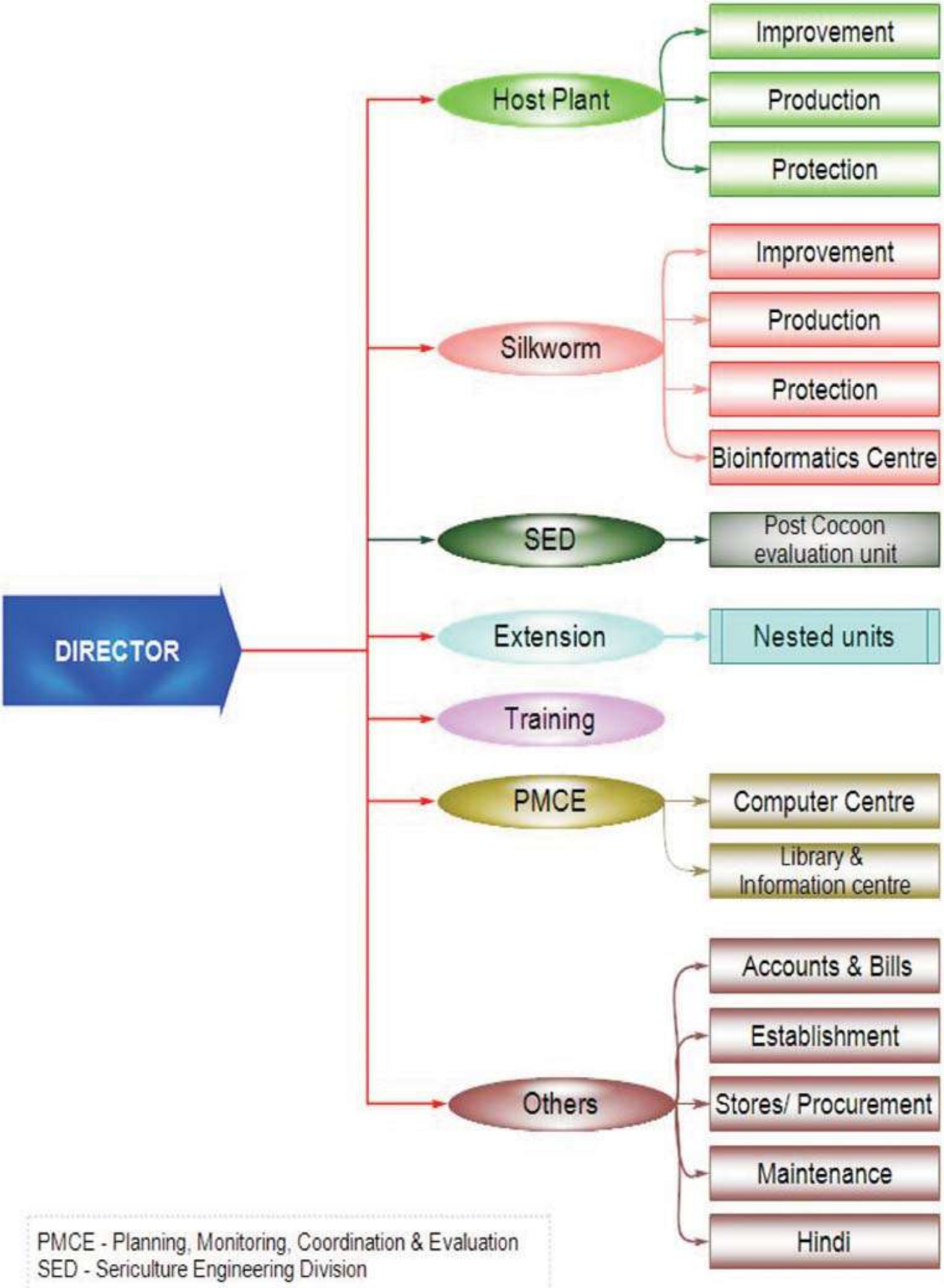
सं./No . 55

के रे अ प्र सं, मैसूरु
CSRTI-Mysuru

वार्षिक प्रतिवेदन
Annual Report
2018-19

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



PMCE - Planning, Monitoring, Coordination & Evaluation
SED - Sericulture Engineering Division

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प्रकाशक

डॉ आर. एस. टेओतिया
निदेशक
केंरेअप्रसं, मैसूरु

Published by

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Director
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CONTENT

प्रस्तावना

दक्षिण भारत में स्थित केंद्रीय रेशम उत्पादन एवं प्रशिक्षण संस्थान, मैसूर रेशम उत्पादन अनुसंधान एवं विकास से संबंधित अग्रणी संस्थान है। रेशम उद्योग के विकास की दिशा में केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूर द्वारा किए गए अनवरत प्रयास से कर्नाटक, आंध्र प्रदेश, तमिलनाडु, तेलंगाना, केरल, महाराष्ट्र एवं मध्य प्रदेश में कृषकों के द्वारा रेशम उत्पादन के क्षेत्र में प्रौद्योगिकी/तकनीक-आधारित कृषि-पद्धति अपनाए जाने की प्रक्रिया प्रारंभ हो सकी।

रेशम उत्पादन में और अधिक सुधार लाने हेतु उत्तम शहतूत प्रभेदों का विश्लेषण जलवायु परिवर्तन से संबंधित कार्यात्मक विशेषकों का पता लगाकर किया गया। विविध सुस्पष्ट लक्षणों के लिए कुल 37 शहतूत प्रभेदों का मूल्यांकन किया गया जिसकी पत्ती- उपज 194.7 - 769.17 ग्राम/पादप(खाकड़) रही। इनमें से 4, 15, 16 एवं 26 प्रभेदों की पत्ती-उपज मानक उपजाति यथा वी-1, एस -13 तथा विशाला और अनंता की तुलना में पर्याप्त रूप से अधिक रही। कृषिजोपजाति (कल्टीवर) जी-4 और तंबाकू कर्तोत्तकों के बीज- पत्रों, बीज पत्राधरों का उपयोग करते हुए आनुवंशिक रूपांतरण संबंधी प्रयोग किए गए। पुनरुज्जीवन प्रोटोकॉल को उच्चतम रखने पर संपूर्ण एमएस मीडियम में अधिकतम शाखांकुरण का पुनर्जीवन हुआ। इष्टतम एवं उप-इष्टतम सिंचित स्थिति (पीआईबी 3631) के अधीन 60% से अधिक मूलन क्षमता वाले सूखा- अनुकूल विशेषताओं से युक्त 21 शहतूत संकरों को नर्सरी बेड में प्रगुणित किया गया और बाद में स्थापना हेतु क्षेत्र में प्रतिरोपित किया गया।

60 विविध शहतूत जनन द्रव्यों का चार बैचों में मूल्यांकन किया गया। इनमें से 12 जनन द्रव्यों ने कर्नाटक, तमिलनाडु, आंध्र प्रदेश के जड़-गाँठ (नीमेटोड रोग) प्रभावित क्षेत्रों में प्रतिरोध शक्ति दर्शाई। 350 विविध जनन द्रव्यों को केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूर एवं इसकी अनुसंधान इकाइयों में प्रगुणित किया गया। प्रतिबल-रोधी जीन- प्ररूप की भी प्रभावित क्षेत्रों में अभीपुष्टि की गई। क्षारीयता प्रतिबल सहनशील जीन-प्ररूप एमआई- 0025 और एमआई -764 की पहचान की गई जिसे आगे के प्रजनन- कार्यों हेतु उपयोग में लाया जाएगा। प्रतिबल स्थितियों में संचित एंटीऑक्सीडेंट और ऑस्मोलाइट का आर्द्रता प्रतिबल सहनशीलता हेतु जैव रासायनिक चिन्हक / सूचक के रूप में उपयोग किया जा सकता है।

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूर ने भारतीय और बुल्गारियन आनुवंशिक-संसाधनों का उपयोग करते हुए नया द्विप्रज संकर नस्ल बीएफसी-1 * बीएफसी-10 विकसित करने की महत्वपूर्ण उपलब्धि अर्जित की। संयुक्त परियोजना के परिणाम-स्वरूप नया संकर विकसित किया गया जिसकी कोसा कवच प्रतिशतता 24.3, तंतु लंबाई -1120 मीटर और रेंडिटा - 5.5 रही। आर्थिक रूप से महत्वपूर्ण विशेषकों की मैपिंग करने हेतु विभिन्न अनुसंधान संस्थानों से प्राप्त 100 रेशम कीट जीन प्ररूपों (40 बहूप्रज* 60द्विप्रज) का मूल्यांकन 5 गुणात्मक और 10 गुणात्मक विशेषकों के लिए वर्गीकृत कर किया गया। परीक्षण में काफी विविधता सामने आई जिसे भविष्य के कार्यक्रम के लिए उपयोग किया जा सकता है। इसके अतिरिक्त देशी और विदेशी द्विप्रज नस्लों का उपयोग करते हुए कुछ गुणवत्ता वाले रेशम (3 ए-श्रेणी) के बहुप्रज नस्ल विकसित करने का कार्य भी शुरू किया गया।

मृदा स्वास्थ्य कार्ड योजना के अंतर्गत केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूर ने आंध्र प्रदेश, तमिलनाडु, तेलंगाना, महाराष्ट्र और मध्य प्रदेश के कृषकों से प्राप्त 7993 नमूनों का विश्लेषण किया। शहतूत की अच्छी फसल को प्राप्त करने हेतु मृदा- उर्वरता के आधारभूत घटकों का मूल्यांकन कर सभी शहतूत बागानों में मृदा उर्वरता को इष्टतम स्तर पर बनाए रखा गया।

of soil health in recovering good mulberry crops. After further studies, useful components of healthy mulberry plots would be analysed and passed on to farmers fields.

In Basic Seed Farms of Karnataka and Tamil Nadu, the incidence of silkworm diseases *viz.,* grasserie, flacherie and Pebrine were contained below economic threshold level. It is interesting to note that no muscardine incidence was reported either from Karnataka or Tamil Nadu. In Karnataka, 31 field level problems occured during silkworm rearing were technically solved. Pebrine testing at CSRTI-Mysuru and P4 BSF-Hassan, P3 BSF-Mysuru and P2 BSF Ambuga were conducted critically.

Efficient monitoring resulted in production of record quantity of 4781.21 MT bivoltine raw silk through Bivoltine Cluster Promotion Programme in 106 Sericulture clusters of Karnataka, Andhra Pradesh, Tamil Nadu, Telangana and Maharashtra by rearing of 433 lakh dfls with an average cocoon yield of 71.79kg. per 100 dfls.

81,141 Sericulturists were sensitized with awareness on new technologies through 1527 extension communication programmes in bivoltine rearing, mulberry and silkworm disease management and quality cocoon production. Besides Sericulture Farmers Workshops were organized in Karnataka-CSRTI-Mysuru, V. Kota, Kolinjipatti, Namakkal (TN) and 3210 farmers were enlightened with improved mulberry Sericulture technologies. At CSRTI-Mysuru 1183 beneficiaries were trained under Capacity Building and Training (CBT) through Technology Orientation Programme (TOP) and Farmers Skill Training (FST). 702 participants were benefitted through need based training programmes in Intensive Bivoltine Technology, Chawki Rearing, Bio Control Agent production, Integrated Pest & Disease Management etc.,

Sixth Asia Pacific Congress of Sericulture and Insect Biotechnology was held from 2nd to 4th March 2019 at Mysuru with a theme “Go for Silk, Go to Nature”. The scientists from over 18 countries were participated and presented 163 research abstracts.

59 PG and 7 UG students’ dissertations works for three months were carried out as part of their course fulfilment. The commercial chawki rearing centre of the Institute reared 65,750 dfls and distributed to over 399 rearers and recorded an average yield of 82.97 kg/100 dfls.

CSRTI-Mysuru continued to be the leading institution in resolving many problematic occurrences in sericulture practice and ably aided the sericulturists well in time of their need. In future also CSRTI-Mysuru will stand by the motto of serving the sericulture fraternity in their routine endeavours.

CSRTI-Mysuru being a premier national institute mandated with R&D activities in Sericulture is continuously searching better approaches to the problems posed before the silk industry in India. The institute has been successfully working to maximise production of mulberry and silkworm cocoons per unit area by synchronising manpower, technology and management practices. The CSRTI has a vision for the rapid growth and development of Sericulture in order to increase living standard of Sericulturists through more income generation.

Dr. R. S. Teotia
Director

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 830 विदेशियों सहित करीब 51,976 व्यक्तियों को प्रशिक्षित किया है। यह संस्थान अनुसंधान, प्रशिक्षण एवं विस्तार कार्य संचालित करने के अलावा राष्ट्रीय एवं अंतर्राष्ट्रीय अभिकरणों को परामर्श एवं सलाहकारी सेवाएँ भी प्रदान करता है।

दृष्टि

द्विप्रज रेशम उत्पादन में उत्कृष्ट अंतर्रराष्ट्रीय रेशम उत्पादन संस्थान के रूप में प्रतिस्थापित होना

लक्ष्य	**उद्देश्य**
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	• भारत में रेशम उत्पादन, उत्पादकता एवं गुणवत्ता बढ़ाने हेतु अनुसंधानशहतूत 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

संगठनात्मक संरचना

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 वैज्ञानिक जुडे हैं। ये कार्मिक कर्नाटक, तमिलनाडु, आंध्रप्रदेश, तेलंगाना, केरल, महाराष्ट्र और मध्यप्रदेश राज्यों के मुख्य संस्थानों और संबद्ध एककों के माध्यम से समुचित प्रौद्यौगिकियों 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 उत्कुष्ट 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 कक्षाएँ हैं और योग्य संकाय सदस्यों द्वारा कार्यक्रम संचालित किए जाते हैं। करीब 125 व्यक्तियों के ठहरने हेतु छात्रावास सुविधाएँ भी उपलब्ध हैं।

अवसंरचना सुविधाएँ

- रेशम उत्पादन विज्ञान में उन्नत अनुसंधान संचालित करने हेतु सुसज्जित प्रयोगशालाएँ, 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 आंकडें संचयन की पुन: प्राप्ति सेवा प्रदान करता है1
- पुस्तकालय सेवाएँ (11215 पुस्तकें, 8023 वैज्ञानिक पत्रिकाओं का बंध खंड, 58 जर्नल, शोध पत्र 310, प्रबंध-51 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 (2015) 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 a 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 51,976 persons including 830 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

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>Objectives

• 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 100 scientists of various disciplines apart from 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, Sericulture 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 international and national level. 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 to ensure faster communication and efficient transfer of technology for effective interactions with nested units, DOSs and other organizations
- Computer center provides internet connectivity to all through LAN with print/file share support
- Bioinformatics Center (NBN Sub-DIC: DBT) provides database retrieval services
- Library Services (11215 books; 8023 bound volumes of scientific journals; 58 journals; dissertations- 310; theses-51; technical reports and CD-ROM database-AGRIS).

अनुसंधान, विस्तार एवं प्रशिक्षण प्रभाग के मुख्यांश

मुख्य उपलब्धियाँ

शहतूत और रेशमकीट प्रजनन, फसल उत्पादन एवं संरक्षण, तकनीकी हस्तांतरण, विस्तारण और प्रशिक्षण गतिविधियों पर संचालित अनुसंधान एवं विकास कार्यक्रम के परिणामस्वरूप आंध्र प्रदेश, कर्नाटक, केरल, तमिलनाडु, तेलंगाना, महाराष्ट्र एवं मध्य प्रदेश राज्यों के रेशम उत्पादन कृषकों की आवश्यकताओं के अनुरूप प्रौद्योगिकियां विकसित की गई। केंरेअप्रसं, मैसूरु की मुख्य उपलब्धियां निम्नवत हैं:-

शहतूत फसल सुधार, उत्पादन एवं संरक्षण

1) जलवायु परिवर्तन से संबंद्ध परिस्थिति अनुकूल क्रियात्मक विशेषकों से युक्त श्रेष्ठ शहतूत प्रभेदों को पहचानने हेतु विभिन्न लक्षण दर्शानेवाले 37 शहतूत प्रभेदों का मूल्यांकन किया गया। पत्ती उपज 194.17 (माउंट आबु -1) से 769.17 ग्रा/पौधा (खाकड़ -1) के बीच पाई गई। परीक्षण किए गए 37 प्रभेदों में 4, 15, 16 एवं 26 प्रभेदों ने क्रमश: वी-1, एस 13, विशाला और अनंता उपजातियों की अपेक्षा काफी अधिक पत्ती उपज दर्शाई।

2) जी–4 शहतूत के बीज पत्र (कोटिलेडन) एवं बीज पत्राधर (हाइपोकोटाइल) कर्त्तोतकों (एक्सप्लैन्ट्स) का उपयोग करते हुए पुनर्जनन प्रक्रिया को अनुकूलतम बनाने हेतु 0.5 मि.ग्रा./ली टी.डी.ज़ेड युक्त हार्मोनीय संयोजन ने बीज पत्र एवं बीजपत्राधर कर्त्तोतकों से क्रमश: 88% और 64% पुनरुज्जीवन आवृत्ति (फ्रीक्वेन्सी) दर्शाई। दृढ़ पौधों को मिट्टी भरे गए कप में प्रतिस्थापित किया गया। तंबाकू, बी.ए.पी. सहित (1 मि.ग्रा./ली) एम.एस. मीडियम + एन ए.ए. (0.1 मि.ग्रा./ली) 1 में की गई पुनर्जनन प्रक्रिया से अधिकतम बहुमुकुल उत्पत्ति एवं प्ररोहों का पुनर्जनन हुआ। बिना हार्मोन/संयोजी (एडिक्टिव) के पूर्णत: एम.एस. मीडियम से पुनरुज्जीवित प्ररोहों में अधिकतम मूलन क्षमता देखी गई। हैदराबाद विश्वविद्यालय से सी.ए + पी ई पी सी की जीन विद्यमान ट्रैन्सजीन प्राप्त हुई। शहतूत जी 4 कल्टिवर से कोटिलेडन/हाइपोकोटाइल तथा तंबाकू की पत्ती पर डिस्क कार्त्तोतकों का उपयोग करते हुए आनुवंशिक रूपांतरण संबंधी प्रयोग ज़ारी है।

3) इष्टतम एवं उप इष्टतम सिंचित स्थितियों में सूखा अनुकूल विशेषकों से युक्त उत्तम शहतूत संकरों के मूल्यांकन तथा पहचान हेतु 60% से अधिक मूलन क्षमता वाले 21 शहतूत संकरों का नर्सरी बेड में प्रगुणन किया गया और बाद में संस्थापित किए जाने हेतु परीक्षणाधीन भूखंडों में प्रतिरोपित किया गया।

4) जीन विशेष पी.सी.आर. एस्से (पी.आई.सी 01003 सी.एन.एन. डब्ल्यू 4 बी) के सहारे 4 एल् बी ए/ट्रान्सजीनी वंशों की जाँच की गई । कृषि विज्ञान विश्वविद्यालय, बेंगलूरु से जी.यू.एस. जीन और एस.एच.एन 1+डी.आर.ई.बी.2 ए युक्त ट्रान्सजीन संरचना (कन्स्ट्रेक्ट्स) प्राप्त हुई। शहतूत उपजाति (कल्टिवर) जी - 4 के कोटिलेडन / हाइपो-कोटाइल एक्सप्लैंड पर केन्द्रित जीन परिवर्तन परीक्षण जारी रखे गए।

5) चौथे सत्र में 60 विविध शहतूत जननद्रव्य का मूल्यांकन पूरा किया गया और 12 जननद्रव्य मूल गांठ नेमटोड प्रतिरोधी पाया गया। चयनित जननद्रव्य से प्रतिरोध शक्ति की अंतिम पुष्टि करने हेतु सी.सी. टैंक का निर्माण कार्य पूरा किया गया। कर्नाटक, तमिलनाडु और आंध्र प्रदेश के मुख्य रूप से मूल गांठ रोग प्रभावित क्षेत्रों में अंतिम बार पुष्टिकरण हेतु चयनित प्रतिरोधी जननद्रव्य का पौधारोपण किया गया।

6) क्षारीय प्रतिबल से संबंद्ध 40 विभिन्न जीनप्ररूपों की, प्रभावी क्षेत्रों में (अविकें – कोप्पल व किनकनहल्ली) और गमलों (केंरेअप्रसं, मैसूरु) में जाँच की गई । क्षारीयता प्रतिबल सहनशील दो जीनप्ररूपों (एम आई 0025 और एम आई 0764) का चयन किया गया जिनकी पुष्टि करने के बाद मैपिंग समूह (व्यवस्थित रूप से) विकसित करने हेतु संकरण कार्यक्रम में उपयोग किया जा सकता है।

7) मुख्य क्षेत्र में पौधारोपण हेतु पौध लगाया गया । आदर्श एवं मानक उपजातियों का डीयूएस डिस्क्रिप्टर आँकड़ा दर्ज किया गया । शहतूत की वर्तमान उपजातियों का यू एस मेट्रिक्स विकसित किया गया । वी 1 एवं जी 4 शहतूत उपजातियों के लिए डीयूएस अनुप्रयोग के साथ तकनीकी प्रश्नावली भी तैयार की गई है और इसे अंतिम रूप दिया जा रहा है।

8) 16 एस.एस.आर. चिह्नकों के सहारे 48 शहतूत जीनप्ररूपों की जाँच की गई। कृषि विश्व विद्यालयबेंगलूरु से एस.एस.आर. चिह्नकों की नई सेट प्राप्त कर विविध शहतूत जीनप्ररूपों का चयन करने हेतु इन चिह्नकों का उपयोग किया जाएगा।

9) केंरेअप्रसं मैसूरु एवं क्षेरेअकें कोडति में 350 विविध जननद्रव्यों का प्रगुणन किया गया।

10) आरकेएन संरोपित स्टेज–1(3 डी.ए.आई) पौधों को द्वि आर.एन.ए. अनुक्रमण हेतु उपयोग किया गया और असंरोपित पौधों के दो स्वतंत्र जैव प्रतिकृतियों को मानक के रूप में उपयोग किया गया। कुल रीड में से असंरोपित प्रतिदर्शों को शहतूत की ट्रैनस्क्रिप्टोम से मिलाया

गया। 26965 जीनों में से 50% को शहतूत (डेटाबेस) आँकड़ा संचय से संबंद्ध किया गया। संक्रमित पौधों को इनकोग्निटों आँकड़ा संचय से मिलाया गया और 4.9% - 5.1% रीड को एम कोग्निटो जीनोम के साथ मैपिंग की गई।

11) शहतूत पौधों में आर्द्रता प्रतिबल सहनशीलता हेतु जैव रासायनिक चिह्नकों / सूचकों को पहचाना गया।

12) सहनशील जीनप्ररूपों में आर्द्रता प्रतिबल स्थितियों में ऐन्टि-ऑक्सिडेन्ट और ओस्मोलाइटस की बढ़ी हुई मात्रा पाई गई । शहतूत में प्रतिबल स्थितियों में इन विशेष एन्टि-ऑक्सिडेन्ट और ओस्मोलाइट को जैव रासायनिक चिह्नक/सूचक के रूप में उपयोग किया जा सकता है।

13) शहतूत के मूलगांठ रोग प्रबंधन हेतु दक्षिण राज्यों के कृषकों के बीच रॉट-फिक्स को लोकप्रिय बनाने हेतु कर्नाटक आंध्र प्रदेश तमिलनाडु और तेलंगाना के 498 कृषकों के बीच 2414 कि.ग्रा. रॉट फिक्स वितरित किया गया । इन राज्यों में इसे कुल 130 जगहों पर प्रदर्शित किया गया। फीडबैक डेटा से यह साबित हुआ है कि रॉट फिक्स के अनुप्रयोग से औसतन 68.62% रोग नियंत्रण हो पाया।

14) टिल्लेज और मल्चिंग कम करते हुए बूँद सिंचाई करने पर मल्चिंग के बिना नाली सिंचाई करने (55.9/ट/हे/व) की तुलना में अधिक पत्ती उपज (63.7 ट/हे/वर्ष) प्राप्त हुई । मृदा विश्लेषण करने पर देखा गया कि उपचारित शहतूत में मानक की तुलना में जैव कार्बन (0.85%), उपलब्ध फोस्फोरस (72.2 कि.ग्रा./हे) पोटैशियम (407.8 कि.ग्रा./हे), कॉपर (1.10 पीपीएम), ज़िंक/ (3.30 पी.पी.एम) लोहा (33.25 पीपीएम) एवं मेंग्नीज़ अंश अधिक है। कार्बन अलग करने पर (पत्ती एवं टहनी सहित) उपचारित शहतूत में मानक (13.6 ट/हे/व) की तुलना में 14.8 ट/हे/व दर्ज किया गया।

15) मृदा स्वास्थ्य कार्ड योजना के अंतर्गत कर्नाटक, आंध्र प्रदेश, तेलंगाना, तमिलनाडु महाराष्ट्र और मध्य प्रदेश के कृषकों के 7201 मृदा नमूनों का विश्लेषण किया गया। परिणाम से यह साबित हुआ है कि कर्नाटक के 79% मृदा नमूनों एवं आंध्र प्रदेश के 57% मृदा नमूनों का पीएच मान 6 - 7.5 है जबकि तमिलनाडु में 80% मृदा नमूनों का पी.एच मान 7.5 से अधिक है। सभी राज्यों में विश्लेषण किए गए 75% से अधिक मृदा नमूनों में मृदा जैव कार्बन स्तर कम है (0.65% से कम)।

