate. The BmNPV was multiplied and the virus isolated and concentrated using Ultracentrifugation. The BmNPV proteins were characterized by SDS-PAGE and Spectroscopy/Nanodrop. The purified BmNPV proteins were sent to outsourcing company for antibody production.

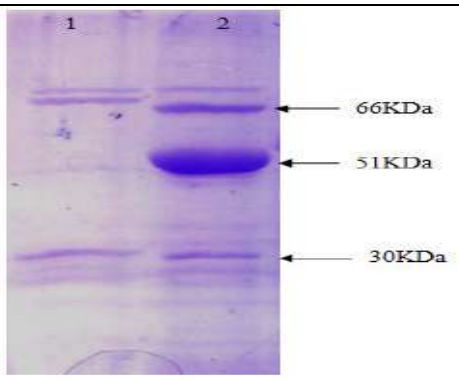
PCR amplified polyhedrin gene of different isolates of BmNPV using degenerate primers. Lane M: DNA molecular weight marker (10 bp), Amplified PCR product from 1. Ghumarwin; 2. Dehradun; 3. Jammu; 4. Anantnag; 5. Kulgam; 6. Pampore; Lane 7. Master Mix with healthy insect DNA (control



Prevalence of BmNPV, BmIFV and BmDNV from different climatic regions of India during 2017



SDS-PAGE (12%) of purified Budded virus proteins of *Bombyx mori* nucleopolyhedrovirus (BmNPV). Lane Description: 1 - Protein marker, 2-Sample



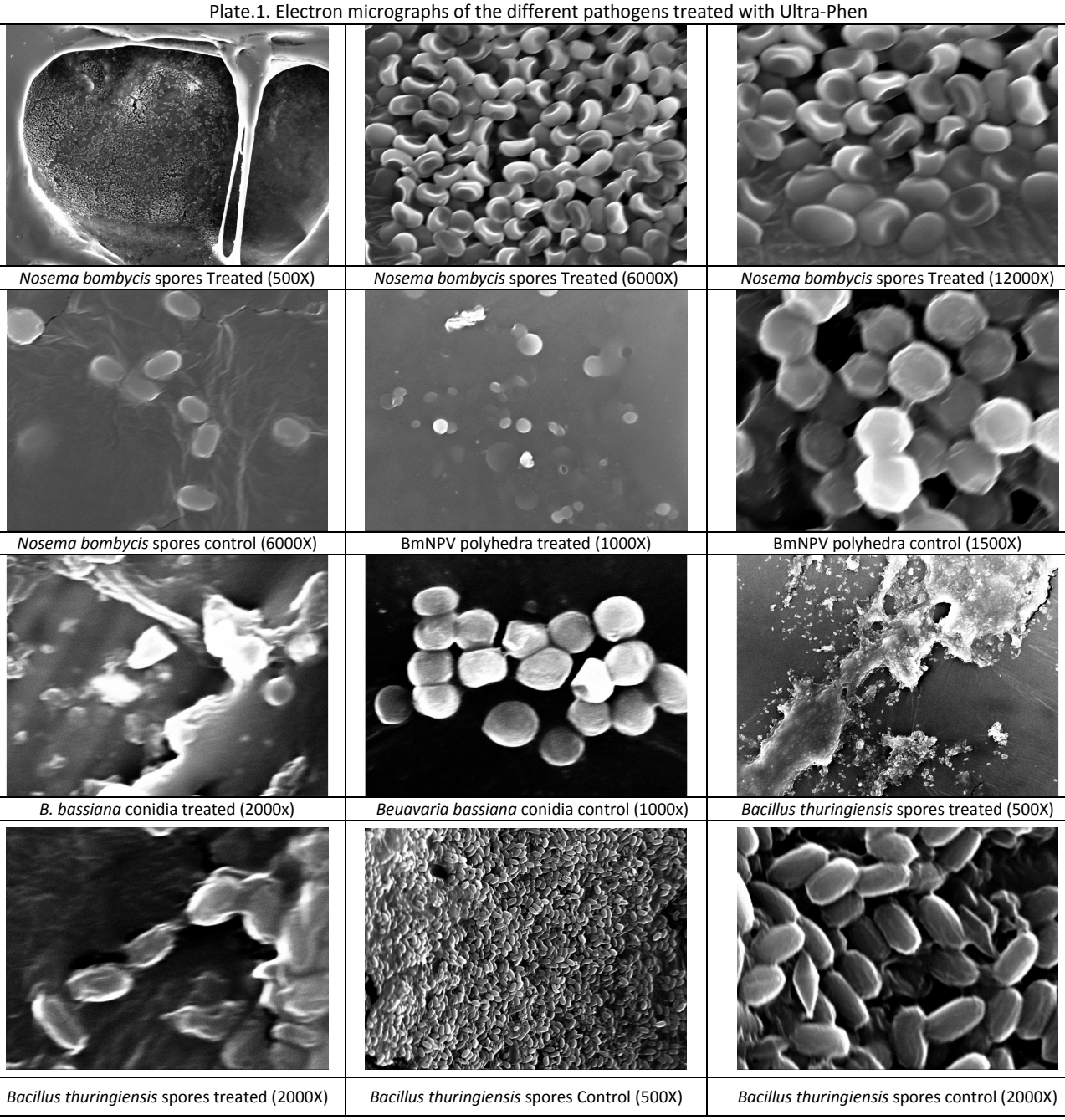
Ultra-Phen, a phenolic compound for effective disinfection in sericulture

A. V. Mary Josepha, Vineet Kumar and G. Mallikarjuna

In search of human friendly and effective disinfectant for the disinfection of rearing house, appliances and environment CSRTI-Mysuru screened few phenolic compounds in collaboration with M/s Kamat Chlorotech, (#256, 257. 3rd Phase, KIADB Industrial Area, Malur-563130, Kolar District, Karnataka) for identifying effective compounds. Ultra-Phen, a formulation rich in

C-10 and C-12 phenolic compounds along with surfactants, buffers and stabilizers was identified. The formulation inactivates all the silkworm pathogens at <1% concentration and is economically effective. The formulation was tested by both *in vitro* and *in vivo* methods and the result was very much encouraging. Industry sponsored project proposal approved by RC and RAC was sent to referees and got positive comments from the referees. The proposal will be placed again before the RAC for final approval before submitting to CO for coding.

Plate.1. Electron micrographs of the different pathogens treated with Ultra-Phen



Nosema bombycis spores Treated (500X) | *Nosema bombycis* spores Treated (6000X) | *Nosema bombycis* spores Treated (12000X)

Nosema bombycis spores control (6000X) | BmNPV polyhedra treated (1000X) | BmNPV polyhedra control (1500X)

B. bassiana conidia treated (2000x) | *Beuavaria bassiana* conidia control (1000x) | *Bacillus thuringiensis* spores treated (500X)

Bacillus thuringiensis spores treated (2000X) | *Bacillus thuringiensis* spores Control (500X) | *Bacillus thuringiensis* spores control (2000X)

Continuous/Other activities

Pebrine monitoring in breeder's stock and seed multiplication units: Pebrine Monitoring done by microscopical examination and also M-LAMP assay. Rearings of P4 BSF Hassan, P3 BSF Mysuru, SSBS Coonoor, Breeders stock of BBL, MBL and other rearing sections of CSRTI, Mysuru were monitored throughout the year and kept the microsporidian infection under check. All the batches in the BSFs were monitored. All the batches in 13 BSFs in Karnataka, 3 BSFs each in Tamil Nadu and Andhra Pradesh

were monitored in the 5th instar. P1 grainages *viz.*, SSPC K. R. Nagar, SSPC Chandapura, SSPC Chikkamalavadi in Karnataka and SSPC Denkanikota in Tamil Nadu were also included under pebrine monitoring.

Conducted one pebrine monitoring meeting including all the scientists involved in the pebrine monitoring at different BSFs, Director NSSO, Bangalore attended the meeting.

Maintenance of the pure culture of the silkworm Pathogens: Pure culture, spores and inoculum of all the silkworm pathogens *viz.,* bacteria, fungi, microsporidia and virus are maintained for experimental purpose.

- A.V. Mary Josepha is acting as Seed Analyst to inspect different Seed Production Centers and Chawki Rearing Centers of H. D. Kote, Nanjaungud and T. Narasipura area. A. R Narasimha Nayaka is working as the seed officer in Channapatna area.
- A. R Narasimha Nayaka is the counterpart in JOCV, JICA, Japan, programme at Ramanagara.
- A. R. Narasimha Nayaka is working as Cluster Development Facilitator of Bannikuppe cluster of Ramanagar, Karnataka to implement Bivoltine Sericulture Technology in the field.

Sensitization of stakeholders: During the period a total of 303 farmers/students/officers/officials who visited the Silkworm Pathology Section were sensitized on Silkworm diseases and their management.

POST COCOON EVALUATION UNIT

M. Shivakumar Hukkeri and M.N. Chandrasheakar

Continuous Activities

A total of 720 cocoon lots received from the breeding labs and RSRSs, RECs, P4 Hassan etc., were test reeled. Further, 2105 lots of cocoons were reeled for monococoon assessment, cold directional reeling for improvement in some of the characters such as filament length etc., received from Bivoltine Breeding Lab and Multivoltine Beeding Divisions.

SERICULTURAL ENGINEERING DIVISION

Developing Entrepreneurship for Disinfection of Silkworms Rearing Houses and Silk Cocoon Harvesting

Satish Verma and V. Sivaprasad

Objectives

- Demonstration and popularisation of power sprayers for disinfection of disinfection of silkworm rearing houses and cocoon harvestor for silk cocoons.
- Development of custom hiring system/agency for disinfection of silkworm rearing houses and cocoon harvesting.
- For entrepreneurship in silkworm rearing house disinfection and silk cocoon harvesting following steps were followed.
- Selection of sericulture farmers/youths for entrepreneurship development.
- Procurement of the power sprayers and cocoon harvestors and providing the same to the proposed entrepreneurs.
- Providing training on use and maintenance of the power sprayers and cocoon harvestor at CSRTI–Mysuru and farmers locations.

Identification of Sericulture farmers/youths/self-help groups for entrepreneurship development: 5 Sericulture farmers/youths/self-help groups for entrepreneurship development was identified (3 female 2 male)

Procurement of the power sprayers for the project: Five units of the power sprayers were procured from M/S Sri Balaji Agencies, Mysuru who has been licenced by NRDC New Delhi for the power sprayer designed and developed by CSRTI-Mysuru. The machines were thoroughly checked and tested from operation aspects.

Fabrications and Testing of Silk Cocoon Harvestors: Five numbers of the silk cocoon harvestors were fabricated departmentally to save cost and also to incorporate latest modifications and improvements in the machine. The figures the machines made ready for the project.

The cocoon harvestors were tested thoroughly before being provided to the entrepreneurs. The machines were fine tuned while testing for higher and fast harvesting of cocoons without any damage.

Training of the Entrepreneurs on operation and maintenance of the Machines at CSRTI-Mysuru: The identified entrepreneurs with their family members and workers were called to CSRTI-Mysuru and were trained for operation and maintenance of the power sprayers and silk cocoon harvestors.

Trainings at Farmers' Locations: To popularise the power sprayer cocoon harvestors among more farmers and also to impart on-field demonstration about operation and maintenance, trainings were organised. There was lot of enthusiasm among silk cocoon growers about machines. The pictures below depict on-farm trainings imparted to the farmers to cover more farmers to demonstrate them usefulness of the power sprayers and cocoon harvestor.

Fabrication: A total of 35 machines, Tray washing machine (18 units), Cocoon harveter (7 units), Mulberry cutting preparation machine (2 units), Chawki dusting machine (1 unit) and Plastic mountage folding tool (7 units) were fabricated.

Training: Training on mechanization in sericulture and silkworm rearing houses imparted to 514 trainees comprising of 31 batches.

Extension and machine popularisation work: Demonstration of machines and equipment for mechanization in sericulture to 2782 farmers in 98 batches from the states of Karnataka, Andhra Pradesh, Tamilnadu, Telangana, Maharashtra, Madhya Pradesh, Uttar Pradesh, West Bengal, etc.

SERICULTURAL EXTENSION, ECONOMICS & MANAGEMENT DIVISION

D. S. Somaprakash, A. Mahima Santhi, G. S. Geetha, H. M. Munikrishnappa and Joycy Rani Dasari

Ongoing Research Projects

MOE 3595: Development of business models for enterprises in pre-cocoon sector of Sericulture (Oct. 2016 - Sept. 2018)

Joycy Rani Dasari and H. Jayaram

Objective: To identify and analyse the feasibility of different seri-business enterprises in pre-cocoon sector and develop optimum business plans to facilitate fund flow

Various enterprises selected under the study i.e., Chawki Rearing Centres (CRCs), mulberry nurseries, seed production centers, bio-control agents production units, mobile disinfection units, mounting halls were identified. Data was collected by personal interview using a well structured registry and pre-tested schedule. Information pertaining to the present status *viz.,* input utilization, cost particulars (establishment and maintenance), level of production, marketing structure, source of income, flow of returns etc. of each seri-enterprise under the study was collected. Depending on the availability of the functioning units of various seri-enterprises selected under the study, data was collected in southern states.

Details of seri-enterprises selected under the study						
Parameter	CRCs	Mulberry nursery	Seed production units	Mounting halls	Mobile Disinfection Units	Bio-control agents production units
Data collected (unit)	30	20	8	7	4	2
Experience (years)	3-11	2-14	5-15	2-4	2-6	3-10
Batches per year (no.)	32-38	1-2	21-24	28-34	-	-
Brushing Capacity	1.2-8.5 lakh	1-2.5 lakh saplings	8-14 lakhs dfls per annum	400-800 available mountages	20-25 disinfections per month	50-100 boxes beetles, 200-300 pouches NT/ month
Unit Price of output (Rs.)	Rs. 2000-3600/100 dfls	Rs. 2-7 per sapling	Rs. 500-700/100dfls	Rs. 12-20 rental charge per mountage	Rs.500 per disinfection	Rs. 250/ box beetles and Rs. 50/pouch

Based on the data collected, economic viability of these enterprises is assessed by using discounted cash flow techniques such as the Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit-Cost Ratio (BCR) to reveal the magnitude of present situation and also to know the extent of profitability. Cost and returns structure of CRCs and mulberry nurseries were studied in detail and business models were developed.

Model Project for Commercial Chawki Rearing Centre (CRC)

The details of estimated cost, means of finance, economics and financial viability is worked out for Commercial Chawki Rearing Centre (CRC) as follows.

Area under chawki garden (acre)	2
Rearing capacity per year (lakh dfls)	1.6
No. of batches per year	32
No. of dfls reared per batch	5000
Chawki rearing house requirement	
Type of rearing house	Brick masonry with asbestos sheet
Standard requirement to brush 5000 dfls/batch	
Total area of chawki rearing house	1800 sq.ft.
Unit cost of construction (Rs./ sq.ft.)	600

A. Project Outlay - Estimated unit cost and finance (Rs. in lakhs)				
#	Particulars	Cost	Loan@75 %	Margin @ 25%
1	Basic infrastructure			
	Land Development	0.50	0.38	0.12
	Bore-well with 5HP submersible pump	1.20	0.90	0.30
	Drip irrigation system for mulberry garden	0.70	0.53	0.17
2	Development of mulberry plantation			
	Exclusive chawki mulberry garden	1.52	1.14	0.38
3	Chawki rearing house			
	Brick masonry with asbestos sheet	10.80	8.10	2.70
	False ceiling	1.00	0.75	0.25
4	Chawki rearing equipment	5.25	3.94	1.31
5	Capitalised working capital			
	Maintenance of chawki garden (per year)	2.89	2.17	0.72
	Rearing of chawki silkworms (1.6 lakh dfls/year)	13.01	9.76	3.25
6	Farm machinery and vehicle			
	Tata ace	3.75	2.81	0.94
	Power tiller with trolley	1.8	1.35	0.45
		Total	31.82	10.61

B. Economics (Year wise income and expenditure)										
Particulars	**1 yr**	**2 yr**	**3 yr**	**4 yr**	**5 yr**	**6 yr**	**7 yr**	**8 yr**	**9 yr**	**10 yr**
Area under chawki mulberry garden (acre)	2	2	2	2	2	2	2	2	2	2
Expected Leaf yield (MT)	14	20	24	32	32	32	32	32	32	32
Rearing rate - quantity of leaf required kg/100 dfls	20	20	20	20	20	20	20	20	20	20
Rearing capacity (lakh dfls)	0.3	1.02	1.2	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Dfls reared per batch (no.)	3000	4000	4000	5000	5000	5000	5000	5000	5000	5000
Batches per year (no.)	10	26	30	32	32	32	32	32	32	32
Sale price /100 dfls of chawki worms (Rs.)	1800	1800	2000	2000	2200	2200	2200	2200	2200	2200
Gross income/Returns (Rs. lakhs)	5.40	18.43	24.00	32.00	35.20	35.20	35.20	35.20	35.20	35.20
Recurring expenditure (Rs. in lakhs)										
Particulars	**1 yr**	**2 yr**	**3 yr**	**4 yr**	**5 yr**	**6 yr**	**7 yr**	**8 yr**	**9 yr**	**10 yr**
Cost of cultivation of chawki mulberry garden	2.3	2.42	2.54	2.66	2.80	2.94	3.08	3.24	3.40	3.57
Cost of material for rearing	2.56	8.72	10.22	13.63	13.63	13.63	13.63	13.63	13.63	13.63
Cost of labour for rearing	0.24	0.82	0.96	1.28	1.44	1.60	1.60	1.76	1.76	1.76
Admin. & overhead expenses	1	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Total recurring expenses	6.10	13.06	14.82	18.67	18.97	19.27	19.41	19.73	19.89	20.06

C. NPW, BCR, IRR and DSCR		
1	NPW @ 30% (Rs. Lakhs)	7.96
2	Benefit Cost Ratio	2.33
3	Internal Rate of Return	28%
4	Debt service coverage ratio	2.50

The basic assumptions considered while preparing the scheme are indicated below.

Model Project for Mulberry nursery	
Area (Unit)	1 acre
Size of nursery bed	3m X 1m
No. of beds	1065
Spacing of cuttings in the bed	20X10 cm
No. of cuttings per bed	150
Total cuttings to be planted	159750
Total saplings expected (80% survival)	127800

- The entrepreneur possesses requisite knowledge, aptitude and skills for taking up nursery production which is a specialized activity
- The location selected is agro-climatically suitable for cultivation / multiplication of mulberry
- The entrepreneur possesses adequate land suitable for nursery production with assured irrigation facilities /potential
- Nursery capacity to produce 2.3 - 2.5 lakh quality mulberry plants per annum
- Plant growing structures like mist chambers, poly house and shade net facilities provided to improve success rate and production of better quality planting material
- Provision made for related infrastructure facilities like irrigation (water storage tank), store house for inputs, work area for operations, fencing, etc.

A. Estimated unit cost					
#	Particulars	Unit	Quantity	Value per unit (Rs.)	Value (Rs.)
I	Variable cost/working capital				
1	Land preparation	Machine hour	4	700	2800
		Bullock labour	2	1000	2000
2	Sand	Tractor load	1	40000	40000
3	Manure	MT	5	1000	5000
4	Preparation of nursery bed (20 beds/ manday)	Mandays	53	300	15975
5	Broadcasting of sand and manuring	Mandays	16	300	4800
6	Planting material (27000 cuttings/MT shoots)	MT	6	3000	18000
7	Planting of cuttings (10 beds/manday)	Mandays	107	300	31950
8	Irrigation	Mandays (2 man-day/ irrigation)	50	300	15000
9	Weeding (3 times)	Mandays	58	250	14500
10	Chemical fertilizer (Urea @ 60g/bed)	kg	65	6	390
11	Fertilizer application	Mandays	10	300	3000
12	Uprooting of saplings (10 beds/ manday i.e. 1200 saplings)	Mandays	107	300	31950
13	Electricity for cutting preparation				500
14	Cutting making machine				10000
15	Plant protection chemicals, rooting promoters and others				2000
16	Miscellaneous				3000
Interest on working capital (@ 12%)					24104
Total variable cost					**224969**
II	**Fixed Cost**				
1	Depreciation of equipments				1232
2	Rental value of land				30000
3	Land revenue				50
4	Managerial cost @10% of working capital				22497
5	Risk premium @ 5% of 80% of working capital				8999
				Total fixed cost	62778
				Total Cost	287746

B. Economics (Income and Expenditure)		
Batches per year	No.	2
No. of cuttings	No.	319500
Saplings recovered	%	80
No. of saplings recovered	No.	255600
Price per sapling	Rs.	3
Total revenue/season	Rs.	383400
Total revenue year	Rs.	766800
Total costs involved		
Total Variable Cost	Rs.	439938
Total Fixed Cost	Rs.	62778
Total Cost	Rs.	502715
Net revenue	Rs.	264085
	B:C Ratio	1.53

MOE 3621: Impact of CPP on socio-economic and communication aspects of women beneficiary (Sept. 2017 - Aug. 2019)

G.S. Geetha, Joycy Rani, Vidhyunmala and Punithavathi

Objectives:

- To study the impact of availability and access to extension communication and training programmes on women involved in sericulture
- To find out effectiveness of accessibility to technology support and common facilities on improvement in socio economic status of seri women
- To analyze the constraints and suggestions perceived by seri women, use them in implementation of future CPP's and every sericulture programs

The project initiated in four southern states *viz.* Karnataka, Tamil Nadu, Andhra Pradesh and Telangana. Multi stage random sampling method is being used for the selection of women beneficiaries. Interview schedule are prepared for the collection of primary data. Secondary data has been collected from directorates of state sericulture department of respective states. Data collection is under progress.

Cluster Promotion Programme (CPP)

Cluster Promotion Programme (CPP) - XII plan (from 2012 to 2017), which is implemented by Central Silk Board in collaboration with the Departments of Sericulture (DoS) of Southern States, was extended for another three years i.e., up to 2020 with the objective to produce 8500MT of import substitute silk. In the Southern zone, CPP is implemented at Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Maharashtra, Madhya Pradesh and Kerala states in 106 potential sericulture clusters to increase the quality raw silk productivity with particular reference to bivoltine.

Clusters are organized in the respective states based on farmers profile and potentiality. Each cluster is directly monitored by two Cluster Development Facilitators (CDFs) each nominated by Central Silk Board and State Department of Sericulture. The clusters in the south zone are coordinated and monitored by the Director, CSRTI-Mysuru and five nodal officers (CSRTI & RSRSs) for effective implementation of CPP. The cluster/state-wise monthly progress is collected from the CDFs and analyzed.