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16) प्राधिकरण परीक्षण के अंतर्गत उच्च कोसा कवच (>23.0%) और निम्न रेंडिट्टा (5.0 – 5.5) वाले द्विप्रज एकल संकर एस 8 x सीएसआर 16 का मूल्यांकन करने पर यह ज्ञात हुआ कि 494 कृषकों को 1,10,450 रोमुबी चकत्तों से औसतन 69.3/100 रोमुच की कोसा उपज प्राप्त हुई।

17) गुणवत्तापूर्ण रेशम हेतु विभिन्न लक्षण दर्शानेवाले रेशमकीट नस्लों में ट्रैन्स्क्रिप्टोमिक विश्लेषण के आधार पर आरएनए पोली ॥ मेनोसिडेस, यू.वी.आई 1 को रेशम फाइब्रोइन विश्लेषण में सम्मिलित सशक्त नियामकों के रूप में पहचाना गया है जो फाइब्रॉइन निर्माण के तरीके और रेशम गुणवत्ता को प्रभावित करता है।

18) बल्गेरियन और देशी रेशमकीट जननद्रव्य संसाधनों का उपयोग करते हुए एक नया द्विप्रज द्विसंकर (बीएफसी 1 x बीएफसी 10) विकसित किया गया। इस संकर की विशेषता 24.3 कोसा कवच प्रतिशतता, 1120 मीटर लंबाई एवं 5.5 रेंडिट्टा है।

19) विभिन्न रेशम उत्पादन अनुसंधान एवं विकास संस्थानों से संग्रहित 100 रेशमकीट जीनप्ररूपों (40 बहुप्रज x 60 बहुप्रज) को पाँच गुणात्मक लक्षणों एवं 10 परिमाणात्मक विशेषकों के लिए वर्गीकृत किया गया। सभी लक्षणों व गुणधर्मों में विविधता पाई गई। परिणाम का उपयोग भविष्य के प्रजनन कार्यक्रम में आर्थिक रूप से महत्वपूर्ण विशेषकों के मैपिंग के लिए किया जाएगा।

20) एक शुद्ध मैसूर वंश की पहचान की गयी, जिसका कोसा वजन 0.230 ग्रा, कोसा कवच अनुपात 17.95%, तंतु लंबाई – 418 मीटर, धागाकरण प्रतिशतता 83%, कच्चा रेशम वसूली 61.41%, स्वच्छता 65%, लगिष्णुता – 3.2 ग्रा/डी, दीर्घीकरण 25% और कोहेसन स्ट्रोक 86 पाया गया। यह दर्शाता है कि वर्तमान पी.एम.लाइन की तुलना में तंतु लंबाई में 30%, कच्चा रेशम वसूली में 29% कोहेसन स्ट्रोक में 30%, दीर्घीकरण प्रतिशत में 47% वृद्धि हुई। प्राप्त संकर ने भी कोसा कवच वजन में 0.34 ग्रा (14.81%) कोसा कवच अनुपात में 19.78% (6.28) 681 मी. तंतु लंबाई में 24.27% रेंडिट्टा में 7.2%, कच्चा रेशम प्रतिशतता में 15.18 (4.69%) एवं स्वच्छता में 85% (3.66%) वृद्धि दर्शाई। नए विकसित वंश का राज्य रेशम विभाग द्वारा मूल्यांकन किया जाएगा।

21) उन्नत संकर नस्ल वंश आई.सी.बी 29 विकसित किया गया है जिसकी विशेषताएँ हैं : अंड जनन क्षमता 483, ई.आर.आर. (संख्या में) 9276, ई.आर.आर. (वजन में) 14.85, एकल कोसा वजन/1.641 कि.ग्रा. एकल कोसा कवच वजन 0.300 ग्रा और कोसा कवच अनुपात 18.3%, द्विप्रज के साथ संकरण करने पर सी.एस.आर. 2, एस. 8, सीएसआर 27, सी ओवल, बीएफसी 7 और एन 23 का कोसा कवच

वजन (4-18%), कोसा कवच अनुपात (6-7%), ई.आर.आर. संख्या (7-10%) एवं वजन (15-29%) धागाकरण क्षमता (6-7.4%) तथा कच्चा रेशम प्राप्ति (8-10%) पीएम x सीएसआर 2 एवं एमवी1 x एस 8 की तुलना में बेहतर रहा।

22) एम.वी 1 x एस 8 (कावेरी गोल्ड) का 64,660 रोमुच उत्पादित करके कृषकों को वितरित किया गया जिसकी उपज 62-73 कि.ग्रा. / 100 रोमुच रही । औसतन 65.22 कि.ग्रा. /100 रोमुच प्राप्त हुई जिससे पीएम x सीएसआर 2 की तुलना में रु. 15-40 रु./कि.ग्रा. अधिक आय प्राप्त हुई, हालांकि उपज अंतर कम है।

23) देशी और विदेशी द्विप्रज संकरों का उपयोग करते हुए उन्नत रेशम गुणवत्ता वाले बहुप्रज नस्ल विकसित करने की परियोजना चालू है। एफ - 2 पीढ़ी पूरी हो गई है और एफ - 3 पीढी के लिए हरित - पीले कोसे का चयन किया गया।

24) भविष्य के प्रजनन कार्यक्रम के लिए मूल नस्ल लक्षणों के अनुरूप तैंतीस बहुप्रज नस्लों का अनुरक्षण किया जा रहा है ताकि जब कभी अपेक्षित है इनका उपयोग किया जा सके।

25) कर्नाटक के मूल बीज फार्म में रेशमकीट रोग प्रकोप क्रमश: ग्रैसरी, फ्लैचरी और पेब्रिन रोग क्रमश: 0.03%, 0.10% और 0.03% पाया गया जबकि तमिलनाडु में ग्रैसरी 0.11%, फ्लैचरी 1.82% और पेब्रिन रोग 0.04% दर्ज किया गया है जो आर्थिक अवसीमा से कम है। कर्नाटक एव तमिलनाडु के मूबीफा में मस्कार्डिन प्रकोप कम रिपोर्ट किया गया।

कर्नाटक क्लस्टरों में 0.66%, 1.84% एवं 1.99% क्रमश: ग्रैसरी, फ्लैचरी एवं मस्कार्डिन रिपोर्ट की गई जबकि आंध्र प्रदेश क्लस्टरों में ग्रैसरी प्रकोप – 4.05%, फ्लैचरी 2.89% और मस्कार्डिन 0.32% रहा । महाराष्ट्र क्लस्टरों में 1% ग्रैसरी एवं फ्लैचरी (प्रत्येक) की प्रकोप रिपोर्ट दर्ज किया गया । तमिलनाडु क्लस्टरों में 0.62% ग्रैसरी एवं 1.16% फ्लैचरी का प्रकोप पाया गया ।

26) अप्रैल 2018 में पेब्रिन अनुवीक्षण संचालित किया गया और रोग अनुवीक्षण परियोजना एआरपी 3519 जारी रखने का निर्णय किया गया ।

27) एम लैप आमापन (एस्से) का उपयोग करते हुए 1291 प्रतिदर्शों का परीक्षण किया गया जिसमें शलभ और अंड कवच शामिल हैं ।

28) पार अंडाशयी (ट्रैन्सवेरियल्ली) एवं गैर पार अंडाशयी (नॉन ट्रैन्सवेरियल्ली) से संक्रमित सूक्ष्म जीवाणु को पृथक करने हेतु किए गए प्रारंभिक अध्ययन के अंतर्गत संस्थान के शहतूत बागान से विभिन्न शलभों को संग्रहित करके लघु बीजाणु संक्रमण हेतु जाँच की गई। 20 शलभों में 09 को उत्पीड़ित पाया गया। पृथक किए गए लघु बीजाणु रेशमकीट के लिए 1-96% तक संक्रामक हैं तथा ये पार अंडाशयी (ट्रैन्सवेरियल्ली) से संक्रमित पाए गए।

29) पूरे कर्नाटक में रोग प्रकोप से संबंधित 31 क्षेत्र समस्याओं का समाधान किया गया।

30) विभिन्न कंपनियों को 32 गुणवत्ता - विश्लेषण रिपोर्ट जारी की गई ।

31) केंरेअप्रसं, मैसूरु, पी - 4 मूबीफा, हासन, पी - 3 मूबीफा, मैसूर एवं पी - 2 मूबीफा, अंबुगा में नियमित रूप से पेब्रिन – परीक्षण कार्यक्रम संचालित किया गया।

HIGHLIGHTS OF RESEARCH, EXTENSION AND TRAINING 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 Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana, Maharashtra and Madhya Pradesh. The salient achievements of CSRTI-Mysuru are as follows:

Mulberry Crop Improvement, Production and Protection:

- In order to identify superior mulberry accessions having adaptive functional traits associated with climate change, 37 mulberry accessions with different characteristics were evaluated and leaf yield ranged from 194.17 (Mount Abu-1) to 769.17 g/ plant (Khakad-1). Out of 37 test accessions, 4, 15, 16 and 26 accessions showed significantly higher leaf yield over the check varieties viz., V1, S13, Vishala and Anantha respectively.
- For optimization of regeneration protocol using cotyledon and hypocotyl explants of G4 mulberry, one hormonal combination containing 0.5 mg/L TDZ showed regeneration frequency of 88% and 64% from cotyledon and hypocotyl explants respectively. The hardened plants were transferred to soil containing cups. Regeneration protocol in tobacco, MS medium with BAP (1 mg/L) + NAA (0.1 mg/L) showed maximum multiple shoot bud induction and regeneration of shootlets. Full strength MS medium without any hormone/ additives showed maximum rooting of the regenerated shootlets. Received transgene constructs containing ***CA+PEPCK*** genes and ***CA*** gene from University of Hyderabad. Genetic transformation experiments are being continued using cotyledon/hypocotyls explants of mulberry cultivar G4 and leaf disc explants of tobacco.
- To evaluate and identify superior mulberry hybrids with drought adaptive traits under optimal and sub-optimal irrigated condition (PIB 3631), 21 mulberry hybrids with more than 60% rooting percentage have been multiplied in nursery beds and subsequently transplanted in experimental plots for establishment.
- Four *HVA1* transgenic lines have been screened by gene specific PCR assay (PIC-01003CN-NW4b). Received transgene constructs containing *GUS* gene and *SHN1*+*DREB2A* genes from University of Agricultural Sciences-Bengaluru. Genetic transformation experiments are being continued using cotyledon/hypocotyls explants of mulberry cultivar G4.
- Evaluation of 60 diverse mulberry germplasm in four batches was completed and found 12 germplasm resistant to root knot nematode. Shortlisted resistant germplasm for final confirmation under root knot nematode hot spots at Karnataka, Tamil Nadu and Andhra Pradesh has been taken up.
- Validated the stress response of 40 alkaline stress contrast mulberry genotypes by screening them in hotspots (REC- Koppal and Kinakanahalli) and pots (CSRTI, Mysuru). Identified two genotypes (MI-0025 and MI-0764) tolerant to alkaline stress which could be used further in crossing programme for development of mapping population after confirmation.
- Saplings were raised for plantation at main field. DUS descriptor data of example and reference varieties were recorded. DUS matrix for extant varieties of mulberry was developed. The draft technical questionnaire has been prepared along with DUS application form for V1 and G4 mulberry varieties and is under finalization.

- Forty eight mulberry genotypes were screened using existing 16 SSR markers. These markers will be used for screening diverse mulberry genotypes.
- 350 diverse germplasm were multiplied in CSRTI-Mysuru and RSRS-Kodathi.
- RKN infested plants stage I (3 DAI) were used for dual RNA sequencing and un-inoculated plants were used as controls with two independent biological replicates of each. Total reads from the un- inoculated samples were aligned to the transcriptome of mulberry. Out of 26965 genes, 50% were mapped to mulberry database. Infested were aligned to *Meloidogyne incognita* database and 4.9% - 5.1% of reads were mapped to the *M. incognita* genome.
- Identified biochemical markers/indicators for moisture stress tolerance in mulberry. Progressive higher accumulation of antioxidants and osmolytes (proline and glycine betaine) were observed during moisture stress in tolerant genotypes and hence these specific antioxidants as well as osmolytes accumulated during stress could be utilized as a biochemical marker/indicator for moisture stress tolerance in mulberry.
- Under popularization of *Rot-fix* for management of root rot disease of mulberry among sericulture farmers of southern states, about 2414 kg of *Rot-fix* has been distributed among 498 farmers belonging to Karnataka, Andhra Pradesh, Tamil Nadu and Telangana. A total of 130 demonstrations were conducted in these states. The feedback data showed an average of 68.62% control of the disease due to application of *Rot-fix*.
- Higher mulberry leaf yield was recorded in drip irrigation with reduced tillage and mulching (63.7 mt/ha/year) than furrow irrigation without mulching (55.9 mt/ha/year). Soil analysis has indicated increase in organic carbon (0.85%), available phosphorus (72.2 kg/ha) and available potassium (407.8 kg/ha) and micronutrient like copper (1.10 ppm), zinc (3.30 ppm), iron (3.25 ppm) and manganese (1.30 ppm) content in treatment compared to control. The total carbon sequestered (leaf and stem together) is estimated 14.8 mt/ha/yr in treatment compared to control i.e., 13.6 mt/ha/yr.
- Analyzed 7993 soil samples of sericulture farmers of Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Maharashtra and Madhya Pradesh under Soil Health Card Scheme. The results showed pH of 79% of soil samples from Karnataka and 57% of soil samples from Andhra Pradesh ranges 6 - 7.5 whereas in Tamil Nadu 80% of soil samples are having pH more than 7.5. The soil organic carbon status was low (less than 0.65%) in more than 75% of the soil samples analysed in all the states.

Silkworm Crop Improvement, Production and Protection:

- S8 x CSR16, a bivoltine single hybrid identified for higher shell content (>23.0%) and lower renditta (5.0 - 5.5) was evaluated under authorization trials has recorded an average cocoon yield of 69.3/100 dfls in Karnataka, Andhra Pradesh Tamil Nadu and Maharashtra covering 494 farmers with 1,10,450 dfls.
- Based on the transcriptomic analysis among silkworm breeds contrasting for silk quality, RNA poly II, mannosidase, Ubi1 have been identified as potential regulators that are involved in silk fibroin synthesis, which would influence the fibroin synthesis pathway and silk quality.
- A new bivoltine double hybrid has been developed (BFC1 x BFC10) utilizing Bulgarian and Indian silkworm genetic resources. The hybrid is characterized by shell percentage of 24.3, filament length of 1120 meter and renditta of 5.5.

- 100 silkworm genotypes (40 multivoltine and 60 multivoltine) collected from different Sericulture R&D institutions were characterized for five qualitative traits and ten quantitative traits. A wide range of diversity was observed for all the characters studied. The results would be used for association mapping for economically important traits in future breeding programme.
- A Pure Mysore (PM) line was isolated with improved shell weight (0.230g), shell ratio (17.95%), filament length (418 meters), reeling percentage (83%), raw silk recovery (61.41%), neatness (65%), tenacity – (3.2g/d), elongation - 25% and cohesion stroke - 86, showing improvement of 30% in filament length, 29% in raw silk recovery, 30% in cohesion stroke and 47% in elongation percentage in comparison to existing PM line. The resultant hybrid also showed improvement in shell weight 0.34g (14.81%), shell ratio 19.78% (6.28%), filament length of 681 meters, (24.27%) renditta 7.2 (20%) and raw silk percentage 15.18 (4.69%) and neatness of 85% (3.66%). Further, the newly developed line will be evaluated by DoS.
- Improved cross breed (ICB) line ICB-29 is developed and is characterized by fecundity of 483, ERR by number 9276, ERR by weight 14.85 kg, single cocoon weight 1.641 g, single shell weight 0.300g and shell ratio of 18.3%. When crossed with bivoltines CSR2, S8, CSR27, C. Oval, BFC-7 and N23 also showed improvement in shell weight (4 - 18%), shell ratio (6 - 7%), ERR by number (7-10%) and weight (15-29%), reelability (6 - 7.4%) and raw silk recovery (8-10%) in comparison to PM x CSR2 and MV1 x S8.
- A total of 64,660 dfls of MV1 x S8 (Cauvery Gold) produced and distributed to farmers and the yield ranged from 62-73 kg/100 dfls with average yield of 65.22kg/100 dfls fetching higher price of 15-40 ₹/kg more in comparison to PM x CSR2, however, the yield difference is narrow.
- Silkworm disease incidence in the BSFs of Karnataka were 0.03, 0.10 and 0.03 percentage for grasserie, flacherie and pebrine disease respectively and in Tamil Nadu 0.11% grasserie, 1.82% flacherie and 0.04% pebrine disease were recorded which is below economic threshold level. No muscardine incidence was reported from both the BSFs in Karnataka and Tamil Nadu.
- In the Karnataka clusters, 0.66%, 1.84% and 1.99% of grasserie, flacherie and muscardine were reported whereas in the Andhra Pradesh clusters grasserie incidence was 4.05%, flacherie - 2.89% and muscardine - 0.32%. In Maharashtra clusters 0.1% each of grasserie and flacherie diseases were reported. In Tamil Nadu clusters 0.62% grasserie and 1.16% flacherie was reported.
- Pebrine monitoring meeting was conducted in the month of April, 2018 and it was decided to continue the disease monitoring project ARP: 3519.
- Tested 1291 samples using M-LAMP assay which included moth and egg shells.
- Under pilot study for isolation of transovarially and non transovarially transmitted microsporidia, different butterflies from the institute mulberry garden were collected and screened for microsporidian infection. Out of 20 butterflies species 09 were found infected. All isolates were infectious to silkworm in the range of 1-96% and got transmitted tranovarially.
- Resolved 31 field problems related with disease incidence from all over Karnataka.
- Issued 32 quality analysis reports to different companies.
- Pebrine testing in different sections of CSRTI-Mysuru, P4 BSF Hassan, P3 BSF Mysuru and P2 BSF Ambuga was undertaken regularly.

- The silkworm pupae oil was extracted by indigenously developed solvent extraction method and the procedures developed for extraction of α-linolenic acid from pupae oil by chemical and enzymatic technologies.
- α-Linolenic acid was recovered by urea inclusion complexation followed by fractional crystallization. High purity of α-linolenic acid was achieved by silica column chromatography.
- Different Chawki Feed Supplement Formulations (CFSFs) were evaluated and select combinations to improve chawki performance were identified.
- Maintenance and culturing of Cordyceps species for the *in-vitro* and *in-vivo* fruiting body formation on mulberry silkworm pupae.
- A total quantity of 4,329 pouches of *Nesolynx thymus* (4.3 crores of adult parasitoids to cover 2.16 lakh dfls rearing), and 307 boxes of *Scymnus coccivora* beetles (76,750 adult beetles to cover 300 acres mulberry) were produced.

Transfer of Technology:

- A record quantity of 4781.21 MT bivoltine raw silk was produced through Bivoltine Cluster Promotion Programme (106 clusters) in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana and Maharashtra from 433 lakh dfls rearing with an average cocoon yield of 71.79 kg /100 dfls.
- 81,141 sericulturists were sensitized with new technologies through 1527 extension communication programmes in bivoltine rearing, mulberry and silkworm disease management and quality cocoon production.
- Under M-*kisan* portal. 96 messages were sent to 71324 registered farmers in every fortnight to Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Maharashtra and Madhya Pradesh in Kannada, Telugu, Tamil and Hindi.
- Resham Krishi Melas were organized in CSRTI-Mysuru (KA), V. Kota (AP), Kolinjipatti, Namakkal (TN) and 3210 farmers were enlightened with improved mulberry sericulture technologies.
- A total of 6681 visitors including farmers, students and foreign nationals visited the institute.

Capacity Building & Training:

- 1183 beneficiaries were trained under Capacity Building & Training (CBT) programme through Technology Orientation Programme (TOP) and Farmer Skill Training (FST).
- Need-based training programmes were conducted for 702 beneficiaries (farmers, entrepreneurs and officials) in Intensive Bivoltine Technology, Chawki Rearing, Bio-Control Agent Production, Integrated Pest & Disease Management.
- Two JOCVs were trained under overseas training programme for a month at CSRTI- Mysuru and posted to Ramanagara (Karnataka) and Hosur (Tamil Nadu).
- Fifty nine post graduate and seven under graduate students completed dissertation works for three months as a part of partial course fulfilment.
- The commercial chawki rearing centre reared and supplied chawki worms of 65750 dfls to 399 rearers and recorded an average yield of 82.97 kg/100 dfls.
- 6th Asia Pacific Congress of Sericulture on Insect Biotechnology was organized between 2nd to 4th March 2019 at Mysore where delegates from 18 countries participated.

Commercialization:

- Powder duster: License was given to M/s. Digiflic Controls (India) Pvt. Ltd., Bengaluru.
- Amruth - Ecofriendly formulation for the control of silkworm diseases, Grasserie and Flacherie: License was renewed.

राजभाषा कार्यान्वयन संबंधी गतिविधियाँ

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु में वर्ष 2018-19 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 संक्षिप्त विवरण निम्नानुसार है:

1. **धारा 3(3) का अनुपालन:** राजभाषा अधिनियम 1963 की धारा 3(3) के अधीन आने वाले सभी कागज़ात द्विभाषी में जारी किए गए।

2. **नियम 11 का अनुपालन:** सभी फार्म, पत्रशीर्ष, रबड़ की मोहरें, सूचनापट्ट, नामपट्ट, पहचान-पत्र आदि द्विभाषी में तैयार किए गए है । इन्हें सुनिश्चित करने हेतु जाँच बिंदु (भंडार अनुभाग, प्रेषण कक्ष और संबंधित अधिकारी के स्तर पर) बनाया गया है ।

3. **हिंदी पत्राचार:** वर्ष के दौरान क, ख तथा ग क्षेत्र स्थित केंद्रीय सरकारी कार्यालयों को क्रमश: 86%, 85% और 76% पत्र हिंदी में भेज कर लक्ष्य से अधिक पत्राचार किया गया है ।

4. **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 2018-19 के अंतर्गत दिनांक 08.05.2018, 25.08.2018, 14.11.2018 एवं 20.02.2019 को राजभाषा कार्यान्वयन समिति की बैठक आयोजित की गई तथा बैठकों में लिए गए निर्णय पर अनुवर्ती कार्रवाई की गई।

5. **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 एवं वैज्ञानिकों के लिए इस वर्ष के दौरान दिनांक 25.05.2018, 30.08.2018, 03.11.2018 और 20.03.2019 को अलग-अलग पूर्णकालिक एक दिवसीय हिंदी कार्यशाला का आयोजन कर कुल 33 अधिकारियों व 36 कर्मचारियों को प्रशिक्षित किया गया ।

6. **हिंदी टिप्पण-आलेखन प्रोत्साहन योजना का कार्यान्वयन:** संस्थान एवं इसके अधीनस्थ केंद्रों में कार्यरत अधिकारियों तथा कर्मचारियों को हिंदी में मूल रूप से काम – काज निष्पादन 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 12 पदधारियों को पुरस्कार प्रदान किया गया ।

7. **हिंदी प्रकाशन:** वर्ष के दौरान अर्धवार्षिक राजभाषा गृह पत्रिका "रेशम किरण" जून-दिसंबर 2017 (संयुक्तांक) का प्रकाशन किया गया । इसके अलावा निम्नलिखित तकनीकी पुस्तक / पुस्तिका / पत्रक का भी हिन्दी में प्रकाशन किया गया । 1. टेक्नॉलाजी डिस्क्रिप्टर 2. अंकुर 3. ट्रे वाशिंग कम डिस्इनफेक्शन मशीन 4. सेरिफिट 5. डॉ सॉयल । इसके अतिरिक्त निम्नलिखित तकनीकी प्रकाशनों का हिन्दी अनुवाद कार्यसंपन्न किया गया - 1. पोषण, 2. ए.जी.बी.-8, 3. बॉयालाजिकल कंट्रोल एवं 4. सेक्स फोरोमोन ट्रैप फॉर ऊजीफ्लाई । संस्थान की वार्षिक रिपोर्ट अंशत: द्विभाषी (हिन्दी - अंग्रेजी) में प्रकाशित की गई ।

8. **राजभाषा नियम 10(4) के अंतर्गत अधीनस्थ कार्यालयों को अधिसूचित किया जाना:** जिन कार्यालयों में हिंदी में कार्यसाधक ज्ञान रखने वाले अधिकारी / कर्मचारी का प्रतिशत 80 या अधिक हो जाता है, उन कार्यालयों को मंत्रालय द्वारा राजभाषा नियम10(4) के अधीन अधिसूचित किया जाता है ।