Particulars of CPP CDFs of Southern Zone clusters for the year 2017-18		
KARNATAKA		
Clusters	CSB	DOS
Andaralahalli	Dr. Veeranna Gowda, Sci.-D, RSRS-Kodathi	Mr. Sundar Raj, ADS, Chikballapura
Aurad	Mr. Ramesh, Sci.-C, REC-Bidar	Mr. Bhimesh Holge, SEO, TSC Aurad (B)
B.R.Koppalu	Mr. D.V. Purandhar, STA, CSRTI-Mysuru	Mr. Mahesh Kumar Vage, ADS, TSC, B.R. Koppalu
Bannikuppe	Dr. A. R. Narasimha Nayaka, Sci.-D, CSRTI-Mysuru	Mr. K. S. Kumara Subramanya, ADS, Ramanagara
Belagam	Mr. Mallannanavar, TA, SSC-Belgaum	Mr. B. M. Nayak, ADS, Srinagar, Belgaum
Bevuru	Dr. D. Guruswamy, Sci.-C, REC SU-Maddur	Mr. H. Anand, SEO, Channapatna
Bidarakote	Dr. D. Guruswamy, Sci.-C, REC SU-Maddur	Mr. Madesh, SEO, TSC, Koppa
Bijapur	Mr. Shreeshail Bheewa Arjune, TA, REC SU- Bijapur	Mr. B.Y. Biradar, ADS, Bijapur
Challakere	Mr. G.N. NiranjanaMurthy, TA, REC-Chitradurga	Mr. K. Konchojirao, ADS, Challakere
Channarayapatna	Mrs. P. Sarawsathi, Sci.-C, RSRS-Kodathi	Mrs. K. Gayathri, ADS, Devanahalli
D. Halasahally	Dr. S. Purushotham, Sci.-D, CSRTI-Mysuru.	Mr. Surendra Moorthy, SEO, D. Halslahally
Davangere	Dr.Y. Srinivasulu, Sci.-C, REC-Chitradurga	Mr. A. Sreeharsha, ADS, Davanagere
Doddalahalli	Mr. B. Kalaiah, TA, REC SU-Kanakapura	Mr. Muthuraju, ADS, Kanakapura
Gajanur	Dr. V.K. Harlapur, Sci.-D, SSPC-Malavalli.	Mr. M. Mallikarjunaswamy, ADS, Mallavalli
Gouribidanur	Dr. Manohar Reddy, Sci.-D, SSPC-Hindupur	Mr. Muralidhara, ADS, Gowribidhanur
Gulbarga	Mr. Ramesh, Sci.-C, REC-Bidar	Mr. Prakash Babu, ADS, Kalburgi
H.D. Kote	Dr. B.T. Srinivasa, Sci.-D, CSRTI-Mysuru	Mr. B. Keshav Murthy, ADS, H. D. Kote
Harohalli (B)	Dr. M. Venkatachalapathy Sci.-D, RSRS-Kodathi.	Mr. M. Ramakrishna Reddy, ADS, Hosakote
Harohalli (KKP)	Dr. Shankara, Sci.-D, SSPC-Ramanagara	Mr. Muthuraju, ADS, Kanakapura
Haveri	Mr. K. N. Nandi, STA, SSC-Haveri	Mr. M. S. Patil, ADS, Haveri
HBhalli	Dr. Raveendra Mattigatti, Sci.-D, REC SU-Kudligi	Mr. V. Sudheer, ADS, Sandur Road, Kudligi
Hiriyur	Mr. K.B. Shivanna, TA, REC-Chitradurga	Mrs. C.D. Usha, ADS, Chitradurga
Humnabad	Mr. Ramesh, Sci.-C, REC-Bidar	Mr. M.S. Ratkal, SEO, TSC Humnabad
Ithandahally	Dr. M. Noble Morrison, Sci.-D, REC-Madivala	Mr. S.N. Sreenivas, ADS, Bangarpet
Jamkhandi	Mr. Pavan Kumar, FA, REC SU-Jamakhandi	Mr. S.M. Deshpande, ADS, DOS, Jamakhandi
K.R. Nagar	Dr. D.S. Somaprakash, Sci.-D, CSRTI-Mysuru	Mr. Somanna, ADS, K.R. Nagar
Kanakapura	Dr. H. Jayaram, Sci.-D, REC SU-Kanakapura	Mr. Muthuraju, ADS, Kanakapura
Kudligi	Dr. Raveendra Mattigatti, Sci.-D, REC SU-Kudligi	Mr. V. Sudheer, ADS, Sandur Road, Kudligi
Kurudumalai	Dr. M. Noble Morrison, Sci.-D, REC- Madivala	Mr. M. Venkatesh, ADS, Mulbagal
Lingasgur	Mr. J. Justin Kumar, TA, REC SU-Koppal	Mr. Rajendrakumar, SEO, Lingasugar
Ranebennur	Dr. M.K. Raghunath, Sci.-D, REC-Ranebennur	Mr. M.S. Patil, ADS, Devagiri, Haveri Dist
Raugodlu	Dr. B.A. Parthasarathy, Sci.-D, SSPC-Bangalore	Mr. Sathish, ADS, Kengeri
Shahapur	Mr. K.V. Srinivasa Raju, FA, REC SU-Shahapur	Mr. Tellur Nadaf, SEO, TSC B. gudi
Shapur (Kolar)	Dr. M. Noble Morrison, Sci.-D, REC- Madivala	Mr. Manjunath, ADS, Kolar
Shirahatti	Mr. H.N. Harish, FA, REC SU-Shirahatti	Mr. Mudgal, ADS, Betageri, Gadag
Siddlaghatta	Dr. P. Muniswamy Reddy, Sci.-C, SSPC-Vijayapura	Mr. Chandrappa MC, ADS, Siddlaghatta
Sira	Mr. K. Vedavyasa, Sci.-D, REC SU-Tumkur	Mr. Mohan, ADS, Sira
Soraba	Dr. Y. Srinivasulu, Sci.-C, REC-Chitradurga	Mr. K.J. Tamanna-gowda, ADS, Shivamogga
T. Narasipura	Dr. S. N. Pallavi, Sci.-D, RSRS-Ch. Nagar	Mr. C.R. Krishna, ADS, T. Narasipura
Tekal	Dr. J. Ravikumar, Sci.-D, SSPC-Chintamani	Mr. M.K. Aswath Narayana, ADS, Malur
Thoresettihalli	Dr. D.S. Somaprakash, Sci.-D, CSRTI- Mysuru Dr. D. Guruswamy, Sci.-C, REC SU-Maddur	Mr. Madesha, SEO, TSC, Koppa
Tubagere	Dr. Veeranna Gowda, Sci.-D, RSRS-Kodathi	Mr. Anjanamurthy, ADS, DOS Doddaballapura
Tumkur	Mr. K. Vedavyasa, Sci.-D, REC SU-Tumkur	Dr. Balakrishnappa, ADS,Tumkur
Y.N. Hosakote	Mr. G. Papaiah, TA	Mr. R. Ranganath, ADS, DOS, Tumkur, Pavagada
Yelburga	Mr. Y.N. Sanath Kumar, Sci.-C, REC SU-Koppal	Mr. P.H. Konnur, ADS, Narebenchifarm, Kushtagi
Yeldur	Dr. J. Ravikumar, Sci.-D, SSPC-Chintamani	Mr. M. Nagaraju, ADS, Srinivasapura
ANDHRA PRADESH		
Clusters	CSB	DOS
Atmakur	Dr. P. Venkataramana, Sci.-D, REC-SU-Atmakur	Mr. D. Anjaneyulu, SO, DoS, Atmakuru
Bhimadole	Dr. T.V.S.S. Rao, Sci.-D, REC-Eluru	Mr. M. Subba Rao, SO, TSC, Bhimadole
Chebrole	Dr. K. Ashok Kumar, Sci.-D, REC-Chebrole	Mr. K. Appa Rao, ASO, TSC, Chebrole
Chittoor	Dr. P. Deepa, Sci.D, SSPC-Chittoor	Mr. P. Vasantha Rayulu, TO, TSC, Chittoor
Giddalur	Dr. N.B. Chowdhary, Sci.-D, REC-SU-Markapur	Mr. G. Sudhakar Sarma, ADS, DoS, Markapuram

Hindupur	Dr. B.N. Murthy, Sci.-D, REC-Madakasira Mr. A. Sivaiah, TA, CPC-Hindupur (from1.11.2017)	Mr. I. Vijaya Kumar, SO, TSC, Hindupur
Kalyanadurg	Dr. K.P. Kiran Kumar, Sci.-C, REC-Kalyanadurgam	Mr. P. Rammohan, ASO, TSC, Kundurpi
Madakasira	Dr. B. Narasimha Murthy, Sci.-D, REC-Madakasira Mr. H.D. Bhaskar, TA, REC-Madakasira	Mr. H. Hanumantharaya, ASO, TSC, Madakasira
Palamaner	Dr. G.V. Prasad, Sci.-D, CDC-Palamaner	Mr. G. Babu, SO, TSC, Palamaner
Pattikonda	Dr. P. Venkataramana, Sci.-D, REC SU-Atmakur	Mr. M. Suresh Kumar, SO, DoS, Peapully
Penukonda	Dr. S. Vidyunmala, Sci.-D, REC SU-Penukonda	Mr. Y. Rammohan Chowdary, ASO, TSC, Roddam
V.Kota	S. Nazeer Ahmed Saheb, Sci.-C, REC-V. Kota	Mr. K. Ramachandra Rao (upto July, 2017) Mt. M. Gajendra, T.O. (Aug., 17 to Jan., 18) Mr. H. Hanumantharaya, SO (Feb. 18), SO, TSC, V Kota
Vijayawada	Dr. R.N. Prasad, Sci.-D, SSC-Vijayawada	Mr. L.K.V.D. Prasada Rao, T.O., TSC, Challapalli
TELANGANA		
Clusters	CSB	DOS
Bhongir	Dr. P.Srinivasulu Reddy, Sci.-D, REC SU-Suryapet	
Metpalli	Mr. B.V. Sanjeeva Rao, Sci.-D, REC SU-Metpalli	Sri. D.M. Reddy, ADS, Hanamkonda
Suryapet	Dr. P.Srinivasulu Reddy, Sci.-D, REC SU-Suryapet	
Zahirabad	Dr. B. Srinath, Sci.-D, REC-Vikarabad	
TAMIL NADU		
Clusters	CSB	DOS
Adaikalapattinam	Dr. S. Rajaram, Sci.-D, REC SU-Srivilliputhur	Mr. P. Murugesan, A.I.S.
Alangkayam	Dr. S. Balasaraswathi, Sci.-D, RSRS-Salem	Mr. R. Ayyanar, A.I.S.
Alangudi	Sri. N.G. Selvaraju, Sci.-D, REC SU-Trichy	Mr. R. Sathya I/C, J.I.S.
Annur	Dr. A.M. Babu, Sci.-D, REC-SU-Avinashi	Mr. T.D.Karthik Ganesh, A.I.S.
Anthiyur	Smt. Rajalakshmi, Sci.-D, REC-Gobichettipalayam	Mr. V. Sankaran, A.I.S.
Bagalur	Dr. Jagadish Prabu, Sci.-D, SSPC-Hosur	Mr. S. Sakthivel, A.I.S.
Berigai	Mr. Y. Humayun Sherif, Sci.-D, REC SU-Berigai	Mr. C. Balakrishnan, A.I.S.
Bhavani	Smt. Rajalakshmi, Sci.-D, REC-Gobichettipalayam	Mr. V. Sankaran, A.I.S.
Dharapuram	Dr. P. Samuthiravelu, Sci.-D, REC-Udumalpet	Mr. M. Muthiah, A.I.S.
Dharmapuri	Dr. V. Chinnadurai, Sci.-D, SSPC-Dharmapuri	Mr. N. Chandiran, A.I.S.
Gobi South	Smt. E. Rajalakshmi, Sci.-D, REC-Gobichettipalayam	Mr. G. Gopalan, I.S.
Gudimangalam	Dr. K. Chandrasekharan, Sci.-D, REC-Udumalpet	Mr. A.M. Shanavas, A.I.S.
Keeranur	Smt. G. Punithavathy, Sci.-D, REC-Udumalpet	Mr. C. Thangavel, A.I.S.
Kodiyalam	Dr. Jagadish Prabu, Sci.-D, SSPC-Hosur	Mr. S. Sakthivel, A.I.S.
Kottur	Mr. A. Raghupathy, TA	Mr. P. Rajendran, A.I.S.
Kumaralingam	Dr. C.M. Babu, Sci.-D , REC-Udumalpet	Mr. S. Sundar (I/C), J.I.S.
Madathukulam	Dr.C.M.Babu, Sci.-D, REC-Udumalpet	Mr. S. Sundar (I/C), J.I.S.
Manurpalayam	Dr. A.M. Babu, Sci.-D, REC SU-Avinashi	Mr. S. Raveendran, A.I.S.
Ottanchathiram	Mr. A. Gnanakumar Daniel, Sci.-D, REC-Samayanallur	Mr. C. Thangavel, A.I.S.
Palani	Smt. G. Punithavathy, Sci.-D, REC-Udumalpet.	Mr. C. Thangavel, A.I.S.
Pitchandampalayam	Smt. E. Rajalakshmi, Sci.-D, REC-obichettipalayam	Mr. G. Gopalan, I.S.
Pollachi	Dr. K. Chandrasekharan, Sci.-D, REC-Udumalpet	Mr. P. Rajendran, A.I.S.
Pongalur	Dr. A.M.Babu, Sci.-D, REC SU-Avinashi	Mr. S. Ravi, A.I.S.
Poolavadi	Dr. P. Samuthiravelu, Sci.-D, REC-Udumalpet	Mr. A.M. Shanavas, A.I.S.
Sanarpatti	Mr. T. Sivasuramonian, Sci.-D, REC-Samayanallur	Mr. S. Ramesh, A.I.S.
Srivilliputhur	Dr. S. Rajaram, Sci.-D, REC-Srivilliputhur	Mr. R. Jegadeesan, A.I.S.
Udumalpet	Dr. P. Samuthiravelu, Sci.-D, REC-Udumalpet.	Mr. S. Sundar (I/C), J.I.S.
Uthangarai	Dr. S. Masilamani, Sci.-D , REC-Krishnagiri	Mrs. C. Pushpha (I/C), J.I.S.
MAHARASHTRA		
Clusters	CSB	DOS
Akola	Mr. R.V. Kushwaha, Sci.-D, REC-Amravati	Mr. S.S. Shinde, District Sericulture Officer, Akola
Beed	Mr. Rahul Singh, Sci.-D, REC SU-Aurangabad	Mr. B.K. Satdive, SDO, Gr.II, Beed
Buldana	Mr. R.V. Kushwaha, Sci.-D, REC-Amravati	Mr. H.S. Chavan, District Sericulture Officer, Buldana
Jalna	Mr. Rahul Singh, Sci.-D, REC SU-Jalna	Mr. Ramesh. B. Hande, SDO, Gr.II
Nanded	Mr. A. J. Karande, Sci.-D, REC-Parbhani	Mr. P. J. Patil, SDO, New Mondha
Osmanabad	Mr. P. Bagde, Sci.-D, REC SU-Osmanabad	Mr. M.K. Mulla, SDO, Osmanabad
Sangli	Mr. Ramprakash, Sci.-D, REC-Baramathi	Mr. Vineet pawar, SDO, Sangli

Satara	Mr. Ramprakash, Sci.-D, REC-Baramathi.	Mr. Vineet Pawar, SDO, Satara
Wardha	Mr. R.V. Kushwaha, Sci.-D, Amravati	Mr. P.S. Padvi, District Sericulture Officer, Wardha
MADHYA PRADESH		
Clusters	CSB	DOS
Betul	Dr. Pradip Shukla, Sci.-D, REC, Hoshangabad, REC SU-Burhanpur	Mr. Arjun Singh, Field officer
Burhanpur		Mr. S. N. Pawar, Field officer
Hoshangabad		Mr. Navneet Gaur, Field officer
Khandwa		Mr. Ashok Gorraya, Field officer
KERALA		
Clusters	CSB	DOS
Palakkad	Smt. K.Sarala, Sci-D, REC-Palakkad	Mr. Sasi ASO, Palakkad
Waynad	Smt. K.Sarala, Sci-D, REC-Palakkad	Mr. Salim Kuar ASO, Wayanad

Performance of Clusters:

Raw silk production: This year south zone clusters recorded a high time achievement of bivoltine raw silk production of 3905 MT (102.77% achievement) against the target of 3800MT with annual increase in bivoltine raw silk production of 719.08 MT (22.57%) over the previous year.

Raw Silk Production in South Zone Clusters			
Year	Target (MT)	Production (MT)	Acheivement (%)
2013-14	1400.00	1420.90	101.49
2014-15	1944.00	2241.15	115.30
2015-16	2491.50	2772.09	111.26
2016-17	3100.00	3186.27	102.84
2017-18	3800.00	3905.35	102.77
Total	12735.50	13525.76	106.20

Bivoltine Raw Silk Production - State wise (2017-18)			
Cluster	Raw Silk Production (MT)		Acheivement (%)
	Target	Acheivement	
KA	1504.00	1423.77	94.67
AP	880.50	1092.15	124.04
TEL	99.00	121.25	122.47
TN	1087.50	1002.31	92.17
MH	168.92	223.74	132.45
MP	38.46	26.51	68.91
Kerala	23.08	15.63	67.73
Total	3800.00	3905.35	102.77

Crop performance: A total of 352.28 lakh dfls were distributed to the farmers against the target of 367.90 lakh (95.76% achievement) and the brushing capacity of farmers increased by 20.63% though majority of clusters were affected by severe drought. A total of 23906.9MT bivoltine cocoons were produced with an average cocoon yield of 72.15 kg/100 dfls.

Performance of South Zone Clusters - Dfls distribution (2017-18)					
Cluster	Target (Lakhs)	Silkworm Crops (Nos)	Dfls (Lakh Nos)	Acheivement (%)	IO (%) 2016-17
Karnataka	150.40	77106	136.86	91.00	15.17
Andhra Pradesh	88.05	36060	96.63	109.74	30.30
Telangana	9.90	4068	11.12	112.30	37.79
Tamil Nadu	94.25	47767	81.11	86.06	10.05
Maharashtra	18.30	10875	22.04	120.45	69.41
Madhya Pradesh	5.00	1622	3.33	66.67	6.39
Kerala	2.00	1018	1.21	60.44	8.04
Total	367.90	178513	352.29	95.76	20.63

The performance of each cluster was documented monthly as per targets and achievements on all the activities are given in the table. In the table IO represents increase over the previous year; figures in parenthesis indicate number of farmers under taken new plantation.

Performance of Karnataka Clusters - Bivoltine Raw Silk Production (2017-18)									
Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Plantation in ac. (farmers)
	Target (lakh)	Crops (No.)	Ach.		Target	Ach.	Ach. (%)	IO 2016 -17 (%)	
Andaralahalli	2.40	973	183075	65.99	24.0	18.59	77.45	23.33	162(136)
Aurad	1.20	339	104650	72.13	12.0	11.61	96.77	63.93	41(51)
B.R. Koppalu	5.00	2610	522670	65.22	50.0	52.44	104.88	19.50	150(121)
Bannikuppe	2.00	1151	180725	65.20	20.0	18.13	90.63	12.04	100(53)
Belagam	5.75	4269	548300	80.82	57.5	68.18	118.57	9.88	356(183)
Bevuru	1.75	1221	146171	66.14	17.5	14.87	84.99	29.82	32(32)
Bidarakote	1.90	1389	211593	66.48	19.0	21.64	113.90	23.06	178(157)
Bijapur	1.60	967	150575	62.71	16.0	14.53	90.80	37.22	425(265)
Challakere	4.50	1756	394875	61.30	45.0	37.24	82.76	32.08	175(91)
Channarayapatna	1.40	732	94025	59.93	14.0	8.67	61.92	41.41	189
D. Halasahally	1.50	1210	170395	72.86	15.0	19.10	127.33	28.76	114(144)
Davangere	3.00	1684	284746	69.27	30.0	30.34	101.15	21.31	120(94)
Doddalahalli	2.50	1989	211755	69.78	25.0	22.73	90.93	14.52	367(489)
Gajanur	2.20	1856	275944	67.25	22.0	28.55	129.78	25.00	34(20)
Gouribidanur	3.50	993	288345	68.03	35.0	30.18	86.22	39.94	
Gulbarga	3.50	1861	384285	59.85	35.0	35.38	101.09	70.32	614(443)
H.D. Kote	2.80	1542	260065	63.92	28.0	25.57	91.33	24.56	51(35)
H B halli	4.25	1752	388512	68.16	42.5	40.74	95.82	22.50	147(137)
Harohalli (B)	3.00	1245	198125	68.55	30.0	20.89	69.65	40.12	198(125)
Harohalli (KKP)	3.60	2772	292737	68.39	36.0	30.80	85.55	19.13	257(540)
Haveri	4.30	2379	463825	65.99	43.0	47.09	109.51	18.33	862(393)
Hiriyur	2.75	1761	287220	61.07	27.5	26.98	98.13	26.67	372(191)
Humnabad	1.30	861	182050	66.77	13.0	18.70	143.84	18.72	77(100)
Ithandahally	8.0	3644	677970	68.44	80.0	71.38	89.23	6.14	
Jamkhandi	4.0	2825	410080	65.57	40.0	41.37	103.41	18.06	468(350)
K.R. Nagar	1.3	741	110277	66.21	12.5	11.23	89.86	24.01	61(60)
Kanakapura	2.5	1702	181015	68.37	25.0	19.04	76.16	11.81	319(336)
Kudligi	6.3	2592	480986	63.29	62.5	46.83	74.93	23.18	132(96)
Kurudumalai	2.5	871	226400	72.58	25.0	25.28	101.12	28.60	75(70)
Lingasgur	2.8	1061	232630	63.85	28.0	22.85	81.62	35.20	27(40)
Ranebennur	8.0	2971	644032	63.95	80.0	63.36	79.20	27.98	327(193)
Raugodlu	1.2	635	140302	73.47	12.0	15.86	131.99	3.93	22(19)
Shahapur	1.0	478	101600	69.81	10.0	10.91	109.12	54.56	190(104)
Shapur (Kolar)	5.7	2305	591635	69.31	57.0	63.09	110.68	10.96	125(66)
Shirahatti	2.8	1789	310700	62.70	28.0	29.97	107.04	28.21	296(179)
Siddlaghatta	2.5	745	171550	64.63	25.0	17.06	68.23	20.71	152(59)
Sira	4.8	2493	434365	66.67	48.0	44.55	92.82	14.97	130(137)
Soraba	1.2	805	98800	74.25	12.0	11.29	94.05	17.30	91(60)
T. Narasipura	3.2	1740	253150	61.61	32.0	23.99	74.98	14.65	120(129)
Tekal	4.0	1704	330430	73.06	40.0	37.14	92.85	7.73	
Thoresettyhally	1.2	553	95635	65.32	12.0	9.61	80.09	74.93	127(136)
Tubagere	1.5	925	127505	76.90	15.0	15.09	100.57	75.00	101()
Tumkur	5.0	3169	554077	73.26	50.0	62.45	124.90	4.87	127(127)
Y.N. Hosakote	11.5	4206	939600	69.47	115.0	100.42	87.32	23.55	199(167)
Yelburga	2.0	1095	190440	63.84	20.0	18.70	93.52	39.47	237(134)
Yeldur	1.8	745	158250	78.66	18.0	19.15	106.39	16.05	
Total /Avg.	150.4	77106	13686092	67.61	1504.0	1423.77	94.66	21.77	8343(6337)

Performance of Andhra Pradesh Clusters - Bivoltine Raw Silk Production (2017-18)									
Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Plantation in ac. (farmers)
	Target (lakhs)	Crops (No.)	Ach.		Target	Ach.	Ach. (%)	IO 2016 -17 (%)	
Atmakur	2.2	718	224400	69.61	22.0	24.03	109.23	22.04	356(252)
Bhimadole	2.6	811	230100	68.22	26.0	24.15	92.88	7.76	50(15)
Chebrolu	4.3	915	430750	76.12	43.0	50.44	117.31	25.92	250(89)
Chittoor	2.9	1528	443000	74.48	29.0	50.76	175.05	80.65	
Giddalur	4.0	1171	407400	73.02	40.5	45.77	113.06	26.99	125(42)
Hindupur	8.2	3711	1014900	75.99	82.0	118.65	144.70	62.51	227(129)
Kalyanadurgam	6.4	2585	653100	75.10	64.0	75.46	117.91	28.78	392(274)
Madakasira	12.0	5804	1581875	73.20	120.0	178.14	148.45	58.87	735(406)
Palamaner	16.0	7128	1652750	72.28	160.0	183.79	114.87	29.88	73(53)
Pattikonda	4.3	1121	426800	75.01	43.0	49.26	114.55	15.49	360(253)
Penukonda	4.3	2522	595200	72.69	43.0	66.56	154.80	69.15	540(538)
V. Kota	17.8	7124	1751500	73.46	178.0	197.94	111.20	18.04	776(555)
Vijayawada	3.0	922	251250	70.41	30.0	27.22	90.72	6.78	
Total/Avg.	88.05	36060	9663025	73.47	880.5	1092.15	124.04	35.44	3883(2606)

Performance of Telangana Clusters - Bivoltine Raw Silk Production (2017-18)									
Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Plantation in ac. (farmers)
	Target (lakhs)	Crops (No.)	Ach.		Target	Ach.	Ach. (%)	IO 16-17 (%)	
Bhongir	2.00	699	224100	73.09	20.0	25.20	126.00	53.94	
Metpally	2.30	902	274300	65.50	23.0	27.64	120.18	44.87	101(68)
Suryapet	3.00	843	317700	74.07	30.0	36.20	120.67	26.53	105(59)
Zaheerabad	2.60	1624	295650	70.79	26.0	32.20	123.84	36.32	42(42)
Total/Avg.	9.90	4068.00	1111750	70.89	99.0	121.2	122.47	38.28	248(148)