9. **हिंदी दिवस / पखवाड़ा का आयोजन :** संस्थान में दिनांक 01.09.2018 से 15.09.2018 तक राजभाषा पखवाड़ा मनाया गया । इस दौरान 4 विभिन्न हिंदी प्रतियोगिताओं यथा सहीलेखन, श्रुतिलेखन, स्मृति परीक्षण, टिप्पण-आलेखन, आदि प्रतियोगिताओं का आयोजन किया गया । प्रत्येक प्रतियोगिता के विजेताओं को प्रथम, द्वितीय, तृतीय एवं सांत्वना पुरस्कार प्रदान किया गया । हिन्द दिवस दिनांक 14.09.2018 को पूर्ण उत्साह के साथ मनाया गया ।

10. **कंप्यूटर पर हिंदी में कार्य:** महत्वपूर्ण मद जैसे धारा 3(3) का अनुपालन, फार्म/प्रपत्र,मानक मसौदे, तिमाही रिपोर्ट तथा मूल्यांकन रिपोर्ट, बैठकों की कार्रवाई संबंधी कार्य कंप्यूटर पर सुचारू रूप से किए जा रहे हैं । 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 ।

11. **राजभाषा निरीक्षण** : राजभाषा नीति के कार्यान्वयन में हुई प्रगति की समीक्षा करने तथा तदनुसार आवश्यक सुझाव एवं मार्गदर्शन देने हेतु अधीनस्थ कार्यालयों - क्षेरेअकें, अनंतपुर, शादनगर अविकें, विकाराबाद एवं हासन, अमरावती का निरीक्षण किया गया । संस्थान के अनुभागों के निरीक्षण हेतु 4 सदस्यीय राजभाषा निरीक्षण समिति का गठन किया गया है जो विभिन्न अनुभागों में जाकर राजभाषा कार्यों का निरीक्षण करती है ।

12. **राजभाषा अभिमुखीकरण कार्यक्रम** : दिनांक 19.03.2019 को संस्थान में राजभाषा अभिमुखीकरण कार्यक्रम का आयोजन कर कुल 138 वैज्ञानिकों, अधिकारियों, कर्मचारियों को राजभाषा प्रावधानों की विस्तृत जानकारी दी गई ।

13. **हिन्दी पुस्तक :** हिन्दी पुस्तकालय हेतु रु. 10,715/- की कुल 12 हिन्दी वैज्ञानिक पुस्तकों की खरीद की गई ।

14. **प्रशिक्षण** : तीन राज्यों (महाराष्ट्र, उत्तर प्रदेश, बिहार) से आए कुल 230 प्रशिक्षणार्थियों को रेशम संवर्धन के विविध विषयों पर कुल 11 पाँच दिवसीय कार्यक्रम में हिन्दी माध्यम से प्रशिक्षण प्रदान किया गया ।

15. **राजभाषा पुरस्कार** : वर्ष 2017-18 के दौरान उत्कृष्ट राजभाषा कार्यान्वयन हेतु राजभाषा विभाग, भारत सरकार द्वारा संस्थान को दक्षिणी क्षेत्र का द्वितीय राजभाषा पुरस्कार प्राप्त हुआ । उक्त पुरस्कार कोचीन में आयोजित राजभाषा सम्मेलन में केरल के महामहिम राज्यपाल एवं पूर्व मुख्य न्यायाधीश, उच्चतम न्यायालय, श्री पी. सदाशिवम के कर कमलों से प्राप्त हुआ ।

ACTIVITIES REGARDING OFFICIAL LANGUAGE IMPLEMENTATION

During 2018-19 Official Language policy was implemented succesfully at Central Sericultural Research and Training Institute, Mysuru. Cent-percent compliance of important official language provisions i.e. Section 3(3) of Official Language Act, Official Language Rule - 5 were ensured. The progress in implementation of Hindi was reviewed regularly by conducting quarterly meeting of the Official Language Implementation Committee and the progress regarding the Official Language was reviewed in each quarter. Apart from doing Hindi noting and drafting in Hindi as per prescribed target, important scientific and technical literature were also published in Hindi.

The details of the action taken on the different Official Language implementation points during the year under report is as follows.

1. **Compliance of Section 3(3)**: All documents specified under section 3(3) of the Official Language Act 1963 were issued in bilingual.
2. **Compliance of Rule 11**: All types of forms, letter heads, rubber stamps, signboards, name plates, identity cards etc are made bilingual. Check points (xerox cell, stores section, despatch section and at the level of concerned officer have been devised to ensure the same in bilingual.
3. **Hindi Correspondence**: During the year, more than the prescribed targets for correspondence of Hindi were achieved by sending 86%, 85% and 76% letters in Hindi to central govt. offices of A, B and C regions respectively.
4. **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 2018-19 Official Language Implementation Committee meetings were organised on 08.05.2018, 25.08.2018, 14.11.2018 and 20.02.2019 and follow up action was taken on the decisions of the meeting.
5. **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 scientists/officers and 32 staffs were trained in 4 Hindi workshops organised on 24.05.2018, 30.08.2018, 03.11.2018 and 20.03.2019.
6. **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 were given for writing prescribed words in Hindi. During the year 12 officials of the institute and subordinate offices were awarded.
7. **Publications in Hindi**: Half yearly house magazine – Resham Kiran June-December 2017 (Joint issue) was published. Besides, Technical book / booklets / bulletins viz., ***Technology Descriptor, Tray washing cum disinfectant machine, Serifit, Dr Soil*** were also published in Hindi. In addition, the following technical books/booklets viz., ***Poshan, AGB 8, Biological control, Sex pheromone trap for control of Uzifly*** were translated in Hindi. Annual report of the Institute was published partly in bilingual.
8. **Notification of the sub-ordinate offices under 10(4) of the Official Languages Rules**: The Offices in which 80% of the staff have attained working knowledge in Hindi are notified under 10(4) of the official languages Rules. In this regard apart from this Institute, 6 sub-ordinate offices of the Institute have already been notified.

9. **Organisation of Hindi Day/Fortnight**: Official Language Fortnight was organised from 01.09.2018 to 14.09.2018 during which 4 different Hindi competitions viz., 1. Correct writing 2. Dictation, 3. Memory test, 4. Noting-drafting competitions were organised. The winners of the competitions were awarded with first, second, third and consolation prizes. Hindi Day was celebrated on 14.09.2018 with all enthusiasm.
10. **Work on Computers in Hindi** : Compliance of Section 3(3), forms, standard drafts, quarterly progress report, evaluation report of works related to meetings are carried out smoothly on computers. Unicode system already installed in all computers which facilitates employees to do work in Hindi, English and other Indian languages.
11. **Official Language Inspection:** 5 Sub-ordinate offices viz. RSRS, Anantapur, Shadnagar, REC Vikarabad, P4 BSF – Hassan and REC-Amravati were inspected for reviewing the progress made regarding implementation of Official Language Policy and necessary suggestions and guidance were extended accordingly. Besides, one Official Language Implementation Committee comprising of 4 members has been constituted for inspecting the Official Language works going on in different sections of the Institute.
12. **Official language Orientation Programme**: Official language orientation programme was conducted on 19.3.2019 at the institute and Scientists, Officers, Officials were made aware of the provisions of Official Language.
13. **Hindi Books: 12** scientific books at a total cost of Rs. 10,715 were purchased for the Library of the Institute.
14. **Training:** 230 trainees from 3 states (Maharashtra, Uttar Pradesh and Bihar) were trained on various topics of sericulture through Hindi medium in 11 five day training programmes.

Award: Official Language Implementation award was conferred to the institute for the year 2017-2018 for excellent implementation of Official Language in the Institute. The award was given away by the Honorable Governor of Kerala and Ex-Chief Justice of Supreme court Shri P. Sadasivam, in Official Language conference held in Cochin.

PROGRESS OF RESEARCH PROJECTS AND PROGRAMMES
MULBERRY BREEDING AND GENETICS LABORATORY

Ongoing Research projects:

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, Gayathri T, Arunakumar, G. S., Jhansi Lakshmi, K. (CSGRC, Hosur) and V. Sivaprasad (upto Jan. 2019), R. S. Teotia

Objective:

- 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 were short listed and planted in augmented design in 3 blocks along with 4 check varieties. 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; which ranged from 6.0 (MI-686) to 14.3 (MI-670). The Check varieties viz., V1, S-13, Vishala and 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 number of days to sprout has been recorded highest in ME-016(16.22 days) followed by the accessions viz., MI-214, MI-458 and ME-107 (14.78 days).

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

Tanmoy Sarkar, A. S. Raghavendra, (Univ. of Hyderabad), S. Gandhi Doss, Gayathri T, Arunakumar G. S., Ravindra K.N. (JRF), V. Sivaprasad (upto Jan. 2019) and R. S. Teotia

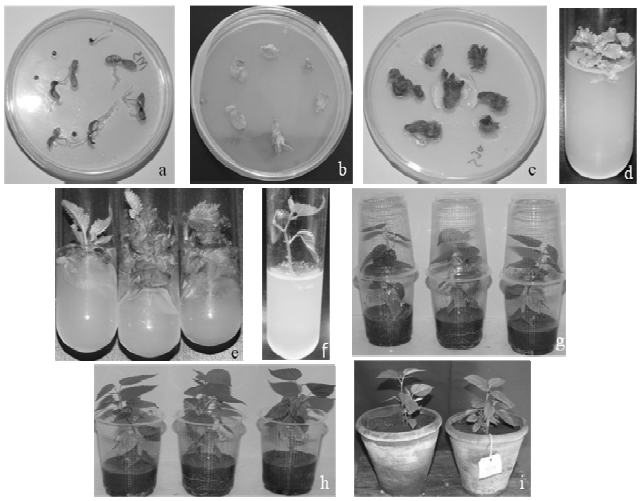
Major objective: To develop transgenic mulberry with C4 traits through *Agrobacterium* mediated genetic transformation for climate resilience.

Specific objectives:

- Construction of expression cassettes containing C4 photosynthetic promoter (GLDPB2) singly and in combination with C4 genes viz., PEPC, CA and PEPC+CA, selectable marker gene in binary vector backbone and mobilization of recombinant binary vector in *Agrobacterium tumefaciens*
- Genetic transformation and molecular characterization of transgenic *Arabidopsis*/tobacco expressing/co-expressing C4 promoter singly and in combination with C4 photosysnthetic genes and selectable marker gene
- Genetic transformation and molecular characterization of transgenic diploid mulberry expressing/co-expressing C4 photosysnthetic genes and selectable marker gene

Optimization of regeneration of protocol using cotyledon and hypocotyl explants of G4 mulberry. Out of six hormonal combinations containing thidiazuron (TDZ), silver nitrate and putrescine, one combination containing 0.5 mg/L TDZ showed regeneration frequency of 88% and 64% from cotyledon and hypocotyl explants respectively. Multiple shoot bud induction per explant was 10.6±0.30 and 5.4±0.24 from cotyledon and hypocotyl, respectively. In elongation medium supplemented with 1 mg/L BAP, 1.5 mg/L GA_3, 2 mg/L $AgNO_3$, 1 mg/L putrescine, additional 75 mM calcium chloride, 0.2% activated charcoal showed maximum shoot length of 4±0.27 cm and number of leaf per shootlets of 6.76±0.50 cm. MS medium amended with 2 mg/L of IBA showed 89.29% rooting frequency and shoot length

(7.57±0.52 cm), primary (4.80.37±0.50 cm) and secondary (1.55±0.37 cm) root length. Further, 70 % of rooted plantlets showed hardening in sand-containing cups. The hardened plants were transferred to soil containing cups shown in figure.



Regeneration of mulberry from cotyledon/hypocotyl explants: (a) *In vitro* germination of seeds, (b-c) multiple shoot bud induction in regeneration medium, (d-f) elongation of shootlets, (g-h) hardening of rooted plantlets in cups, (i) transfer of hardened plants in soil containing pots.

Genetic transformation and selection of putative transformed tissue of G4 mulberry							
Gene	Batch	No. of Explant Co-cultivated		No. of Explant discarded due to necrosis		No. of explants with regenerating shoot buds in selection medium	
		Cotyledon	Hypocotyl	Cotyledon	Hypocotyl	Cotyledon	Hypocotyl
CA+PEPCK	1	9	6	4	4	5	2
CA	1	11	6	5	6	6	0

Transgene constructs containing C_4 photosynthesis related carbonic anhydrase (CA) and PEPC+ phosphoenolpyruvate carboxykinase (PEPCK) were received from University of Hyderabad. These gene constructs were used for genetic transformation in mulberry using cotyledon and hypocotyl explants of G4 mulberry cultivar. The regenerated shoot buds were transferred to hygromycin containing selection medium to select putative transformed shootlets of mulberry.

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, V. Girish Naik, S. Gandhi Doss, Bharath Gowda (JRF) and R. S. Teotia

Objectives:

- To identify superior genotypes with drought adaptive traits under sub-optimal irrigation condition
- Evaluation of introgression lines/mapping populations developed for drought adaption using molecular markers/carbon isotope discrimination-$\Delta^{13}C$

47 mulberry hybrids with drought adaptive traits and 5 check varieties have been multiplied in nursery beds for raising saplings under uniform quantum of irrigation and cultural practices. Out of 47 mulberry hybrids,

Raising of mulberry saplings in nursery beds

21 hybrids with over 60% rooting have been further multiplied in nursery beds for plantation in experimental field (Fig). Transplanting of 21 hybrids and check varieties in experimental plots for establishment primary yield evaluation experiments under sub-optimal irrigated condition was done. Drought adaptive trait associated molecular markers have been identified from the available literatures and the trait associated SSR markers have been synthesized for further validation in mulberry hybrids.

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, V. Sivaprasad (upto Jan. 2019) and R. S. Teotia

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 conditions

Six month old mulberry saplings of promising triploid genotypes, short-listed for the study *viz*., 1, 5, 6, 8, 9 and 10, were planted in the experimental plot under RBD in 3 replication both in optimal and sub-optimal irrigated experiments in all the test centres *viz.,* CSRTI-Mysuru, RSRS-Kodathi, RSRS-Anantapur and RSRS-Salem. The plants are maintained with cultural operations for establishment.

PIC-01003CN: Genetic enhancement of mulberry by genomics approach: a multi-component project

Sub-component: Development of new generation transgenic mulberry for drought stress tolerance and characterization of existing transgenic mulberry for confined field trials (NW3b) (Sep. 2018 –Aug. 2021)

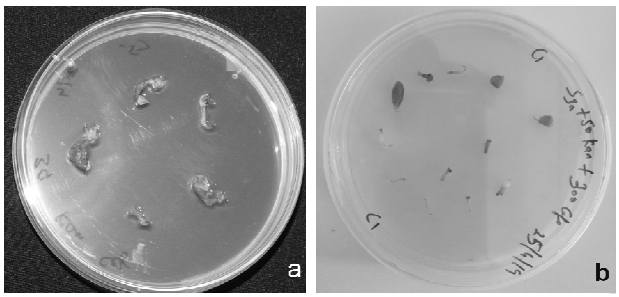
Tanmoy Sarkar, Nataraja Karaba N (UAS-Bengaluru), S. Gandhi Doss, Lalitha Kumari (PA), R. S. Teotia

Main Objective: Development of transgenic mulberry co-expressing transcription factors for drought stress tolerance and characterization of existing transgenic mulberry for confined field trials

Specific objectives:

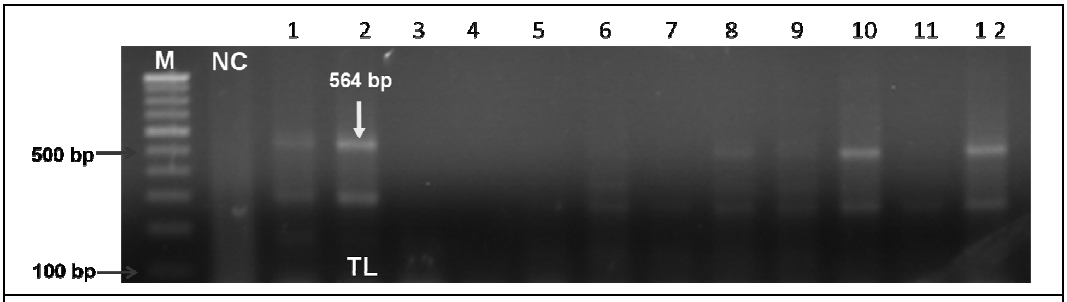
- Development of new generation transgenic mulberry expressing stress-responsive regulatory genes to improve drought and salinity stress tolerant traits
- Molecular characterization and evaluation of new generation transgenic mulberry and analysis of existing transgenic lines for confined field trials
- Development of proposal/application for event evaluation/confined field trials of existing transgenic lines

Developed whole plant regeneration protocol using cotyledon and hypocotyl explants of G4 mulberry. Obtained gene constructs containing *AtSHN1+AtDREB2* from GKVK, University of Agricultural Sciences, Bengaluru. These gene constructs were used for genetic transformation in mulberry using cotyledon and hypocotyl explants of G4 mulberry cultivar**.** The regenerated shoot buds were transferred to kanamycin containing selection medium to select putative transformed shootlets of mulberry. Screened existing *HVA1* transgenic mulberry lines using gene specific PCR assay.



Selection of putative transformed mulberry shoot buds on selection medium. Selection of tissue transformed with *GUS* gene (a) selection of tissue transformed with *SHN1+DREB2A* genes (b) in kanamycin containing regeneration medium

Genetic transformation in mulberry using cotyledon/hypocotyl explants of G4 cultivar							
Gene	Batch	No. of explant cocultivated		No. of explant discard		No. of explants with regenerating shoot buds in selection medium	
		Cotyledon	Hypocotyl	Cotyledon	Hypocotyl	Cotyledon	Hypocotyl
GUS	1	2	4	1	2	1	2
	2	4	3	2	2	2	1
	3	6	4	0	2	6	2
DREB2A +SHN1	1	1	5	0	2	1	3



PCR screening of existing *HVA1* transgenic mulberry lines. M: Marker; NC: Negative control; TL: Transgenic line

Continuous/Other Activities:

Maintenance of mulberry germplasm, mother culture and demonstration plot

S. Gandhi Doss, Tanmoy Sarkar and Gayathri T (upto 27-03-2019) and R. S. Teotia

A working germplasm with 28 accessions were 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 conditions.

MULBERRY MOLECULAR BIOLOGY LABORATORY

Ongoing Research Projects:

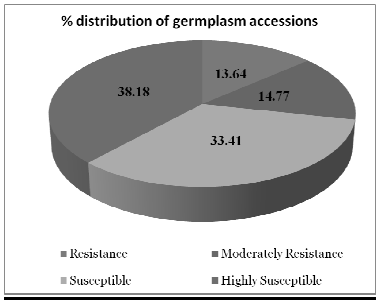
PRP-3591: Identification of resistance in mulberry germplasm for root knot nematode disease (Oct. 2016 – Sep. 2019)

G. S. Arunakumar and Gandhi Doss S.

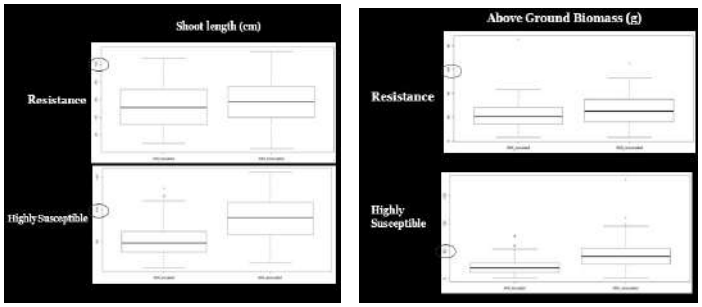
Objective: Identification of mulberry genetic resources for root knot nematode resistance

Under the project 440 germplasm accessions were screened in earthen pots (RKN inoculation) under glass house condition among them 60 germplasm were found immune to resistance response (RKN) and remaining germplasm accessions exhibited varied range of reaction to root knot nematode. The RKN inoculation was done at three different intervals to maintain sufficient inoculum load (three J_2 nematodes/g soil). Four months after the inoculation, the accessions were uprooted and data recorded on biomass (g), longest shoot length (cm) and number of galls/5g root mass.

The results indicated that 60 germplasm accessions exhibited immune and resistance reaction whereas 65 accessions showed moderate resistance, 147 germplasm accessions exhibited susceptibility and 168 accessions showed highly susceptible reaction to RKN. Further confirmation of resistance of selected germplasm accessions were done by re-planting under inoculated condition and checked the resistance over a period of time. Plantation of shortlisted resistance germplasm accessions and other check varieties were undertaken at root knot nematode hot spot locations of Karnataka, Tamil Nadu and Andhra Pradesh for final confirmation. Among 440 germplasm accessions 13.64% germplasm were identified as immune and resistant to RKN. However, 14.77 % germplasm were identified as moderately resistant to RKN. Whereas, 33.41% and 38.18% germplasm showed susceptible and highly susceptible reactions to RKN respectively which is represented in the figure below.



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 440 germplasm accessions were evaluated in four consecutive batches and categorized into four 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). However, there was no significant difference in the RKN inoculated and uninoculated condition of immune to resistant group of germplasm. The germplasm accessions MI-0298 & MI-0290 that showed selected resistance were taken for further evaluation.

Resistance observed in mulberry germplasm (MI-0298)

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

PIE-3511: Development of Distinctness, Uniformity and Stability (DUS) Descriptors for Mulberry (*Morus* spp.) and their Validation. Phase-II (Apr. 2017-Mar. 2020)

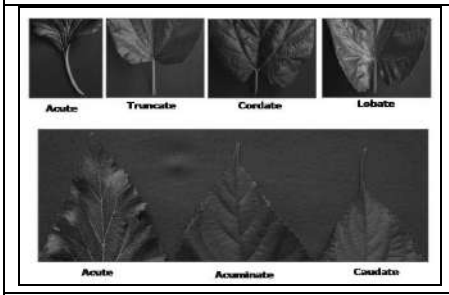
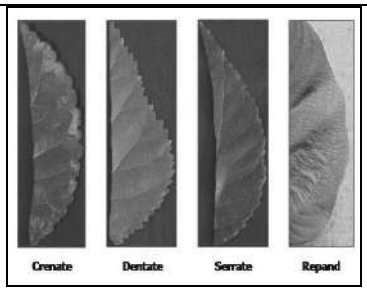
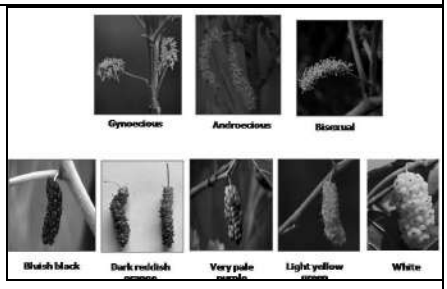
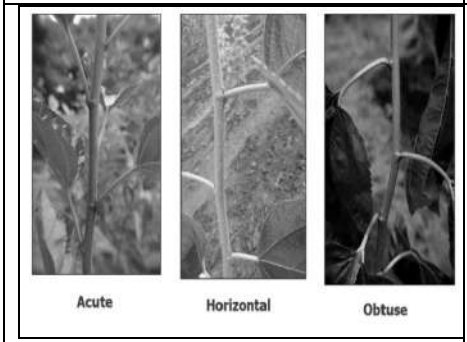
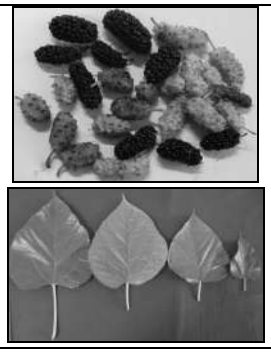
PI: R.S. Teotia, V. Sivaprasad (upto 01-02-2019)

Co-PI: Jalaja S. Kumar, Bhavya M.R., V.Girish Naik (upto 30-04-2017), P.V. Vaijayanthi (upto 27-03-2019) and P. Sowbhagya

Objectives:

- Development of database for the descriptors of mulberry to add on to INDUS (India Database for DUS)
- Establishment of Co-nodal DUS test centre at CSRTI-Berhampore
- Establishment and maintenance of example and reference varieties
- DUS testing of new/extant varieties of mulberry

A total of 35 DUS descriptors which includes both essential/asterisked and non-essential characteristics were validated for reference varieties towards development of INDUS database and the same was communicated to PPV&FRA, New Delhi. Distinctiveness in mulberry for few characteristics is shown below. Essential characteristics are useful for the international harmonization of the variety descriptions and should always be examined for variety registration. Accordingly, DUS matrix is applicable for the selection of appropriate reference varieties for conducting DUS testing. DUS matrix of extant mulberry varieties (#16) released from CSRTI-Mysuru was prepared as per the suggestion of MVAC and RCC of Central Silk Board. In view of this, sixteen extant varieties *viz.,* Mysore Local, Kanva-2, S-36, S-13, S-34, AR-11, AR-12, RFS-135, RFS-175, RC-1, RC-2, Sahana, V-1, G-2, G-4 and S-1635 mulberry varieties were characterized in accordance with the guidelines to form DUS matrix. Work has been initiated towards establishment of Co-nodal DUS test center at CSRTI-Berhampore, West Bengal. The identified example and reference varieties (#45) were maintained in the PDG plot of CSRTI-Mysuru and also these varieties are multiplied in nursery beds towards establishment of separate DUS test plot at nodal centre. Work has been initiated towards the filing of application for registration of extant/new mulberry varieties. In this connection, a draft DUS test applications for two extant varieties of mulberry, V-1 and G-4 has been prepared and is under finalization.