Performance of Tamil Nadu Clusters - Bivoltine Raw Silk Production (2017-18)									
Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Plantation in ac. (farmers)
	Target (lakhs)	Crops (No.)	Ach.		Target	Ach.	Ach. (%)	IO 2016-17 (%)	
Adaikalapattinam	2.8	1752	286475	76.91	32.3	33.89	104.79	22.81	36(26)
Alangkayam	7.0	2423	720030	81.17	81.1	89.92	110.84	28.15	24(35)
Alangudi	2.2	1256	206875	76.10	25.4	24.22	95.41	25.36	63(36)
Annur	4.8	2940	471955	79.53	55.6	57.75	103.85	22.50	144(88)
Anthiyur	2.7	1571	241835	84.06	31.2	31.27	100.39	53.61	80(51)
Bagalur	1.5	607	126400	81.13	17.3	15.78	91.16	1.66	
Berigai	6.5	3150	639805	79.79	75.0	78.54	104.72	15.18	145(83)
Bhavani	2.7	1366	198641	83.29	31.2	25.45	81.70	36.40	50(31)
Dharapuram	3.0	2071	258525	79.41	34.6	31.58	91.24	13.57	31(21)
Dharmapuri	3.0	2380	282870	79.57	34.6	34.63	100.04	24.20	525(301)
Gobi South	2.8	1644	245175	82.08	32.3	30.96	95.83	54.19	57(26)
Gudimangalam	2.8	1144	171350	77.63	32.3	20.46	63.34	25.34	10(7)
Keeranur	3.5	1311	240875	79.13	40.4	29.32	72.61	-6.76	24(13)
Kodiyalam	2.2	586	168750	82.00	25.4	21.29	83.86	0.89	
Komaralingam	1.5	510	89075	80.45	17.3	11.02	63.70	-8.05	12(6)
Kottur	1.4	478	100450	80.57	16.2	12.45	77.08	-7.22	
Madathukulam	3.0	1192	192550	80.56	34.6	23.87	68.94	-8.46	25(13)

Manurpalayam	2.4	1563	198860	83.32	27.4	25.49	92.95	6.17	39(36)
Ottanchatram	3.6	1600	316945	81.66	41.5	39.82	95.85	15.34	37(19)
Palani	4.5	1468	303500	80.24	51.9	37.46	72.15	-9.24	28(14)
Pitchandampalayam	3.4	1823	302475	83.47	39.2	38.84	99.01	34.68	67(34)
Pollachi	3.3	1502	261715	80.14	38.2	32.27	84.45	-5.26	29(15)
Pongalur	1.7	1024	136050	81.25	19.6	17.01	86.70	-2.15	17(17)
Poolavadi	4.0	1862	292400	79.60	46.2	35.81	77.59	-7.06	33(25)
Sannarpatti	3.3	1759	311650	79.14	38.1	37.95	99.66	18.58	31(23)
Srivilliputhur	4.0	2163	407575	77.95	46.2	48.88	105.90	23.21	38(29)
Udumalpet	5.1	1998	313125	80.49	58.8	38.77	65.89	22.28	25(17)
Uthangarai	5.5	4624	625053	80.67	63.6	77.58	122.07	42.79	255(433)
Total /Avg.	94.2	47767	8110984	80.32	1087	1002	92.17	12.84	1821(1399)

Performance of Maharashtra Clusters - Bivoltine Raw Silk Production (2017-18)

Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Plantation ac. (farmers)
	Target (lakhs)	Crops (No.)	Achivement		Target	Achivement	Achivement (%)	IO 16-17 (%)	
Akola	1.00	211	33600	67.21	9.2	3.47	37.64	-0.05	116 (116)
Beed	4.00	2478	606000	64.25	40.0	59.90	149.75	0.83	153(153)
Buldana	1.00	626	111739	65.72	10.0	11.30	112.98	0.94	245(245)
Jalna	3.80	1967	469600	62.18	38.0	44.93	118.23	0.47	158(157)
Nanded	2.00	759	158300	56.98	20.0	13.88	69.39	0.84	126(120)
Osmanabad	1.70	1921	339750	69.36	17.0	36.25	213.26	1.44	230(230)
Sangli	1.40	883	145150	67.71	14.0	15.12	108.01	0.32	177(159)
Satara	1.90	1477	211212	74.73	19.0	24.28	127.81	0.44	444(419)
Wardha	1.50	553	128800	70.96	15.0	14.06	93.75	0.86	401(261)
Total /Avg.	18.30	10875	2204151	66.07	182.2	223.20	122.48	0.70	2050(1860)

Performance of Madhya Pradesh Clusters - Bivoltine Raw Silk Production (2017-18)

Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Plantation in ac. (farmers)
	Target (lakhs)	Crops (No.)	Ach.		Target	Ach.	Ach. (%)	IO 2016-17 (%)	
Betul	2.00	481	133700	52.17	15.4	10.73	69.75	-0.09	Nil
Burhanpur	1.00	345	49475	50.62	7.7	3.85	50.09	0.04	Nil
Hoshangabad	1.00	420	78950	50.89	7.7	6.18	80.35	0.32	Nil
Khandwa	1.00	376	71228	51.93	7.7	5.69	73.98	0.59	Nil
Total /Avg.	5.00	1622	333353	51.68	38.5	26.46	68.79	0.12	Nil

Performance of Kerala Clusters - Bivoltine Raw Silk Production (2017-18)

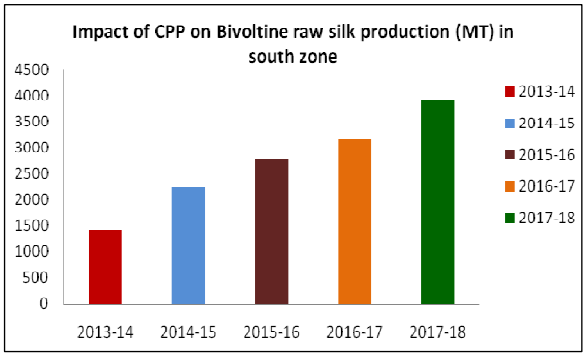
Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Plantation in ac. (farmers)
	Target (lakhs)	Crops (No.)	Ach.		Target	Ach.	Ach. (%)	IO 2016-17 (%)	
Palakkad	1.25	887	109721	84.08	14.4	14.19	98.41	0.12	20(20)
Wynad	0.75	131	11155	83.70	8.7	1.44	16.60	-0.02	15(15)
Total/Avg.	2.00	1018	120876	84.05	23.1	15.63	67.73	0.11	35(35)

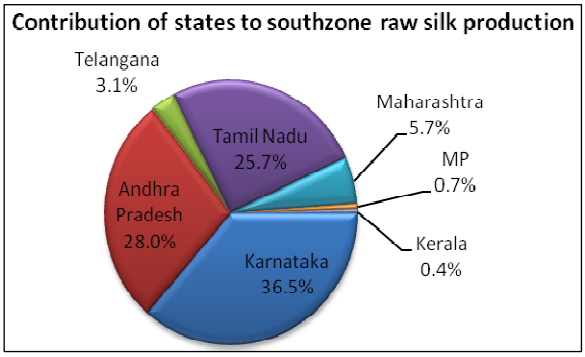
In order to increase the silk production in the clusters, more emphasis was given on horizontal expansion and 12385 farmers were motivated to plant improved mulberry varieties to the extent of 16381 acres in the 106 clusters. During the year, various ECPs (group discussion; Field days; awareness, enlightenment and training programmes; exposure visits; exhibitions)

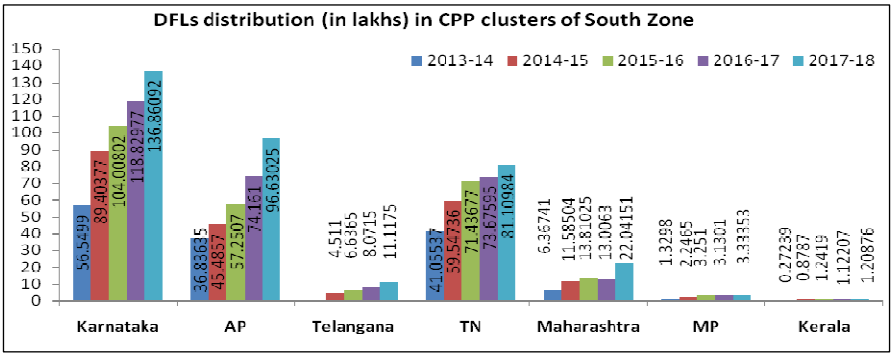
were conducted and farmers were sensitized on new technologies in the clusters. These programmes helped in changing the attitude of farmers and improved the technology adoption levels for improved productivity in bivoltine silk production.

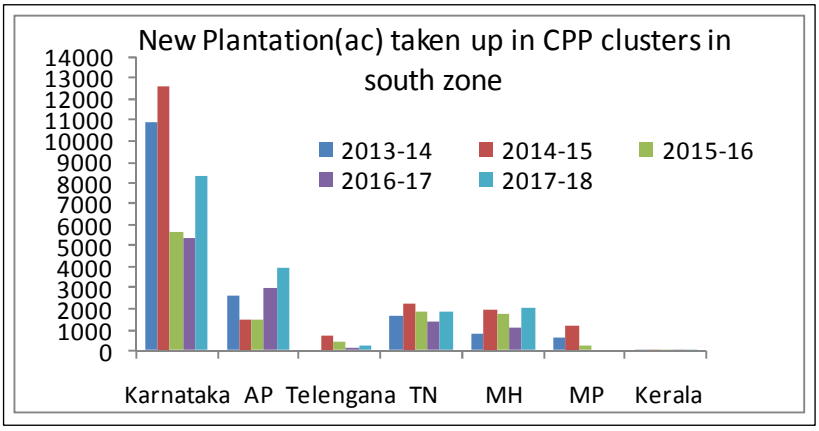
Topic
• Mulberry cultivation
• Mulberry Diseases/Pests & its management
• New Mulberry Varieties
• New Silkworm Hybrids
• Silkworm Rearing management
• Silkworm Disease/Pest control measures
• Management of rearing climate
• Fertilizer application

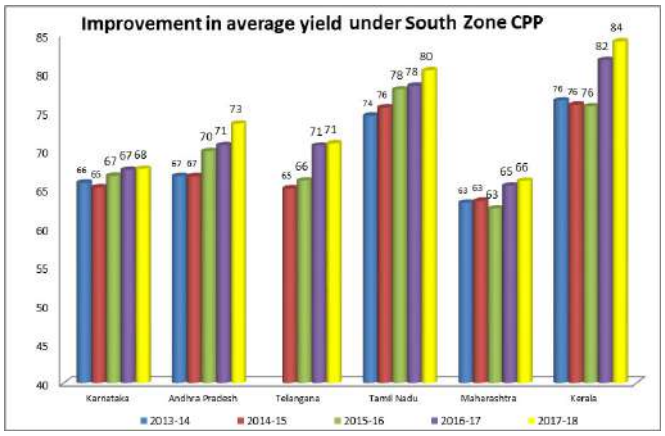
State	New mulberry plantation	
	No. of Farmers	Acres
Karnataka	6337	8343.59
Andhra Pradesh	2606	3883.50
Telangana	148	248.00
Tamil Nadu	1399	1821.40
Maharashtra	1860	2050.00
Madhya Pradesh		
Kerala	35	35.00
Grand Total	12385	16381

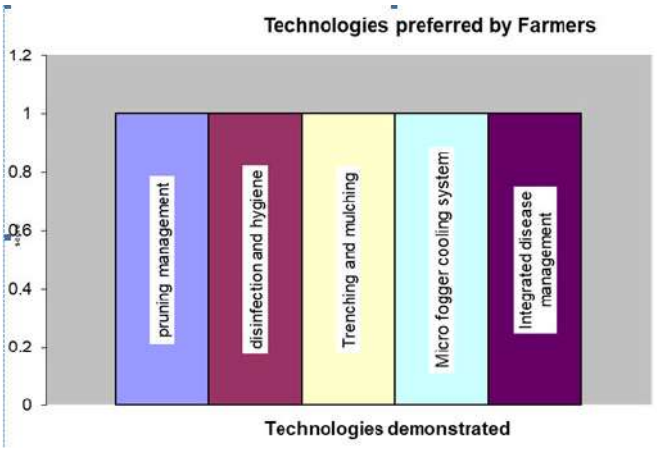


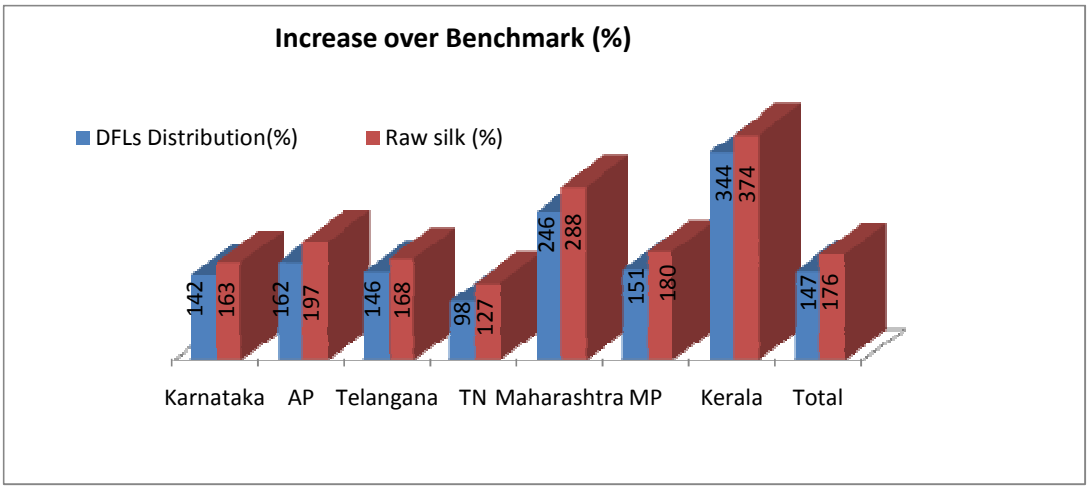












Continuous/Other Activities:

Extension Communication Programmes (ECPs): A total of 1678 Extension Communication Programmes were conducted and sensitized 1.25 lakh farmers in the states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh through extension units. The main technologies and topics covered under field day and awareness programes were management of pruning; trenching and mulching; micro-fogger cooling system; disinfection and hygiene; Poshan; *Nesolynx thymus*; Serifit; Rot fix; Cocoon harvestor; new mulberry variety; wider spacing/tree plantation drip irrigation Integrated Pest Management soil sample collection nimahari control measures for white fly Integrated Nutrient Management practices for mulberry popularization of new silkworm hybrids integrated disease management practices demonstration of rotary mountages mounting & spinning care etc.

Activity wise Extension Communication Programmes Conducted		
ECPs	Events	Farmers sensitized
Group Discussion	751	14988
Field day	122	7440
Demonstration of Technology	17	254
Awareness Programme	120	9386
Exhibition	27	29261
Workshop/Seminar/ Farmers Meet	13	2101
Farmers' Day	408	13420
Resham Krishi Mela	05	4515
Exposure visits	16	48
Farmers Meet	10	2101
Any other Programme	199	7912
Total	1678	125754

m-Kisan Portal: Regular SMSs are being sent once in every fortnight to transfer the technologies to the farmers in vernacular languages across the nation. A total of 97 SMSs, covering 60600 farmers in Karnataka, AP, Telangana, TN, Maharashtra and MP were sent during the year as a part of ToT programme with ecxcellent feedback.

Visitors' Service: CSRTI-Mysuru being the premier research institute in mulberry sericulture, people visits the institute to know about sericulture and latest technologies in mulberry cultivation and silkworm rearing. Every year sericulture farmers, students and general farmers from all over the country and foreign nationals visit throughout the year. This year 4842 people visited the institute for awareness and to receive updates on the recent innovations in sericulture.

Category	Persons visited (Nos.)
Farmers	2060
Students	2253
Foreigners	76
Others	453
Total	4842

Sericulture Farmers' Workshops

Karnataka: CSRTI-Mysuru had organised the Sericulture Farmers' Workshop on 6th March, 2018 at Hassan in coordination with the DoS, Government of Karnataka with theme 'Sericulture Enterprise - for farmer's prosperity'. Over 1500 farmers from sericulture districts of Karnataka, officials from the DoS and also the CSB Scientists participated in the workshop. The main thrust of workshop was to create awareness and empower farmers on the innovative sericulture technologies for bivoltine sericulture. A sericulture exhibition was also organized wherein new technologies/products/machines/equipments/publications developed by the institute were exhibited. Progressive sericulture farmers under different categories were awarded for their success. CDFs of State and CSB (Karnataka) were also awarded with appreciation certificates for their commendable achievement in CPP.

Products/Books Release
• New Mulberry Varieties - G4 Authorized variety for commercial release & AGB-8 Release of new variety for AICEM evaluation
• New silkworm Thermotolerant breeds TT21 x TT 56 for OST trials
• Uzi Sex pheromone traps
• ANKUR- An organic and inorganic nutrient suppliment for soil fertility and health
• Booklet on Automatic Disinfection Unit
• Booklet on Tree Mulberry Cultivation Technology
• Booklet on Model Rearing House
• Pamphlets on new technologies
• Booklets on Maragaddi brought by DoS-Karnataka

Tamil Nadu: RSRS-Salem organized a Resham Krishi Mela and Farmers Workshop in coordination with DoS-Tamil Nadu at Krishnagiri on 16-03-2018. ~500 farmers/officials including entrepreneurs attended the programme. A book on "Commercial Chawki rearing" and Pamphlets on six latest technologies in sericulture was released on this occasion. Progressive sericulture farmers from the region were honoured.

Telangana: RSRS-Anantapur also organized a workshop at Siddipet, Telangana on 11.10.2017 and was inaugurated by Sri. K. M. Hanumantharayappa, Hon'ble Chairman, CSB, Bengaluru. In the workshop, 1373 farmers including DoS officials and CSB Scientists/staff participated. Soil Health cards were distributed to farmers by the dignitaries. Scientists from CSRTI-Mysuru, RSRS-Anantapur and nested units delivered lectures on various aspects and interactive sessions with farmers on adoption of new technologies in sericulture.

Inaguration of Resham Krishimela

Inaguration of Exhibition

Release of New Silkworm Breeds

Section of Audience

Andhra Pradesh: RSRS-Anantapur organized a Sericultural Farmers' Workshop on "Bivoltine Sericulture for sustainable income in Andhra Pradesh - Technologies for enhancing productivity" at Chebrolu, East Godavari district on 21.12.2017 in coordination with DoS-AP. 954 farmers participated in the programme benefited from the deliberations and exhibition. The soil health cards were distributed to the farmers by the dignitaries.

Activities of RECs attached to SEEM Division, CSRTI-Mysuru: The performance of RECs in Karnataka, Maharashtra and Madhya Pradesh (attached to SEEM Division, CSRTI-Mysuru) with regard to the supply of seed cuttings/saplings of improved mulberry varieties for expansion of mulberry planatation; performance of CSR hybrids and extension communication programmes conducted for creating awareness on new technologies is summarized.

Centre	Area (Ac.)	Farmers (Nos)	Dfls (Nos)	Avg. Yield/ 100 dfls (kg)	GD	WS	Far. Day	FD/ AW	Exhibition	Demo of technology	Misc.
REC SU-Maddur	19468	15132	540149	64.78	24		16	13			3
REC-Amravathi	1509	1170	301901	70.0	18		12	3	6	3	31
REC-Aurangabad	1115	1051	705000	64.0	06		5	4	3		1
REC-Parbhani	280	1469	281400	57.8	09		5	3	6		7
REC SU-Osmanabad	733	664	340000	69.36	25		1	2		5	1
REC-Baramathi	188	191	183640	72.9	21	1	12	9	5		5
REC SU-Jalna	724	718	469600	62.0	07		5	2			1
REC-Hoshangabad	350	350	211700	51.52	12		4	4			
REC SU-Burhanpur	150	150	116698	47.5	12		9	4			
GD-Group Discussion; WS-Workshop; Farmers Day; FD-Field Day; AW-Awareness											

***Reshme Vahini* - AIR Mysuru Broadcasting Programme:** CSRTI-Mysuru sponsored AII India Radio (AIR)- for broadcasting a special series on Sericulture namely *"Reshme Vahini"* Krishi Ranga Programme. In this series, 29 episodes, each of 45 minutes duration, were broadcasted on every Wednesday at 6.50 pm from 8th March 2017 to 29th November 2017. 24 scientists, expertise in various disciplines, from CSRTI-Mysuru participated in the programmes. Technologies *viz.,* New silkworm races and silkworm rearing for summer season; Tree mulberry cultivation; AMIT Technology & LAC production; Drought management practices in sericulture; Organic farming; Trenching and Mulching in mulberry cultivation; Uzi fly management; Soil health management; Mulberry cultivation; Soil testing and Soil Health Cards; Economics of sericulture; Silkworm rearing technologies; Mulberry diseases management; Biological control of pests in sericulture; Silkworm diseases management; Implementation of Cluster Promotion Programme for Bivoltine Silk Production; New Improved Cross Breed (ICB) for quality silk production; Suitable rearing houses for silkworm rearing; Nutrient management in mulberry cultivation; Chawki rearing technologies; high yielding mulberry varieties; Paired row system of mulberry cultivation and wider spacing; Value addition of reeling by-products; Silkworm rearing in winter seasons; Mountages for production of quality cocoons; role of Information & Communication Technology in Sericulture extension; Women in Sericulture; New reeling technologies for quality silk production were broadcasted through AIR, Mysuru.

Phone-in-Programmes: Ten Phone-In Programmes were also arranged to facilitate farmers to have direct interaction with the scientists on various new technologies developed by CSRTI-Mysuru as mentioned above. Farmer's opinion on *Reshme Vahini* AIR Series programme was discussed and experiences of farmers were shared.

Technology demonstrations conducted at farmer's field: Five technology demonstrations on trenching and mulching, mulberry tree plantation and disinfection and hygiene were also organized in collaboration with AIR-Mysuru at progressive farmer's field with a total participation of 456 farmers (Balepura Doddi, Kanakapura; Hosakere, Maddur; Venugopala Pura, Bangarpet; Kebbepura, Nanjangud and Duddagere, Mysore).

Technology demonstration

Japanese Overseas Cooperative Volunteer Programme (JOCV): Japan Overseas Cooperation Volunteers under JICA was initiated during January 2015 to support CSB in extension activities - organising self help groups/Community Based Organisations in clusters. Two JOCVs are under operation in Hindupur and Madakasira (AP), Berigai and Bagalur (TN) respectively. The JOCV volunteers formed two SHGs for women in Penukonda area, AP and three at Tamil Nadu *viz.,* Thendurgum, Achettipalli and G. Agraharam. As a follow up action regular group meetings were conducted to review the progress of groups. Besides linking SHGs with Banks, group members were taken on exposure visit to CSRTI-Mysuru to enlighten with new sericulture technologies. JOCVs attended training on micro-credit and meta-facilitation at Murano Mirai in Visakapatnam to learn effective methods for community development and micro-credit.

Orientation training

Technology demonstration programme

Adarsha Resham Gram (ARG):CSRTI-Mysuru participated in 'Vignana Mela' a science day exhibition organized by the Government High school, Gopalapura, Adarsha Reshme Grama, programme on 09.01.2018. The event was inaugurated by the president of the village panchayat, followed by participation of staff and students of two nearby schools. The Institute contributed 80 Kannada books on varied science subjects during the occasion to the students. Over 300 children from three schools visited and interacted with the scientists and technical staff during the event.

Institute -Village Linkage Programme (Seri Model Village)

Objective: Transfer of technology through Institute - Village Linkage Programme (IVLP) for sustainable/stable bivoltine cocoon production.

IVLP was re-initiated in eleven clusters through CSRTI-Mysuru and its nested units in the states of Karnataka (4), Andhra Pradesh (2), Tamil Nadu (2), Maharashtra (2) and Madhya Pradesh (1) with 1000 farmers identified covering nearly 1000 acres of mulberry plantation.

State	Cluster	Scientists
Karnataka	Kadakola	Shri. S.B. Nagaraja, Sci.-D (upto June, 2017) and Shri. D.V. Purandhar, STA, CSRTI-Mysuru
	K.M. Doddi	Dr. D. Guruswamy, Sci.-C, REC-Maddur
	Hosakote	Dr. Ishwar, Sci.-C, REC- Bidarguppe
	Chamarajanagara	Dr. V. Girish Nayak, Sci.-D, RSRS-Chamarajanagara
Tamil Nadu	Sathyamangalam	Smt. Rajalakshmi E, Sci.-D, REC- Gobi
	Thondamathur	Smt. K. Sarala, Sci.-C, REC-Palakkad
Andhra Pradesh	Rayachoty	Dr. A. Venugopal, Sci.-D, REC- Rayachoty
	Vizanagaram	Dr.T.V.S. Rao, Sci.-D, REC- Chebrolu
Maharashtra	Ahmadnagar	Shri. Ramprakash, Sci.-D, REC- Baramathi
	Baramathi	
Madhya Pradesh	Hoshangabad	Shri. Pradip Shukla, Sci.-D, REC SU-Burhanpur

Awareness programmes on various technologies was carried out through demonstrations and ECPs. A total 14.56 lakh dfls of bivoltine hybrids were reared with farmers with an average yield of 68.27 kg/100 dfls was recorded representing 18.4% improvement in cocoon yield against bench marks. Through the programme the crossbreed rearing farmers were encouraged to rear bivoltine hybrids, a quantity of 129.6 MT of bivoltine raw silk was produced through IVLP.

IVLP Cluster-wise Progress (Seri Model Village Programme) April 2017- March 2018

State	IVLP Centre	Ann. Target (dfls)	Dfls Brushed	Bench Mark (kg/100 dfls)		% Improvement	Rate/ kg (Rs.)	Est. raw silk (MT)	
				Yield	Avg.			Target	Ach.
KA	Kadakola	150000	222940	60.00	66.23	10.38	518	15.00	19.68
	K.M.Doddi	90000	86750	58.00	61.19	5.20	472	9.00	7.08
	Hosakote	90000	67900	55.00	64.20	16.73	467	9.00	5.81
	Chamarajanagar	8000	2670	55.00	67.72	23.13	392	0.74	0.24
TN	Sathyamangalam	150000	158100	59.00	82.44	39.73	540	16.15	17.38
	Thondamuthur	130000	209050	67.00	80.00	19.40	510	14.00	22.30
AP	Rayachoty	60000	160950	60.00	68.97	14.95	477	5.57	14.80
	Vizanagaram	60000	60450	50.00	64.71	29.42	349	5.57	5.22
MH	Ahmadnagar	60000	160883	60.00	69.80	16.33	415	5.53	14.97
	Baramati	80000	42850 IVLP 42850 IVLP 175680	60.00	72.90	21.50	435	7.38	17.08
MP	Hoshangabad	30000	65066	50.00	52.80	05.60	420	2.14	4.60
	Total	9,08,000	14,56,139	58.42	68.27	18.40	454	90.10	129.16

CAPACITY BUILDING AND TRAINING

Rajashekar K and C. Parameswara

Several training programmes designed to serve the needs of practitioners and facilitators were conducted at the Institute and its nested units. The target groups consisted of personnel of the State Departments of Sericulture, teachers, researchers, students and practitioners including cocoon producers and chawki rearers, who were trained under different programmes - Technology Orientation Programme - TOP, Farmers' Skill Training-FST, Need Based Training-NBT, Intensive

Training in Bivoltine Sericulture-IBT, etc. Of the 2885 persons trained during the year, 925 were trained at CSRTI-Mysuru and 1960 at its Regional stations (RSRS) and extension units (REC).

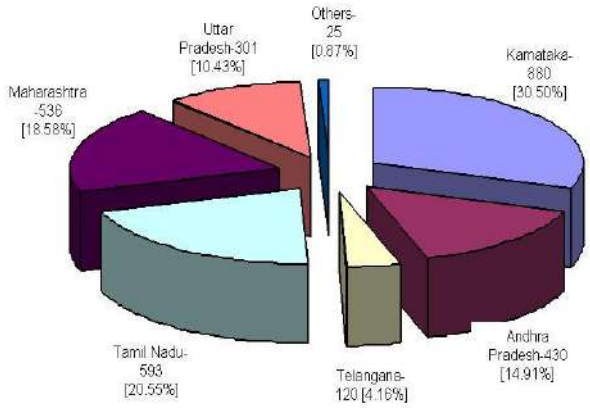
Programme	Name of the course	Duration (days)
Technology Orientation Programme (TOP)	Refresher course	10
	Orientation programme	5
Farmers' Skill Training (FST)	Chawki silkworm rearing	10
	Late age silkworm rearing	10
	Mulberry cultivation technology	5
Need Based Training (Officials) (NBT)	Orientation programme	15/40
	Popularization of high yielding mulberry varieties and silkworm races	3
	Training on Sericulture in relation to Watershed management	2
	Mulberry & silkworm breeding and genetics	22
Need Based Training (Farmers) (NBT)	Chawki silkworm rearing	10
	Intensive training in bivoltine sericulture	90
	Awareness programme	5
	Commercial chawki rearing	90
	Intensive training in bivoltine sericulture	35
	Integrated pest and disease management	5
	Sericulture technology	5

Prog.	Location	Category of trainees	State							Total
			KA	AP	TS	TN	MAH	UP	Others	
TOP	CSRTI-Mysuru	O	47			60	25			132
FST		F	103	14	66					183
TOP	RSRS & RECs	O	77	0	0	57	0		0	134
FST	RSRS & RECs	F	577	409	50	420	370		0	1826
NBT	CSRTI-Mysuru	O	15	1	0	49	0		15	80
NBT		F	55	3	3	7	138	301	09	516
IBT		O	6	3	1		3		01	14
Total			880	430	120	593	536	301	25	2885
F- Farmers; O-Officers; KA- Karnataka; AP-Andhra Pradesh; TS-Telangana; TN-Tamil Nadu; MAH-Maharashtra; UP-Uttar Pradesh										

Number of persons trained at the nested units of CSRTI-Mysuru			
Unit	FST	TOP	Total
RSRS-Kodathi & RECs in Karnataka	522	55	577
RSRS-Chamarajanagara, Karnataka	55	22	77
RSRS-Anantapur & RECs in AP and Telangana	459	0	459
RSRS-Salem & RECs in Tamil Nadu and Kerala	420	57	477
REC-Baramati, Maharashtra	75	0	75
REC-Amaravathi, Maharashtra	60	0	60
REC-Parbhani, Maharashtra	90	0	90
REC-Aurangabad, Maharashtra	75	0	75
REC-Jalna, Maharashtra	70	0	70
Total	1826	134	1960

Training in Commercial Chawki Rearing for potential entrepreneurs:

The programme is designed to train potential entrepreneurs who wish to establish Commercial chawki (young age silkworm) rearing centres. The 90 days programme includes classroom sessions on technologies involved in chawki silkworm rearing, mulberry cultivation, crop protection, mechanization and economics of chawki rearing. The participants are trained in chawki silkworm rearing over 9 crop cycles. Successful completion of this training is mandatory for registration of their enterprise. During the year, 62 entrepreneurs (Kar.-45; TS-2; AP-1; TN-5 and Mah.-9) were trained under this programme.



Number of Persons Trained – State-wise

	Programme	Duration (days)	State					Total
			KA	AP	TN	MAH	Others	
fficials	Orientation training	15/40	1		9			10
	Training on Sericulture in relation to Watershed management	2	14					14
	Chawki silkworm rearing	8/10		1			9	10
	Popularization of high yielding mulberry varieties & silkworm races	3			40			40
	Mulberry & Silkworm breeding and genetics	22					6	6
		Total	**15**	**1**	**49**		**15**	**80**
Sericulturists	Chawki silkworm Rearing	10	1	1		45	9	56
	Integrated pest & disease management	5				23		23
	Intensive training in Bivoltine sericulture	90	2					2
	Awareness Programme	5				59	280	339
	Intensive training in Bivoltine sericulture	35	7	1	2	2	1	13
	Sericulture technology	5					21	21
		Total	**10**	**1**	**2**	**129**	**311**	**454**

Training Programmes conducted on request by outside agencies:

During the year, the Institute conducted three special programmes designed to meet the requirements of the sponsoring agencies.

A. **Training on Sericulture in relation to Watershed management:** The programme was designed to cater the needs of officers of the Department of Sericulture involved in the implementation of SUJALA III programme of the Department of Watershed Development, Government of Karnataka. The programme emphasized on the sericulture technologies with special reference to water stress situations. Thirteen officers attended the two day programme during 21st-22nd August 2017.

B. **Popularization of high yielding mulberry varieties and silkworm races:** The three day programme was organized on request from the State Agricultural Management and Extension Training Institute [SAMETI], Tamil Nadu. Forty personnel of Department of Sericulture, Government of Tamil Nadu participated in two batches during 12th-14th and 29th-31st January 2018.

C. **Mulberry & Silkworm breeding and genetics:** A training programme of three weeks duration in Mulberry and Silkworm breeding and genetics was conducted for the benefit of five newly recruited Assistant professors from the Temperate Sericulture Research Institute, Sher-E-Kashmir University of agricultural sciences and technology, Mirgund, J&K and one research scholar from the University of Mysore was conducted at the Institute during 19th Feb. to 12th March 2018. The participants were trained in various methodologies involved in both conventional and non-conventional breeding

Need Based Training Programmes [NBT]:

These programmes are tailor made to suit the specific requirements of the target groups like State government personnel, sericulturists, unemployed youth, personnel from NGOs, Universities etc.

techniques by the Scientists of the Institute. In addition, external faculties who have contributed immensely to silkworm and mulberry crop improvement were also invited for guest lectures.

Project work by students:

The Institute also offers guidance and facilities to undergraduate and postgraduate students for carrying out research work as a partial fulfillment of their courses. During the year 13 undergraduate and 68 post-graduate students enrolled for dissertation work in the areas of microbiology, biochemistry, biotechnology, Silkworm breeding, Pest management and bioinformatics. 38 post-graduate and 04 undergraduate students have completed their research work and submitted their dissertations.

#	Subject	Name of the College/University	No. of students	
			UG	PG
I	Microbiology	Mangalore University, Kodagu		4
		Pooja Bhagavat Memorial Mahajana Education Centre, Mysuru		11
		The Oxford college of Science, Bengaluru		3
		Maharani's Science College for Women, Mysuru		7
II	Biochemistry	JSS University, Mysuru		2
		Markaz Arts and Science College, Karthala, Malappuram, Kerala		3
		Pazhassiraja College, Kerala		3
		Maharani's Science College for Women, Mysuru		4
III	Biotechnology	Sri Jayachamarajendra College of Engineering, Mysuru	5	
		Sri. Dharmasthala Manjunatheshwara PG Centre, Ujire		10
		Pooja Bhagavat Memorial Mahajana Education Centre, Mysuru		6
		Adhiyaman College of Engineering, Hosur, Tamil Nadu	4	
		Yuvarajas Science College, University of Mysore, Mysuru		1
		University of Madras, Chennai, Tamil Nadu		3
IV	Bioinformatics	Sri. Krishna Arts College, Tamil Nadu		3
		Periyar Maniammal University, Tanjavur, Tamil Nadu	4	2
		JSS University, Mysuru		3
V	Silkworm breeding	Shivaji University, Kolhapur, Maharashtra		2
VI	Pest management	Shivaji University, Kolhapur, Maharashtra		1
		Total	13	68
UG- Undergraduate; PG- Post-graduate				

Silkworm Rearing:

The Institute also conducts Chawki and late age silkworm rearings as part of the training programmes for skill development. During the year 83,600 dfls were chawki reared and distributed among 578 rearers. Late age silkworm rearings were conducted in five batches to impart skills in the participants of training programmes. The details of chawki rearing and late age silkworm rearings are presented in the tables.

Details of Chawki Rearing			
Month	No. of dfls reared	No. of farmers served	Cocoon yield /100 dfls
April 2017	6650	45	79.0
May 2017	5950	41	86.0
June 2017	7400	49	85.0
July 2017	8100	47	72.0
August 2017	8200	55	81.0
September 2017	8500	64	71.0
October 2017	8800	57	80.0
November 2017	8400	62	80.0
December 2017	6650	51	79.0
January 2018	7100	55	84.0
February 2018	4500	30	88.0
March 2018	3350	22	87.2
Total / Av.	83600	578	81.0

Details of late age silkworm rearings							
Season	Hybrids	No. of dfls	Hatching (%)	SCW (g)	SSW (g)	Shell (%)	Yld./100 dfls (kg)
Jul. - Aug. 2017	Double Hybrid	100	97.00	1.625	0.366	22.52	81.53
Aug.- Sept. 2017	Double Hybrid	100	89.33	1.420	0.322	21.11	60.32
Feb.- Mar. 2018	Double Hybrid	100	94.00	1.716	0.370	21.72	76.28
Aug.- Sept. 2017	Double Hybrid	100	89.33	1.420	0.322	21.11	60.32
Feb.- Mar. 2017	Double Hybrid	100	94.00	1.716	0.370	21.72	76.28
	Total/Avg	500	90.07	1.579	0.35	21.49	68.13
SCW- Single Cocoon Weight; SSW-Single Shell Weight							

Feedback evaluation:

Feedback evaluation is conducted at the end of training programmes through a questionnaire. The course-wise feedback is tabulated and presented hereunder.

Course	Training Utility Index	Training Efficiency Index	Training Facility Index	Course Coverage	Training Mgmt. Index	Variance over benchmark of 65%
Orientation Course	94.32	93.44	92.11	89.20	92.27	27.27
Refresher course	86.26	88.29	80.75	91.74	86.76	21.76
Training on Sericulture in relation to Watershed management	72.57	77.86	78.64	72.86	75.48	10.48
Chawki silkworm rearing	88.00	86.67	83.17	91.11	87.24	22.24
Popularization of high yielding mulberry varieties and silkworm races	76.55	82.78	81.96	80.50	81.20	16.20
Intensive Training in Bivoltine Sericulture	80.67	85.38	82.14	85.00	83.30	18.30

Other activities:

1. Training R & D personnel of CSRTI–Mysuru in Capacity building

The Training Division organized workshop on '**Capacity building with special reference to presentation and communication skills**' for the benefit of R&D personnel of the Institute. The workshop was conducted on two days for two separate batches of scientists on 7th and 8th December 2018. Forty scientists participated in the workshop that was conduced with trainers from the Focus academy of life skills and entrepreneurship development, Mysuru.

2. Participation in science exhibitions

(a) Government high school, Gopalapura, Mysuru district on 9th January 2018

The Institute participated in the 'Vignana Mela' a science day and exhibition organized by the Government High school, Gopalapura, which is a village adopted by the Institute for its overall development under the Adarsha Reshme Grama programme. The Institute contributed 80 books on varied science subjects published in Kannada during the occasion to be distributed among the students. Scientists and technical staff of the Institute set up exhibits to elicit soil types, soil properties, root infesting nematodes, anatomy of leaf, root and stem, anatomy of silkworm with special emphasis on silk gland, life cycle of silkworm, reeling silk and cocoon handicrafts through live specimen, demonstration and posters. Over 300 children from three schools visited and interacted with the scientists and technical staff during the event.

(b) Government higher primary school, Kumbarakoppalu, Mysuru on 17th January 2018

The Institute participated in the Science exhibition organized by the Government higher primary school, Kumbarakoppalu, Mysuru, under the National Innovation Programme. The event was inaugurated by Ms. Manjula, Deputy Director, Department of Education, Mysuru. NGOs like Kalisu Foundation and Agastya Foundation also participated in the event, which attracted over 200 students from two nearby schools in addition to the students of the host institution. Scientists and technical staff of the Institute set up exhibits to elicit soil types, soil properties, root infesting nematodes, anatomy of leaf, root and stem, anatomy of silkworm with special emphasis on silk gland, life cycle of silkworm, reeling silk and cocoon handicrafts through live specimen, demonstration and posters.

FARM MANAGEMENT SECTION

B. T. Sreenivasa

Continuous Activities

- Maintained 19.0 acres of mulberry garden, 2.0 acres chawki garden and 3.0 acres tree plantation for continues production of quality mulberry leaf with recommended package of practices, with mechanization, synchronizing with the different rearing programmes of the institute.
- Maintained all the farm machineries i.e., Tractors (two), Power Tillers (four), Irrigation pump sets (nine), Pruning machines and other equipments for effective management of mulberry garden of the section, experimental plots of other sections, transportation facilities to different rearing sections for effective implementation of research and related programmes and general upkeeping of the Institute.
- Maintained chawki plot with recommended package of practices with V1, G2 & G4 varieties, (4+3)x2 ft spacing, for continuous supply of quality chawki leaf for chawki rearing.
- Supplied 60680kg mulberry leaf and 100750kg mulberry shoot from 13.0 acres to different rearing sections viz., BBL, MBL, Transgenic, SW Genetics, SW Physiology, SW Pathology, RTI, TVDC and Training Divisions respectively for rearing of 7105 Dfls under different projects/experiment/race maintenance programmes.
- Supplied 25720kg chawki leaf from 3.00ac chawki plot to Commercial Chawki Rearing Centre of the Institute for quality chawki rearing of 85100 dfls.
- Demarcated 5.0 acre V1, G2 & G4 mulberry garden for production and supply of seed cuttings for multiplication in field level.
- Supplied mulberry seed cuttings (V1: 110.39 MT, 182 farmers, 441.56 acres; G2: 6.814 MT, 16 farmers, 27.254 acres; G4: 30.297 MT, 80 farmers, 121.188 acres) for establishing new plantations.

BIOINFORMATICS CENTER (Sub-DIC under BTISNET)

V. Sivaprasad (Coordinator), S. Manthira Moorthy (Co-Coordinator) and R. Sumathy

The Bioinformatics Centre at CSRTI-Mysuru was established in November, 1999 as Sub-DIC under BTISNET-DBT, GoI. A notable aspect of the center has been accessibility of the center to Scientists, Researchers, Teachers and students who are involved in research in the field of Sericulture, Seri-biotechnology and Seri-bioinformatics not only in the institute but also from other **CSB** research institutes and universities. The center has worked like a catalyst for bringing out the awareness in Bioinformatics among the students, scientists and researchers of various colleges, research institutes and biotechnology industries in and around the region thus contributing significantly for the Human Resource Development in the field of Biotechnology and Bioinformatics.

Seven students of Periyar Maniammai Institute of Science and Technology, Thanjavur and Sri Krishna Arts and Science College, Coimbatore completed their dissertation work. 31 participants included students, research scholars and faculty of various universities/ institutes and organizations have participated in the workshop on Bioinformatics and its application in Biological Research conducted on 20-21 March 2018.

Databases developed and maintained (http://btismysore.in)	
Database	Utility
SILKPROT	An Annotated Protein Database for Silkworm
SilkTF	Silkworm specific transcription factor databases
MulTF	Mulberry specific transcription factor databases
Mulberry Genome Database	Extensive molecular marker data on different mulberry genomes in the form of DNA fingerprints and molecular IDs, binary scores etc.
Soilinfo	Information on types of soils in South India including physio-chemical properties, micro-nutrient status etc.
SilkPPI	Protein-protein interaction in Silkworm, *Bombyx mori*
MulSatDB	Comprehensive database for mulberry microsatellite marker database
STRPLOT	A program for drawing elegant STRUCTURE bar plots in user friendly interface.
Growth Index	Growth Index- Construction of growth indices in popular breeds/hybrids of silkworm *Bombyx mori* in relation to nutritional supplement.
MULINDUS	Mulberry DUS descriptors and test guidelines

Regional Sericultural Research Stations (RSRS'S)

Regional Sericultural Research Stations (RSR'S) are established to address the regional problems of sericulturists through research & extension support of sericulture technologies in varied agro-climatic regions. Their main objective includes undertaking validation trials & demonstration of new sericulture technologies evolved by the main institute to the sericulturists. The proven technologies are transferred further to the field through Research Extension Centres (REC) and sub-units functioning under RSRS.

RSRS-KODATHI

RSRS-Kodathi
RECs
Bidaraguppe
Chitradurga
Madivala
Sub-Units
Bijapur
Jamkhandi
Kanakapura
Koppal
Kudlagi
Ranebennur
Shahapur
Shirahatti
Tumkur

Command Area	Staff	
	In-charge Officers Dr. Jalaja S Kumar, Sci.-D	
Karnataka	Scientists	11 at RSRS 08 at Sub-units
	Technical Staff	09 at RSRS
	Administrative Staff	03

Farm Based Units		
Unit	Total Area (Ac.)	Mulberry (Ac.)
RSRS-Kodathi	66.90	11.00
REC-Bidaraguppe	7.00	2.07
REC-Chitradurga	7.00	2.41
REC-Madivala	8.00	3.50
REC SU-Koppal	8.00	1.50
Total	96.90	20.48

Research Project:

MOE 3564: Impact of CPP on Sericulture development in North Karnataka (Mar. 2016 - Sept. 2017)

Raveendra M. Mattigatti, (PI), H. Jayaram, M. K. Raghunath and Y. Sanathkumar

Objectives:

- To study the impact of CPP on technology adoption and productivity improvement in sericulture in North Karnataka
- To study the impact of CPP on socio-economic development of sericulturists in North Karnataka
- To study the technological efficiency as impact of CPP

Collaborative Research Projects/Programmes	
Project Code	Title
PRE 3527	Survey and surveillance of major pests and their natural enemies in mulberry eco-system. (REC-Madivala & REC SU-Kanakapura)
PRE 3535	Popularisation of Nemahari - A bio-nematicide for management of root knot disease in mulberry. (REC SU-Kanakapura)-Concluded
PPA 3580	Soil health cards for sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh. (RSRS-Kodathi)
ARP 3519	Silkworm disease monitoring of seed and commercial crop rearing of south Indian state. (All CPP clusters of Karnataka)
MOE 3595	Development of business models for enterprises in pre-cocoon sector of Sericulture (REC, SU-Kanakpura)

PPA 3580: Soil health cards for sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh

P. Sudhakar and Jalaja S Kumar

Objective: To make the farmers aware about the importance of soil fertility on the production of quality mulberry leaves by issuance of soil health cards

1684 soil samples received from the sericulture farmers of different CPP clusters in Karnataka were subjected for processing, labelling and chemical analysis for their soil reaction (pH, EC) and available nutrient parameters such as macro N, P, K kg/ha & micro S, Zn, B, Fe, Mn & Cu.

Range of soil parameters					
#	Parameters	Range	Analysis range	Nutrient trends	Nutrient distribution
1	pH	Min	6.17	<6.5	18
		Max	7.73	6.5-7.5	61
		Avg	7.10	>7.5	21
2	EC (dS/m^2)	Min	0.12	<1.00	99
		Max	0.80	>1.00	1
		Avg	0.39	--	--
3	OC (%)	Min	0.15	<0.65	74
		Max	0.86	0.65-1.00	24
		Avg	0.47	>1.00	2
4	Nitrogen (N) (kg/ha)	Min	115.02	<250	76
		Max	225.56	250-500	23
		Avg	169.28	>500	1
5	Phosphorus (P) (kg/ha)	Min	9.88	<10	34
		Max	132.36	10-20	30
		Avg	36.49	>20	36
6	Potash (K) (kg/ha)	Min	182.70	<110	18
		Max	896.58	110-240	40
		Avg	554.35	>240	42
7	Sulphur (S) (ppm/ha)	Min	9.04	<10	15
		Max	80.78	10-15	34
		Avg	29.50	>15	51
8	Boron (B) (ppm/ha)	Min	0.12	<0.5	56
		Max	1.27	0.5-1.0	31
		Avg	0.56	>1.0	13

Cluster Promotion Programme (CPP): Bivoltine sericulture technologies were disseminated in 36 clusters across Karnataka. A total of 110.98 lakh bivoltine hybrid dfls with 95.32% achievement against the target (121.53 lakh dfls) were brushed with an average yield of 68.84 kg/100 dfls and 6964 acres of new plantation was undertaken with 4928 farmers 15179 farmers sensitized through 325 extension programmes.