<table>
<tr><td colspan="3">Distinctiveness in Mulberry</td></tr>
<tr><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td>Leaf base and Leaf apex</td><td>Leaf margin</td><td>Sex expression and Fruit color</td></tr>
<tr><td> 
</td><td>  </td><td>  </td></tr>
<tr><td>Leaf angle</td><td>Variability in Fruit color and Petiole length</td><td>Mulberry saplings in nursery beds (For development of separate DUS test plot)</td></tr>
</table>

DUS Matrix for Extant varieties of Mulberry														
Varieties	Descriptors													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Mysore local	3	3	5	9	5	3	3	5	5	7	3	5	1	3
Kanva-2	5	3	5	9	5	5	5	5	5	7	1	5	1	3
S-36	5	5	5	9	5	5	5	9	5	7	1	5	1	3
S-13	5	3	5	9	5	5	3	5	5	7	1	5	2	5
S-34	5	3	5	9	5	5	3	7	5	7	1	5	2	5
AR-11	3	3	5	5	5	5	3	7	5	7	1	5	2	5
AR-12	7	5	7	9	7	7	5	7	5	7	1	5	2	5
RFS-135	5	5	5	9	7	7	5	7	5	7	1	5	2	5
RFS-175	5	5	5	9	7	7	5	7	5	7	1	5	2	5
RC-1	5	5	5	9	7	7	5	9	5	7	1	5	1	5
RC-2	5	5	5	9	5	5	5	9	5	7	1	5	1	5
SAHANA	5	7	5	3	5	5	5	9	5	3	1	7	1	5
V-1	7	3	5	9	7	5	5	5	5	7	1	7	2	5
G-2	7	3	5	9	5	7	5	7	5	7	1	7	1	5
G-4	7	3	5	9	5	5	5	7	5	7	1	7	1	5
S-1635	7	7	7	9	5	7	5	7	5	7	1	9	2	5

A: Plant vigor (3=Low, 5=Medium, 7=High), B: Plant growth habit (3=Erect, 5=Semierect, 7=Spreading), C: Internodal distance (3=Short, 5=Medium, 7=Long), D: Phyllotaxy (3=Distichous, 5=Tristichous, 9=Mixed type), E: Leaf lamina length (5=Medium, 7=Long) , F: Leaf lamina width (3=Narrow, 5=Medium, 7=Broad), G: Leaf size (3=Small, 5=Medium), H: Leaf base (5=Truncate, 7=Cordate, 9=Lobate), I: Leaf apex (5=Acuminate), J: Leaf margin (3=Crenate, 7=Serrate) K: Leaf type (1=Unlobed, 3=Mixed type), L: Mature bud shape (5=Acute Triangle, 7=Long Triangle, 9=Spindle) M: Sex (1=Gynoecious, 2=Androecious), N: Mature inflorescence length (3=Short, 5=Medium).

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

B. N. Gnanesh

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

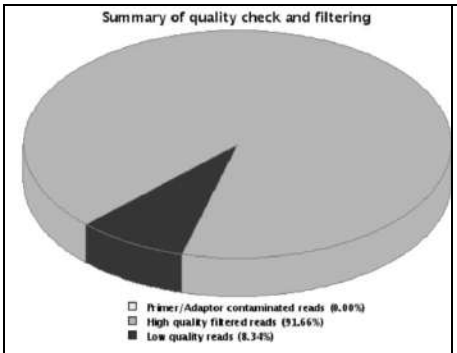
Transcriptome of Mulberry in response to Root Knot Nematode (RKN)

Root Knot Nematode (RKN) *Meloidogyne incognita* (Kofoid & White) Chitwood, is a very serious and chronic endoparasitic nematode affecting mulberry. RKN not only cause direct damage, but also its infection leads to the development of root disease complexes like root rot and Fusarium wilt. To our knowledge, information on global gene expression profiling in mulberry infected with RKN is not available and hence diverse accessions showing highly resistant and susceptible to RKN were used for transcriptomic studies. Comprehensive transcriptomic approach to investigate the expression of RKN genes in mulberry roots were conducted at two infection time intervals and stored at -80 $^{\circ}$C. RKN infested plants stage I (3 DAI) were used for Dual RNA Sequencing and Un-inoculated plants were used as controls with two independent biological replicates of each. Transcriptome sequencing of 3 DAI generated total of 24.27 Million HQ reads. Quality filtering of raw reads was performed for a mean phred quality score of >30 and any contaminating adapter sequences were removed. Overall data quality was good with 91.66% high quality reads. High

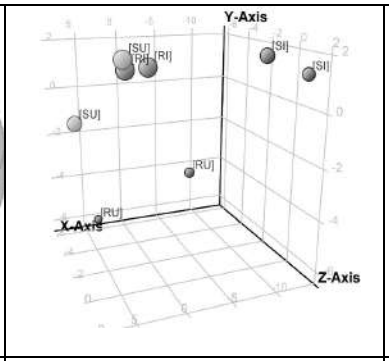
correlation was found between the replicates. Total reads from the uninoculated samples were aligned to the transcriptome of mulberry and infested were aligned to *M. incognita* data base. In total, out of 26965 genes, 50 % were mapped to mulberry and for infected samples, 4.9 % – 5.1 % of reads were mapped to the *Meloidogyne incognita* genome. Assembly contained 58,914 final transcripts with a N50 value of 1143 bp and GC content of 41.82 %. The gene expression profiles in resistant was used as baseline. Based on DESeq R package, if the gene expression in inoculated recorded a 2-fold (or more) difference relative to baseline (p-value < 0.05), the gene was regarded as differentially expressed gene (DEG). Annotation of 58,914 final transcript sequences were hit against Refseq plants (NCBI Refseq Protein database) which contains 2,91,424 proteins sequences using Blastx program. Functional annotation was performed by searching GO and KEGG database, 43,054 (73 %) transcripts were annotated with e-value cut off 0.001. The functional classifications were assigned using GO terms. Further, work is under progress.

Developmental stages of RKN in mulberry					
Stages	DAI	RI	RUI	SI	SUI
Stage I	03	RI-BR1-03	RU-BR1-03	SI-BR1-03	SU-BR1-03
Stage III	14	RI-BR1-14	RU-BR1-14	SI-BR1-14	SU-BR1-14
Stage I. Invasion of J2/initiation of feeding sites					
Stage III. Feeding J2s and J3s/ expansion of feeding sites					
R-Resistant, S-Susceptible, I- Inoculated, UI-Uninoculated					

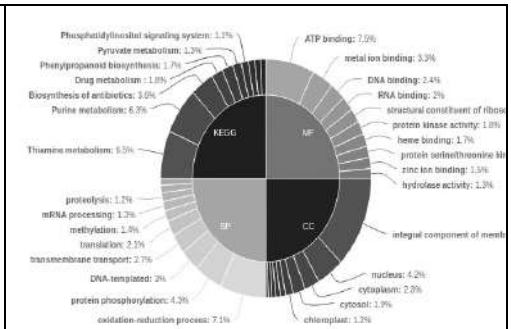
Summary of assembled results	
Final Transcripts	58,914
Total bases (Mbp)	51,903,228
Min sequence length (bp)	301
Max sequence length (bp)	12,331
Average sequence length (bp)	881
N50 length (bp)	1,143
(G + C)s	41.82%



Summary of quality check & filtering



Scatter plot of replicates



The GO, KEGG pathway analysis

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

Vaijayanthi P V (upto 27.03.2019), Bhavya M R, Gayathri T, Mahalingappa, K. C and Sanath Kumar, Y. N

Objective: To validate the response of accessions contrasting for alkalinity stress and development of mapping population.

Alkalinity is one of the abiotic stresses that limit mulberry productivity in the tropics. Previous experiments conducted by different research institutes resulted in the identification of few alkaline tolerant and susceptible accessions. With this background, two alkalinity hotspots (REC- Koppal & Kinakanahalli) were chosen to validate the stress response of these previously identified 40 genotypes. Initial soil analysis was carried out in both hotspots and the results are in conformity with high alkaline status. The genotypes were screened in hotspots (REC- Koppal & Kinakanahalli) and pots (CSRTI-Mysuru). Data was recorded on growth, yield and physiological parameters. Based on the results two genotypes (MI-0025 and MI-764) tolerant to alkaline stress were identified. After confirmation these genotypes can be used further in crossing programme for development of mapping population to map QTLs controlling alkalinity tolerance in mulberry.

PIB-3633: Evolution of highly productive and widely adapted mulberry using exotics and wild germplasm (Jul. 2018 – Jun. 2023)

Arunakumar G. S., Vaijayanthi P.V (upto Feb. 2019) and Bhavya M R

Objectives:

- To generate divergent hybrid populations using exotics, wild related accessions and cultivated mulberry varieties
- To identify highly productive and adaptive hybrids at PRT

Selected parental germplasm accessions were multiplied in nursery beds and a total of seven crosses were undertaken using hybridization of indegenous and exotic parents during the reporting period under existing plot. The crosses selected include G2 × Thai Male, MR-2 × V1, G-4 – OPH, LH × V1, Boquequet × Kosen, *M. multicaulis* × V1, Zimbabwe -4× Gaj-2, BR-2 × S13, Zimbawbe -2× Gaj-2 and Kanzan × Kosen. These crossed seeds were extracted and stored for further evaluation.

	
Bagging of selected female parents for attempting crosses	Pollination of selected parents at PDG plot

PIC-01003 CN (NW2a): Validation of a high-density SNP genotyping array for QTL discovery by association mapping and bi-parental analysis in Mulberry (Sep. 2018 - Aug. 2021)

Gnanesh B N, Sivaprasad V and Manoj Kumar H B (RA)

Objectives:

- SNP genotyping of panel of diverse germplasm and mapping population
- Construction of a genetic linkage map using SNP markers
- QTL discovery by marker-trait association and linkage mapping using phenotypic data for different traits

Availability of genomic resources such as marker system and genetic resources like mapping population and panel of germplasm had been a constraint for QTL discovery and initiating focused molecular breeding program in mulberry. In an effort to develop robust SNP genotyping platform SNPs generated from NW1 project will be validated and used in QTL discovery. SNP genotyping lab has been established at CSRTI, Mysuru and lab equipment's procurement is under progress. Isolation of DNA from 311 mulberry accessions was completed and SSR profiling was employed to assess genetic relation among the diverse mulberry accessions. Initially a set of 48 mulberry genotypes were screened using available SSR markers, only five showed polymorphism. A new set of polymorphic SSR markers will be procured from UAS, Bangalore and will be screened against diverse mulberry accessions and mapping population. Standardization of KASP SNP genotyping will begin after the procurement of genotyping equipments.

PIC-01003CN (NW2b): Discovery of QTL to drought adaptive traits by association mapping in mulberry (Sep. 2018 – Sep. 2021)

Jalaja S Kumar and K.V. Rajini (JRF)

Objectives:

- To evaluate the panel of diverse germplasm (~350 entries) for drought adaptive traits
- To identify QTLs for drought adaptive traits by association mapping

Mulberry leaf production appears to be the most significant limitation for the silk production in India. Progress in mulberry crop improvement to enhance leaf production not withstanding tremendous loss of leaf yield due to moisture stress has been recognized as one of the most important constraint. Although considerable progress has been made in identifying suitable varieties for sustained leaf production under moisture stress conditions, there have not been any attempts to breed for superior cultivars with enhanced quality leaf production under moisture stress. Screening genotypes for less reduction in yield under stress has led to the identification of varieties such as S-13 & S34 etc., (Susheelamma *et al.,* 1992). However a focused breeding approach is required to meet the silk production demand in the years to come. It is widely accepted that a trait based breeding needs to be adopted in order to improve mulberry productivity. Recent research outputs in various crop species have enumerated several traits that have relevance in sustaining productivity under moisture stress conditions. We have demonstrated that maintenance of leaf tissue water relations associated with roots and maintenance of metabolism associated with chloroplast characteristics have prominent relevance in sustaining growth and productivity. Mulberry germplasm accessions required for the project experiments planned to take up at CSRTI-Mysuru and UAS-Bengaluru were multiplied (350 diverse germplasm) at CSRTI-Mysuru and RSRS, Kodathi. Molecular work has been initiated to finalize the panel of germplasm.

PIC-01003CN (NW 2C): Identification of QTLs for yield associated traits in mulberry (Sep. 2018 – Aug. 2021)

Vaijayanthi P V (upto 27.03.2019), Bhavya M R, Tanmoy Sarkar and Jalaja S Kumar

Objective: To evaluate the panel of diverse germplasm (~350 entries) for yield and associated traits

Mulberry productivity is the key factor for sustainable sericulture. Mulberry leaf yield is a complex trait and the yield potential of different cultivars range from 10 – 60 MT/ha/annum. This yield increment is mainly due to higher input involving higher cost of cultivation. But, there is a potential scope to exploit genetic potential available in the germplasm resources by locating genes associated with the trait and pyramid them for sustaining mulberry yield under lesser input conditions. The project proposes to utilize a panel of diverse germplasm (~350 entries), a representative collection developed from the whole collection (<1000 acc.) having almost all the phenotypic and genotypic diversity. In this respect, 350 diverse germplasm were multiplied at CSRTI-Mysuru and RSRS-Kodathi. Genotypes with less number of saplings (due to less survivability) have been again multiplied in nursery. Main field preparation is under progress for establishing diverse germplasm (350 entries) to evaluate for yield and associated traits. Molecular work has been initiated to finalize the panel for association mapping.

PIC-01003CN (NW2e): Sustaining Mulberry Yield: Identification of QTLs conferring resistance to Root rot disease by linkage mapping and trait introgression (Sep. 2018 to Aug. 2021)

Arunakumar G S and Gnanesh B N

Objectives:

- To develop mapping populations (by crossing of contrasts) for root rot resistance by pseudo-test cross strategy
- Evaluation of segregating F1 progeny for disease resistance phenotype
- QTL analysis for disease resistance by linkage mapping (genotypic data input from the subprogram NW2a)

Mulberry (*Morus* spp.) is seriously affected by root rot diseases. Different types of root rots have been reported such as dry root rot caused by *Fusarium solani* and *F. oxysporum.* Black root rot caused by *Lasiodiplodia theobromae* and charcoal root rot caused by *Macrophomina phaseolina*. Resistance to root rot is an important and long term strategy to combat the dreaded disease. The genes conferring resistance needs to be mined from the natural gene pool. Development of improved variety/genotype having resistance to root rot pathogens through breeding programmes is an effective approach to avoid crop loss and to improve the sustainable mulberry production.

Mapping population (F_1) seedlings were raised in nursery beds under glass house condition. These seedlings after four months, were transplanted to main field with IJS spacing. Backup crosses required to meet sufficient number of population in each cross were attempted and seeds were recovered.

Development of mapping population for root rot trait under field condition.

Continuous/Other Activities:

Maintenance and extension of Panel of Diverse Germplasm (PDG), mulberry germplasm nursery and mapping resources

- Yield and yield contributing traits (Mysore 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 V1 progeny - 169 Nos)
- Introgressed lines for WUE and root traits (20 Nos)
- Panel of Diverse Germplasm (~260)
- New set of Panel of Diverse Germplasm (56)

MULBERRY PHYSIOLOGY LABORATORY

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

Gayathri T, Gandhi Doss S and Tamoy Sarkar

Objective: To identify physio biochemical indicators (indices) of abiotic stress tolerance in mulberry

Ten mulberry varieties (V1, RC1, RC2, AGB8, MSG2, S13, S34, RFS 175, K2, Mysore Local) and six germplasm accessions (MI 0256, MI 0332, MI 0214, MI 0699, MI 0025 & MI 0026) were short-listed for evaluating physio-biochemical responses of these plants under moisture stress conditions. Moisture stress experiments were conducted in these genotypes at four different water regimes based on the pot water holding capacity (PC) viz., (i) control: pots

maintained at 100% PC (ii) low water stress: 75% PC (iii) medium water stress: 50% PC (iv) high water stress: 25% PC. 12 plants were selected per genotype (control and 3 treatments: 3 replications each) and experiments were conducted from 45th to 70th day after pruning. Moisture experiments were continued for 25 days and fresh leaves were collected from experimental plants for analysis of stress specific physio-biochemical parameters.

Methodology:

1. Biochemical analysis:

Estimation of antioxidants (enzymatic: superoxide dismutase & peroxidase; non-enzymatic: reduced glutathione, phenols & ascorbic acid) and osmolytes (proline, glycine betaine & soluble sugars) were carried out by standard procedures in all genotypes at low (75% PC), medium (50% PC) and high moisture stress (25% PC) along with control plants.

2. **Physiological parameters:**

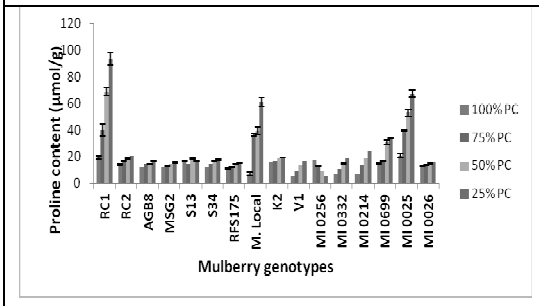
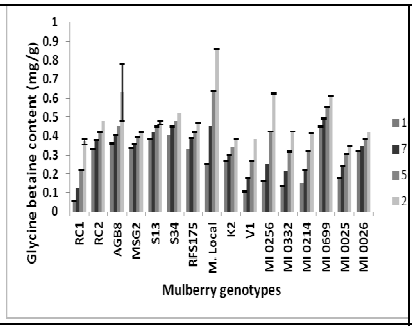
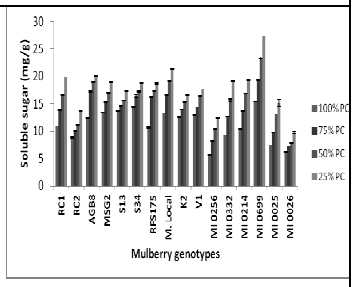
Photosynthetic rate and leaf gas exchange parameters were recorded during the stress period with portable photosynthesis system LI-6400 XT (LI-COR Inc., Lincoln, NE, USA) in the leaves of low, medium and high stressed plants along with control (non-stressed) plants between 10.00 and 11.30 a.m.

Results:

Photosynthetic efficiency of mulberry genotypes under low, medium and high moisture stress

Genotype	Photosynthetic rate (PN)			
	100% PC	75% PC	50% PC	25% PC
V1	11.16±0.55	8.74±1.86	7.80±0.39	6.45±0.59
RFS 175	8.98±1.27	4.86±0.72	5.26±1.83	4.39±0.11
AGB8	13.62±0.85	10.94±1.11	10.58±0.67	9.46±1.19
RC2	13.87±1.12	12.60±0.91	12.95±0.21	8.76±2.54
S34	10.69±0.27	11.38±0.63	6.84±0.86	4.77±1.04
MSG2	12.71±1.65	12.15±0.66	10.91±1.3	10.15±2.29
S13	16.45±1.19	16.22±2.59	10.79±3.0	4.62±1.14
Mysore Local	16.00±1.97	13.38±2.13	8.47±1.04	3.46±0.67
RC1	11.38±0.532	11.59±1.25	10.35±0.18	8.88±1.45
K2	9.33±0.35	5.56±0.19	4.66±0.25	3.50±0.18
MI 0332	13.32±2.47	13.23±0.47	9.46±3.80	7.45±1.66
MI 0214	10.04± 2.43	8.35± 0.36	6.32± 1.26	5.34± 0.06
MI 0699	11.28±0.42	11.57±1.36	10.61±1.04	3.62±1.71
MI 0025	11.46±0.77	12.01±1.16	9.87±1.08	4.88±1.15
MI 0026	12.12±0.63	10.91±1.16	12.1±1.82	8.74±1.38

*PC: pot water holding capacity

<table>
<tr><td colspan="3">Accumulation of osmolytes in mulberry genotypes during moisture stress</td></tr>
<tr><td> 
</td><td> 
</td><td> 
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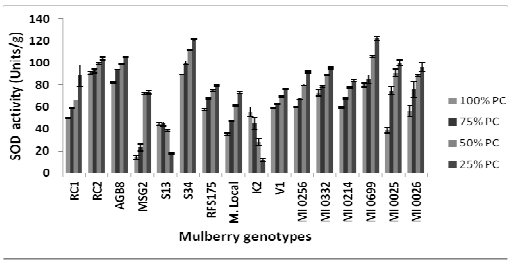
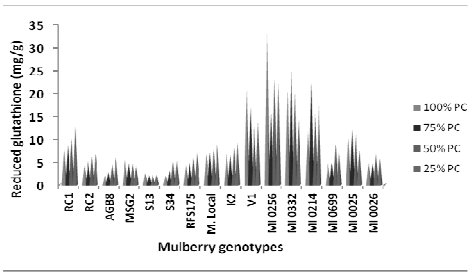
<tr><td>(a) Proline</td><td>(b) Glycine betaine</td><td>(c) Soluble sugars</td></tr>
<tr><td> 
</td><td colspan="2"> 
</td></tr>
<tr><td>Activity of antioxidant enzyme (SOD) during moisture stress</td><td colspan="2">Changes in reduced glutathione content during moisture stress</td></tr>
</table>

Photosynthetic rate would be maintained even under high stress in tolerant genotypes such as RC1(8.88 µmol $m^{-2}s^{-1}$), MSG2 (10.15 µmol $m^{-2}s^{-1}$), AGB8 (9.46 µmol $m^{-2}s^{-1}$), MI 0332 (7.45 µmol $m^{-2}s^{-1}$), MI 0026 (8.74 µmol $m^{-2}s^{-1}$); whereas a significant reduction was recorded in K2 (3.50 µmol $m^{-2}s^{-1}$) and Mysore Local (3.46 µmol $m^{-2}s^{-1}$).

Progressive higher accumulation of antioxidants (enzymatic: Superoxide dismutase and Peroxidase; non-enzymatic: reduced glutathione and phenol) and osmolytes (proline and glycine betaine) were observed during moisture stress in tolerant genotypes and hence these specific antioxidants as well as osmolytes accumulated in stress can be utilized as a biochemical marker/indicator for moisture stress tolerance in mulberry.

PIC-01 003 CN: NW4a: Quantitative and qualitative analysis of secondary metabolites for identification of biomarkers responsible for feed quality in mulberry (Sept. 2018 - Oct. 2021)

Thulasiram H V (CSIR-National Chemical Laboratory, Pune), Gayathri T, and Bhuvaneswari E

Objective: To develop biomarkers with respect to secondary/primary metabolites responsible for nutritive quality of mulberry for facilitating easy selection of the genotype with desired traits responsible for high nutritive quality

Saplings of selected varieties (V1, G2, G4, S36, S13, ME-0168, MR2, Mysore Local, K2, MI-0027) were raised in nursery and maintained with intercultural operations for establishing experimental plantation. Fresh mulberry leaves of short-listed genotypes were supplied to the CSIR-NCL Pune for standardizing the procedure of secondary metabolites extraction and characterization. Feed conversion efficiency study was conducted with few evolved multivoltine hybrids, PM and Cauvery Gold with V1 leaves for standardizing the procedure.

SOIL SCIENCE AND 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 to Mar.2019)

Sobhana V, Sibayan Sen, Sudhakar P[1], Dhahira Beevi N[2] and Vijaya Naidu B[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. Imbalanced use of fertilizers, low addition of organic matter and non-replacement of depleted micro and secondary nutrients over the years, has resulted in decrease in soil fertility. Site specific nutrient management involving soil test based application of fertilizers is critical to maintain good soil health and 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, Zn, Fe, Cu, Mn and B. Based on test results, the fertilizer recommendations and soil amendments to be applied are recommended for the farmer. Testing of soil samples that are received are being conducted at the main institute and RSRSs at Anantapur, Kodathi and Salem.

A total of 7201 soil samples were collected from sericulture farmers of Karnataka, Tamil Nadu, Andhra Pradesh and Maharashtra in coordination with CSB field units and DOSs. The state wise number of soil samples analysed during 2018-19 are shown below. These soil samples were analyzed for pH, electrical conductivity, organic carbon, major nutrients and micronutrients.

State wise number of soil samples analyzed	
State	Number of soil samples analysed
Karnataka	1877
Tamil Nadu	3318
Andhra Pradesh & Telangana	970
Maharashtra	1036
Total	7201

The results show 6% of soil samples analysed in Karnataka were alkaline, whereas it was 81% in Tamil Nadu, 38% in Andhra Pradesh and 20% in Maharashtra. Nearly 79% soil samples analysed in Karnataka showed neutral pH. Maximum soils with alkalinity problems are observed in Tamil Nadu. Most of the samples analysed in all the states exhibited normal range with respect to electrical conductivity (EC <1.0 dS/m). The organic carbon content was low in 74% of the soil samples of Karnataka, 67% soil samples of Tamil Nadu 93% soil samples of Andhra Pradesh and 58% soil samples of Maharashtra.