Zone	Parameters	Target	Ach.
South Karnataka (22 Clusters)	Dfls (lakhs)	74.25	67.42 (90.8%)
	Yield / 100 dfls (kg)		70.71
North Karnataka (14 Clusters)	Dfls (lakhs)	48.75	45.93 (94.22%)
	Yield / 100 dfls (kg)		66.97
Total	Dfls (lakhs)	123	113.3 (92.2%)
	Yield / 100 dfls (kg)		68.84

On station trials of newly developed Bivoltine test hybrids

M. Venkatachalapathy, G. Veeranna Gowda and Jalaja S. Kumar

1. Rearing performance of new BV hybrids (4 trials)

4 trials of rearing of new Bivoltine hybrids *viz.,* N21 x N56, N23 x N67, N2 x N6 and FC1 x FC2 (control) were conducted during, May-17, June-17, August-17 and October-17. The mean of 4 trials data revealed that there is significant difference between treatments, seasons and treatment and seasons.

Treatment	Fecundity (No.)	Hatching (%)	ERR (No.)	ERR (kg)	Single Cocoon wt. (g)	Single Shell (g)	SR (%)
T1 (N21 x 56)	522	95.35	9267 ± 101.75	17.20 ± 0.41	1.893 ± 0.05	0.405 ± 0.01	21.34 ± 0.23
T2 (N23 x 67)	488	95.45	9286 ± 41.10	16.87 ± 0.37	1.846 ± 0.04	0.404 ± 0.01	21.89 ± 0.27
T3 (N2 x N6)	492	94.83	9144 ± 80.32	16.38 ± 0.45	1.827 ± 0.05	0.402 ± 0.01	21.95 + 0.23
T4 (FC1 x FC2)	498	95.45	9354 ± 78.09	17.71 ± 0.41	1.941 ± 0.05	0.423 ± 0.01	21.80 ± 0.25
Mean	500	95.27	9263 ± 39.39	17.04 ± 0.21	1.876 + 0.02	0.408 ± 0.01	21.75 ± 0.12
Treatment			2.96 *	12.99 **	335.90 **	5.77 **	NS
Season			18.42 **	144.95 **	122.00 **	21.04 **	5.94 **
Treatment x Season			6.60 **	3.26 **	57.48 **	5.38 **	3.38 **
Note: Mean ± SE; ** - Significant at 1% level; * - Significant at 5% level							

Rearing performance new BV breeds: Rearing of 3 tests breeds *viz.,* MASN4, MASN6, MASN7 and FC1 x FC2 as control (Three trials) were carried out during September-2017, November-2017 and January-2018. The data revealed that there is a significant difference between treatments, seasons and treatment and season.

Rearing performance new BV hybrids							
Treatment	Fec. (No.)	Hatching (%)	ERR (No.)	ERR (kg)	Single Cocoon wt. (g)	Single Shell (g)	SR (%)
T1 (MASN4)	460	92	9022±63.54	13.64±0.28	1.51±0.03	0.33±0.01	21.57±0.28
T2 (MASN6)	499	97	9053±93.53	13.57±0.24	1.50±0.03	0.31±0.01	20.53±0.13
T3 (MASN7)	486	96	9093±58.95	14.21±0.56	1.56±0.05	0.31±0.01	19.99±0.16
T4 (FC1xFC2)	563	96	9636±25.00	14.21±0.62	1.79±0.06	0.38±0.01	20.81±0.55
Mean	502	95.25	9201±45.63	14.65± 0.29	1.59±0.03	0.33±0.01	20.72±0.18
Treatment			33.54 **	363.11 **	335.90 **	167.55 **	17.49 **
Season			47.26 **	541.51 **	122.00 **	196.58 **	36.15 **
Treatment x Season			12.95 **	50.15 **	57.48 **	68.96 **	19.95 **
Note: Mean ± SE; ** - Significant at 1% level; * - Significant at 5% level							

Continuous/Other activities:

Popularization of new bivoltine breeds and mulberry varieties in the field: New silkworm hybrids of bivoltine double, single hybrids and improved cross breeds were test verified with 312 farmers and 67393 dfls were distributed and popularized. Similarly, new mulberry varieties *viz.,* V1, G2, G4 and RC1 saplings/cuttings were supplied to the farmers and popularized from RSRS, Kodathi and its nested units.

Unit	Dfls (Nos.)	Farmer (Nos.)
RSRS Kodathi	1243	
REC Chitradurga	10750	50
REC Madivala	48800	224
REC SU Koppal	1700	08
REC SU Kanakapura	4900	30
Total	67393	312

Supply of saplings/cuttings					
Unit	Variety	Supply		Farmers (No.)	Area (Ac.)
		Saplings	Cutting		
RSRS-Kodathi	G4	10895	35500	17	25.5
	G2		15050	3	6.52
	RC1		5500	1	1.01
	V1		25100	3	4.61
REC-Chitradurga		4000	Planted & maintained		
REC-SU-Kanakapura	G4			2	2.5
REC-Bidaraguppe	G4			13	10
	V1			11	16.5
REC-Madivala	G4			1	0.5

Institute Village Linked Programme (IVLP): 62300 Bivoltine hybrid dfls were reared with an average yield of 64.31 kg/100 dfls with an improvement of 14.33% cocoon yield over bench mark.

Production of Biological Control Agents: A total of 91850ml of *Nesolynx thymus* were produced and supplied on housefly pupa at REC Madivala and distributed to stakeholders for the management of uzi fly.

Farm rearing: During the year, a total of 2348 dfls were reared at RSRS and nested units (REC Madivala, Bidaraguppe and REC SU Koppal). A total of 3050 dfls of bivoltine hybrids were chawki reared and distributed to farmers through REC Chitradurga and REC sub unit Koppal.

Farm maintenance: A total of 20.48 acres of mulberry garden was maintained by RSRS and farm based nested units and produced 99.14 MT mulberry leaves and utilized for farm rearing and excess leaf was sold. Farm waste was recycled and produced total of 37MT compost and 31MT vermicompost that was utilized for manuring of mulberry gardens. The technologies implemented in the farm was demonstrated/ explained to the farmers / students who visited the station.

Capacity Building Training Programme (CBT): RSRS and its nested units carried out 27 Farmers Skill Training Programmes (FST) and trained 522 farmers (3 days/programme) on different technologies. A total of 55 officials/students were also trained for five days under Technology orientation programme (TOP) in five programmes conducted by RECs Chitradurga and Madivala.

Special Farmers meet during 2017-18: District level farmers meet was organized at Kanakapura, Tumkur, Devanahalli, Bidar, Chitradurga and Doddaballapura for the benefit of sericulturists. A total of 1682 farmers were sensitized in seven programmes.

Centre	Date	Place	Farmers (No.)
REC-Kanakapura	06.09.2017	Kirangere, Kanakapura Taluk, Ramanagara Dist.	310
REC SU-Tumkur	11.09.2017	Hullenahalli, Tumkur Taluk & Dist.	165
REC-Madivala	20.09.2017	Doddabommanahalli, Chinthamani Tq. Chikkballapura Dist.	103
RSRS-Kodathi C.R. Patna cluster	23.09.2017	Channahalli, Devanahalli Taluk, Bangalore rural Dist.	200
REC SU-Bidar	03.11.2017	Pratapa nagara, Nowbada, Bidar	234
REC-Chitradurga	08.11.2017	Nayakanahatti, Chitradurga	240
RSRS-Kodathi Tubugere cluster	28.02.2018	Doddaballapura	430
		Total	1682

Visitors: The officials/Sericulture farmers are visiting RSRS Kodathi as a part of their training curriculum. Training is rendered to all during their visit about technologies, cultivation packages & different types of mulberry. During the period, a total of 1813 sericulture farmers, students and officials visited the RSRS station and REC-Bidaraguppe.

RSRS-CHAMARAJANAGAR

REC & Sub-Units
REC SU-Kinakanahally

Staff	
In-charge Officer	Dr. V. Girish Naik
Scientists	4
Technical Staff	10
Administrative staff	2

Farm Based Units		
Unit	Total Area (Acres)	Mulberry Acreage
Chamarajanagar	14.02	6.153
Kinakanahally	17.40	2.60

Concluded Research Projects

ARP 3519: Silkworm disease monitoring of seed and commercial crop rearing of South Indian states

S. N. Pallavi and Mary Josepha A.V.

Objectives:

- To estimate the prevalence of silkworm diseases at selected BSFs & Commercial crop rearings (CPP clusters) in South Indian States.
- To suggest remedial measures on spot to the farms/farmers to manage the silkworm diseases and to prevent disease outbreaks.

The project was initiated during July 2015 and seed and commercial silkworm crops were regularly monitored for disease incidence among selected 10 farmers every month till March 2018 in CPP cluster of T. Narasipura under the jurisdiction of RSRS Chamarajanagar and suitable recommendations were given for farmers on prevention and control of diseases.

The study reveals that silkworm crops are mainly affected by Grasserie and a major problem in achieving higher cocoon yield levels. However, during 2017-18, both Grasserie and Flacherie disease incidences were prevalent and contributed to decreased yield levels (i.e., 62.31 kg/100 dfls) compared to previous two years. Overall, due to the interventions of extension staff, the disease progression could be controlled by timely recommendations and contributed to successful harvest of silkworm crops among the select farmers. Management of rearing by proper disinfection of rearing house and implements, ensuring quality leaf during young age, control of humidity and providing sufficient spacing particularly in late age were found to be major factors for controlling Grasserie and successful harvest of crop.

Collaborative Research Projects/Programmes: RSRS-Chamarajanagar and its nested unit are involved in the data collection for the following collaborative projects with the main institute and other RSRSs.

Project Code	Title	Unit
PRP 3567	Assessing the efficacy of recommended chemicals in insect/disease/weed management and their impact on soil-biota of mulberry eco-system in South India	RSRS-Chamarajanagar

Continuous/Other Activities:

Survey and surveillance of major pests and their natural enemies in mulberry eco-system

V. Girish Naik and S. N. Pallavi

Objectives:

- To monitor the incidence of insect pests and their natural enemies in mulberry eco-system.
- To construct life tables and study tri-trophic interaction of pests and their natural enemies.
- To establish cultures of new potential natural enemies of mulberry pests

The program is a continuous activity. Surveys are conducted every fortnight on the incidence of pests and diseases on mulberry. A total of five farmers are being regularly monitored for mulberry pests in their respective gardens. The survey reveals that in Chamarajanagar area the incidence of pests in mulberry garden are comparatively less, possibly due to dry weather and lower moisture content in the leaf.

OST of New Silkworm Hybrids:

Rearing performance of thermo-tolerant hybrids

Serani Nagendra and V. Girish Naik

Objective: To evaluate the rearing performance of new thermo-tolerant hybrids under Chamarajanagar condition

Three trials with three new thermo-tolerant hybrids viz., N21 x N56, N23 x N67 and N2 x N6 along with the control FC1 x FC2 were conducted. Besides, OST trials of MASN4, MASN6 and MASN7 were also conducted. Cocoons were sent to the Reeling Section of CSRTI-Mysuru for evaluation of reeling parameters.

Rearing performance of new thermo-tolerant hybrids

Race	Trial	No. of Dfls	Hatching (%)	Larval wt. (g)	Actual yield		ERR		SCW (g)	SSW (g)	Shell (%)
					No.	Wt.	No.	Wt. (kg)			
N21 x N56	I	10	95.6	35.17	2637	4.125	5720	8.948	1.564	0.335	21.39
	II	10	87.48	31.16	2941	4.300	7698	11.256	1.460	0.295	20.25
	III	10	96.5	39.09	4309	5.792	8176	10.990	1.463	0.297	20.30
N23 x N67	I	10	97.3	37.82	2550	3.855	5809	8.781	1.512	0.352	23.28
	II	10	87.53	30.95	2024	2.850	4936	6.950	1.408	0.305	21.68
	III	10	97.50	38.44	3814	5.372	6462	9.080	1.342	0.260	19.37
N2 x N6	I	10	96.3	35.45	2720	3.710	6099	8.318	1.364	0.303	22.22
	II	10	88.64	29.34	2645	3.900	6906	10.180	1.474	0.286	19.41
	III	10	95.90	39.71	3423	5.267	7043	10.837	1.357	0.287	21.46
FC1 x FC2	I	10	97.80	36.45	3044	4.670	5992	9.193	1.534	0.320	20.83
	II	10	88.00	31.33	3604	5.190	6984	10.050	1.440	0.290	20.34
	III	10	99.30	40.96	3086	4.822	5969	9.326	1.499	0.309	20.63

Reeling Performance (of 1st Trial)

Name of hybrid	Reelability (%)	AFL (m)	NBFL (m)	Denier	Rendita (kg)	Raw silk (%)	Raw silk recovery (%)	Neatness
N21 x N56	78.85	674.88	532.11	2.75	7.62	13.12	61.26	96
N23 x N67	79.32	615.60	488.29	3.32	6.70	14.93	64.15	98
N2 x N6	76.85	701.99	539.45	2.68	6.56	15.24	68.59	98

Rearing performance of MASN breeds											
Race	Trial	Dfls (No.)	Hatching (%)	Larval wt.(g)	Actual yield		ERR by		SCW (g)	SSW (g)	Shell (%)
					No.	Wt.	No.	Wt. (kg)			
MASN4	I	10	89.37	32.01	2378	3.130	4823	6.348	1.301	0.232	17.8
	II	10	95.40	31.75	5066	2.840	9761	5.929	1.784	0.307	17.2
	III	10	98.26	28.31	4609	3.720	8779	7.085	1.239	0.234	19.6
MASN6	I	10	94.8	34.88	2354	2.675	5162	5.866	1.277	0256	20.1
	II	10	93.5	35.47	3931	2.895	9472	6.975	1.358	0.278	20.47
	III	08	83.27	27.19	2283	1.875	7393	6.071	1.218	0242	19.86
MASN7	I	10	92.6	31.02	2260	2.825	4593	6.361	1.265	0.256	20.20
	II	10	95.0	32.25	5195	4.065	9839	9.497	1.278	0.258	20.18
	III	10	85.59	29.23	3407	2.900	8016	6.823	1.175	0.239	20.34

Chawki rearing and supply: A total of 18268 dfls of PMxCSR2 hybrid were chawki reared at REC (SU), Kinkanahally and supplied to 178 farmers in 96 villages. The average cocoon yield realized by rearing of chawki silkworms was 62.81kg/100dfls.

Forecasting and forewarning of mulberry pests

V. Girish Naik and S.N. Pallavi

Objectives:

- To monitor pest incidence at fortnightly intervals & collection of weather parameters at weekly interval
- To issue forewarning to stakeholders for the effective pest management

Survey was conducted at fortnightly interval during the year at five farmer's field covering different villages. Pest incidence and its progress were recorded in relation to weather parameter. Twenty-four surveys were conducted. No severe pest and disease incidence was noticed in majority of the mulberry fields. However, in some farmer's field tukra incidence was recorded during April to June 2017 which ranged from 0.3 to 8.0%. However, incidence of Thrips were also reported in May 2017 (0.2 - 0.6%) and July 2017 (10.0%).

Incidence of major pests of mulberry in five select farmer's field			
Month	Tukra (%)	Thrips (%)	BHC (%)
Apr. 2017	3.0 - 5.0		
May 2017	0.3 - 0.8	0.2 - 0.6	
Jun. 2017	5.0 - 8.0		
Jul. 2017		10.0	
Aug.- Dec. 2017			
Jan. - Feb. 2018			
Mar. 2018			

Cluster Promotion Programme (CPP): Bivoltine sericulture technologies were disseminated in one cluster under RSRS-Chamarajanagar. 2.21 lakh bivoltine hybrid dfls were reared with an average yield of 61.91kg/100 dfls. 48.91 acres of new plantations were also established with 129 farmers and conducted 17 ECPs for the benefit of 1016 farmers.

Institute Village Linked Programme (IVLP): A quantity of 2670 dfls were reared by IVLP beneficiaries and realized an average yield of 67.72kg/100 dfls with 23.13% improvement over the bench mark yield (55 kg/100 dfls). The farmers earned an average rate of Rs. 392.50/kg from the cocoon sales.

Farmers Advisory Cell: Farmers' advisory cell was established with technology charts and exhibits. During the year, many farmers, officials and students visited the station and explained various sericulture technologies recommended under water deficit conditions and offered the technical guidance in sericulture activity.

Farm Rearings: A total of 798 dfls were reared during the year and 398.45 kg of cocoons were produced, of which 18.18 kg of cocoons were sent to CSRTI-Mysuru for analysis of reeling parameters. A total of 367.51 kg of cocoons were marketed and a revenue of Rs. 126263/- was generated.

Farm Maintenance: RSRS and its farm based nested unit produced a total of 7695 kg of mulberry leaf was produced and utilized for chawki, general and rearings.

Capacity Building Training Programmes (CBT) : RSRS-Chamarajanagar and its nested unit conducted 3 Farmers Skill Training Programmes (FST; 7days) and trained 92 farmers on various sericulture technologies. 22 officials/students were also trained under Technology Orientation Programme (TOP; 3 days).

Awards & Recognitions: Awarded First Prize in the exhibition of Sericulture Technology Stall in Krishi Mela at Sri Shketra Suttur Jathra festival from 13 to 18, January 2018.

Extension Communication Programmes: Various ECPs were conducted by RSRS and its nested unit for the transfer of technology developed by the main institute and fine-tuned.

Unit	Cluster	Extension Communication Programme (ECP)											
		Group Discussion		Exhibition		Farmers Day		Aware. Prog.		Exposure Visit		Total	
		Tar.	Ach.	Tar.	Ach.	Tar.	Ach.	Tar.	Ach.	Tar.	Ach.	Tar.	Ach.
RSRS-Ch.Nagar	T. Narsipura	15	11 (310)		1 (3898)	12	6 (310)		7 (433)	8	8 (808)	35	33 (5759)
REC SU-Kinkanahally		6	6 (132)			4	4 (159)			2	2 (161)	12	12 (452)
Total		21	17 (442)		1 (3998)	16	7 (469)		7 (433)	10	10 (969)	47	45 (6211)

Specific activities on women empowerment, development of SC/ST or people below poverty line: A TOP programme was exclusively conducted to benefit 22 women and to motivate them to actively involve in sericulture enterprise.

Visitors: RSRS-Chamrajanagar is a regular visiting place of sericulture farmers, students and officials among them are Dr. M.Mahadevappa, Former Vice-Chancellor, UAS, Dharwad and Ex-Chairman, ASRB, New Delhi.

RSRS-SALEM

Command Area	Scientists / Staff	
	In-charge Officer	Dr. S. Rajakumar
Tamil Nadu Kerala	Scientists	24
	Technical Staff	22
	Administrative Staff	21

Farm Based Units		
Unit	Total Area (Acres)	Mulberry Acreage
RSRS-Salem	20.0	3.4
REC-Krishnagiri	2.77	2.5
REC-Samayanallur	2.62	0.6

RSRS-Salem
RECs
REC- Gobichettipalayam
REC- Krishnagiri
REC- Samayanallur
REC-Srivilliputhur
REC-Udumalpet
REC-Palakkad
Sub-Units
REC SU-Avinashi
REC SU-Berigai
REC SU-Tiruchurapalli
CDC-Agali

Ongoing Research Projects:

PPA 3580: Soil Health Cards for sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh

N. Dhahira Beevi and S. Rajakumar

Objective: To monitor the soil fertility statuses of mulberry gardens of Karnataka, Andhra Pradesh & Tamil Nadu and recommend balanced fertilizers & manures and create database

3500 soil samples from CPP Tamil Nadu (28 clusters) and Kerala (2 clusters) and other sericulture farmers were analyzed for pH, EC, OC%, available P, K and S. The soil samples were also sent to CSRTI-Mysuru for micronutrient analysis and preparation of Soil Health Cards (SHC) for individual farmers.

Parameter	Normal Range	Samples (%)
pH	6.50 - 7.50	20.02
EC (m.mhos/cm)	< 1.00	99.26
OC (%)	0.65 - 1.00	54.87
Phosphorous (P) kg/ ha	10 - 25	0.84
Potash (K) kg/ha	110 - 240	10.32
Sulphur (S) ppm	10 - 15	71.22

MOE 3562: Socio-economic impact of Cluster Promotion Programme on Bivoltine seri- farmers in Tamil Nadu (Mar. 2016 - Aug. 2017)

S. Rajakumar (PI), J. Ravikumar, N. Dhahira Beevi, A.G.K. Daniel, N.G. Selvaraju, G. Punithavathy and Y. Humayun Sharief

Objectives

- To analyze the impact of CPP on technology adoption and productivity improvement in sericulture in the study area of Tamil Nadu
- To estimate the socio-economic impact of CPP on marginal and small sericulturists in the study area
- To elucidate the cost and returns from bivoltine sericulture among different farm size holdings
- To elicit the constraints in non-adoption of technologies faced by farmers and suggestions

The Technology adoption level of the farmers ranged from 75-92%, productivity improvement was observed from 69.70kgs/100 dfls during 2012-13 to 78.00kgs/100 dfls during 2016-17 i.e., 8.30kgs more productivity over the years. When compared to National average, it is 18.50kgs (59.50kgs during 2016-17) which is comparitvely more than the national average.

PRP 3567: Assessing the efficacy of recommended chemicals in insect/disease/weed management and their impact on soil biota of mulberry eco system in South India (Apr. 2016 - Mar. 2019)

S. Balasaraswathi (PI), S.Rajakumar, M.Noble Morrison, M.A.Shanthan Babu and S.N.Pallavi

Objectives

- To assess the efficacy of chemicals in mulberry cultivation for the management of insect pests/diseases/weeds
- To assess the factors influencing the efficacy of chemicals utilized for mulberry insect pests/diseases/weed management
- To study the effect of pesticides on soil biota
- To analyze the residual toxicity of pesticides in mulberry ecosystem

Data on chemical insecticides recorded with maximum % reduction of tukra incidence by application of DDVP for leaf. Experiment with the following treatments *viz*., Dimethoate (3ml/L water), Dichlorvos (2.63ml/L water), Dichlorvos (1ml/L water), Bavistin (2g/L water), Mancozeb (2g/L water), Glyphosphate (7.5ml/L water with 10g of ammonium sulphate), Gramaxone (7.5ml/L water) and bio-pesticide Navinya (10g/L of water) along with control was conducted to study the impact of recommended chemicals for pest and disease management in mulberry on soil biota. Results on the enumeration of soil microbes revealed maximum reduction of bacterial population on third day after treatment in Dimethoate ($72.1x10^6$ CFUs/g of soil) followed by Dichlorvos ($83.2 x10^6$ CFUs/g of soil), Bavistin and Mancozeb ($91.8 x10^6$ CFUs/g of soil) when compared to the control ($112x10^6$ CFUs/g of soil) over population of soil microbes in pre-treatment. Maximum reduction of fungal colonies and Actinomycetes was recorded in 3rd day after treatment in Dimethoate ($4.2 x 10^4$ CFUs/g of soil), $3.2 x10^2$ CFUs/gram of soil) respectively. No significant reduction of the fungal/bacterial/Actinomycetes population in soil was found with regard to bio-pesticides

Efficacy of insecticides on incidence of tukra and thrips (pooled data)						
Name of the centre	% reduction of tukra by DDVP			% reduction of thrips by Dimethoate		
	Treated	Control	t values	Treated	Control	t values
RSRS-Salem	80.00 (63.44)	14.58 (22.45)	3.43*	74.32 (59.60)	15.08 (22.90)	7.58**
RSRS-Anantapur	72.22 (58.19)	10.46 (18.84)	4.62**	77.81(61.90)	32.74 (34.90)	5.25*
RSRS-Chamarajnagar	80.39 63.71)	0.86 (5.31)	15.90**	70.66 (57.20)	3.51 (10.80)	6.48**
REC-Madivala	76.10 (60.73)	15.30 (23.03)	3.21*	82.1 (64.97)	15.50 (16.66)	6.20**
Figures in parentheses are in transformed values: *Significant at 5% level; **Significant at 1% level						

Collaborative Research Projects/Programmes: RSRS-Salem and its nested units are involved in the data collection for the following collaborative projects with the main institute and other RSRSs.

Project Code	Title	Units
PRE 3527	Survey and surveillance of major pests and their natural enemies in mulberry eco-system	RSRS-Salem
PPA 3580	Soil health cards for sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh	RSRS-Salem
ARP 3519	Silkworm disease monitoring of seed and commercial crop rearing of south Indian states	CPP clusters - TN & Kerala

Cluster Promotion Programme (CPP)

Bivoltine sericulture technologies were disseminated in 30 clusters across Tamil Nadu and Kerala and a total of 82.32 lakh bivoltine hybrid dfls were brushed. The average cocoon yield recorded was 82.16 kg/100 dfls.