State	Samples analyzed	% Soil samples analysed							
		pH			EC		OC		
		Acidic	Neutral	Alkaline	<1	>1	L	M	H
KA	1877	14.4	79.2	6.4	100	0	74.3	25.05	0.59
TN	3318	0.5	11	81	92.9	6.2	66.6	28.6	5.9
AP	970	4.8	57	38.2	99.8	0.2	93.1	6.9	0
MH	1036	0	80.7	19.3	98.4	1.6	58.1	35.2	6.7

Most of the soils samples analysed in all the states varied from low to moderate values with respect to available N status. > 65% of the soil samples analysed in all the states were having high levels of available K content. Available K was high (> 240 kg/ha) in 83% of soil samples of Karnataka, 85% soil samples of Tamil Nadu, 86% soil samples of Maharashtra and 64% soil samples of Andhra Pradesh . The available sulphur status showed most of the soils samples analysed were under medium to high category. More than 50% of the soil samples analysed in all the states were low in available boron content.

State	% Soil samples analysed														
	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	8.9	90.7	0.4	13.6	35.4	78.2	1.8	15	83.2	3.27	47.3	49.4	58.7	39.6	1.7
TN	90	10	0	51	16	33	3	12	85	30	35	35	67	15	18
AP	47.5	51.2	1.3	35.2	27.5	37.3	2.9	33.1	64	21	50.2	28.8	68.3	27.5	4.2
MH	32.5	60	7.5	39.03	31.4	29.57	1.57	12.4	86.03	16.7	45.8	37.5	88.8	9.56	1.64

PIC-1003 CN (NW2d): Genetic enhancement of Mulberry through Genomic approaches (Sep. 2018- Aug. 2021)

Sub Project: Identification of QTLs for Nutrient Use Efficiency

Sobhana V, Jhansi Lakshmi K and Ravindra

Objectives:

- To evaluate the panel of diverse mulberry genetic resources for uptake and utilization efficiency of Nitrogen, Phosphorous, Zinc and Sulphur
- To identify QTLs for Nutrient use efficiency and associated traits by linkage disequilibrium mapping (SNP genotypic data on the panel to be provided by NW2a of the mulberry network programme)

127 diverse mulberry genetic resources shortlisted were collected from CSGRC, Hosur and multiplied in the nursery at CSRTI-Mysuru. The nursery is maintained with proper, intercultural operations and plant protection measures at regular interval.

AGRONOMY SECTION

Ongoing research project:

PIN-3563: Evaluation of improved mulberry genotypes for yield potential, nutrient uptake and use efficiency (NUE) under varied cultivation practices (February 2016 – March 2020)

Vinod Kumar Yadav, Sibayan Sen, Sobhana V, Bhuvaneshwari E and Thirupathaiah Y

Objectives:

- To evaluate yield potential, nutrient 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 production

In the light of alarming reduction in ground water availability, lack of adequate irrigation facilities, non-availability of chemical fertilizers in adequate quantities at the appropriate times, raising cost of farm inputs, has prompted scientists to look for newer varieties that are superior in respect of water and nutrient use efficiency. Although an estimated 60%

of the input in cocoon production goes into production of mulberry foliage, far from adequate attention has been paid to the important aspect of mineral nutrition of mulberry viz., nutrient budgeting and optimization of use efficiency. An improved NUE will also provide economic benefits at farm gate as availability of fertilizers is increasingly becoming an issue and prices have risen steeply. The application of new technologies in mulberry cultivation and silkworm rearing will promote increased silk production. Further, the choice of appropriate plant type, cultivation practices, silkworm hybrids and rearing packages that lead to judicious use of inputs also would contribute to reduce the negative environmental impacts for sustainable production. Therefore, evaluation of improved mulberry genotypes for yield potential, nutrient uptake and use efficiency under varied cultivation practices has been undertaken. The package of practices include two levels of irrigations (I_0= 100% and I_1= 60%) and three fertilizer inputs (F_0- 350: 140: 140 + 25MT FYM; F_1- 280: 112: 112+ 25MT FYM i.e. 80% of F_0 and F_2- 210: 84: 84+ 25MT FYM i.e. 60% of F_0) tested with four mulberry varieties viz., AGB-8, MSG-2, G-4 and V-1) in split plot design with three replications. During the period, the experiment has been laid down with installation of drip irrigation and initial soil samples have been collected and analysed for its chemical properties and available macro and micro nutrient status. Further work is under progress.

Initial chemical properties and available macro and micro nutrient status of experimental plots										
Repl.	pH	EC (dSm^{-1})	OC (gkg^{-1})	Avg. N ($kgha^{-1}$)	Avg. P ($kgha^{-1}$)	Avg. K ($kgha^{-1}$)	Avg. Fe (μgg^{-1})	Avg. Mn (μgg^{-1})	Avg. Zn (μgg^{-1})	Avg. Cu (μgg^{-1})
R_1	6.70	0.16	5.80	332.8	19.2	210.0	1.48	2.79	1.05	1.64
R_2	6.40	0.21	7.60	460.6	24.6	196.7	1.52	3.05	0.96	1.59
R_3	6.40	0.14	7.00	418.0	22.8	202.4	1.35	3.38	0.89	1.55
Mean	6.50	0.17	6.80	403.8	22.2	203.0	1.45	3.07	0.97	1.59

Concluded projects:

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

Vinod Kumar Yadav, Dhaneshwar Padhan, Sibayan Sen and Gayathri T

Objectives:

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

Effect of irrigation with and without mulching and reduced tillage on soil properties						
Treatment	pH	EC (dSm^{-1})	OC (gkg^{-1})	BD (Mgm^{-3})	WHC (%)	Microbial Biomass ($x\ 10^{-3}\ \mu gg^{-1}$)
T_1	6.90	0.54	6.63	1.27	17.7	1.26
T_2	6.80	0.50	7.83	1.25	19.8	1.63
T_3	6.83	0.53	7.07	1.25	18.7	1.38
T_4	6.72	0.49	8.52	1.22	21.8	1.69
Initial	7.04	0.41	5.88	1.31	15.8	1.02
SEm±	0.06	0.27	0.38	0.66	1.28	0.12
CD (P<0.05)	0.15	0.82	1.20	NS	3.98	0.40

Carbon sequestration refers to the removal of carbon dioxide from atmosphere and fixed it in to a long lived stable pool. One such way is to trap carbon dioxide (CO_2) through plant. It is 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 hectares in the country. The potential of mulberry to sequester the atmospheric CO_2 depends upon the cultivation strategies and management practices followed. The package of practices include minimum tillage, large inputs of inorganic and organic nutrients followed by mulching with and without drip and furrow irrigations. 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 treatment: NPK 350:140:140 kg/ha/yr in 5 split doses and FYM 25MT/ha/yr in 2 split doses with reduced tillage (two times in a year) and mulching of cover crops two times) having six replication.

Fifteen crops were harvested and biomass yield was recorded. Mulberry leaf yield during 2018 was higher in drip irrigation with reduced tillage and mulching (63.7 t $ha^{-1}year^{-1}$) compared to furrow irrigation without mulching

Effect of irrigation with and without mulching and reduced tillage on available macro and micro nutrients in soils						
Treatment	Avail. P (kg ha^{-1})	Avail. K (kg ha^{-1})	Avail Fe (µg g^{-1})	Avail. Mn (µg g^{-1})	Avail. Cu (µg g^{-1})	Avail. Zn (µg g^{-1})
T_1	66.5	316.1	1.90	0.79	0.63	1.41
T_2	70.4	360.3	3.18	1.06	0.96	3.17
T_3	68.9	345.8	1.97	0.80	0.69	1.73
T_4	72.2	407.8	3.25	1.30	1.10	3.30
Initial	60.3	373.9	2.53	1.11	0.91	2.40
SEm±	3.66	6.89	1.40	0.53	0.46	1.34
CD (P<0.05)	11.12	20.74	4.24	1.62	1.39	4.07

treatment (55.9 t $ha^{-1}year^{-1}$). Soil analysis indicated that drip irrigation with reduced tillage and mulching increased the organic carbon (8.52 g kg^{-1}), water holding capacity (21.8%), available phosphorus (72.2 kg ha^{-1}), available potassium (407.8 kg ha^{-1}), available iron (3.25 µg g^{-1}), available manganese (1.30 µg g^{-1}), available copper (1.10 µg g^{-1}) and available zinc (3.30 µg g^{-1}) while reduced pH (6.72) and electrical conductivity (0.49dSm^{-1}) compared to initial and other management practices. The total carbon sequestered in mulberry (leaf and stem) was estimated and it was found that drip irrigation with reduced tillage and mulching on average witnessed 14.8 t ha^{-1} $year^{-1}$ compared to furrow irrigation without mulching i.e., 13.2 t ha^{-1} $year^{-1}$.

Effect of two levels of irrigation (drip and furrow) with and without mulching and reduced tillage on carbon sequestration potential of mulberry stem and leaf (t ha^{-1} $year^{-1}$)				
Treatments	First year	Second year	Third year	Average
T_1	13.2	12.8	13.6	13.2
T_2	14.4	15.2	13.6	14.4
T_3	13.2	14.8	14.6	14.2
T_4	13.9	15.6	14.8	14.8
SEm±	0.38	0.91	0.38	-
CD (P<0.05)	1.14	2.72	1.24	-

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

Vinod Kumar Yadav, Sobhana V, Sibayan Sen, Mary Josepha A V, Balachandran N and Chandrashekhar M N

Objectives:

- To produce mulberry leaf and cocoon through organic practices
- 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 which comprised of 350:140:100 NPK kg/ha/yr + 25 MT of FYM/ha/yr and organic practice which included application of 10 MT of FYM and Seri compost/Vermicompost (8 MT) + Green manure seeds (12 kg) + bio-fertilizers (*Azotobacter*-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 ecofriendly botanical products solution for 1 hour and washing in hot water.

During the period project inspection of mulberry gardens for third year (conversion period) and certification was done by identified agency for production of mulberry leaves, cocoons and silk reeling process through organic practices. Further, five crops were harvested, wherein yield and other growth parameters were recorded as per schedule. The conventional nutrient management practices (control) recorded higher yield (62.9 t ha^{-1} $year^{-1}$) compared to organic practice (58.6 t ha^{-1} $year^{-1}$). Soil analysis indicated increase in organic carbon (6.9 g kg^{-1}), available phosphorous (35.7 kg ha^{-1}), available potassium (352.8 kg ha^{-1}), micronutrient like available zinc (1.02 µgg^{-1}), iron (12.8 µg g^{-1}) and manganese (37.4 µg g^{-1}) in organic practice compared to control. Microbial population viz., fungi, bacteria and actinomycetes were higher in organic practice compared to control. Mulberry leaves were analysed for macro (N- 3.71%, P- 0.2% and K- 1.86%) and micronutrients (Fe- 214.6 µg g^{-1}, Cu- 14.2 µg g^{-1}, Zn- 34.7 µg g^{-1} and Mn- 55.2 µg g^{-1}). The bivoltine S8 race was used to carry out bio assay studies using organically grown leaf and leaf grown under recommended practice (control).

Improvement in physical, chemical and available nutrient status in soils of organic cultivation over conventional											
Treatment	pH	EC (dSm^{-1})	BD (Mgm^{-3})	WHC (%)	OC (gkg^{-1})	Avg. P ($kgha^{-1}$)	Avg. K ($kgha^{-1}$)	Avg. Fe (µgg^{-1})	Avg. Mn (µgg^{-1})	Avg. Zn (µgg^{-1})	Avg. Cu (µgg^{-1})
Organic	7.63	0.19	1.25	38.4	0.69	35.7	352.8	2.92	1.02	12.8	37.4
Control	7.59	0.34	1.29	37.1	0.63	34.1	340.6	3.24	0.92	9.21	33.6
#	0.5	-44.1	-3.10	3.50	9.5	4.7	3.6	-9.9	10.9	39.0	11.3
#- % improvement											

Improvement in microbial population in soils of organic cultivation over conventional			
Treatment	Fungi (x106) cFu	Bacteria (x 107) cFu	Actinomycetes (x107) cFu
Organic	29	142	108
Control	24	134	104
per cent improvement	20.83	5.97	3.85

Improvement in macro and micro nutrient content of leaf of organic cultivation over conventional							
Treatment	N (%)	P (%)	K (%)	Fe (µg g^{-1})	Cu (µg g^{-1})	Zn (µg g^{-1})	Mn (µg g^{-1})
Organic	3.71	0.2	1.86	214.6	14.2	34.7	53.0
Control	3.24	0.15	1.79	202.4	13.8	32.1	42.7
per cent improvement	14.5	33.3	3.9	6.0	2.9	8.0	24.0

Reeling parameters under organic cultivation practice with S8 silkworm race over 3 years											
Breed	a	b	c	d	e	f	g	h	i	j	k
S8	1.7	0.4	21.77	615.82	507.29	2.86	8.54	80.65	11.71	57.15	96
S8	2.0	0.4	20.50	635.0	510.91	2.75	8.65	75.19	12.54	58.87	95
S8	1.9	0.4	20.94	620.89	506.45	2.85	8.56	77.88	12.93	59.12	95
#	1.9	0.4	21.1	623.9	508.2	2.8	8.6	77.9	12.4	58.4	95.3
a: single cocoon weight (g); b: single shell weight (g); c: shell (%); d: average filament length (m), e: NBFL (m); f: denier; g: renditta; h: reelability (%); i: raw silk (%); j: raw silk recovery (%) and k: neatness (points) #: average											

MULBERRY PATHOLOGY LABORATORY

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

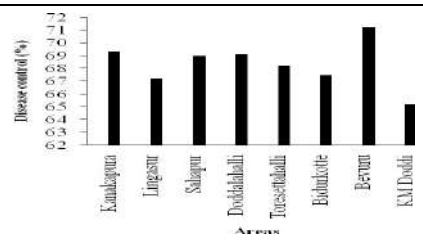
Pratheesh Kumar P M, Rajakumar S, Jayaram H, Srinivasarao T V, Venugopal A

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

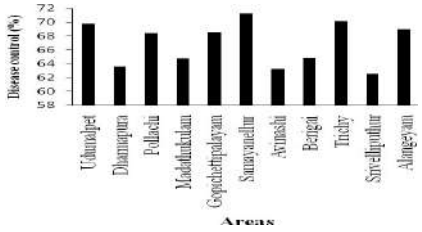
A total of 3135 kg *Rot-fix* have been prepared and distributed 2414 kg to 498 farmers in various places of Karnataka (578 kg), Tamil Nadu (1122 kg), Andhra Pradesh (471 kg) and Telangana (243 kg) for control of root rot disease of mulberry. Demonstrations were conducted in these areas and the feedback information were collected from the farmers on the performance of *Rot-fix* on control of root rot disease.

In Karnataka > 65 % disease control was observed with highest (71.22%) in Bevuru with an average of 68.19%. In case of Tamil Nadu, disease control was recorded >66% with highest 74.22% in Gopichettipalayam area with an average of 70.89%. In Andhra Pradesh, the control was >60% with highest (74.92%) in Eluru area with average 66.50% and in Telangana, the disease control was >64% with highest (73.20%) in Shadnagar area with average control of 68.81%. The overall average disease control was found to be 68.60% due to the application of *Rot-fix* in terms of revival of root rot infected mulberry plants.

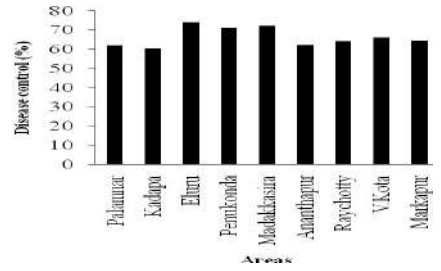
Performance of *Rot-fix* in different southern states



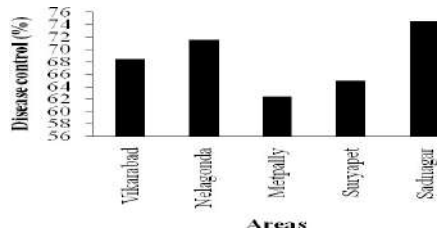
Karnataka



Tamil Nadu



Andhra Pradesh



Telangana

Distribution, demonstration and performance of *Rot-fix* in various southern states				
States	Farmers covered (no.)	Demonstrations conducted (no.)	*Rot-fix* supplied (Kg)	Avg. control (%)
Karnataka	112	32	578	68.19
Tamil Nadu	186	46	1122	70.89
Andhra Pradesh	128	30	741	66.50
Telangana	72	22	423	68.81
Average/Total	498	130	2414	68.60

Continuous /Other Activities:

Studies on growth promotion and mildew suppressive effect of phylloplane bacteria of mulberry (Jan. 2017- Jun. 2018)

Pratheesh Kumar P M.

Objectives: To study the growth promotion and mildew suppressive effect of certain phylloplane bacteria of mulberry

In vitro studies were conducted to assess mildew (*Phyllactinia corylea*) suppressive effect through conidial germination and the selected bacteria were evaluated in plants raised on earthen pots. The growth promotion effect of bacteria was done through seed germination tests. The effective bacteria were identified through morphological and biochemical characterisation. The selected phylloplane bacteria were tested *in vivo* for their mildew suppressive effect.

The *in vitro* conidial germination showed significant influence of phylloplane bacteria and the hours after inoculation on suppression of conidial germination. Among eighteen bacterial isolates, ten bacterial isolates significantly (P<0.05) reduced conidial germination. Among these, four isolates highly (P<0.01) reduced the conidial germination suppressing > 70%. The highest reduction was observed in isolate Pb-5 (13.87%) by suppressing 86.13% followed by Pb-4 82.17%, Pb-12 (74.72%) and Pb-15 (78.94%).

Influence of phylloplane bacteria on conidial germination of *P. corylea*

Bacterial isolates	Conidial germination (%)						Total	
	24-hr		48-hr		72-hr			
Pb-1	37.00	(37.46)	64.03	(53.15)	76.39	(60.93)	59.56	(50.51)*
Pb-2	74.05	(59.37)	78.91	(62.66)	90.62	(72.17)	81.78	(64.73)
Pb-3	62.72	(52.37)	71.24	(57.57)	75.25	(60.17)	69.86	(56.70)*
Pb-4	11.50	(19.82)	17.10	(24.42)	23.99	(29.33)	17.23	(24.52)**
Pb-5	7.44	(15.83)	15.47	(23.16)	20.05	(26.60)	13.87	(21.86)**
Pb-6	69.39	(56.41)	77.49	(61.67)	81.77	(64.73)	76.40	(60.94)*
Pb-7	70.98	(57.40)	78.02	(62.04)	85.83	(67.89)	78.60	(62.44)
Pb-8	76.14	(60.76)	82.95	(65.61)	88.68	(70.33)	82.89	(65.57)
Pb-9	80.26	(63.62)	85.99	(68.02)	95.08	(77.18)	87.86	(69.61)
Pb-10	75.01	(60.00)	82.25	(65.08)	89.34	(70.94)	82.60	(65.34)
Pb-11	68.23	(55.69)	77.51	(61.69)	80.69	(63.93)	75.66	(60.44)*
Pb-12	13.94	(21.92)	23.56	(29.04)	26.50	(30.98)	21.06	(27.31)**
Pb-13	79.33	(62.96)	86.18	(68.18)	93.21	(74.89)	86.77	(68.67)
Pb-14	61.90	(51.89)	71.16	(57.52)	74.29	(59.54)	69.23	(56.31)*
Pb-15	18.55	(25.51)	26.98	(31.29)	30.87	(33.75)	25.28	(30.18)**
Pb-16	68.81	(56.05)	76.99	(61.34)	81.13	(64.25)	75.82	(60.54)*
Pb-17	72.43	(58.33)	82.29	(65.12)	84.78	(67.04)	80.08	(63.49)
Pb-18	76.60	(61.07)	84.88	(67.12)	90.70	(72.25)	84.50	(66.81)
Control	76.74	(61.16)	84.07	(66.47)	90.82	(72.36)	84.31	(66.67)
Mean	57.56	(49.35)*	67.63	(55.32)	74.94	(59.96)*		

Figures in parentheses are arcsin transformed values: CD: *P<0.05; **P<0.01

Various phylloplane bacterial isolates influenced the seed germination of mulberry. Among the bacterial isolates, six isolates significantly increased the seed germination. Highly significant (P<0.01) seed germination (93.44%) was obtained with Pb-6 followed by Pb-7 (86.22%), Pb-3 (86.22%) and Pb-4 (85.47%). However, biopriming with twelve isolates resulted less germination compared to control (82.46%) with least germination in Pb-9 (70.22%).

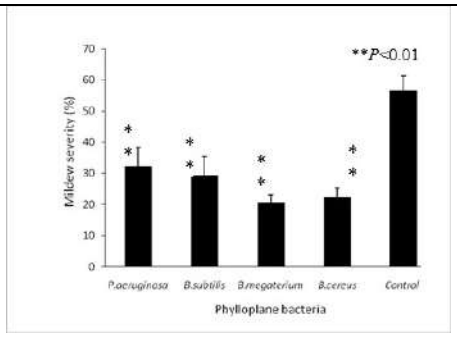
Effect of Phylloplane bacteria on seedling growth of mulberry					
Bacterial isolates	Germination (%)	Root length (mm)	Shoot length (mm)	Total length (mm)	Vigour Index
Pb-1	82.41	2.467*	2.189*	4.656**	383.70**
Pb-2	79.62	1.033	1.533	2.567	204.38
Pb-3	86.22**	2.022*	2.078*	4.100**	315.91*
Pb-4	85.47**	2.089*	1.189	3.278	299.83
Pb-5	84.25*	1.489	2.333**	3.822*	322.00*
Pb-6	93.44**	1.878	1.511	3.389*	316.67*
Pb-7	86.22**	1.622	1.700	3.322	286.42
Pb-8	74.21	2.140*	1.524	3.664*	158.81
Pb-9	70.22	1.860	1.648	3.508*	130.61
Pb-10	80.24	1.356	1.367	2.722	218.41
Pb-11	82.14	0.844	1.922	2.767	227.28
Pb-12	85.22*	1.600	2.622**	4.222**	359.80**
Pb-13	80.24	2.000	1.189	3.189	255.89
Pb-14	76.39	1.967	1.411	3.378*	258.05
Pb-15	74.12	1.956	2.511**	4.467**	331.09**
Pb-16	78.44	1.556	1.976*	3.522	276.27
Pb-17	74.29	1.480	1.522	3.004	109.95
Pb-18	82.14	2.111*	1.767	3.878*	318.54*
Control	82.46	1.833	1.436	3.269	269.56
CD: *P<0.05; ** P<0.01					

Highest root length (2.47mm) was obtained due to biopriming with isolates Pb-1 followed by Pb-18 (2.11mm) and Pb-4(2.089mm) and least (0.844mm) in case of seedlings obtained from Pb-11 bioprimed seeds. Likewise, highly significant (P<0.01) elongation of shoot was found in the seedlings obtained after biopriming with the isolates Pb-12 (2.622 mm), Pb-15 (2.51 mm) and Pb-5(2.33 mm). The shoot length was found least (1.18 mm) in case of the seeds treated with isolates Pb-4 and Pb-13. The seedling length was significantly high (P<0.01) in case of seedlings obtained from seeds bioprimed with isolate Pb-1 (4.66 mm) followed by Pb-15(4.47 mm), Pb-12 (4.22 mm) and Pb-3(4.10 mm). The total seedling length was found less than that of control (3.27 mm) in case of seedlings obtained from three isolates with least (2.57 mm) due to isolate Pb-2. The bacterial biopriming influenced the vigour index of mulberry seedlings. Biopriming with three bacterial isolates Pb-1 (383.70), Pb-12 (359.80) and Pb-15 (331.09) resulted highly significant (P<0.01) seedling vigour.

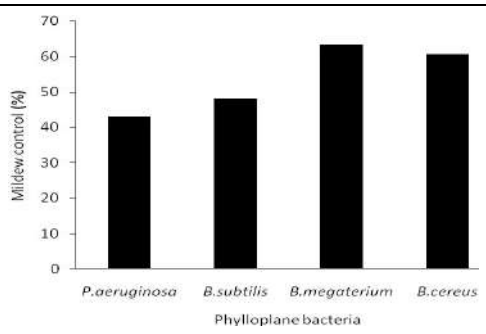
Biochemical characterization of antagonistic bacterial isolates				
Biochemical tests	*B. megaterium* (Pb-1)	*B. subtilis* (Pb-5)	*B.cereus* (Pb-12)	*P. aeruginosae* (Pb-15)
Basic characters				
Gram	+	+	+	-
Shape	Rod	Rod	Rod	Rod

Pigment	-	-	-	+
Motility	+	+	+	+
Catalase	+	+	+	+
Oxidase	+	-	-	+
Methyl Red	-	-	-	-
Voges Proskauer	-	+	+	-
Citrate utilization	+	+	+	+
Indole production	-	-	-	-
Nitrate reduction	+	+	+	+
Casein hydrolysis	+	+	+	
Gelatin hydrolysis	+	+	+	+
Substrate utilization				
Starch	+	+	+	-
D-Glucose	+	+	+	-
D-Xylose	+	+	-	-
D-Arabinose	+	+	-	-
Lactose	+	+	-	-
Sucrose	+	+	+	-
Fructose	+	+	+	-
Galactose	+	+	-	-
Maltose	+	+	+	-
D-Mannose	-	+	-	-
D-Mannitol	+	+	-	+

Effective bacterial isolates selected were further characterized morphologically and based on biochemical reactions showed that these bacterial isolates are *Bacillus megaterium* (Pb-1) *Bacillus subtilis* (Pb-1) *Bacillus cereus* (Pb-1) and *Pseudomonas aeruginosae* (Pb-1). Highly significant (P<0.01) reduction in disease severity was observed due to application of all four bacterial isolates. The severity was less (20.67%) due to the application of *B. megaterium*, *B.cereus* (22.19%) and high in control plants (56.54%). Bacterial isolates *B. megaterium* (63.42%) and *B.cereus* (60.73%) controlled >60% disease compared with the untreated control.



Effect of selected bacterial isolates on severity of powdery mildew



Effect of selected bacterial isolates on control of powdery mildew

BIVOLTINE SILKWORM BREEDING LABORATORY

Concluded Projects:

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

Manthira Moorthy S, Kishor Kumar C M, Mary Josepha A V, Hukkeri S M, Meenal R and Ranjini M S

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

Six oval breeds (CSR2, CSR17, CSR27, CSR50, CSR52 and S8) and six dumbbell breeds (CSR4, CSR6, CSR16, CSR26, CSR51 and CSR53) were selected as recurrent bivoltine parental breeds and two bivoltine parents [MASN 6 (oval), 5N (dumbbell)] were selected as donor parents.

Lines Development: Using above parental breeds, twelve breeding lines (oval x oval and dumbbell x dumbbell) were prepared by crossing the recurrent and donor bivoltine parental breeds. The second moult larvae of the breeding lines, CSR2N, CSR4N, CSR6N, CSR16N, CSR17N, CSR26N, CSR27N, CSR50N, CSR51N, CSR52N, CSR53N and S8N were exposed for BmNPV inoculation at the dose of $2x10^6$ PIB/ml/100 larvae. The selected progenies were back crossed with respective recurrent parents and BC_1 population raised. During 2^{nd} moult BC1 progenies were again exposed to BmNPV inoculums. The batch with high survival were selected and continued. Back crossing was continued from BC1 to BC6, followed by inbreeding for two generations ($BC6S_1$ – $BC6S_2$) for isolating homozygous lines. Using above technique 12 *Bm*NPV tolerant bivoltine breeds (CSR2N, CSR4N, CSRN6, CSR16N, CSR17N, CSR26N, CSR27N, CSR50N, CSR51N, CSR52N, CSR53N and S8N) were developed.

Hybridization programme: Further based on survival, two oval breeds viz., CSR52N, S8N and three dumbbell breeds viz., CSR6N, CSR16N and CSR26N were selected for preparation of F1 hybrids.

Evaluation of single hybrid: Six F1 hybrids, CSR52N x CSR6N, CSR52N x CSR16N, CSR52N x CSR26N, S8N x CSR6N, S8N x CSR16N and S8N x CSR26N were prepared by utilizing the selected parental breeds and evaluated. The popular hybrid, CSR2 x CSR4 was used as control hybrid. The important parameters that govern silk quality and quantity such as fecundity, pupation, cocoon yield, cocoon weight, shell weight, shell percentage, reelability, filament length, raw silk percentage, filament size and neatness were considered.

Data was subjected to multiple trait evaluation index for selection of better performing hybrids. The hybrid CSR52N x CSR26N was found best (64.5) followed by the hybrid S8N x CSR16 (55.7). The cocoon uniformity in terms of standard deviation (SD±) calculated based on the length and breadth ranged from 6.75 (CSR52N x CSR26N) to 8.52 (CSR2 x CSR4). The cocoon uniformity (SD±) less than 8, which is a target for selection of hybrid for commercial purpose.

Evaluation of double hybrid: Three double hybrids viz., (CSR52N x S8N) x (CSR6N x CSR16N), (CSR52N x S8N x (CSR6N x CSR26N) and (CSR52N x S8N) x (CSR16N x CSR26N), were prepared by utilizing one oval FC and four dumbbell FC and evaluated. The popular hybrid FC1 x FC2 served as control. The important parameters that govern silk quality and quantity were recorded. All these hybrids were evaluated by multiple trait evaluation index. The maximum index of 58.5 was obtained for the hybrid, **(CSR52N x S8N) x (CSR16N x CSR26N)** followed by the hybrid **(CSR52N x S8N) x (CSR6N x CSR16N)** (54.5). The cocoon uniformity in terms of standard deviation (SD±) calculated based on the length and breadth ranged from 6.5 **(CSR52N x S8N) x (CSR16N x CSR26N)** to 7.52 **(CSR52N x S8N x (CSR6N x CSR26N)** however, the cocoon uniformity (SD±) < 8 is a target for selection of hybrid for commercial utilization.

Verification of tolerance: Further, these selected breeds were reared under normal conditions and also challenged with *Bm*NPV in 15^{th} generation after development to understand their tolerance level. 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. Upon successful performance, the hybrid was tested for on station trial at RSRSs.

On Station Trial (OST) of hybrids: The identified single hybrid (CSR52N x CSR26N) and double hybrid, (CSR52N x S8N) x (CSR16N x CSR26N) was subjected to OST at four RSRSs (Anantapur, Salem, Kodathi and Chamarajanagar) of CSRTI. 10 dfls each of hybrid along with control, FC1 x FC2 was evaluated. At RSRS-Kodathi three crops were conducted during summer and rainy season. At RSRS-Salem, Anantapur and Chamarajanagara, two crops each were conducted during summer and rainy season. Mean of nine trials revealed (CSR2N x S8N) x (16N x 26N) was better and showed yield improvement of 12% over control and in single hybrid CSR52N x 26N revealed only 2% yield improvement over control.

Conclusion: Based on rearing and reeling and OST performance, double hybrid (CSR2N x S8N) x (16N x 26N) was found better and it could be recommended for field trial at farmers' level. It could also be reared during unfavourable seasons.

Survival of breeding lines exposed to NPV BmNPV inoculation of 2 x 10^6 spores/ml/100 larvae		
Line	BC1	BC6S2
Oval lines		
CSR2N	36	43.0
CSR17N	46	52.0
CSR27N	38	42.0
CSR50N	30	36.0
CSR52N	52	71.0
S8N	50	76.0
Dumbbell lines		
CSR4N	43	52.0
CSR6N	42	61.0
CSR16N	44	68.0
CSR26N	45	67.0
CSR51N	31	42.0
CSR53N	32	43.0

Performance of single hybrids										
Hybrids	Pupa-tion (%)	Coc. yield (Kg)	Coc. wt. (g)	Shell wt. (g)	Shell (%)	Reel (%)	Fil. length (m)	Raw silk (%)	Denier	Neat-ness
CSR52N x CSR6N	94.1	17.9	1.902	0.434	22.8	86	975	17.7	2.8	94
CSR52N x CSR16N	93.2	17.7	1.895	0.428	22.6	88	1002	18.6	2.9	95
CSR52N x CSR26N	96.9	18.9	1.955	0.465	23.8	89	1020	19.2	2.8	96
S8N x CSR6N	94.2	17.8	1.885	0.430	22.8	85	985	18.1	2.8	95
S8N x CSR16N	96.5	18.7	1.942	0.458	23.6	88	1046	18.8	2.7	94
S8N x CSR26N	95.2	18.2	1.916	0.429	22.4	87	1100	19.3	2.9	96
CSR2 x CSR4 (Control)	95.2	18.0	1.892	0.439	23.2	86	950	18.6	2.7	95
Mean	95.04	18.17	1.91	0.44	23.0	87	1011	184	2.8	95
SD	1.3	0.5	0.03	0.02	0.5	2.0	86	0.7	0.08	0.08
CD at 5%	1.6	1.34	0.08	0.026	1.0	ns	65	1.1	ns	ns

Performance of double hybrids											
Hybrid	Pupa-tion (%)	Coc. yield (kg)	Coc. wt. (g)	Shell wt. (g)	Shell (%)	Reel-ability (%)	Fila-ment Length (ml)	Raw silk (%)	Denier	Neat-ness	EI
(CSR52N x S8N) x (CSR6N x CSR16N)	95.2	18.6	1.95	0.439	22.5	88	1022	18.2	2.98	94	54.5
(CSR52N x S8N x (CSR6N x CSR26N)	94.3	18.8	1.99	0.446	22.4	87	975	17.9	3.00	94	52.0
(CSR52N x S8N) x (CSR16N x CSR26N)	96.3	20.0	2.08	0.489	23.5	89	1075	19.2	2.89	96	58.0
(CSR6 x CSR26) x (CSR2 x 27) (Control)	96.1	19.0	1.98	0.451	22.8	87	1005	18.9	2.97	95	53.5
Mean	95.48	19.10	2.00	0.4563	22.80	87.75	1019	18.55	2.96	94.7	54.5
SD	0.92	0.62	0.06	0.02	0.50	0.96	41.94	0.60	0.05	0.96	2.55

Performance of selected parents challenged with *Bm*NPV (15th Gen.)						
Breeds	Pupation %	Yield/10000 larvae (No)	Yield/10000 larvae (wt.kg)	SCW (g)	SSW (g)	Shell %
CSR52N	56±1.0	5600±20	8.235±0.17	1.528±0.01	0.324±0.02	21.2±0.60
CSR8N	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

On Station Trial of hybrids at RSRS-Kodathi								
Hybrid	Date of Brushing	Fec. (no.)	Yield/ 10000 larvae (no.)	Yield/ 10000 larvae (wt.kg)	Yld/ 100 dfls (kg)	SCW (g)	SSW (g)	Shell %
CSR52N x S8N) x (CSR16N x CSR26N)	Summer (Mar. 2018)	603	8752	14.10	70.00	1.639	0.38	23.18
	Summer (May 2018)	624	9050	15.74	78.10	1.745	0.397	22.75
	Rainy (Aug. 2018)	653	8950	15.25	76.25	1.705	0.396	23.23
	Average	627	8917	15.03	74.78	1.696	0.391	23.05
CSR52N x CSR26N	Summer (Mar. 2018)	612	8520	13.65	68.00	1.602	0.362	22.59
	Summer (May18)	592	8650	14.05	70.25	1.627	0.354	21.75
	Rainy (Aug. 2018)	553	8600	14.00	70.00	1.639	0.36	21.96
	Average	586	8590	13.90	69.42	1.623	0.359	22.1
FC1 x FC2 (Control)	Summer (Mar. 2018)	658	8210	13.34	66.70	1.625	0.381	23.45
	Summer (May 2018)	633	8100	13.60	68.00	1.720	0.385	22.38
	Rainy (Aug. 2018)	650	8350	14.10	70.50	1.712	0.387	22.61
	Average	647	8220	13.68	68.40	1.686	0.384	22.81

On Station Trial of hybrids at RSRS-Chamarajanagar								
Hybrid	Date of Brushing	Fec (no.)	Yield/ 10000 larvae (no.)	Yield/10000 larvae (wt.kg)	Yld/100 dfls (kg)	SCW (g)	SSW (g)	Shell (%)
CSR52N x S8N) x (CSR16N x CSR26N)	Summer (Apr.20 18)	625	8252	12.30	61.50	1.439	0.326	22.65
	Rainy (Aug. 2018)	585	8720	14.12	70..60	1.645	0.365	22.18
	Average	605	8486	13.21	61.50	1.542	0.346	22.415
CSR52N x CSR26N	Summer (April 2018)	524	7623	10.65	53.25	1.418	0.308	21.72
	Rainy (Aug. 2018)	495	8250	12.60	63.00	1.527	0.314	20.56
	Average	510	7937	11.625	58.13	1.473	0.311	21.14
FC1 x FC2 (Control)	Summer (April 2018)	639	7025	9.650	48.25	1.418	0.323	22.77
	Rainy (Aug. 2018)	656	8200	13.10	65.50	1.598	0.316	21..97
	Average	648	7613	11.375	56.88	1.508	0.32	22.77

On Station Trial of hybrids at RSRS Anantapur								
Hybrid	Date of Brushing	Fec. (no.)	Yield/10000 larvae (no.)	Yield/10000 larvae (wt.kg)	Yld/100 dfls (kg)	SCW (g)	SSW (g)	Shell (%)
CSR52N x S8N) x (CSR16N x CSR26N)	Summer (Apr. 2018)	603	8325	13.50	67.00	1.629	0.348	21.36
	Rainy (Aug. 2018)	628	7945	12.10	60.50	1.525	0.342	21.04
	Average	615.5	8135	12.8	63.75	1.577	0.345	21.2
CSR52N x CSR26N	Summer (Apr. 2018)	610	7052	10.55	52.75	1.512	0.318	21.03
	Rainy (Aug. 2018)	592	7350	10.5	52.50	1.427	0.312	21.86
	Average	601	7201	10.525	52.63	1.47	0.315	21.45
FC1 x FC2 (Control)	Summer (Apr. 2018)	659	7225	11.9	59.55	1.650	0.348	21.09
	Rainy (Aug. 2018)	661	7032	10.60	53.00	1.508	0.335	22.22
	Average	660	7129	11.25	56.28	1.579	0.342	21.66

On Station Trial of hybrids at RSRS-Salem								
Hybrid	Date of Brushing	Fec. (no.)	Yield/10000 larvae (no.)	Yield/10000 larvae (wt.kg)	Yld/100 dfls (kg)	SCW (g)	SSW (g)	Shell (%)
(CSR52N x S8N) x (CSR16N x CSR26N)	Summer (Mar. 2018)	625	8522	12.75	63.75	1.503	0.339	22.55
	Rainy (Aug. 2018)	644	8369	12.30	61.50	1.478	0.323	21.85
	Average	634	8446	12.53	62.63	1.491	0.331	22.2
CSR52N x CSR26N	Summer (Mar. 2018)	580	7525	10.65	53.25	1.445	0.312	21.59
	Rainy (Aug. 2018)	537	7365	10.35	51.75	1.398	0.264	21.15
	Average	559	7445	10.50	52.50	1.422	0.288	21.37
FC1 x FC2 (Control)	Summer (Mar. 2018)	638	7623	11.57	57.85	1.518	0.342	22.52
	Rainy (Aug. 2018)	659	7090	10.12	50.60	1.438	0.316	21..97
	Average	648.5	7357	10.85	54.23	1.478	0.329	22.52

Performance of hybrids in RSRSs (Mean of nine trials)								
Hybrid	Fec. (no.)	Yield/10000 larvae (no.)	Yield/10000 larvae (wt.kg)	Yld/100 dfls (kg)	SCW (g)	SSW (g)	Shell (%)	% yield impr.
CSR2N x S8N) x (16N x 26N)	620	8496	13.391	66.48	1.576	0.354	22.42	12.0
CSR52N x 26N	564	7793	11.638	60.25	1.497	0.318	21.51	2.0
FC1 x FC2	651	7579	11.788	58.94	1.563	0.344	22.43	-
Mean	610	8047	12.5	62.10	1.556	0.342	22.04	-
SD	44	619	1.66	8.35	0.11	0.03	0.77	-
CD at 5%	*	*	ns	*	ns	ns	*	-

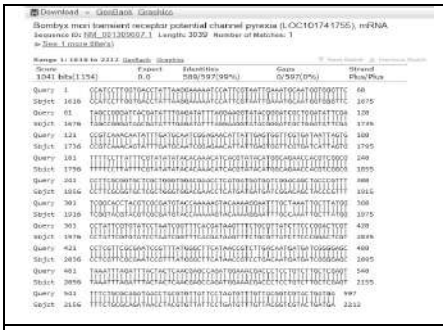
Pilot project: Development of Hygro-tolerant bivoltine breeds/hybrids through molecular marker assisted selection (Pilot project approved by CSB) (Aug. 2017- Jul. 2018)

Madhusudan K N, Ranjini M S and Manthira Moorthy S

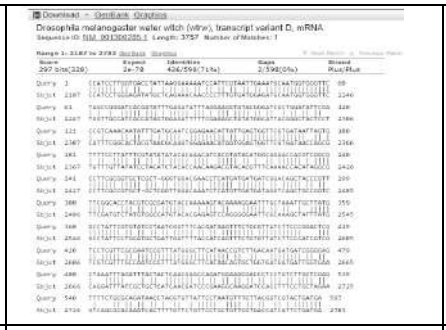
Objectives:

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

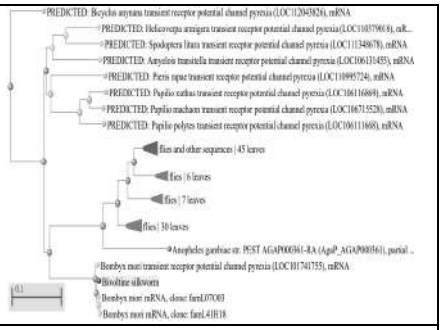
Isolation of genomic DNA and screening of TRP and Ionotropic receptor family genes was carried out. PCR amplification revealed a band size of TRP Pyrexia and Ionotropic receptor 25a was 597bp and 428bp respectively. PCR products were sequenced and analysed using bioinformatics tools.



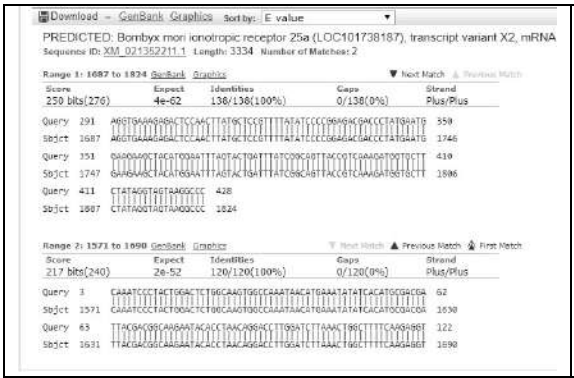
Blast result of TRP Pyrexia of bivoltine silkworm breed and *B.mori* available reference sequence



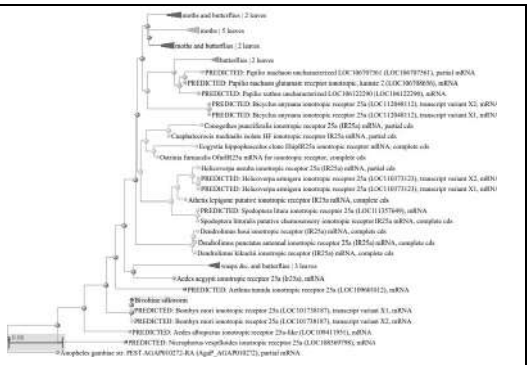
Blast result of TRP Pyrexia of bivoltine silk worm breed and *D.melanogaster water witch.*



Neighbour joining tree for TRP-Pyrexia gene sequence



Blast result of Ionotropic receptor 25a of bivoltine silkworm breed and *B.mori* available reference sequence

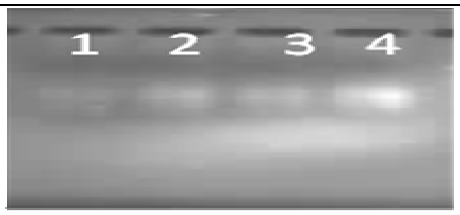


Neighbour joining tree for Ionotropic receptor 25 agene sequence

The blast result of TRP Pyrexia depicted the identity of obtained sequence with available reference gene sequence of *B.mori* which is 589 base pairs out of 597 base pairs. It also showed 71% identity with the *Drosophila melanogaster water witch* gene which is related to be involved in sensing wet air i.e., high humidity. The blast result of Ionotropic receptor 25a depicted the identity of obtained sequence with available reference gene sequence of *B.mori* which is 258bp only, however, the PCR band and the sequence obtained were 428bp. Hence, the IR25a gene has not been taken up for the further analysis. The NJ tree of both the genes supported that the genes show similarities with flies, other moths, butterflies, mosquitoes and other sequences however with varying degrees of divergence. These results helped to further carry out semi-quantitative RT PCR for pyrexia gene in both humidity exposed and control samples which can be used for high relative humidity sensing marker.

Semi quantitative Reverse Transcription PCR of pyrexia gene

Total mRNA isolation was carried out. The mRNA was converted to cDNA and the variation in the differential expression of Pyrexia gene was carried out by using RT-PCR. The more level of transcript accumulation of Pyrexia gene was noticed in RT-PCR. The densitometric analysis of the electrophoresed gel also confirms the more density in the pyrexia gene bands in relative humidity exposed larval samples in comparison with control ones.



Variation in expression profile of Pyrexia gene from control and relative humidity exposed silkworms. (1:Control 24h, 2:Control 48h, 3:RH 24h,4:RH48h)

Conclusion: Exposure of silkworm to high relative humidity results in the reduction in cocoon characters. The Pyrexia gene can be used as potential candidate gene for identifying high humidity sensing in silkworm. The blast result of TRP Pyrexia indicating 71% of identity with the *waterwitch* gene of *D. melanogaster* which has been reported in sensing wet air i.e., high humidity. Based on the output of the present project, further breeding programmes can be initiated for

development of hygrotolerant bivoltine breeds/hybrids through Molecular Assisted Selection (MAS) that can sustain varying RH conditions throughout its life cycle which ultimately helps in production of quality silk.

Ongoing Research Projects

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

Manthira Moorthy S, Paramesh (JRF), Sivaprasad V and Teotia R S

Objectives:

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

Silkworm genetic resources obtained from Bulgaria (Kom-2, CV-1071-2, ShV, Vr2012 and JH4) were evaluated in laboratory and maintained by following appropriate procedures. These breeds showed true characteristics and rearing performance revealed cocoon weight (g) of 1.578 to 1.752 and shell % of 23.45 to 24.42. These genetic resources (GRs) along with Indian GRs were utilized for new line development and also utilized in direct hybridization programme to develop double hybrid with high silk content. In first approach, Bulgarian genotypes were crossed with adaptive Indian genotypes from which ten new oval and six dumbbell lines are under development. Presently, these lines are in F5-F8 generation. Among the oval lines BMO2, BMO9 and BMO10 showed better shell % > 24% and among the dumbbell lines BMD1, BMD2 and BMD5 shown better shell % of > 23%.

In the second approach, 110 double hybrids were prepared by using seven Bulgarian genotypes (including 3 sub lines) and sixteen Indian genotypes. These combinations were reared in three seasons. Data obtained were subjected to evaluation index, of which BFC1 x BFC10 was found best with EI value of 59 with 24.41 shell% and renditta of 5.5 followed by BFC1 x BFC12 with EI value of 56 with shell % of 23.3 with renditta of 6.0. Further evaluation of new hybrid combinations are under progress.