Institute Village Linked Programme (IVLP): 3.67 lakh bivoltine hybrid dfls were reared with 200 farmers in two clusters (Sathyamangalam & Thondamuthur) and recorded an average yield of 82.6 kg/100 dfls, which is an improvement of 11.22% cocoon yield over benchmark.

On-Station Trials

Rearing performance of New Bivoltine Hybrids (Average of Five Trials) (Season: April 2017, May-June 2017, June-July 2017, July-Aug. 2017, Sept. 2017)							
Name of the Hybrids	Fecundity (No.)	ERR (No.)	ERR Wt. (kg)	Yld/50000 eggs (kg)	SCW (g)	SSW (g)	SR (%)
N21 X N56	627	6430	8.756	43.78	1.354	0.284	20.97
N23 X N67	635	5882	8.203	41.02	1.375	0.299	21.75
N2 X N6	538	6772	9.430	47.15	1.352	0.286	21.15
FC1 x FC2 (C)**	601	4518	5.935	42.25	1.233	0.266	21.57
** Average data of 3 trials only. IV and V trial control batch rejected due to grasserie							

Testing of New Bivoltine Hybrids: Five rearing trials were conducted with three New Bivoltine Hybrids viz., N21 x N56, N23 x N67, N2 x N6 and FC1 x FC2 as control. Rearing performance of the new hybrids was better during September 2017. Among the three hybrids N2 x N6 has performed better.

Reeling Performance of New Bivoltine Hybrids (Average of Five Trials)							
Race	Reelability (%)	AFL (m)	NBFL (m)	Denier (m)	Renditta (kg)	RS (%)	RSR (%)
N21 X N56	81.67	891.78	763.0	2.96	7.62	15.15	58.80
N23 x N67	78.04	884.29	736.16	2.86	7.85	15.23	61.75
N2 X N6	82.99	861.24	748.12	3.03	7.61	15.20	58.36
FC1 x FC2 (C)	79.67	844.13	724.84	2.85	7.68	15.82	63.76

On-Farm-Trials: Newly developed silkworm hybrids (improved cross breeds and bivoltine double and single hybrids were test verified with the farmers by the RSRS-Salem & its nested units.

Centre	Race /Combination	Dfls (No.)	Farmers (No.)	Yield (kg)	Yield/100 Dfls (kg)
RSRS-Salem	CSR16XCSR17	900	3	743.00	82.0
	S8XCSR16	12700	38	10233.00	80.0
	DXO2	100	1	81.00	81.0
	O2XD	100	1	80.00	80.0
	DXO3	100	1	78.00	78.0
	O3XD	100	1	84.00	84.0
	CSR16XS8	6450	23	4980.00	77.0
REC-Samayanallur	N21 x N56	1975	12	1518.00	76.9
	N23 x N67	150	1	92.70	61.8
	BH1	175	1	117.00	66.9
REC SU-Trichy	N23XN67	500	3	347.00	69.4
	N21X N56	600	4	387.50	64.6
Total / Average (combination wise)	CSR16XCSR17	900	3	743.00	82.0
	S8XCSR16	12700	38	10233.00	80.0
	DXO2	100	1	81.00	81.0
	O2XD	100	1	80.00	80.0
	DXO3	100	1	78.00	78.0
	O3XD	100	1	84.00	84.0
	CSR16XS8	6450	23	4980.00	77.0
	N21 x N56	2575	16	1905.50	74.0
	N23 x N67	650	4	439.70	67.6
	BH1	175	1	117.00	66.9
Total / Average		23850	89	18741.20	77.05

Continuous/Other ativities

Popularization of New Silkworm Hybrids and Mulberry Varieties: Newly developed silkworm hybrids (bivoltine: DH & SH; ICBs) were test verified with 3.55 lakh dfls with 1,229 farmers and the rearing performance was recorded as a part of popularization. Similarly, new mulberry varieties (G2, G4 and RC1) saplings/cuttings were supplied to 875 farmers (138186 ac.).

Production of Biological Control Agents: Biological control agents such as 2.96 lakh *Acerophagus papayae* (1186 units; 1010 farmers); 2.5 lakh *Chrysoperla zastrowi sillemi* (174 farmers;) 569 units of *Trichogramma chilonis* (298 farmers) and 1271 units (1011 farmers) *Bracon brevicornis* were distributed through DOS/**CSB** units in the mulberry gardens infested with papaya mealybug and other pests. The biocontrol agents reduced infestation of papaya mealy bugs, thrips and tukra mealy bug by 99%; 95% and 72.3%, respectively.

Capacity Building Training Programmes (CBT): RSRS and its nested units conducted 22 Farmers Skill Training Programmes and trained 420 farmers on various sericulture technologies. 57 officials/students were also trained under 9 Technology Orientation Programme at RSRS-Salem and its RECs.

Sericulture Resource Centers: Sericulture Resource Centre at Thadiyamanai - Mangadu village (REC, SU, Trichy) and Kannammanaickanoor village (REC, Udumalpet) 10 batches of Sericulture training was conducted with a total 200 (in co-ordination with the lead farmer Sri. A. Kalaichezhiyan) and 222 farmers, respectively.

Extension Communication Programmes: Various ECPs were conducted by the RSRS and its nested units for the transfer of technology developed by the main institute and fine-tuned.

Centre	Tech. Demo.	GD	Awar. Prog.	FD	Fa. Day	Exhi.	Study Tour
RSRS-Salem	208 (07)	208 (07)	1066 (09)	650 (12)			208 (07)
REC-Krishnagiri		133 (05)	249 (03)	146 (03)			
REC-Samayanallur	40 (05)	386 (14)	732 (07)	594 (13)	104(02)		40 (05)
REC-Udumalpet		1080 (54)	1148 (13)	1092(28)	592(02)	160(07)	
REC-Gobi	296(13)	765(31)	679(08)	942(20)			296(13)
REC-Srivilliputhur	135(04)	557(21)	438(04)	426(08)			135(04)
REC SU-Berigai		269(09)	212(02)	210(04)			

REC SU-Avinashi	27(01)	311(15)	175(02)	197(04)			27(01)
REC SU-Trichy		167(07)	183(02)	533(10)			
REC-Palakkad		468(19)	447(06)	568(12)			
CDC-Agali		188(06)	644(06)	473(10)			
Figures in parentheses indicates the number of programmes conducted							

Ph.D. Students: Periyar University, Salem recognized RSRS, Salem as Centre for Higher Studies in Botany and Sericulture for doing M. Phil., and Ph.D. During the year 2017-18 one student has completed external viva-voce. At present 8 students are pursuing Ph.D., under Periyar University, Salem and 1 student pursuing Ph.D. under Manonmaniam Sundaranar University, Tirunelveli.

Students: One student of Sri Sakthi Kailaash Arts and Science College for Women, Salem completed her dissertation work for Master of Science in Microbiology.

Visitors: RSRS-Salem is a regular visiting place for sericultural farmers, students and officials for enriching knowledge on new technologies of silkworm rearing and mulberry cultivation.

RSRS-ANANTAPUR

Command Area	Scientists / Staff	
	In-charge Officer:	Ch. Satyanarayana Raju (up to 28.02.2017) Dr.M.A. Shanthan Babu (w.e.f. 01.03.2017)
Andhra Pradesh Telangana Karnataka	Scientists:	16
	Technical Staff:	29
	Administrative Staff:	17

Farm Based Units		
Unit	Total Area (Acres)	Mulberry Acreage
RSRS-Anantapur	40.73	4.00
REC-Rayachoti	5.00	1.00
REC-Vikarabad	5.50	1.86
REC SU-Bidar	11.33	5.50

RSRS-Ananthapur
REC- V Kota
REC- Madakasira
REC- Eluru
REC-Kalyandurg
REC-Royachoity
REC-Vikarabad
REC SU-Atmakur
REC SU-Markapur
REC SU-Penukonda
REC SU-Hindupur
REC SU-Palamner
REC SU-Chebrolu
REC SU-Atmakur
REC SU-Markapur
REC SU-Suryapet
REC SU-Metapally
REC SU-Bidar

Ongoing Research Projects

PRP 3567: Assessing the efficacy of recommended chemicals in insect/disease/weed management and their impact on soil biota of mulberry ecosystem in South India (2016-2019)

M. A. Shanthan Babu and Ch. Satyanarayana Raju (Coordinator)

Objectives:

- To assess the chemicals in mulberry cultivation for the management of pests/diseases/weeds
- To assess the factors influencing efficacy of chemicals utilized for mulberry pests/diseases/weed management
- To study the effect of pesticides on the soil biota
- To analyze the residual toxicity of pesticides in mulberry ecosystem

Project laid out in Random Block Design in a fixed V1 mulberry plot. Collected weather data of April 2017 to March, 2018 and submitted to RSRS, Salem. Experimental plot was pruned and treatments imposed as per schedule for 3 crops. Soil samples collected on 10^{th}, 20^{th} and 30^{th} day after treatments imposed from 3 crops and sent to RSRS, Salem for residual and microbial analysis. Collection of pre-treatment data on target pests infestation/infection and non-target organisms is under progress.

PPA 3580: Soil health cards for sericulture farmers in states of Karnataka, Tamilnadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh (2016 - 2019)

B.Vijaya Naidu, and Ch. Satyanarayana Raju

Objective: To make **the** farmers aware about the importance of soil fertility on the production of quality mulberry leaves by issuance of soil health cards

1550 soil samples were collected from farmers and soil samples were analyzed for pH, EC and OC. Soil samples were sent to CSRTI-Mysuru for further analysis of phosphorus, potash and other micro nutrients.

MOE 3565: Studies on yield gaps in silkworm cocoon production in the states of Andhra Pradesh and Telangana (Jan. 2016 - Jun. 2018)

M.A. Shanthan Babu, G.V. Prasad, T.V.S.S. Rao, P.S. Reddy, B. Srinath, Ch. Satyanarayana Raju, and V. Sivaprasad

Objectives:

- To quantify the yield gaps in mulberry and silkworm cocoon production in Andhra Pradesh and Telangana states
- To analyse the reasons for the yield gaps in mulberry and cocoon production

Information on socio-economic characteristics revealed that most of the respondents were in the active age group of 30-40 years, educated and small farmers with fewer years of experience in sericulture farming and married in both the states of Andhra Pradesh and Telangana. Fellow farmers (45.30% in Telangana; 49.5% in Andhra Pradesh) were major source of information on improved sericultural technologies since the farmers were brought together under the umbrella of Cluster Promotion Programme. It was observed that yield gap I is lower than the yield gap II in case of mulberry leaf production and silkworm cocoon productivity in both states. Before cluster approach in Telangana 29.84% of yield gap has been recorded in case of mulberry leaf production followed by 40.06% for cocoon production. After cluster approach, the yield gaps were reduced to 12.90% & 9.38% in case of mulberry leaf and cocoon production, respectively. However, in case of Andhra Pradesh 26.05% of yield gap was recorded for mulberry leaf production and 35.24% for cocoon production with a reduction in yield gaps of 11.21% and 12.48% for mulberry leaf and cocoon production, respectively after cluster approach.

The study emphasizes on the need to take up more demonstrations at farmers' field to motivate adoption of improved practices which would implicate quantity and quality cocoon yield. By utilizing the findings it is possible to further narrow down the constraints associated with the yield gaps at farmers' level to boost the quality raw silk productivity.

PIE 3575: Evaluation of mulberry genetic resources for functional traits associated with resilience to climate conditions (May 2016 - Mar. 2019) (Collaborative with CSGRC-Hosur)

M. A. Shanthan Babu

Objectives:

- To estimate variability in different functional traits associated with nitrogen use efficiency and drought tolerance
- To identify donor parents for specific traits having adoptive significance
- To develop screening tools to identify desired mulberry genotypes for different functional traits

Saplings of 39 test mulberry genotypes & 4 checks were collected from CSGRC-Hosur and planted in the spacing of (5'+3') x 2' in ARBD experimental plot on 9.11.2017. Survival percentage of plants was recorded. Experimental plot is under maintenance.

AIB 3561: Identification of robust bivoltine silkworm hybrids suitable for different regions of high temperature and high humidity conditions

M. A. Shanthan Babu, T. V. S. S. Rao, S. Purusotham and V. Sivaprasad

35 silkworm double hybrids have been tested at REC, Rayachoty and REC-SU, Chebrolu in AP for evaluation of silkworm breeds suitable for high temperature and high humidity during the year.

Continuous/Other activities

Cluster Promotion Programme: Bivoltine sericulture technologies were disseminated in 13 clusters in Andhra Pradesh State and 4 clusters in Telangana State. 107.75 Lakhs dfls of bivoltine hybrids were reared with an achievement of 110.00% against the target of 97.95 Lakhs dfls and recorded the cocoon yield of 73.20kg/ 100dfls. The raw silk production achievement was 1213.41 MT against the target of 1088.42 MT.

Performance of Andhra Pradesh Clusters - Bivoltine Raw Silk Production (2017-18)										
Cluster	Dfls distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New plantation (acres)	ECP (farmers)
	Target (lakhs)	Crops (No)	Ach.		Target	Ach.	Ach. (%)	IO 2016-17 (%)		
Andhra Pradesh										
Atmakur	2.20	718	224400	69.61	22	24.03	109.23	22.05	252 (356)	21 (1089)
Bhimadole	2.60	811	230100	68.22	26	24.15	92.88	7.76	15 (50)	14 (818)
Chebrolu	4.30	915	430750	76.12	43	50.44	117.31	25.92	89 (250)	15 (962)
Chittoor	2.90	1528	443000	74.48	29	50.76	175.04	80.64	0	0
Giddalur	4.05	1171	407400	73.20	40.05	45.77	113.00	26.99	42 (125)	17 (987)
Hindupur	8.20	3711	1014900	75.99	82	118.65	144.69	62.51	129 (227)	14 (1205)
Kalyanadurg	6.40	2585	653100	75.10	64	75.46	117.90	28.77	274 (391.5)	16 (1318)
Madakasira	12.00	5804	1581875	73.20	120	178.14	148.45	58.87	406 (735)	16 (1763)
Palamaner	16.00	7128	1652750	72.28	160	183.79	114.87	29.87	53 (73)	15 (819)
Pathikonda	4.30	1121	426800	75.01	43	49.25	114.54	15.48	253 (360)	0
Penukonda	4.30	2522	595200	72.69	43	66.56	154.79	69.15	538 (540)	14 (1110)
V. Kota	17.80	7124	1751500	73.46	178	197.95	111.21	18.05	555 (776)	14 (992)
Vijayawada	3.00	922	251250	70.41	30	27.22	90.72	6.77	0	0
Total/Avg.	88.05	36060	9663025	73.05	880.05	1085.91	123.33	34.61	2606 (3884)	156 (11063)

Performance of Telangana Clusters – Bivoltine Raw Silk Production (2017-18)										
Cluster	Dfls distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New plantation (acres)	ECP (farmers)
	Target (lakhs)	Crops (No)	Ach.		Target	Ach.	Ach (%)	IO 2015-16 (%)		
Telangana										
Bhongir	2.00	611	224100	73.09	20	25.20	126.00	53.94	0	0
Metpalli	2.30	902	274300	65.50	23	27.64	120.18	44.87	68 (101)	14 (1055)
Suryapet	3.00	843	317700	74.07	30	36.20	120.68	26.54	44 (105)	17 (1122)
Zaheerabad	2.60	1624	295650	70.79	26	32.20	123.84	36.32	21 (42)	13 (720)
Total/Avg.	9.90	4068	1111750	70.89	99	121.20	122.43	38.23	133 (248)	44 (2897)

Adarsha Gram (IVLP): A total of 221400 dfls of bivoltine hybrids were reared in two clusters (Rayachoty & Vizianagaram) and average yield of 66.84kg/100dfls was recorded which indicated an improvement of 27.41% against the bench mark.

Achievements of IVLP (2017-18)						
IVLP cluster	Dfls brushings (No.)		Cocoon yield/100 dfls (kg)			RS production (MT)
	Target	Achieve-ment	Bench mark	Avg. Yield/ 100 dfls (kg)	Improvement %	
Rayachoty	60000	160950	55.00	68.97	25.40	15.86
Vizianagaram	60000	60450	50.00	64.71	29.42	5.59
Total	120000	221400	52.50	66.84	27.41	21.45

On station trials (OST)

Performance of new improved Bivoltine Hybrids: One rearing trial (Aug. – Sept. 2017) of 7 new improved bivoltine hybrids (MASN4, MASN6, MASN7, N21 x N56, N2 x N6, N23 x N67) was conducted with FC1 x FC2 as control.

Reeling performance of new bivoltine breeds/hybrids							
Reeling characters	MASN44	MASN6	MASN7	N21 X N56	N23 X N67	N2 X N6	FC1 X FC2
Reelability (%)	83.90	85.29	86.28	86.97	86.36	85.96	86.55
Average FL (m)	1002.92	979.87	999.65	1273.37	1098.76	1245.84	1145.76
NBFL (m)	878.54	788.68	786.80	945.15	824.80	971.68	872.22
Denier(D)	2.67	2.76	2.89	3.09	3.11	3.26	2.99
Renditta	7.90	7.60	7.70	7.0	7.19	7.12	7.0
RS (%)	14.89	15.20	15.80	14.97	15.45	15.93	14.96
RS Recovery (%)	70.71	71.0	72.82	74.70	71.69	72.20	74.40
Neatness (p)	92	93	93	94	93	94	93

OST-2 Evaluation of new single/double Bivoltine hybrids under on station trail							
Hybrids	Hatching (%)	Fecundity (No.)	ERR		SCW (g)	SSW (g)	SR (%)
			No.	wt (kg)			
MASN4	96.2	441	6767	8.870	1.437	0.237	16.50
MASN6	96.1	436	6476	8.809	1.496	0.245	16.40
MASN7	96.5	439	6046	9.325	1.649	0.289	17.50
N21 X N56	96.7	459	7141	11.05	1.685	0.358	21.20
N23 X N67	95.0	443	9114	14.09	1.752	0.391	22.30
FC1 X FC2	97.0	467	6181	09.79	1.671	0.378	22.20

OST-3: Evaluation of new single/double Bivoltine hybrids under on Station trials

One rearing trial (Dec. 2017 - Jan. 2018) of 4 new improved bivoltine (N23XN67, 67XN23, N56XN21 and N21XN56) was conducted.

Silkworm hybrids	Hatching (%)	Fec.	ERR		SCW (g)	SSW (g)	SR (%)
			No.	Wt. (kg)			
N23 XN67	97.0	482	9705	16.59	1.91	0.409	21.20
N67XN23	97.0	487	9532	15.91	1.92	0.412	21.45
N56XN21	97.5	484	9124	14.45	2.15	0.452	21.0
N21XN56	97.2	490	9529	15.80	1.86	0.392	21.01

On Farm Trials (OFT):

Newly developed silkworm hybrids (improved cross breeds and bivoltine double and single hybrids) were test verified with the farmers by RSRS, Anantapur and its nested units.

Unit	Hybrid combination	dfls No.	Yield/100 dfls (kg)	Rate/kg (RS.)
REC, Eluru	S8 X CSR16	8500	68.00	368
	MV1 X S8	800	45.00	292

Production of *N. thymus* at RSRS-Anantapur for control of Uzi flies infestation on silkworm crop in field

Vijaya Naidu (from September 2016) and M. A. Shanthan Babu (Coordinator)

N. thymus was produced using house fly pupa and supplied to different areas as per their requirement. The produced parasitized house fly pupae were sold to different areas and also used for a demo on Uzi fly parasitoid combined with Uzi trap where 210 farmers were benefited through this programme. The following are the details of supply of *N. thymus*. 791 pouches of *N. thymus* (50 ml, 2000 pupa) were supplied. Data collected on the suppression of Uzi indicated that there was a significant decrease in the Uzi infestation (15.4% - 2.8%) through integrated control measures adopted.

Demonstration of Rot fix for management of root rot in mulberry: Demonstrations were conducted at farmers' level by RSRS-Anantapur and RECs - V. Kota, Rayachoty, Eluru, Atmakur and Suryapet for management of root rot in mulberry. The survivability of plants recorded and it ranged between 42% to 90%.

Extension communication programme: Workshops, Group discussions, Awareness Programmes, Field Days, Farmers Days and Exposure visits were conducted by RSRS-Anantapur and its nested units for transfer of technologies developed by main institute and are fine tuned.

Centre	Group Discussion		Farmers' Day		FD / Awareness Programmes		Study Tour		Farmers workshop	
	Prog. (No)	Far (No)	Prog. (No)	Far (No)	Prog. (No)	Far (No)	Prog. (No)	Far (No)	Prog. (No)	Far (No)
Andhra Pradesh										
Anantapur	6	225	8	556	4	533	0	0	2	2327
Atmakur	9	223	4	181	6	565	0	0	0	0
Eluru	6	192	4	243	3	331	0	0	0	0
Chebrolu	6	230	4	220	4	437	0	0	0	0
Markapuram	6	190	4	230	3	350	01	12	0	0
Hindupur	6	256	4	314	3	516	0	0	0	0
Kalyanadurg	6	207	4	278	3	371	0	0	0	0
Madakasira	6	297	4	295	3	977	01	22	0	0
Palamaner	8	245	4	227	3	347	0	0	0	0
Penukonda	6	246	4	337	3	417	0	0	0	0
V. Kota	6	256	4	252	3	410	0	0	0	0
Telangana										
Metpalli	6	207	4	212	3	386	0	0	0	0
Suryapet	5	120	4	180	7	773	0	0	0	0
Vikarabad	5	120	4	210	3	350	0	0	0	0
Karnataka										
Bidar	1	20	1	45	0	0	0	0	0	0
Total	**107**	**3549**	**69**	**4131**	**57**	**7637**	**02**	**34**	**2**	**2327**

Resham Krishimela

1	**Siddipeta (Telangana State) on 11-10-2017** 1373 Farmers including DOS staff, **CSB** scientists/staff attended the workshop.
2	**Chebrolu (Andhra Pradesh state) on 21-12-2017** 954 Farmers including DOS staff, **CSB** scientists/staff attended the workshop.

Popularisation of improved mulberry varieties: A total of 4135.5 acres were planted with improved mulberry variety with 2743 farmers.