Rearing performance of Bulgarian silkworm genetic resources						
Breeds	Fec. (no.)	Yield/10000 larvae (no.)	Yield/10000 larvae (wt.kg)	SCW (g)	SSW (g)	Shell (%)
KOM-2	545±18	9400±150	15.125 ±0.23	1.752±0.012	0.410 ±0.011	23.45±0.32
CV10712	538±35	9250±50	15.324±0.29	1.698±0.025	0.411±0.010	24.15±0.28
JH4	550±20	9150±120	15.204±0.32	1.709±0.23	0.409±0.012	23.93±0.16
ShV	532±23	9250±50	15.759±0.24	1.712±0.017	0.418±0.020	24.42±0.29
Vr 2012	513±29	8300±90	14.856±0.29	1.578±0.21	0.384±0.016	24.30±0.12

Rearing performance of new lines						
Lines / Generation	Fec. (no.)	Yield/ 10000 larvae (no.)	Yield/10000 larvae (wt.kg)	SCW (g)	SSW (g)	Shell (%)
Oval lines						
BMO1(F_8)	585	9151	14.36	1.653	0.395	23.87
BMO2((F_8)	565	8742	13.43	1.624	0.393	24.22
BMO3(F_6)	573	9129	14.02	1.601	0.382	23.84
BMO4(F_6)	562	9057	14.60	1.620	0.384	23.70
BMO5(F_6)	523	9000	14.25	1.554	0.336	21.62
BMO6(F_6)	542	8900	14.65	1.587	0.356	22.43
BMO7(F_6)	550	8750	14.20	1.591	0.365	22.94
BMO8(F_5)	503	8800	14.74	1.617	0.356	22.02

BMO9(F_5)	539	8950	14.32	1.600	0.388	24.25
BMO10(F_5)	555	9200	14.53	1.589	0.385	24.23
Dumbbell lines						
BMD1(F_8)	516	8669	13.30	1.603	0.378	23.58
BMD2(F_8)	520	8812	13.10	1.52	0.352	23.16
BMD3(F_6)	512	8677	13.14	1.569	0.345	21.99
BMD4(F_6)	504	9200	14.20	1.609	0.356	22.13
BMD5(F_5)	509	9000	13.84	1.518	0.35	23.06
BMD6(F_5)	515	8900	13.64	1.525	0.348	22.82

Performance of new double hybrids										
Hybrids	Yield/ 10000 larvae (no.)	Yield/ 10000 larvae (wt.kg)	SCW (g)	Shell (%)	Reelability (%)	FL (m)	Denier	Renditta	Neatness	Evaluation Index
BFC1 x 10	8950	18.26	1.852	24.41	92.59	1120	2.79	5.50	94	59.38
BFC1 x 12	9250	16.65	1.744	24.31	92.59	958	2.98	6.00	94	56.31
BFC5 x 12	9200	16.25	1.757	24.30	92.59	1035	2.71	5.75	94	56.29
BFC7 x 10	8950	17.65	1.902	23.76	92.59	912	3.18	6.00	94	56.02
BFC7 x 11	9250	17.00	1.773	24.03	92.59	980	2.79	6.25	94	55.82
BFC9 x 12	9250	16.54	1.731	24.57	90.00	991	2.94	6.50	94	55.22
BFC9 x 15	9200	16.39	1.753	24.30	92.59	956	2.98	6.25	94	54.79
BFC20 x 16	9200	17.85	1.855	22.70	89.00	775	3.36	6.53	94	54.14
BFC21 x12	9000	18.00	1.935	22.32	92.59	874	3.58	5.76	94	54.03
BFC23 x 10	9200	16.54	1.748	24.31	92.59	985	2.89	6.00	93	53.05
FC1 x FC2 (control)	8900	15.25	1.725	22.25	90.0	985	2.95	6.2	92	
Mean	9122	17.01	1.820	22.82	91.91	825	3.01	7.01	93	
SD	141	0.98	0.101	1.08	0.97	108	0.25	1.03	0.71	

Inter-Institutional Collaborative Project

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

Coordinator: Sivaprasad V

Investigators: Manthira Moorthy S and Mohan B

Objective: To evaluate crossbreed and bivoltine hybrids utilizing MASN lines

Three MASN lines viz., MASN4, MASN6, MASN7 were evaluated in four RSRSs of CSRTI-Mysuru and MASN4 was found better among three lines. After identification, MASN4 was multiplied at CSRTI- Mysuru and SSBS-Coonoor. The P1 seed of MASN4 and CSR4 were prepared and was supplied to NSSO for raising seed cocoons to prepare MASN hybrids. A total of 1100 dfls of MASN4 and 600 dfls of CSR4 were supplied to NSSO and 109450 dfls of MASN4 x CSR4 and 72000 dfls of PM x MASN4 were prepared by SSPC-Chintamani. Also P1 seed cocoons of Nistari was also raised at CSRTI-Mysuru and supplied to SSPC-Chintamani to prepare Nistari x MASN4 hybrid for supplying to Eastern India. PM x MASN4 was evaluated among the farmers of South India and MASN4 x CSR4 was evaluated among the farmers of Northern and Eastern India. Evaluation of MASN4 x CSR4 in Southern India is under progress.

Performance of PM x MASN4 in field							
State	Hybrid	No. of dfls	No. of farmers	Yield / 100 dfls (kg)	Cocoon weight (g)	Shell weight (g)	Shell (%)
Karnataka	PM x MASN4	59000	108	54.0	1.658	0.299	18.03
Andhra Pradesh	PM x MASN4	4500	13	62.09	1.712	0.315	18.39
Avg/ Total	PM x MASN4	63500	121	58.0	1.685	0.307	18.2
Karnataka	PM x CSR2	3500	18	66.0	1.752	0.319	18.20
Andhra Pradesh	PM x CSR2	4350	15	58.2	1.76	0.323	18.37
Avg/ Total	PM x CSR2	7850	33	62.1	1.756	0.321	18.28

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 - Nov. 2020)

Manthira Moorthy S, Kusuma L, Sumathy, Bindhya (JRF) and Vidya Niranjan (RVCE-Bangalore)

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

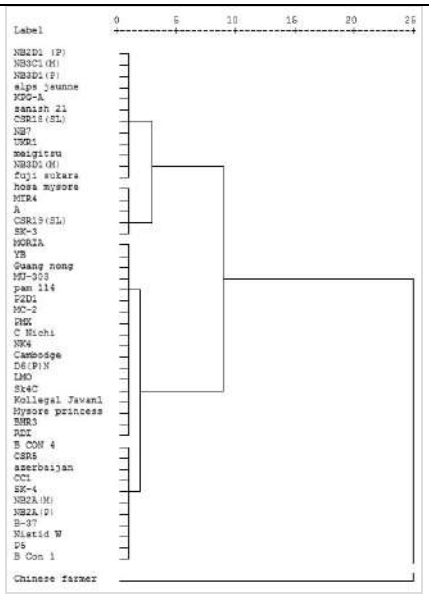
Genome Wide Association Studies (GWAS) have been widely used to identify Quantitative Trait Loci (QTL) underlying quantitative traits. Association mapping identifies QTL based on the historic recombination in a panel of diverse germplasm via the presence of linkage dis-equilibrium (LD) between Single Nucleotide Polymorphism (SNPs) and QTL. The project has two components; 1) Collection of diverse genotypes and their phenotyping for qualitative and quantitative traits and 2) SNP genotyping by GBS and GWAS for economically important traits. Accordingly, 100 diverse silkworm genotypes (60 bivoltine & 40 multivoltine), were collected from different sericulture R&D Institutes of India (CSRTI-Mysuru, CSRTI-Berhampore, CSRTI-Pampore; CSGRC-Hosur; APSSRDI-Hindupur and KSSRDI-Thalaghattapura) were reared and maintained. These genotypes were subjected for phenotyping for five qualitative traits (egg colour, larval colour, larval marking, cocoon colour and shape) and ten quantitative traits [survival% (pupation%), cocoon weight, shell weight, thermo tolerance, disease tolerance (NPV), filament length; reelability %; raw silk %; neatness, evenness]

Phenotyping was carried out for three cycles (generations) in order to obtain higher homozygosity within the genotype and individuals/ progenies were selected based on phenotype data and taken for next generation rearing. Data thus obtained (three cycles) were subjected to ANOVA, frequency distribution and hierarchical clustering. Analysis of variance revealed significant variation among the genotypes for the characters studied. Pupation (survival) ranged from 55 – 97%, cocoon weight (0.850 – 1.752 g), shell weight (0.099 – 0.389 g), thermotolerance (10 – 87 %), NPV tolerance (6 – 80 %), filament length (252 – 863 m), reelability (70 – 88 %), raw silk (7 – 13 %), neatness (75 – 90) and evenness (70 – 85) were observed among the genotypes signifying the wide variability.

After phenotyping for three cycles, DNA isolated from 100 genotypes were purified, quantified and will be subjected for SNP genotyping.

Genotype collected from different Institutions		
Institute	Multivoltine	Bivoltine
CSRTI-Mysuru	14	12
CSRTI-Berhampore	12	14
CSRTI-Pampore	-	14
CSGRC- Hosur	12	15
KSSRDI-Thalaghattapura	-	2
APSSRDI-Hindupur	2	3

Analysis of phenotyping of 100 genotypes					
Characters	Min	Max	Mean	SD	CD at 5%
Survival (%)	55.0	97.0	82.75	9.82	0.15
Cocoon weight (g)	0.850	1.752	1.307	0.211	0.12
Shell weight (g)	0.099	0.389	0.248	0.0671	0.20
Thermo tolerance	10.0	87.0	52.5	15.47	0.47
Disease tolerance (NPV)	6.0	80.0	49.75	17.072	0.69
Filament length (m)	252	863	558	226.20	0.51
Reelability (%)	70.0	88.0	76.0	9.15	0.14
Raw silk (%)	7.0	13.0	9.385	2.56	0.16
Neatness	75.0	90.0	77.42	3.101	0.12
Evenness	70.0	85.0	78.57	6.241	0.10



Dendrogram of 100 genotypes based on ten quantitative traits

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

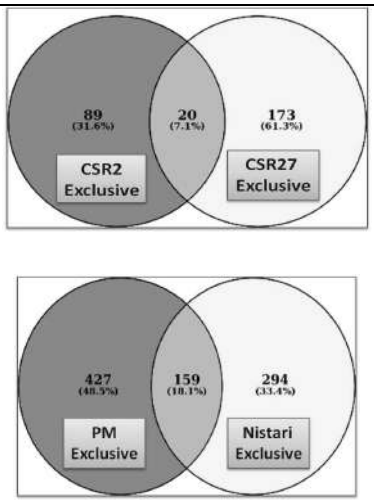
Kusuma L, Kishor Kumar C M, Manthira Moorthy S and Chandrashekar M N

Objectives:

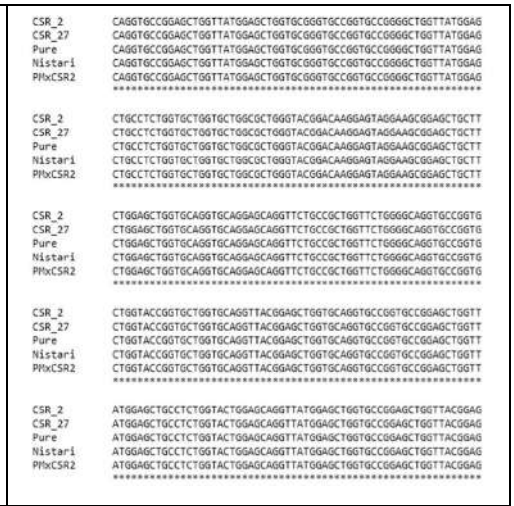
- To carry out transcriptome analysis of silk gland in mulberry silkworm breeds for identification of markers for silk quality
- To analyze important trait related gene pathways in silkworm and establish gene-gene and gene-protein interaction pathway

Transcriptome sequence analysis with reference to differentially expressed genes and its annotation was carried out for CSR2 vs PM x CSR2, PM vs PM x CSR2, and CSR27 vs Nistari. The log2 transformed fold change values i.e., log2FC were used for correlating the upregulated and downregulated genes. The criterion used to identify upregulated and downregulated genes is that if the log2FC > 0 it is considered upregulated whereas if the log2FC < 0 it is considers as downregulated. Among 109 genes found to be exclusively expressed in CSR27 two newer transcripts were identified

which showed similarities with fibroin heavy chain like transcript. A total of 586 genes were found exclusively expressed in Nistari some of which include transcription elongation factor, transcription initiation factor, etc. The transcripts of all five samples (CSR2, CSR27, PM, Nistari and PM x CSR2) were compared to understand percent identity and shared transcripts. Results indicated that in comparison between CSR2 and CSR27, there were 7.1% shared genes whereas CSR2 had 31.6% exclusive genes and CSR27 revealed 61.3% exclusive genes. In comparison with PM vs Nistari sharing of genes was 18.1% whereas PM hosted 48.5% exclusive genes and Nistari, 33.4%.



Venn diagram representing the number of shared and exclusively expressed transcripts

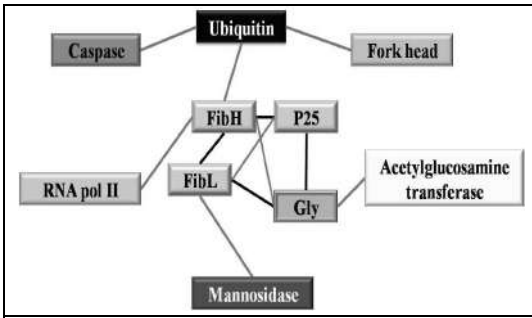


Fib-H sequence compared among the five samples under study

Mapped genes from present analysis showed their involvement in metabolism, genetic information processing, environmental information processing and cellular processes. Based on the bioinformatics analysis of the gene-protein and protein-protein interactions, a few potential candidate genes like RNA poly II, mannosidase, *Ubi1* have been identified as key players, which are likely to influence the fibroin synthesis pathway and silk quality. Further, comparative analysis of transcript sequences fibroin H, fibroin L and fibrohexamerin among all the five samples was carried out to check the variants. Identification of the transcript variants (SNPs) was carried out using transcript variant calling (GATK calling structured programming framework of variants like SNPs, indels, etc.). The results recorded 6787 SNPs for CSR2, CSR27 (8314), PM (7771), Nistari (7493) and PM x CSR2 (8314).

Functional annotation of novel transcripts and isoforms was carried and identified 55 different isoforms showing similarities with *Fibroin H* and 210 *B. mori Sericin-1 like* (LOC101740082) variants. From the present investigations, RNA poly II, mannosidase, *Ubi1* have been identified as potential regulators involved in silk fibroin synthesis, which would influence the fibroin synthesis pathway and silk quality and is thus, represented in the Fig. 3. The transcripts identified were further subjected for classifying into functional groups by using text mining technique, which is in accordance with the expression patterns of the genes. Variant analysis is under progress. Transcript data has been submitted to NCBI and accession have been obtained - CSR2 (SRR8816550), CSR27 (SRR8816551), PM (SRR8816552), Nistari (SRR8816553) and PM X CSR2 (SRR8816554).

SNPs identified among the sample	
Sample	Number of SNPs
CSR2	6787
CSR27	8314
PM	7771
Nistari	7493
PM x CSR2	9864



Representation of the probable interactions of identified regulators in fibroin synthesis

Expression pattern of regulators involved in fibroin synthesis among comparison set in the present analysis (UR: Up Regulated; DR: Down Regulated)						
Regulators	CSR2 vs KG		CSR2 vs PM		CSR27 vs Nistari	
	UR	DR	UR	DR	UR	DR
Caspase		✓	✓		×	×
Ubiquitin		✓		✓	✓	
RNA Pol II	✓		✓		×	×
RNA Pol III		✓		✓	×	×
Mannosidase					✓	
Acetyl glucosamine					×	×

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 – Sept. 2020)

Satish L, Kusuma L, Manthira Moorthy S 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.

Base populations resistant/tolerant individually to BmDNV1, BmIFV & BmNPV were short listed and reared for pyramiding virus tolerance genes and also improvement of productivity in viral diseases tolerant lines. 6 Oval lines (resistant for BmDNV1) with good shell weight were crossed with 3 Dumbbell lines (resistance for BmNPV and BmIFV) with good survivability percentage. 18 hybrids and 9 parents were reared and inoculated each with BmDNV1, BmIFV and BmNPV. The rearing performance with survival percentage and cocoon assessment of each line was recorded. Simultaneously, the breed performance under different seasons with different viral inoculum concentrations was also done. All these rearings were performed without using any bed disinfectants. The lines that are tolerant to BmDNV1, BmIFV and BmNPV were shortlisted after directional selection. Molecular screening with specific SCAR markers for BmDNV1 and BmNPV was carried out for selecting tolerant/resistant breeds. SDS-PAGE analysis was performed for BmIFV tolerant breeds. The potential characteristics with respect to pre and post cocoon parameters were also analyzed. Based on the results, few promising bivoltine breeds (oval and dumbbell) were short listed and used further in developing productive multi viral tolerant/ resistant breeds/hybrids. The identified hybrids will be selected for OST/OFT rearing.

AIB-01002 MI: Evaluation of S8 x CSR16, a new bivoltine hybrid under authorization trials among the farmers of South India (Jul. 2018 – Jun. 2020)

Kishor Kumar C M, Meenal R, Shivakumar Hukkeri M, Shashindran Nair, Shankara and Sivaprasad V

Objective: To evaluate the field performance of newly evolved bivoltine hybrid, S8 x CSR16 for productivity and silk quality

Large scale evaluation of newly identified bivoltine single hybrid, S8 X CSR16 was undertaken with the farmers of South India. A total of 121350 dfls were distributed to about 555 farmers covering Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra. The hybrid has shown promising results and recorded an overall average cocoon yield of 68.9 Kgs / 100 dfls. The average cocoon yield of 73.7, 55.6, 69.9 and 60.1 Kgs / 100 dfls was recorded in Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra respectively. The corresponding control data of popular FC1 x FC2 recorded an average cocoon yield of about 67.7 Kgs / 100 dfls. The details of performance of the hybrid are given below.

Performance of S8 x CSR16 under large scale evaluation in south India					
State	Dfls (no.)	No. of farmers	Coc. harvested (Kg)	Yield / 100 dfls (Kg)	FC1 x FC2* 100 dfls (Kg)
Karnataka	55950	253	41259	73.7	67.5*
Andhra Pradesh	22000	112	12229	55.6	67.6
Tamil Nadu	47600	184	28920	69.9	73.6
Maharashtra	2000	6	1202	60.1	62.0
Total/Avg.	121350	555	83610	68.9	67.7
* Data of control hybrid taken from CPP Bangarpet, Karnataka for respective crop months					

Continuous/ Other Activities:

Maintenance of bivoltine genetic resources

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

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. (no.)	Pupation rate (%)	Cocoon wt. (g)	Shell ratio (%)	Fil. length (m)	Raw silk (%)	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	CSR52 CSR53 S8 D2	>500	>90	>1.60-1.80	>22-23	>900	>15.0	2.7-3.0

	CSR50 CSR51	NB1							
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 assisted 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

SATELLITE SILKWORM BREEDING STATION - COONOOR

Mohan B

Maintenance of bivoltine silkworm germplasm stocks

Maintenance of 35 breeder's stock germplasm viz., CNR3, CNR4, CNR5, CNR15, SLD1, SLD8, SLD9, D1, D2, D11, D13, D15, D17, SSBS2, SSB3, SSBS4, SSBS5, SSBS6, SSBS7, SSBS8, SSBS9, SSBS10, SSBS11, SSBS12, SSBS16, SSBS17, CSR2, CSR4, CSR6, CSR16, CSR26, CSR27, CSR51, CSR202, CSR204 was carried out through rearing and the racial characters of each line was confirmed during characterisation and important rearing parameters were recorded. All the stocks were found true-to-type for the parameters and no significant deviation was found. After cocoon characterisation and stringent moth examination for pebrine, the dfls were conserved for further rearing. The rearing performance is tabulated below.

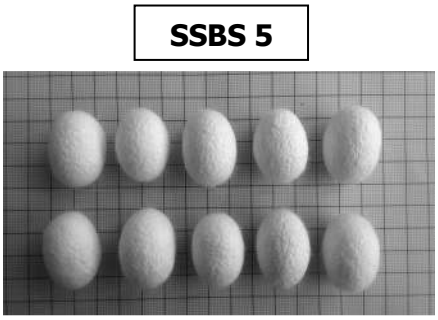
Rearing performance of bivoltine silkworm germplasm stocks

Race	Fecundity (no.)	Pupation (%)	Avg. cocoon wt. (g)	Avg. shell wt. (g)	Avg. SR (%)
CNR3	511	97.8	1.499	0.305	20.360
CNR4	528	97.5	1.552	0.346	22.325
CNR5	589	97.5	1.680	0.370	22.015
CNR15	541	97.8	1.530	0.335	21.873
SLD1	591	93.8	1.482	0.336	22.655
SLD8	539	95.2	1.521	0.340	22.346
SLD9	516	98.9	1.641	0.340	20.745
SSBS2	588	98.1	1.639	0.371	22.626
SSBS3	571	98.0	1.605	0.376	23.419
SSBS4	652	94.7	1.580	0.336	21.257
SSBS5	571	96.2	1.544	0.366	23.669
SSBS6	556	97.9	1.534	0.357	23.242
SSBS7	560	97.5	1.550	0.350	22.608
SSBS8	569	96.8	1.596	0.377	23.634
SSBS9	574	96.7	1.662	0.384	23.124
SSBS10	581	96.4	1.526	0.358	23.453
SSBS11	601	97.6	1.554	0.346	22.253
SSBS12	548	98.1	1.635	0.366	22.403
SSBS16	551	98.8	1.504	0.333	22.137
SSBS17	548	98.7	1.370	0.283	20.685
D1	533	97.4	1.513	0.349	23.054
D2	524	97.9	1.496	0.321	21.446
D11	598	98.9	1.393	0.295	21.140
D13	548	83.3	1.355	0.275	20.322
D15	536	97.5	1.349	0.278	20.593
D17	509	94.9	1.438	0.307	21.356
CSR2	523	97.5	1.513	0.320	21.136
CSR4	516	97.7	1.508	0.321	21.311
CSR6	588	96.5	1.491	0.303	20.339
CSR16	568	99.1	1.470	0.298	20.299
CSR26	618	98.8	1.418	0.295	20.804
CSR27	627	98.2	1.391	0.339	24.364
CSR51	554	97.2	1.391	0.295	21.209

CSR202	469	97.2	1.296	0.283	21.845
CSR204	468	92.3	1.542	0.356	23.085

Evaluation of new bivoltine silkworm double hybrid, SSBS 5 x SSBS 6 at farmers' level (Proposal submitted to CSB and approved for small scale testing at RSRS)

Rearing of parental lines were undertaken for production of FCs of SSBS 5 x SSBS 6 bivoltine double hybrid for field testing. After cocoon selection, a total of 880 foundation cross dfls have been prepared for production of 88,000 of dfls for field testing after approval.



ARP-3605: Validation of DNA Markers in Silkworm Breed Developed by introgression of DNA markers associated with NPV resistance using marker-assisted selection breeding and large scale field trial (as CI)

Two evaluation rearings with marker-assisted lines of bivoltine lines were carried out. During April-May 2018, 25 bivoltine hybrid combinations with 85 beds and during June-July 2018 11 BV combinations with 105 beds were reared and evaluation data along with 3,772 dfls were supplied to CSRTI-Mysore for further studies.

Evaluation of bivoltine races/hybrids developed by Bivoltine Breeding Laboratory of CSRTI-Mysore

Under this, 20 combinations of BMFC hybrids viz., BMFC1 X 10 , BMFC1 X 11, BMFC1 X 12 , BMFC1 X 13, BMFC2 X 10, BMFC2 X 11, BMFC2 X 12, BMFC2 X 13, BMFC3 X 10, BMFC3 X 11, BMFC3 X 12, BMFC3 X 13, BMFC4 X 10, BMFC4 X 11, BMFC4 X 12, BMFC4 X 13, BMFC5 X 10, BMFC5 X 11, BMFC5 X 12, BMFC5 X 13 were reared and rearing data along with 6.00 kg of cocoons were sent for reeling test at CSRTI-Mysore.

In another rearing, 58 combinations of BB series bivoltine hybrids were reared, characterized and rearing data along with 25.10 kg of green cocoons were supplied to CSRTI-Mysuru for further reeling test.

P4 BASIC SEED FARM HASSAN

Bivoltine Silkworm Race Maintenance and Multiplication

Nishita Naik V and Dayananda

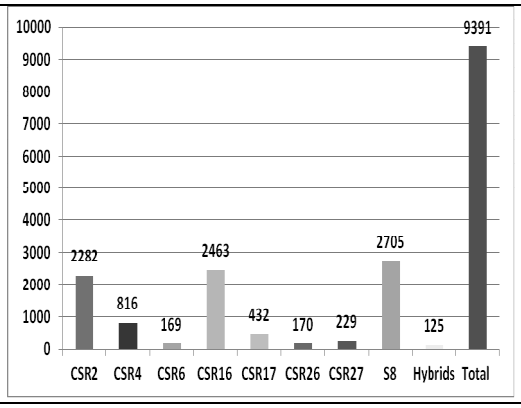
Objective: Systematic maintenance of mulberry garden, bivoltine silkworm races and supply of quality bivoltine eggs to downstream multiplication centers

Maintenance of bivoltine silkworm breeds:

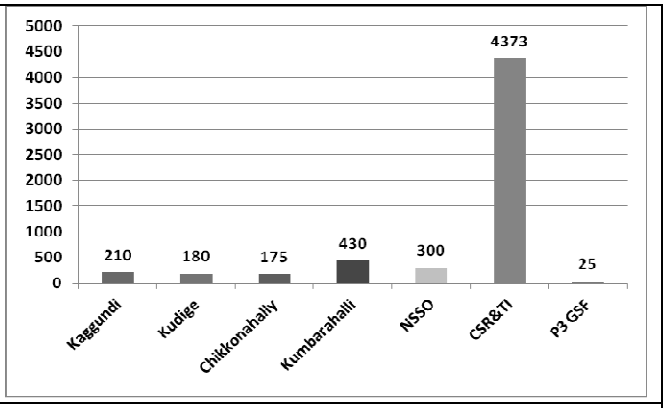
During silkworm rearing, many circumstances the quality of the cocoons produced is not in conformity with the original breed characters. This accredited to adopt stringent selection methods at various levels of maintenance and multiplication. Therefore, maintenance of silkworm races confirming to their original breed characters for many generations is most important. In view of this, eight bivoltine breeds *viz*., CSR2, CSR4, CSR6, CSR16, CSR17 CSR26, CSR27 and S8 were reared during 2018-19 by following silkworm race maintenance procedure. The performance of these races (Average of 4 crops) is presented below.