Unit	Farmers	Acres
Andhra Pradesh		
Anantapur	4	4
Atmakur	252	356
Eluru	15	50
Chebrolu	89	250
Markapuram	42	125
Hindupur	129	227
Kalyanadurg	274	391.5
Madakasira	406	735
Palamaner	53	73
Penukonda	538	540
V. Kota	555	776
Total	**2610**	**3887.5**
Telangana		
Metpalli	68	101
Suryapet	44	105
Vikarabad	21	42
Total	**131**	**248**
Grand total	**2743**	**4135.5**

Radio/ TV programmes			
#	Centre	Radio	TV
1	REC SU-Markapur	5	2
2	REC-Kalyanadurg	5	0
3	REC-Eluru	0	1
4	REC-Rayachoti	2	1
	Total	12	4

Training Programmes under Capacity building and training				
Unit	TOP (5 days)		FST (3 days)	
	Prog(No.)	Beneficiaries (No.)	Prog. (No.)	Beneficiaries (No.)
Andhra Pradesh				
RSRS-Anantapur	0	30	3	45
REC-V .Kota			3	30
REC-Kalyanadurg			4	55
REC-Eluru			3	30
REC-Rayachoty			1	30
REC-Madakasira			3	30
REC SU-Chebrolu			3	30
REC SU-Markapur			3	30
REC SU-Atmakur			2	30
REC-SU-Penukonda			3	30
REC-SU-Hindupur			1	30
REC SU-Palamaner			2	30
Telangana				
REC-Vikarabad			0	0
REC SU-Metpalli			1	25
REC-SU-Suryapeta			1	25
Karnataka				
REC SU-Bidar			0	0
Total		30	33	459

ADMINISTRATIVE REPORT

Main Institute

Central Sericultural Research & Training Institute

Regional Sericultural Research Stations (RSRS)

State/Units	RSRS	RECs	REC-SUs	CDP/CDCs
Karnataka	Kodathi	3	13	
	Chamarajanagara		1	
Andhra Pradesh	Ananthapur	5	3	2
Tamil Nadu	Salem	4	5	1
Telangana	Shadnagar	1	2	
Kerala		1		
Maharashtra		3	3	
Madhya Pradesh		1	1	
	Total	18	28	3
P4 Basic Seed Farm, Hassan [KA]				
Satellite Silkworm Breeding Station, Coonoor [TN]				

R&D and Administrative Personnel of CSRTI and Nested Units

R&D Personnel

CSRTI-Mysuru

Director
Sivaprasad V

Scientist-E
Satish Verma (Engineer)

Scientist-D
Anuradha H Jingade
Bhagya R (upto 29.04.2017)
Chandrashekar KB
Chandrashekar MN
Dasappa (Retd. 31.05.2017)
Gandhi Doss S
Gangadhar B (Expired May 2017)
Kariyappa (upto 29.04.2017)
Kishor Kumar CM
Kulakarni SB
Manthira Moorthy S
Mogili T (Retd. 28.02.2018)
Mary (Josepha) AV
Mahima Santhi A
Meenal R
Nagaraja SB (Retd. 30.06.2017)
Narasimha Nayak AR
Narendra Kumar JB
Parameshwara C
Pratheesh Kumar PM
Purushotham S
Rajashekar K
Sabitha MG (upto 29.04.2017)
Santha PC
Sathyaprasad K (Retd. 30.01.2018)
Shivakumar M. Hukkeri (From 12.06.2017)
Somaprakash DS
Srinivasa B.T
Soudaminy P.V
Suma AS (upto 29.04.2017)
Vineet Kumar

Scientist-C
Geetha GS (S.S.)
Madhusudhan KN
Munikrishnappa HM
Sibayan Sen
Vinod Kumar Yadav

Scientist-B
Arunkumar GS
Bhuvaneshwari E
Gayathri T
Joycy Rani D
Kusuma L
Mallikarjuna G
Ranjini MS
Satish L
Sobhana V
Tanmoy Sarkar
Vaijayanthi PV
Yeruva Thirupathaiah

Nested Units

Karnataka

Scientist - D
Jalaja S Kumar
Ambika PK
Dayananda
Girish Naik V
Jagadeesh N (upto 31.05.2017)
Jayaram H
Lakshmanan V
Maheshwari M
Mukund V Kirsur (Retd. 31.07.2017)
Nishitha Naik V
Noble Morrison M
Pallavi SN
Philomina KL (Retd. 31.08.2017)
Raghunath M K
Ravindra M Mattigatti
Saraswathi P
Sudhakar P
Vedavyasa K
Veeranna Gowda H
Venkatachalapathy M

Scientist – C

Guruswamy D
Hanumantharayappa SK
Ishwar
Mahalingappa KC
Saraswathi P
Srinivasulu Y
Sanat Kumar YN
Serani Nagendra

Tamil Nadu

Scientist - D

Rajakumar S
Babu CM
Balasaraswathi S
Chandrasekaran K
Dhahira Beevi N
Gnanakumar Daniel A
Issac Joseph (Retd. 31.12.2017)
Mary Flora CA
Masilamani S
Mohamed Babu A
Mohan B
Mohan Das TP
Punithavathi G
Rajalakshmi E
Rajaram S
Ravikumar J
Sakthivel N
Samuthiravelu P
Selvaraju NG
Vijayakumar R

Scientist - C

Anbazhagan R (Retd. 31.12.2017)
Humayun Sherief Y
Kamaraj S
Mahiba Helen S
Sivasubramonian T

Kerala

Scientist-D
Sarala K
Mohandas TP

Andhra Pradesh

Scientist - D
Shanthan Babu MA
Ashok Kumar K
Chowdhary NB
Murthy BN (Retd. 31.10.2017)
Prasad GV
Srinath B
Srinivasa Rao TVS
Venkataramana P
Venugopal A
Vidyunmala S
Vijaya Naidu B

Scientist-C
Kiran Kumr P

Telangana

Scientist-D
Praveen Kumar K
Sanjeeva Rao BV
Srinath B
Srinivasulu Reddy P

Maharashtra

Scientist –D
Bagde AP
Karande AJ
Kushuwaha RV
Rahul Singh
Ram Prakash

Madhya Pradesh

Scientist-D
Pradeep Shukla

Technical Personnel
Ganesan V
Rekha M
Sumathy R – Info. Officer (DBT-Sub DIC)

Administrative Personnel
Dheeraj Kumar DD (A&A)
Balappa Yallappa Talawar LIO
Bheemsen S Pappu AD (Pub)
Girijamma AD (A&A)
Mohan AD (A&A)
Rama Rao HK AD (A&A)
Vishwanath BS AD (A&A)

Budget (Rs. In lakhs) for 2017-18

Particulars	Grant Released	Expenditure
Plan Salaries – 36	5272.91	5272.91
Plan-Gen-31	549.46	712.74
Plan-Cap-35	62.77	62.77
Total	**6048.42**	**6048.42**

Details of Review Meeting

Meeting	Date	Venue
41st Research Advisory Committee (RAC)	20-21 April 2017	CSRTI- Mysuru
42nd Research Advisory Committee (RAC)	27-28 November 2017	CSRTI-Mysuru
3rd Regional Research Advisory Committee (RRAC)	21 August 2018	Madurai
60th Research Committee (RC)	28 Oct 2017	CSRTI-Mysore

28. RESEARCH ADVISORY COMMITTEE

Chairman
Prof. S. R. Niranjana
Professor & Hon'ble Vice Chancellor
GulburgaUniversity, Jnana Ganga
Kalaburagi - 585 106, Karnataka

Members
Dr. Chandrasekharaiah
Director (Rtd.), APSSRDI-Hindupur
Kathriguppe, BSK III Stage
Bengaluru - 560 085, Karnataka

Dr. A. Ramesh Sundar
Principal Scientist, Plant Pathology
Sugarcane Breeding Institute (ICAR)
Coiambatore - 641 007, Tamil Nadu

Prof. Ranganathan Ramani
Director (Rtd.) (IINRG)
2A, Visakha, Doshi Nakshatra 1,
Old SBI Colony, West Tambaram,
Chennai 600 045

Prof. K.C. Narayana Swamy
Department of Sericulture
University of Agricultural Sciences (UAS)
GKVK, Bengaluru - 560 065, Karnataka

Invitees
The Commissioner Sericulture Development
& Director of Sericulture, Govt. of Karnataka,
5th Floor, M. S. Building, Dr. B. R. Ambedkar Beedhi,
Bengaluru - 560 001, Karnataka

The Director of Sericulture
Department of Sericulture
Govt. of Tamil Nadu
Nethaji Nagar, Hasthampatty
Salem - 636 007, Tamil Nadu

The Commissioner of Sericulture
Govt. of Andhra Pradesh
TTPC Building, First Floor, Old Market Yard
Chuttugunta (Besides Mini Rythu Bazar)
Guntur - 522 007, Andhra Pradesh

The Commissioner of Sericulture
Govt. of Telangana
Road No. 72, Prashasan Nagar
Adjacent to Water Tank, Jubilee Hills
Hyderabad - 500 033, Telangana

The Commissioner
Commissionerate of Rural Development
Govt. of Kerala
LMS Compound, VikasBhavan
Thiruvananthapuram - 695 033, Kerala

The Commissioner
Directorate of Sericulture
Govt. of Madhya Pradesh
Lower Basement, SatpuraBhavan
Bhopal - 461 004, Madhya Pradesh

The Director
CSTRI
Central Silk Board
CSB Complex, BTM Layout
Madivala, Bengaluru - 560 068, Karnataka

Director (Tech)
Central Silk Board
CSB Complex, BTM Layout
Madivala, Bengaluru - 560 068, Karnataka

Member Convener
Director
Central Sericultural Research and Training Institute,
Srirampura, Mysuru - 570008, Karnataka

Two Farmers/ Stakeholders nominated by respective State Department of Sericulture

METEOROGICAL DATA

Meteorological Data 2017: CSRTI-Mysuru							
Month	Temperature [^{0}C]			Humidity [%]			Rainfall [mm]
	Max	Min	Avg	Max	Min	Avg	
January	32.50	19.70	26.10	88.00	69.00	78.50	3.8
February	34.90	19.60	27.25	93.00	44.00	68.50	0.0
March	36.60	22.90	29.75	91.00	74.00	82.50	0.0
April	36.80	23.40	30.10	87.00	61.00	74.00	171.3
May	35.00	23.50	29.25	93.00	89.00	91.00	213.6
June	31.90	21.40	26.65	93.00	84.00	88.50	31.6
July	31.80	21.40	26.60	92.00	91.00	91.50	57.7
August	32.50	21.30	26.90	98.00	90.00	94.00	114.3
September	32.00	22.10	27.05	96.00	95.00	95.50	349.9
October	31.40	21.50	26.45	96.00	91.00	93.50	145.0
November	31.00	22.10	26.55	85.00	85.00	85.00	5.6
December	31.10	20.60	25.85	98.00	90.00	94.00	15.2
Mean	33.13	21.63		92.50	80.25		
Extm. High	36.80	23.50		98.00	95.00		
Extm. Low	31.00	19.60		85.00	44.00		
						Total Rainfall	1108.00
						No. of Rainy Days	60

HIGHLIGHTS OF RESEARCH FRAME WORK DOCUMENT (RFD)

#	**Success Indicator**	**Unit**	Target	Achievement
1	Total on- going Projects	No.	27	33
2	Projects Concluded	No.	9	9
3	New Projects taken up	No.	12	8
4	No. of Technologies / innovations developed /likely to be developed out of concluded projects	No	3	4
5	New Technologies for field testing	No.	6	6
6	Machines / equipment absorbed in the field	No.	2	2
7	Technologies commercialized	No.	1	3
8	Technologies applied for patenting	No.	1	1
9	No. of Farmers database created for m-Kisan Portal	No.	60000	60200
10	No. of Messages up-loaded in M-Kisan Portal	No.	96	97
11	Digitization of Soil Health Records	No.	12000	12000
12	% of implementation of Direct Benefit Transfer(DBT)	%	100	100
13	Submission of DBT Annexure 1&4	%	100	100
14	Number of Seri-model Village identified	No.	10	10
15	No. of farmers adopted	No.	1000	1000
16	Expected raw silk output	MT	70	129.16
17	No. of dfls proposed for large scale trial	Lakh Nos.	6	1.65161
18	Number of Clusters	Number	100	106
19	No. of farmers covered	No.	25000	31500
20	Raw silk output	MT	3200	3905.35
21	Popularization of improved mulberry varieties	sapling/ cutting(lakh.)	10	515.339
22	No. of villages covered	No.	1	1
23	Adoption of villages	%	100	100

24	Number of farmers covers under 100% adoption of technology	No.	1000	1000
25	No of programmes conducted	No.	1400	1438
26	No of farmers covered	No.	50000	107978
27	Post programme follow up	%	80	80
28	Participation in Radio Programmes	No.	8	55
29	Participation in TV Programmes	No.	8	9
30	No. of Success stories submitted for publication under various aspects	No.	7	6
31	Video of International quality on Various aspects of Institute	No.	3	4
32	Number of papers / popular articles published including in Indian Silk	No.	30	35
33	No. of Seri Tourism corridor developed	No.	1	nil
34	Beneficiaries trained under structured programmes, need based programme etc.	No.	2000	2885
35	Revenue generation through commercialization of technology	Rs. (lakh)	7.8	8.11
36	Revenue generation through other methods	Rs. (lakh)	234	362.68
37	Effective utilization of cultivable land for assigned mandates	Acres	45	45
38	Extent of utilization of facilities for the core purpose of assigned mandates	%	95	95
39	Utilization of scientific manpower for research activities	%	95	95
40	Monitoring of progress of construction works at Institute & SUs	%	95	95
41	Submission of UCs	%	60	80
42	Financial expenditure as per allotment	%	100	100
43	Submission of UCs	%	100	100
44	Projects taken up for collaborative research	No.	7	10

PUBLICATIONS

International Journals

Fernando WGD, Zhang X, Selin C, Zou Z, Liban SH, McLaren D, Kubinec A, Parks PS, Rashid H, Padmathilke KRE, Rong L, Cunchun Yang, Gnanesh BN, Huang S (2017) A six-year investigation of the dynamics of avirulence allele profiles, blackleg incidence, and mating type alleles of *Leptosphaeria maculans* populations associated with canola crops in Manitoba, Canada. *Plant Dis., 2017, doi.org/10.1094/PDIS-05-17-0630-RE.*

Kamaraj S, Pandiaraj T, Prabhu IG, Nidhi V and Sinha AK (2017) Comparative study on performance of Tasar silkworm *Antheraea mylitta* Drury under chawki garden and direct rearing method. *Int. J Curr. Microbiol. Appl. Sci.*, 6(4): 1-5.

Kamaraj S, Pandiaraj T, Prabhu IG, Sanjukumari and Sinha AK (2017) Effect of soya protein enriched fortified feed of tasar silkworm *Antheraea mylit*ta Drury on rearing performance and economical cocoon characters, *Int. J. Adv. Biol. Res*., 7(1): 61-64.

Kiran Kumar KP, Sinha AK, Singh GP and Alok Sahay (2017) Development and laboratory trails of Tasar Silkworm Egg Washing and Sterilization Machine II (TSEWSM-II) for small scale tasar silkworm eggs cleaning and surface sterilization towards drudgery reduction. *Int. J. Res. Zool*., 7(2): 16-20.

Madhusudhan KN, Laltlankimi, Moorthy SM, Naqvi AH, Gupta VP, Sahay A and Sivaprasad V (2017) Impact of varying different abiotic factors on the survivability of tasar silkworm in outdoor rearing fields. *J. Entomol. & Zool. Stud.*, 5(6): 957-963.

Madhusudhan KN, Manila, Moorthy SM, Gupta VP, Sinha AK and Sivaprasad V (2018) Studies on biochemical changes during Tropical tasar silkworm pebrine interaction. *Int. J. Adv. Res.,* 6(2):635-647.

Madhusudhan KN, Meghana PB, Vinaya Rani G, Moorthy SM, Mary Josepha AV, Kishorekumar C, Prakash HS and Sivaprasad V (2017) Extraction and characterization of chitin and chitosan from Aspergillus niger, synthesis of silver-chitosan nanocomposites and evaluation of their antimicrobial potential. *J. Adv. Biotech*. 6(3): 939-945.

Madhusudhan KN, Poojanag N, Moorthy SM, Mary Josepha AV and Sivaprasad V (2018) Evaluation of antibacterial potential of botanicals against silkworm bacterial pathogen *Bacillus thuringiensis*. *Int. J. Pharm. Drug Anal*., 6(2): 339-341.

Mahimasanthi A, Vedavyasa, Morrison MN and Sivaprasasd V (2018) Study on drought management practices in mulberry sericulture in Karnataka state. *Int. Res. J. Biological Sci*., 7(3): 24-28.

Mahimasanthi A, Vidyunmala S, Reddy MP, and Sivaprasasd V (2018) Drought management in mulberry sericulture in scarce rainfall zones of Andhra Pradesh, *India. Int. J. Tropical Agric*., 35 (4): 935-942.

Mary Josepha AV (2017) Identification of *Bemisia tabaci* (Gennadius) infesting mulberry using mitochondrial coenzyme 1 gene sequence. *Int. J. Ani. Plant Environ. Sci*., 7(3): 60-67.

Pratheesh Kumar PM and Sivaprasad V (2017) fluorescent pseudomonas induced systemic resistance to powdery mildew in mulberry (Morus spp.) *Int. J. Indust. Entomol.*, 35(2): 63-70.

Pratheesh Kumar PM, Divya Bharathi HB, Sivaprasad V (2017). Antifungal effect of chitosan on certain soil borne fungal pathogens of mulberry (*Morus spp.*). International Journal of Sciences and Applied Research, 4(11): 4–11.

Rajaram S, Mahimasanthi A, Dhahira Beevi N, Rajakumar S and Sivaprasad V (2018) Impact of simple agro-ergonomic practices adoption in mulberry cultivation for natural resources saving; cost reduction and increase income to sericulture farmers. *Int. J. Applied & Pure Sci. & Agric.,* 4(2): 9-15.

Rajaram S, Qadri SMH and Sivaprasad V (2017) Irrigation water savings in mulberry cultivation without affecting the quality linked productivity of raw silk and income to sericulture farmers. *Int. J. Tropical Agric*. [NAAS], 35(4): 1073-1081.

Ravi Kumara R, Ramesh HL, Swamy Gowda MR and Sudhakar P (2018) Morphological and Micro-anatomical variation in different ploids of mulberry genotypes (*Morus* sp.). *Green Farming*, 9(2): 129-132.

Rukmangada MS, Sumathy R, Sivaprasad V and Girish Naik V (2018) Growth performance in contrasting sets of mulberry (*Morus* Spp.) genotypes explained by logistic and linear regression models using morphological and gas exchange parameters. *Scientia Horticulturae*, 235: 53-61.

Sakthivel N (2018) Standardization of cassava leaf harvest in relation to ericulture cum tuber production, *Int. J. Agric. Innovations & Res.,* 6(5): 190-195.

Sakthivel N and Qadri SMH (2017) Utilization of cassava foliage for large scale production of eri silk, *Int. J. Sci. Environ. & Technol.,* 6(4): 2521–2534.

Sarkar T, Mogili T and Sivaprasad V (2017) Improvement of abiotic stress adaptive traits in mulberry (spp.): An update on biotechnological *Morus* interventions, 3 *Biotech*, 7(3):214.

Srinath B, Shanthan Babu MA, Reddy PL, Sujatha B and Sankar Naik S (2018) Hatching patterns in the silkworm *Bombyx mori L*. under 'black boxing' system: A photoperiodic perspective. *Int. J Adv. Sci. & Res*., 3(1):152-157.

Srinath B, Shanthan Babu MA, Reddy PL, Sujatha B and Sankar Naik S (2018) Impact of phytoecdysone, 'Sampoorna' on the synchronization of ripening in the commercial silkworm, *Bombyx mori* L. – A chronobiological perspective. *Int. J Sci. & Nature*, 9(1): 11-16.

Sudhakar P, Hanumantharayappa SK, Jalaja S Kumar and Sivaprasad V (2018) Evaluation of Affordable Micro-Irrigation Technologies (AMITS) for enhanced quality mulberry leaf production. *Imp. J. of Interdis. Res.,* 4(1): 97-102.

Sudhakar P, Hanumantharayappa SK, Jalaja S Kumar and Sivaprasad V (2018) Evaluation of Affordable Micro-Irrigation Technologies (AMITs) for quality mulberry leaf production. *Green Farming*, 9(1): 176-178.

Sudhakar P, Hanumantharayappa SK, Jalaja S Kumar and Sivaprasad V (2018) 'DRUM KIT' - A novel method of irrigation to combat with drought stricken conditions in seri-farming. *Imp. J. of Interdis. Res*., 4(1): 415-419.

Sudhakar P, Hanumantharayappa SK, Jalaja S Kumar and Sivaprasad V (2018) Enhancement and maintenance of organic carbon in tropical soils through organic and green manuring. *Green Farming*, 9(1): 31-35.

Sudhakar P, Hanumantharayappa SK, Sudhakar Rao P, Jalaja S Kumar and Sivaprasad V (2018) Influence of tree mulberry (*Morus alba* L.) in varied geometries on mulberry leaf and silkworm rearing. *Int. J. Cur. Res. Life Sci*. 7(3): 1381-1386.

Sudhakar P, Krishnappa BL, Jalaja S Kumar and Sivaprasad V (2017) Adoption of tree mulberry and imparting Bivoltine sericulture replacing mango garden as profitable venture under Cluster Promotion Programme (CPP), Shapur, Kolar - Success story. *Imp. J. of Interdis. Res*., 3(12): 434-439.

Sudhakar P, Krishnappa BL, Jalaja S Kumar and Sivaprasad V (2018) Impact of Cluster Promotion Programme (CPP) on the Bivoltine cocoon production under Shapur cluster, Kolar, Karnataka. *Green Farming*, 9(1): 129-133.

Sumathy R, Sivaprasad V and Manthira Moorthy S (2018) Insilico characterization of glutathione s-transferases and their interaction study in mulberry silkworm, *Bombyx mori*. *Int. J. of Adv. Res*., 6(2): 1204-1212.

Veeranna Gowda, Muthulakshmi M, Geetha N Murthy and Alok Sahay (2017) Identification of potential Bivoltine breeds of Silkworm *Bombyx mori*. L. For utilization in breeding studies, *IJRIEST*, 2(1): 72-78.

National Journals

Balavenkatasubbaiah M, Rajkumar S, Thirunavukarasu, Selvaraju MG, Chandrasekharan K, Mary Josepha AV, Narasimha Nayaka AR and Sivaprasad V (2015) Impact of silkworm diseases on cocoon production in the selected areas of Tamil Nadu, India. *Indian J. Seric*., 54(1-2): 51-59.

Gayathri T, Gandhi Doss S and Rajashekar K (2017) Studies on physio-biochemical traits contributing to leaf yield and quality in three improved mulberry varieties. *J Cytol. Genet., 18: 21-29.*

Geetha G.S (2017) "Women Development And Empowerment Approach in Sericulture" IJS V-56 (1-2): 73-75.

Nivedita S, Saraswathi P and Alok Sahay (2016) Value addition to mulberry wood. *Indian J. Seric*., 55(1-2): 65-68.

Pratheesh Kumar PM, Divya Bharathi HB, Sivaprasad V. (2017). Mycotoxic effect of chitin on root rot pathogens of mulberry (Morus spp.). Indian Journal of Sericulture 55(1, 2) 25–30.

Sakthivel N (2016) Biochemical alteration in spiralling whitefly affected cassava leaves and its impact on eri silkworm *Samia cynthia ricini* Boisduval. *Indian J. Entomol., 80 Online IJE 16151 / December 2017*.

Sakthivel N, Chikkanna, Narendra Kumar JB and Sivaprasad V (2017) *Batocera rufomaculata* De Geer: A new stem borer pest of mulberry. *Indian Silk*, 8(5-7): 4-6.

Sakthivel N, Kumaresan P and Qadri SMH (2017) Sericulture on cassava: An analysis of its economic feasibility in Tamil Nadu. *Indian J. Seric*., 55(1-2): 60-64.

Sivaprasad V, Dayananda, Mal Reddy N, Balavenkatasubbaiah M, Kulkarni SB and Kariyappa (2016) Development of a new improved crossbreed "Cauvery Gold" (MV1 × S8) for south Indian Sericulture. *Indian J. Seric*., 55(1-2): 1-7.

Thirupathaiah Y, Sivaprasad V, Bhuvaneswari E, Munirathnam Reddy M, and Chandrashakharaiah M (2017) Extaction and characterization of mulberry silkworm, *Bombyx mori* L., pupae oil, *Indian J. Seric*., 55(1-2): 31-37.

Seminars, Workshops and Conferences

Arunakumar GS, Gnanesh BN, Mogili T, Sivaprasad V (2018) Development of mapping populations for identification of QTLs resistance to Meloidogyne incognita in mulberry. In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, University of Mysuru, 15-17th Feb 2018, Mysuru. p: 132.

Arunakumar GS, Revanna S, Gnanesh BN, Vinod K Yadav, Mogili T, Sivaprasad V (2018) Root knot nematode in major mulberry growing areas of southern Karnataka. National conference on Scientific Advancements for Sustainable Development, SDM MMV, GASYM, Mysuru, February 22nd - 23rd, 2018. AB-V1_16, p:16, www.ijpbs.net.

Amreen A, Arunakumar GS, Gnanesh BN, Yadav V, Mogili T, Sivaprasad V (2017*)* Efficacy of botanicals against *Fusarium solani* and *F. oxysporum* causing dry root rot of mulberry. *In: The 1st life sciences research symposium, University of Mysuru, 19th May 2017, Mysuru.* p: 35.

Balasaraswathi S, Rajakumar S, Ravikumar J and Sivaprasad V (2018) Impact of insecticides, fungicides, herbicides and bio pesticides used for pest, weed and disease management in mulberry on soil biota. *In: Abstract of the National conference on Seri-Biomics, Challenges, Innovations and Solutions - Department of studies in sericulture, University of Mysuru, Mysuru - 15-17.02.2018,* p.61.

Chowdary NB and Sivaprasad V (2017) Adoption of improved sericultural technologies by cluster farmers of Giddalur, Prakasam dt., A.P. *In: International Conference & Expo on Agriculture & Veterinary Sciences: Research and Technology, Hyderabad 23-25 October 2017,* p: 30.

Dayananda, Sivaprasad V, Kulkarni SB, Balavenkatasubbaiah M and Kariyappa (2018) Productive polyvoltine breeds of Silkworm *Bombyx mori* tolerant to high temperature and BmNPV. *In: National Conference on Seri–Biomics: Challenges, Innovations and Solutions, at University of Mysuru, Mysuru held on 15-17 Feburary, 2018*, p: 77.

Dhahira Beevi N and Qadri SMH (2018) Influence of co-inoculation of microbial consortium on mulberry leaf yield and rearing parameters of silkworm (*Bombyx mori*). *In: Zoology Congress-2018 (ZOOCONG-18), Department of Zoology, St. Xavier's College (Autonomous), Palayamkottai-627 002, 10-13 January 2018, Tamil Nadu, India*. p: 11.

Doss SG, Rajashekar K, Mogili T, Kumar PMP, Sarkar T, Gayathri T and Sivaprasad V (2018) Selection of mulberry hybrids resistant to root-rot and root-knot diseases with higher leaf productivity. *In: Abstract of the National conference on Seri-Biomics, Challenges, Innovations and Solutions - Department of studies in sericulture, University of Mysuru, Mysuru -15-17.02.2018,* p. 45.

Gayathri T, Mogili T, Gandhi Doss S, Tarkar T and Sivaprasad V (2018) Evaluation of improved mulberry varieties for antioxidant potential under optimal input conditions. *In: 30th Kerala Science Congress, 28-30th January 2018 at Government Brennen College, Thalassery, Kannur, Kerala,* p: 283-284.

Gnanesh BN, Arunakumar GS, Mogili T and Sivaprasad V (2018) Recent advancement in Mulberry Genomics. *In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, University of Mysuru, 15-17 Feb. 2018, Mysuru.* p: 120.

Gnanesh BN, Roa AV, Arunakumar GS, Mogili T, Sivaprasad V (2018) Molecular Characterization of root rot causing fungal pathogens and standardization of inoculation methods in mulberry. National conference on Scientific Advancements for Sustainable Development, SDM MMV, GASYM, Mysuru, February 22nd - 23rd, 2018. AB-V1_50, P: 50 www.ijpbs.net.

Hukkeri SM, Chandrashekar MN, Kishor Kumar CM Satish Verma and Sivaprasad V (2018) Adoption of water conditioning technology for the betterment of silk industry. In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DOS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru, 15-17 Feb 2018. p: 169.

Kavyashree TM, Madhusudhan KN, Moorthy SM and Sivaprasad V (2017) Synthesis and Characterization of antibacterial Chitosan-silver nanocomposites from male moths of mulberry silkworm (Bombyx mori L.). In: Conference of Asociation of Microbiologist India conference in JSS University, Mysuru, p: 32.

Kusuma L, Satish L, Manthira Moorthy S, Sivaprasad V (2017) ಹಿಪ್ಪುನೇರಳೆ ರೇಷ್ಮೆ ಹುಳುವಿನ ರೇಷ್ಮೆ ಗುಣಮಟ್ಟದ ಗುರುತಿಸುವಿಕೆಗಾಗಿ ಆಣ್ವಿಕ ಮಾರ್ಕರ್ಸ್/ಟ್ರಾನ್ಸ್ಕ್ರಿಪ್ಟ್ಸ್ ವಿಶ್ಲೇಷಣೆ: ವಿಮರ್ಶೆ. In: Kannada Science and Technology Conference (Kanndadalli Vigjnana matthu Thantrajnana Sammelana), JSS Arts, Commerce and Science college, BN Road, Mysuru, 24-25 Nov. 2017. p: 18.

Kusuma L, Satish L, Moorthy SM and Sivaprasad V (2018) Identification of molecular markers fro silk quality: A transcriptome approach. In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DOS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru, 15-17 Feb 2018. p: 123.

Madhusudhan KN, Chaitra S, Moorthy SM and Sivaprasad V (2018) Utilization of antimicrobial chitosan isolated from fifth instar silkworm larva (Bombyx mori L) for the waste water management. In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DOS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru, 15 -17 Feb 2018. p: 148.

Mahalakshmi RK, Roa AV, Arunakumar GS, Gnanesh BN, Mogili T, Pratheesh Kumar PM and Sivaprasad V (2017) Characterization of Fusarium spp. causing dry root rot of mulberry. National conference on Biology of Microbes: Evolution along Technology, Association of Microbiologists of India, Mysuru Chapter, Mysuru, 25th April 2017, Mysuru, p: 35.

Mahimasanthi A, Rajaram S, Daniel AGK, Vidunmala M, Vedavyasa K, Morrison MN and Sivaprasasd V (2018) Bridging of adoption gaps of technologies for yield improvement in mulberry in drought prone areas of South India. In: National Seminar on Doubling farmers income and farm production through skill Development and Technology Application, BAU, Sabour, Bihar, 28-30th Nov. 2017, p: 110.

Mahimasanthi A, Vidyunmala S, Reddy MP, and Sivaprasasd V (2018) Drought management in mulberry sericulture in scarce rainfall zones of Andhra Pradesh, India. In: ICRAAHS 2017- IJTA 6th International conference, The Hans, New Delhi, 16-17 Dec 2017, p: 95-105.

Mary Josepha AV, Santhosh V, Parameswar C and Sivaprasad V (2018) Study on the secondary contamination and increase in pathogenicity load during chawki rearing. In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DOS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru, 15-17 Feb. 2018. P: 92.

Mudasir Gani, Mary Josepha AV, Satish L, Chouhan S, Mallikarjun G, Bharath Kumar N, Mir Nasir Ahmad, Ghosh MK and Sivaprasad V (2018) Prevalence and molecular characterization of viruses causing diseases in Bombyx mori L. In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DoS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru, 15-17 Feb 2018, Mysuru. p: 131.

Narasimha Nayaka AR, Mallikarjuna G, Santha PC and Sivaprasad V (2018) Automated disinfection of silkworm rearing house. In: National conference on 'Seri-Biomics: Challenges, Innovations and Solutions, DoS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru 15-17 Feb 2018, Mysuru. p: 90.

Narendra Kumar JB, Sreenivasa BT, Morrison N, Meenal A, and Sivaprasad V (2018) Impact of crop diversity on insect pest incidence and conservation of natural enemies in mulberry eco-system. In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DoS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru 15-17 Feb. 2018, Mysuru. No. MCI-13: p: 57.

Pooja D, Arunakumar GS, Gnanesh BN, Mogili T and Sivaprasad V (2017) In vitro evaluation of recent fungicides against *Cercospora moricola* causing leaf spot of mulberry. The 1st life sciences research symposium, University of Mysuru, 19th May 2017, Mysuru, p:36.

Poojashree K, Arunakumar GS, Gnanesh BN, Mogili T, Prateesh Kumar PM and Sivaprasad V (2017) Evaluation of recent fungicide molecules against *Cerotelium fici* causing leaf rust of mulberry. The 1st life sciences research symposium, University of Mysuru, 19th May 2017, Mysuru, p: 37.

Prasad PB, Arunakumar GS, Gnanesh BN, Mogili T and Sivaprasad V (2017) Compatibility studies between different bio-agents effective against root rot and root knot causing pathogens of mulberry. The 1st life sciences research symposium, University of Mysuru, 19th May 2017, Mysuru, p: 34.

Pratheesh Kumar, P.M. Meghna, Y., Sivaprasad, V. (2017), Biocontrol and growth promotion activity of indigenous trichoderma isolates of mulberry gardens. *International Conference on Recent Trends in Agriculture, Veterinary & Life Sciences,* 28-30 December 2017, Carmel College for Women, Nuvem, Goa, India. (Abstract LA01A. pp. 36).

Pratheesh Kumar, P.M.., Navyashree, B.U and Sivaprasad, V. (2018) Mycotoxic effect of certain chemicals to soil borne pathogens of mulberry. National conference on seri-biomics: challenges, innovations and solutions. 15-17 February 2018, University of Mysore, Mysure, Karnataka, India

Rajakumar S and Sivaprasad V (2017) Scientific breakthrough coupled with technological interventions shows the way in augmentation of productivity and income for sustainable sericulture. *In: Abstract of International Conference and Expo on Agriculture and Veterinary Science: Research and Technology, Second Green Revolution called for Sustainable Agriculture held at Prof. Jayasankar, Telengana State Agricultural University, Hyderabad, 23-25 Oct.2017, Hyderabad,* p: 7.

Rajakumar S and Sivaprasad V (2018) Seribiodiversity conservation for sustainable livelihood. *In: Abstract of 8th International Conference on Wild Silk Moth held at Guwahati, Assam, India, 22-24th Jan. 2018*, p: 117.

Rajaram S, Mahima Santhi A, Dhahira Beevi N, Rajakumar S and Sivaprasad V (2017) Impact of simple agro-ergonomic practices adoption in mulberry cultivation for natural resources saving; cost reduction and increase income to sericulture farmers. *In: National Seminar on Doubling Farmers' Income and Farm Production through Skill Development and Technology Application held at Bihar Agricultural University, Sabour (Bihar), India, 28-30, Nov. 2017,* p: 137.

Ranjini MS, Sivaprasad V, Sangannavar PA, Gogoi DK, Kumar R, Goswami D (2018) Hormesis induced effective improvement of rearing crops in Muga silkworm. *In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DOS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru 15-17 February, Mysuru,* p: 173.

Sakthivel N (2018) Need based innovative technologies for leveraging mulberry silk production in India. *in: XVI AZRA International Conference on Applied Zoological Research for Sustainable Agriculture and Food Security, 9-11 Feb. 2018, jointly organized by Applied Zoologists Research Association (AZRA), Bhubaneswar, Odisha and Dept. of Entomology & Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, India,* p: 145.

Sakthivel N and Qadri SMH (2018) Response of some popular cassava varieties to mosaic virus and two major sucking pests under field conditions in Tamil Nadu, India. *In: Zoology Congress-2018 (ZOOCONG-18), Department of Zoology, St. Xavier's College (Autonomous), Palayamnkotti-627002, Tamil Nadu, India. 10-13 Jan.* p: 10.

Sakthivel N and Qadri SMH (2018) Studies on feasibility of utilizing rainfed cassava for ericulture. *In: 1st Farm Innovation Congress, 2018 and National Conference on Innovative Farming for Food and Livelihood Security in Changing Climate, FACC, BCKV, Kalyani , West Bengal. 12-13th January,* p: 75.

Sarkar T, Raghavendra AS, Mogili T, Doss SG, Gayathri T, Arunakumar GS, Kavya Shree B and Sivaprasad V (2018) Functional characterization of C4 photosynthesis-related genes in tobacco (*Nicotiana* spp.) and mulberry (*Morus* spp.): a gain of function approach. *In: Abstract of the National conference on Seri-Biomics, Challenges, Innovations and Solutions - Department of studies in sericulture, University of Mysuru, Mysuru -15-17.02.2018,* p. 129.

Satish L, Kusuma, L and Sivaprasad V (2018) Development of multi-viral disease tolerant bivoltine silkworm breeds/hybrids of *Bombyx mori* L. through Marker Assisted Selection (MAS) *In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DOS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru, 15-17 Feb 2018, Mysuru*. p: 126.

Satish L, Kusuma L, Moorthy SM and Sivaprasad V (2017) Molecular approaches in Sericulture sustenance *In: National Conference on Science and Technology in Kannada, JSS University, Mysuru, Mysuru, 24-25 Nov. 2017.* p: 38.

Sreenivasa BT, Divya SH, Narendra Kumar JB and Sivaprasad V (2018) Damage and Management of the Giant African Snail, *Achatina fulica* Bowdich in mulberry eco-system. *In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DOS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru 15-17 Feb 2018, Mysuru*. No. MCI-18.

Sujith Nade, Narendra Kumar JB and Jadhav AD (2018) Suitability of killed housefly pupa for multiplication of *Nesolynx thymus* (Hymenoptera: Eulophidae, an ecto-pupal parasitoid of the silkworm uzi fly, Exorista bombycis. *In: National Conference on Recent Advances in Agrochemicals and Integrated Pest Management (RAAIPM), Department of Agrochemicals and Pest management, Shivaji University, Kohlapur (Maharashtra) 6 Mar. 2018,* No. P-18.

Sumathy R, Amalin Jai Rubella, Sivaprasad V and Manthira Moorthy S. (2018) SilkLoc: Silkworm subcellular localization database. *In: National conference on Seri-Biomics: Challenges, Innovations and Solutions, DoS in Sericulture Science, University of Mysuru, Manasagangotri, Mysuru 15-17 Feb 2018*., p: 123.

Thirupathaiah Y, Stella M, Sivaprasad V, Bhuvaneswari E and Vineetkumar (2018) Characterization of mulberry silk fibroin nanoparticle produced by *Fusarium oxysporum*. *In: National Conference on Seri-Biomics: Challenges, innovations and solutions, University of Mysuru, Manasagangotri, Mysuru,* (Souvenir): SBB-13:137.

Popular articles

Devamani M and Sakthivel N (2018) Problems in mulberry production during winter season and their remedies. *Pattu Malar*, January 2018, Department of Sericulture, Government of Tamil Nadu. 7(5): 4-6.

Dhahira Beevi N and Devamani M (2017) Soil fertility in mulberry cultivation. *Pattu Malar*, August 2017, Department of Sericulture, Government of Tamil Nadu. 6(12): 12-14.

Jalaja S Kumar and Saraswathi P (2017) Shahatut ek kalpavruksh, *Resham Kiran*, 6(1):7-8. (Hindi).

Joycy Rani D, Mahima Santhi A and Sivaprasad V (2017) Karuvulo mulberry sagutho manchi aadayam-1. *Annadatha*, April, p: 30-33. (Telugu).

Joycy Rani D, Mahima Santhi A and Sivaprasad V (2017) Karuvulo mulberry sagutho manchi aadayam-1. *Annadatha*, May- p: 58-59. (Telugu).

Joycy Rani Dasari (2017) Resham Uthpadan – Aajivika sudharne hethu behthareen vikalp. *Resham Kiran*, 6(4): 9-10 (Hindi).

Kiran Kumar KP (2017) Aake Pantaku Soku, Andhra Jyothi News Paper, 21 Feb 2017, p: 8 (Telugu).

Kiran Kumar KP (2017) Laabhalu Pattu, Saakshi News Paper, 13 Sept 2017, p: 13 (Telugu).

Kiran Kumar KP (2017) Pattubigiste…Sirulapante, Eenadu News Paper, 21st March' 2017, p: 16. (Telugu).

Kiran Kumar KP (2017) Vangadalathonu pattu saadinchavachhu, Saakshi News Paper, 23th September 2017. p: 15 (Telugu).

Kiran Kumar KP (2017) Varshakala Yajamanyam - Digubadiki pattu, Saakshi News Paper, 17th October 2017, P: 10 (Telugu).

Kiran Kumar KP (2017) Yajamaanya Paddatulu Patiste…Mulberrylo Manchi Laabhalu, Saakshi News Paper, 11th March 2017, p: 12 (Telugu).

Kiran Kumar KP (2017) Adikadigubadulanu andinche mulberry panta rakaalu, Chaitanya sedyam, October 2017, P: 31-32 (Telugu)

Kiran Kumar KP (2017) Mulberry Saagulo Prayojanaalu Enno, Vaartha News Paper, 19.09.16, p:6. (Telugu)

Kiran Kumar KP (2017) Mulberry tegullu, Nivarana; Chaitanya Sedhyam (farmer's monthly magazine, samputi 3, Sanchika 03, March, 2017, p: 14 (Telugu).

Kiran Kumar KP (2017) Pattugulla utpattiki Uzi debba, Saakshi News Paper, 23rd October 2017. p: 10 (Telugu).

Kiran Kumar KP (2017) Valasabatukullo…Mulberry velugulu a success story, Andhra Jyothi, News Paper, 14th September 2017, p: 8 (Telugu).

Kiran Kumar KP, Shantan Babu MA, Vijaya Naidu B and Sivaprasad V (2017) Adhika digubadulanu andinche mulberry vangadalu. p: 13 (Telugu).

Mahiba Helen S, Rajakumar S, and Jeeva E (2018) Biological control of mulberry pests. Pattu Malar, February, 2018, Department of Sericulture, Government of Tamil Nadu, p: 7-9.

Pratheesh Kumar, PM, Rajasekher K, Sivaprasad V. (2017). Rot-fix sahatut ke mool vikalan niyanthrit karne hethu ek paristhithi anukool broad spectrum suthrikarana. Resham Kiran 6(1): 11-12.

Rao TVSS (2017) On organization of Awareness programme on September 26, 2017 at Chithapur village, Chatrai Mandal, Krishna district, Andhra Pradesh. *Indian Silk, 8(Old 56): (8-9): 74.*

Rao TVSS (2017) On organization of Farmers Skill Training Programme for 3 days between 30.10.17, 31.10.17 with a Study Tour on 06.11.17 at Kethavaram village, Jangareddy gudem Mandal, West Godavari district, Andhra Pradesh. *Indian Silk 8(Old 56)(8-9): 81.*

Rao TVSS (2017) On organization of Farmers' Day on October 5, 2017 at Karicherlagudem village, Koyyalagudem Mandal, West Godavari district, Andhra Pradesh. *Indian Silk, 8(Old 56)(8-9): 76.*

Rao TVSS (2017) On organization of Farmers' Days on 27.07.2017 at Vegiwada (Pedavegi Mandal) and on August 24, 2017 in Dibbagudem village, (Jeelugumilli Mandal). *Indian Silk, 8(Old 56)(5-7): 38*.

Sakthivel N (2017) Black polythene mulching in mulberry garden: One technology triple benefits (Weed control, soil moisture conservation and plan growth promotion). *Pattu Malar, 6(11): 10-12*.

Sakthivel N, Chikkanna, Narendra Kumar JB and Sivaprasad V (2017) *Batocera rufomaculata* De Geer: An emerging stem borer pest of mulberry. *Indian Silk, 8(old 56)():4-6.*

Sakthivel N (2017) How a Fogging System Can Help Improve Indian Sericulture? Farmer's Notebook: The Wire, dated: 11/05/2017. *(https://thewire.in/134404/farmers-notebook-sericulture).*

Sakthivel N (2017) Post harvest hydration technology for prevention of withering of mulberry shoot in summer. *Pattu Malar 6(9): 8-9*.

Sakthivel N (2017) Technology for maintenance of appropriate temperature and humidity in silkworm rearing shed with fogging system. *Pattu Malar, 6(7): 13-17.*

Sakthivel N and Dhahira Beevi N (2017) Biogas from silkworm litter: Success story of sericulture farmer. The Hindu (Tamil), 06/10/2017, p: 4.

Veeranna Gowda, and Mishra PK (2017) Mahilonmukhi resham ugyog- Ek Sarvekshan, *Resham Bharathi, 28(55-57): 72-78*. (Hindi)

REPORTS

Kushwaha RV and Dawle MB (2017) Awareness cum Framers Training programme under CPP Buldana 21-22.12.2016. *Indian Silk, 7(55 old)(9-11):35*.

Kushwaha RV and Kasampure SG (2017) Field Day at Fubgaon Amravati on 11.11.2017 *Indian Silk, 7(55 old)(9-11):38.*

Kushwaha RV and Kumawat BL (2017) Field day under CPP Buldana on 08.11.2017 *Indian Silk, 7(55 old)(9-11):38*.

Kushwaha RV and Phadke SP (2017) Framers Day at Yeranda taluka Barshitakli Akola on 03.12.2017. *Indian Silk, 7(55 old)(9-11):38.*

Kushwaha RV, Padvi PS and Dinesh Chandra (2017), Framers Skill Training at Wardha under CPP Wardha 15-17.12.2017. *Indian Silk*, 7(55 old)(9-11):41.

Kushwaha RV, Phadke SP and Kavitkar SS (2017) Framers Skill Training on 20.22.12.2016. Indian Silk, 7(55 old)(9-11):41-42.

Kushwaha RV and Sunanda G Kasampure (2017) Field discussion on 07.07.2017. *Indian Silk, 8(56 old)(5-7):37.*

Kushwaha RV and Sunanda G Kasampure (2017) Field discussion on 19.07.2017. *Indian Silk, 8(56 old)(5-7):37.*

Kushwaha, R.V., S.P. Phadke and S.S. Kavitkar (2017) Field discussion on 05.08.2017. *Indian Silk,* 8(56 old)(5-7):39.

Kushwaha RV, Phadke SP and Kavitkar SS (2017) Field discussion on 14.08.2017. *Indian Silk, 8(56 old)(5-7):39.*

Kushwaha RV and Sunanda G Kasampure (2017) Exhibitioni Samadhan Krishi Mahitsav 2017 at Selu on 30.07.2017. *Indian Silk, 8(56 old)(5-7):43.*

Books/Chapters

Joycy R Dasari and Sivaprasad V (2017) Grading and Marketing of cocoons - Modern marketing methods of agricultural, horticultural, animal husbandry and forest products, UAS, Raichur p: 93-103.

Narendra Kumar JB (2018) Rearing house for silkworm rearing (original in English - Satish Verma and Sivaprasad V) (Kannada).

Narendra Kumar JB and Arun Kumar GS (2018) Tree Mulberry Plantation (original in English - Mogili *et. al*.)

Pratheesh Kumar, P.M. Meghna, Y., Sivaprasad, V. (2017). Biocontrol and Growth Promotion Activity of Indigenous Trichoderma Isolates of Mulberry Gardens. In: Recent Trends in Agriculture, Veterinary & Life Sciences. (Eds. Reddy PB and Ratnakar DB, IMRF Publications, Andhra Pradesh, India. Pp. 11-20. (ISBN978-93-86435-18-7)

Technical Bulletins/Pamphlets

Sivaprasad V, Narendra Kumar JB, Bakthavatsalam N and Morrison N (2018) Sex Pheromone Trap for Uzi fly Control (CSRTI Technical Brochure in Kannada & English), Technical Bulletin No. 46.

Extension brochure on Management of giant African snail, *Achatina fulica* - a pest of mulberry. Released during sericulture farmers work shop held on 6th March, 2018 at Hassan

Sequences published in NCBI

Accession Number	Organism Identified	Source
KY884641	*Fusarium solani*	Mulberry root rot
KY884642	*Fusarium solani*	Mulberry root rot
KY884643	*Fusarium solani*	Mulberry root rot
KY964307	*Lasiodiplodia theobromae*	Mulberry root rot
KY964308	*Lasiodiplodia theobromae*	Mulberry root rot
KY964309	*Lasiodiplodia theobromae*	Mulberry root rot
KY971448	*Acinetobacter baumannii*	Mulberry Silkworm
KY996477	*Stenotrophomonas pavanii*	Mulberry Silkworm
MG831720	*Nosema assamensis*	*Antheraea assamensis* H.
MG831719	*Nosema bombycis*	Mulberry Silkworm

All India Radio Programme

Advantage of paired row and wider spacing in mulberry cultivation - broadcasted on 12.9.2017.

Phone-in programme on Advantage of paired row and wider spacing in mulberry cultivation- broadcasted on 4.10.2017

Phone- in programe on Mechanization in sericulture - broadcasted on 15.11.2017

M-kissan portal

Forewarning on Damage and management of giant African snail, *Achatina fulica* Bowdich in mulberry eco-system.

CSRTI, MYSORE - EXTENSION NETWORK

BSF - Basic Seed Farm (1)
RSRS - Regional Sericultural Research Station (5)
CDC - Cluster Development Centre (2)
CPC - Cluster Promotion Centre (2)
SU - Sub Unit of REC (20)
REC - Research Extension Centre (15)
SBSS - Satellite Silkworm Breeding Station (1)

Farmers workshop
at Hassan on 06.03.2018

Farmers workshop
at Siddipet (Telangana) on 11.10.2017

Farmers workshop
at Chebrolu (Andhra Pradesh) on 21.12.2017

Farmers workshop
at Krishnagiri (Tamil Nadu) on 16.03.2018

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान

(आई एस ओ 9001: 2015) प्रामाणिति

Central Sericultural Research and Training Institute

(ISO 9001: 2015 Certified)

केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार, मैसूरु 570 008

Central Silk Board, Ministry of Textiles, Government of India, Mysuru 570 008