Performance of bivoltine breeds					
Breed	ERR (no.)	ERR wt. (kg)	SC wt (g)	SS wt (g)	CS (%)
CSR2	9640±135.49	16.90±0.97	1.774±0.12	0.404±0.03	22.76±0.27
CSR4	9476±152.99	15.30±0.65	1.624±0.06	0.354±0.01	21.81±0.55
CSR6	9389±269.02	15.4±0.77	1.649±0.08	0.360±0.02	21.77±0.28
CSR26	9564±132.74	15.60±1.12	1.671±0.10	0.358±0.03	21.39±1.04
CSR27	9542±210.40	16.30±0.88	1.760±0.08	0.404±0.02	22.96±0.86
CSR16	9326±330.22	10.4.8±1.09	1.620±0.06	0.345±0.02	21.28±0.25
CSR17	9586±189.25	17.40±0.81	1.830±0.09	0.391±0.02	21.37±0.16
S8	9609±97.78	16.90±0.85	1.804±0.15	0.407±0.03	22.57±0.50

All the eight silkworm breed characters were maintained in conformity with the original breed characters and hybrid vigour was recorded for some authorized combinations. The crops were carefully monitored for pebrine incidence. A total of 9266 pure stock dfls were prepared for supply to P3 and P2 multiplication centres and 125 hybrid dfls were prepared. The dfls were supplied to four P3 station (995) *viz.*, Kaggundi, Kudige, Chikkonahally, Kumbarahally, One P2 farm (25), NSSO (300) and CSRTI- Mysuru (4373).



Production of disease free layings (Pure & Hybrids)



Distribution of disease free layings (P3 & Others)

Continuous/Other Activities:

- Maintenance of 1.5 acres mulberry garden.
- Raised G4, G2 and V1 tree mulberry plantation.
- Generated 10.5 MT of vermi compost and 11 MT of compost.
- A total quantity of 5693 dfls of bivoltine silkworm pure stock was supplied to P3 multiplication centers of DOS, Karnataka, NSSO and CSRTI-Mysuru

MULTIVOLTINE BREEDING LABORATORY

Ongoing Projects

AIB-3534: Development of Improved Cross Breeds of silkworm *Bombyx mori L*. suitable for south India (Mar. 2015 - Mar. 2019)

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

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

During the year 5 rearings were conducted and retained six lines viz., ICB-2, ICB 7, ICB 14, ICB 17, ICB 29 and ICB 30 for stabilisation, on station trails were conducted. Under the on station trial ICB 29 was found superior with fecundity of 483, ERR by no.9276, ERR by wt. 14.85(g), single cocoon wt. 1.641 (g), single shell wt. 0.30 (g) and shell ratio of 18.3 %.

Rearing performance of ICB lines								
ICB line	Fecundity (no.)	Hatching (%)	Yield/ 10000 larvae		Single cocoon wt. (g)	Shell wt. (g)	Shell ratio (%)	AEI
			no.	wt.kg				
ICB-2	443	91.9	9089	13.85	1.570	0.275	17.5	49
ICB-7	449	97.5	9128	14.35	1.589	0.286	18.0	54
ICB-14	440	96.5	8417	10.10	1.221	0.222	18.2	45
ICB-17	424	95.2	9052	13.86	1.56o	0.276	17.7	51
ICB-29	483	97.3	9276	14.85	1.641	0.300	18.3	58
ICB-30	457	96.1	9136	14.49	1.609	0.293	18.2	55
MV1	463	91.5	9320	14.00	1.466	0.278	19.0	55
PM	400	94.0	8024	12.90	0.952	0.139	14.9	33
Mean	448.8	95.0	8930.3	13.6	1.5	0.3	17.7	
STD	30.21	2.33	459.44	1.51	0.24	0.05	1.21	
CV %	6.7	2.4	5.1	11.1	16.7	20.8	6.8	

Further, the cross breed evaluation was undertaken with bivoltine parent CSR2, CSR27 and S8, C.Oval. Based on evaluation index ranking ICB-29 x S8, ICB-29 x CSR27, ICB-29 x C.Oval, were found superior followed by ICB-14 x S8, ICB-7 x C.Oval. The ICB-29 showed better performance with all four bivoltine parents and also showed improvement over MV1 X S8, PM x CSR2. In particular ICB-29 x S8 was found superior, when compared with MV1 x S8 it is found that the improvement in ERR by number 9344 (6.58 %) by wt. 17.00 (21.43 %), single cocoon 1.87 (10 %) shell wt. by 0.40 g (8.8 %). Other reeling parameters viz., reelability 91%, filament length 627 m, raw silk 11 %, raw silk recovery 56% and Neatness of 85% were on par with MV1 x S8. Similarly ICB-29 x CSR2 when compared with PM x CSR2 the improvement was found that in ERR by number 9.9 %, by wt. by 15.4 %, single cocoon wt by 4.6 % shell wt. by 10.0 % shell ratio by 7.2 %. The reeling parameters *viz*., reelability 89 %, filament lenghth 616 m, raw silk % 10 and raw silk recovery 55% and neatness 85% was observed.

Rearing and reeling performance of the shortlisted ICB line hybrids											
#	Combination	Yield/ 10000 larvae		Coc wt. (g)	Shell wt. (g)	Shell ratio (%)	Reel. (%)	Fil. length (m)	Raw silk (%)	Raw silk recovery (%)	Neat-ness
		no.	wt. (kg)								
1	ICB-2 x CSR2	9167	16.51	1.768	0.366	20.08	86.21	614	9.60	47.70	85
2	ICB-2 x CSR27	8569	14.69	1.752	0.335	19.12	89.29	735	12.30	51.00	84
3	ICB-2 x S8	8723	14.97	1.801	0.354	19.66	89.29	649	10.20	47.20	83
4	ICB-2 x C. Oval	8521	14.32	1.634	0.280	17.50	84.00	638	10.10	48.00	81

Rearing and reeling performance of the shortlisted ICB line hybrids											
#	Combination	Yield/ 10000 larvae		Coc wt. (g)	Shell wt. (g)	Shell ratio (%)	Reel. (%)	Fil. length (m)	Raw silk (%)	Raw silk recovery (%)	Neat-ness
		no.	wt. (kg)								
6	ICB-7 x CSR2	8721	12.00	1.470	0.280	18.84	78.00	564	10.00	49.00	81
7	ICB-7 x CSR27	8921	12.00	1.350	0.260	19.48	81.00	540	10.00	50.00	81
8	ICB-7 x S8	9378	16.89	1.815	0.348	19.70	68.85	610	9.60	50.60	82
9	ICB-7 x C.Oval	9334	16.12	1.696	0.343	20.22	89.29	586	11.80	59.00	83
10	ICB-14 x CSR2	8300	12.00	1.400	0.250	17.80	83.00	542	10.00	48.00	81
11	ICB-14 x CSR27	8900	13.25	1.569	0.295	18.80	87.72	583	9.60	51.30	82
12	ICB-14 x S8	9211	15.12	1.728	0.347	20.08	92.59	653	10.60	52.80	85
13	ICB-14 x C.Oval	9500	15.96	1.650	0.315	18.99	86.21	567	10.50	57.40	84
14	ICB-17 x CSR2	9033	16.07	1.785	0.339	8.97	90.91	657	10.30	54.70	86
15	ICB-17 x CSR27	7816	13.69	1.670	0.334	19.99	86.21	659	11.40	58.80	83
16	ICB-17 x S8	7916	12.00	1.520	0.290	19.00	82.00	624	10.00	54.00	82
17	ICB-17 x C.Oval	8933	15.60	1.770	0.332	18.70	87.72	615	9.10	49.70	86
18	ICB-29 x CSR2	9367	14.96	1.715	0.334	19.47	89.29	616	10.31	54.70	85
19	ICB-29 x CSR27	9435	16.20	1.889	0.381	20.12	87.72	558	10.40	61.50	83
20	ICB-29 x S8	9344	17.10	1.871	0.365	19.51	90.91	627	11.00	65.00	86
21	ICB-29 x C.Oval	9320	15.69	1.742	0.345	19.80	90.91	609	12.30	67.30	84
22	ICB-30 x CSR2	9496	16.65	1.771	0.341	19.25	87.72	591	9.70	50.60	84
23	ICB-30 x CSR27	9222	15.10	1.750	0.343	19.58	87.72	608	9.60	49.40	84
24	ICB-30 x S8	9169	15.30	1.693	0.347	20.50	87.72	601	10.70	51.40	82
25	ICB-30 x C.Oval	9503	16.98	1.794	0.354	19.75	90.91	627	9.10	46.30	83
26	MV1 x S8	8767	14.00	1.700	0.331	19.47	83.00	628	12.00	57.00	83
27	PM x CSR2	8522	13.00	1.530	0.297	19.41	84.00	616	13.00	56.00	86
Mean		8965	15.00	2.000	0.000	19.00	86.00	614	10.00	53.00	83
STD		474	2.00	0.140	0.030	0.77	4.99	43	1.03	5.59	1.65

Evaluation Index values on the economically important traits of the hybrid combinations												
#	Combination	Yield/ 10000 larvae		Coc wt. (g)	Shell wt. (g)	Shell ratio (%)	Reel. (%)	Fil. length (m)	Raw silk (%)	Raw silk recov. (%)	Neat-ness	AEI
		No.	wt. (kg)									
1	ICB-2 x CSR2	54	62	56	60	58	50	50	42	39	60	53
2	ICB-2 x CSR27	42	51	55	54	45	56	78	65	46	53	54
3	ICB-2 x S8	45	51	59	57	53	56	58	45	39	47	51
4	ICB-2 x C.oval	41	45	44	36	25	46	56	45	40	35	41
6	ICB-7 xCSR2	45	35	35	36	42	34	38	45	42	35	39
7	ICB-7 x CSR27	49	33	26	30	50	40	33	45	44	35	39

Evaluation Index values on the economically important traits of the hybrid combinations												
#	Combination	Yield/ 10000 larvae		Coc wt. (g)	Shell wt. (g)	Shell ratio (%)	Reel. (%)	Fil. length (m)	Raw silk (%)	Raw silk recov. (%)	Neat-ness	AEI
		No.	wt. (kg)									
8	ICB-7 x S8	59	62	60	57	47	15	49	42	46	41	48
9	ICB-7 x C.Oval	58	57	51	54	60	56	43	65	60	47	55
13	ICB-14 x CSR2	36	33	30	27	29	44	33	45	40	35	35
14	ICB-14 x CSR27	49	39	42	42	42	53	43	42	46	41	44
15	ICB-14 x S8	55	51	54	57	58	63	59	55	49	60	56
16	ICB-14 x C.Oval	61	57	48	48	44	50	39	55	56	53	51
20	ICB-17 x CSR2	51	57	58	54	44	59	60	45	53	66	55
21	ICB-17 x CSR27	26	45	49	51	57	50	60	55	60	47	50
22	ICB-17 x S8	28	33	38	39	44	42	52	45	51	41	41
23	ICB-17 x C.Oval	49	57	57	51	40	53	50	37	44	66	50
27	ICB-29 x CSR2	58	51	44	51	67	56	50	45	53	60	54
28	ICB-29 x CSR27	60	57	65	66	58	53	37	45	65	47	55
29	ICB-29 x S8	58	62	64	63	51	59	53	55	71	66	60
30	ICB-29 x C.Oval	57	57	54	57	55	59	49	65	74	53	58
32	ICB-30 x CSR2	61	62	56	54	48	53	45	42	46	53	52
33	ICB-30 x CSR27	55	51	55	54	52	53	49	42	42	53	51
34	ICB-30 x S8	54	51	51	57	64	53	47	55	46	41	52
35	ICB-30 x C.Oval	61	62	58	57	55	59	53	37	37	47	53
36	MV1 x S8	46	45	51	54	62	43	63	65	56	47	53

The performance of ICB lines crossed with foundation crosses was evaluated, based on evaluation index it was found that ICB-7 x (S8 x D2) was superior followed by ICB-29 x BFC-7, ICB-29 x BFC-1, ICB-17 x (S8x D2), ICB-7 x BFC-1 and ICB-29 x (S8x D2). Similar to bivoltine single parent cross with ICB-29, the trend of improvement in rearing-reeling parameters was observed when ICB 29 was crossed with foundation crosses.

Rearing and reeling performance of the shortlisted improved cross breed lines with foundation crosses											
#	Combination	Yield/ 10000 larvae		Shell wt. (g)	Shell ratio (%)	Reel. (%)	Fil. lengt h (m)	Raw silk (%)	Raw silk recovery (%)	Neat-ness	AEI
1	ICB-2x(S8x D2)	8967	14.21	1.681	0.311	19.17	89.29	665	10.70	58.70	85
2	ICB-2 x BFC-1	9012	14.17	1.647	0.334	20.28	87.72	614	10.60	50.00	84
3	ICB-2 x BFC-7	8367	13.90	1.717	0.356	20.74	86.21	530	11.20	51.40	83
4	ICB-7x (S8x D2)	8933	15.50	1.795	0.341	19.00	92.59	679	12.30	62.70	85
5	ICB-7 x BFC-1	9467	14.47	1.660	0.341	20.54	89.29	650	10.60	52.90	83
6	ICB-7 x BFC-7	9633	15.10	1.619	0.322	19.39	87.72	529	8.50	46.50	82
7	ICB-14x(S8x D2)	9067	15.23	1.806	0.312	17.25	87.72	530	11.70	61.70	82
8	ICB-14xBFC-1	8500	14.00	1.500	0.300	18.00	85.00	521	10.00	55.00	81
9	ICB-14xBFC-7	8867	14.10	1.632	0.309	18.95	86.21	636	9.10	47.10	83
10	ICB-17x(S8x D2)	9123	15.98	1.812	0.349	19.24	87.72	531	10.30	53.10	84

Rearing and reeling performance of the shortlisted improved cross breed lines with foundation crosses											
#	Combination	Yield/ 10000 larvae		Shell wt. (g)	Shell ratio (%)	Reel. (%)	Fil. length (m)	Raw silk (%)	Raw silk recovery (%)	Neat-ness	AEI
11	ICB-17xBFC-1	8796	13.47	1.639	0.325	19.82	84.75	547	8.60	43.10	83
12	ICB-17xBFC-7	8456	14.11	1.684	0.329	19.52	86.21	530	9.40	45.60	82
13	ICB-29x(S8x D2)	9432	15.26	1.643	0.328	19.95	87.72	603	10.57	53.30	84
14	ICB-29 x BFC-1	9500	15.98	1.692	0.351	20.74	87.72	636	11.20	59.40	83
15	ICB-29 x BFC-7	9531	15.96	1.729	0.346	20.01	87.72	600	1.80	63.80	82
16	ICB-30x(S8x D2)	9133	15.12	1.695	0.330	19.49	87.72	531	9.40	48.50	84
17	ICB-30xBFC-1	9333	16.12	1.744	0.357	20.44	92.59	655	10.20	49.40	82
18	ICB-30xBFC-7	8500	14.00	1.700	0.300	18.00	88.00	531	10.00	49.00	81
19	PMxFC2	9058	13.00	1.610	0.333	20.50	86.00	610	10.00	50.00	82
	Mean	9036	15.00	1.700	0.300	20.00	88.00	586	10.00	53.00	83
	STD	389	0.96	0.070	0.020	0.91	2.09	57	1.08	6.00	1.20

Evaluation Index values on the economically important traits of the hybrid combinations with foundation crosses													
#	Combination	No.	Wt. (kg)	SCW (g)	SSW (g)	SR (%)	Reel. (%)	FL (m)	Denier	RS (%)	RSR (%)	Neat-ness	AEI
1	ICB-2 x (S8 x D2)	48	45	43	40	45	57	64	42	56	61	68	52
2	ICB-2 x BFC-1	49	45	46	50	58	50	55	45	56	46	59	51
3	ICB-2 x BFC-7	33	42	55	65	62	42	40	67	56	47	51	51
4	ICB-7 x (S8 x D2)	47	58	66	55	43	73	66	60	65	66	68	61
5	ICB-7 x BFC-1	61	48	47	55	60	57	61	45	56	51	51	54
6	ICB-7 x BFC-7	65	54	42	45	53	50	40	38	33	41	43	46
7	ICB-14 x (S8 x D2)	51	55	67	40	25	50	40	60	65	66	43	51
8	ICB-7 x BFC-1	36	37	28	25	37	37	39	57	47	54	34	39
9	ICB-14 x BFC-7	46	44	43	40	43	42	59	42	38	41	51	44
10	ICB-17 x (S8 x D2)	52	63	67	60	46	50	40	67	47	51	59	55
11	ICB-17 x BFC-1	44	37	44	50	52	36	43	35	34	34	51	42
12	ICB-17 x BFC-7	35	44	50	50	49	42	40	42	41	39	43	43
13	ICB-29 x (S8 x D2)	60	56	44	50	54	50	53	48	56	51	59	53
14	ICB-29 x BFC-1	62	63	51	60	62	50	59	51	56	61	51	57
15	ICB-29 x BFC-7	63	63	56	60	54	50	53	64	65	69	43	58
16	ICB-30 x (S8 x D2)	53	54	52	50	49	50	40	51	41	44	59	49
17	ICB-30 x BFC-1	58	65	58	65	59	73	62	42	47	44	43	56
18	ICB-30 x BFC-7	36	44	50	40	37	52	40	42	47	44	34	42
19	PM X FC2	51	32	40	50	60	41	54	54	47	46	43	47

The on farm trial of rearing of selected ICBs conducted at RSRS Kodathi showed that ICB29 x S8 is superior followed by ICB-29 x CSR2 the details are given below.

Performance of the ICB cross at OST level at RSRS Kodathi							
ICB cross	Fecundity (No.)	Hatching (%)	ERR		SC wt. (g)	SS wt. (g)	SR (%)
			no.	wt.(kg)			
ICB29 x CSR2	474	95	8374	10.21	1.421	0.281	19.77
ICB29 x S8	426	95	9653	12.35	1.441	0.285	19.79
ICB30 x CSR2	410	86	8115	9.11	1.472	0.287	19.51
ICB30 x S8	483	91	9299	10.04	1.351	0.257	19.02
PM4 x CSR2	494	91	8336	9.36	1.482	0.277	18.72
MV1 x S8	450	89	8581	10.15	1.521	0.293	19.26
Mean	456	91	8726	10.20	1.431	0.281	19.63
STD	33.31	3.49	609.59	1.14	0.047	0.014	0.782

Evaluation Index values of the rearing traits of the hybrid combinations reared at RSRS Kodathi								
ICB cross	Fecundity (No.)	Hatching (%)	ERR		SC wt. (g)	SSwt. (g)	SR %	AEI
			No.	wt.(kg)				
ICB29 x CSR2	55	61	44	50	55	57	56	54
ICB29 x S8	41	61	65	69	64	65	61	61
ICB30 x CSR2	36	35	40	40	49	40	32	39
ICB30 x S8	58	50	59	49	35	40	50	49
PM4 x CSR2	61	50	44	43	44	44	49	48
MV1 x S8	48	44	48	50	54	53	52	50

AIB-01004 MI: Development of multivoltine breeds with improved silk quality utilizing indigenous and exotic bivoltine breeds (Sep. 2018 to Aug. 2022)

K.B. Chandrashekhar, S.Manthira Moorthy, K.M. Ponnuvel, S.B. Kulkarni, S.M. Hukkeri, P.V. Soudaminy and L. Kusuma

Objectives:

- To develop multvoltine breeds with improved silk quality (3A grade) with bivoltine breeds through marker assisted selection
- To develop multivoltine hybrids with improved silk quality and productivity

Two multivoltine parents MV1 (superior fibre quality) and HB4 (thermo tolerant / BmNPV resistant) and bivoltine breed S8 and one exotic, (Bulgarian), high shell ratio bivoltine breed BM2 are utilised for fibre quality improvement through marker assisted selection. The F3 generation of MV1 x S8, MV1 x BM2, HB4 x S8 and HB4 x BM2 is under progress. Greenish yellow cocoons selected from F2 population were further taken for molecular evaluation - RNA isolation and differential expression study for diapause and non diapause character /gene at SBRL-Bangalore.

AIB-01001MI: Evaluation of Cauvery Gold (MV1 x S8): An improved cross breed for cocoon productivity and silk quality (Jun. 2018 - May 2020)

S.B. Kulkarni, K.B.Chandrashekhar, P.V. Soudaminy, N. Balachandran, S.M.Hukkeri, Noble Morrison, Dayananda, K.S. Nair and Shankara

Objectives: To evaluate the field performance of newly developed cross breed Cauvery Gold for productivity and silk quality.

P1 seed cocoons of MV1 and S8 were generated for the production of new improved cross breed (MV1 x S8) at institute and at farmers' level. The cocoons were processed at SSPCs of NSSO units at Ramangaram and Chintamani. A total 64660 dfls of MV1 x S8 were distributed to farmers (free of cost). The yield/100 dfls ranged from 62-74 kg/100 dfls

with average of 65.2 kg, whereas the average yield of PM x CSR2 in field is 66.5kg/ 100 dfls. The new cross breed, Cauvery Gold has gained popularity as the cocoon fetched higher price by Rs.15 to 45 /kg in comparison to Kolar gold (PM X CSR2) and giving a graded silk 2A to 3A silk to the reelers.

Concluded Research projects

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

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

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

A pure Mysore line was isolated with improved shell wt. 0.23(g), shell ratio 17.95 %, filament length of 418 m, reelability 83 %, raw silk recovery 61.41 %, neatness 65 %, tenacity 3.2 g/d, elongation 25% and cohesion stroke 86, showing improvement of 36.2 % in filament length, 29.8 % in raw silk recovery, 30 % in cohesion stroke and 47 % in elongation % in comparison to existing PM line.

Percentage of improvement in the PM lines with CSGRC Hosur			
Particulars	CSGRC PM	Improved PM-4	Improvement over control (%)
Fecundity (no.)	404	453	12.1
Denier	2.41	2.17	-9.6
Renditta (Kg)	12.0	11.8	-1.7
Raw silk (%)	12.01	12.41	3.4
Raw silk recovery (%)	47.3	61.41	29.8
Neatness (%)	81.5	85.5	5.6
Tenacity (g/d)	3.2	3.2	0.0
Cohesion stroke	66	86	30.3
Elongation (%)	17	25	47.1

Further, the newly developed line has been evaluated by NSSO at P3 Basic seed farm Nagenahalli, Kunigal.

Performance of improved Pure Mysore at P3 BSF Nagenahalli, Kunigal							
Breed	Fecundity (No.)	Hatching (%)	ERR		SC wt. (g)	SSwt. (g)	SR %
			By no.	By wt.(kg)			
PM4 (CSRTI source)	492	96.6	9983	12.19	1.22	0.192	15.75
Nagenahalli (NSSO)	481	95.65	9284	9.78	1.33	0.196	14.76

The resultant hybrid (new PM line – PM4 crossed with CSR2) also showed improvement in shell wt. 0.34g (14.81%), Shell ratio 19.78% (6.28%), filament length of 681 m. (24.27%), renditta of 7.2 (20%) and raw silk % 15.18 (4.69%) and neatness of 85% (3.66 %).

Comparison of improved PM x CSR2 with existing PM x CSR2			
Parameter	PM x CSR2 (Control)	PM4 x CSR2	Improvement (%)
Fecundity (No.)	466	495	6.22
Pupation rate (%)	93.0	93.0	0.0
Single cocoon weight (g)	1.468	1.720	14.57
Single shell weight (g)	0.27	0.34	14.81
Shell ratio (%)	18.61	19.78	6.28
Reelability (%)	84	86	2.38
Filament length (m)	548	681	24.27

NBFL (m)	459	560	22.00
Renditta (Kg.)	9.0	7.2	-20.0
Denier	3.21	2.77	-13.71
Raw silk (%)	14.5	15.18	4.69
Raw silk recovery (%)	69.49	73.49	5.76
Neatness	80	85	3.66

AIB-3577: Evaluation of multivoltine germplasm to identify potential parent for developing cross breeds for Southern and Eastern India (In collaboration with CSGRC Hosur)

K.B. Chandrashekhar, S.B. Kulkarni, P.V. Soudaminy (CSRTI, Mysuru) N. Balachandran, G. Punithavathy (CSGRC, Hosur)

Under the project four trials of total 20 crossbreeds in 3 replications were conducted during the year.The rearing performance is tabulated.

Performance of shortlisted improved cross breed lines with foundation crosses

Sl.No.	Accession no.	Fecundity (no.)	ERR		SC wt (g)	S S wt (g)	SR (%)
			by no.	by wt (kg)			
1	001 x 290	455	9490	14.30	1.464	0.262	18.01
2	007 x 290	425	9380	11.32	1.212	0.212	17.47
3	017 x 290	437	9517	13.29	1.363	0.242	17.73
4	022 x 290	433	9297	13.35	1.432	0.257	18.05
5	025 x 290	436	9463	14.10	1.419	0.242	17.16
6	026 x 290	434	9297	12.29	1.411	0.234	16.84
7	030 x 290	444	9483	12.96	1.357	0.230	17.18
8	048 x 290	441	9370	13.94	1.422	0.256	18.05
9	054 x 290	448	9443	13.40	1.405	0.242	17.27
10	055 x 290	445	9360	12.54	1.299	0.226	17.52
11	068 x 290	394	9470	13.66	1.396	0.250	18.03
12	069 x290	450	9317	13.19	1.383	0.251	18.21
13	074 x 290	430	9373	13.39	1.516	0.262	17.38
14	076 x 290	434	9337	12.51	1.378	0.272	19.76
15	077 x 290	445	9477	12.37	1.311	0.252	19.15
16	078 x 290	423	9227	11.83	1.409	0.266	18.73
17	079 x 290	443	9342	12.79	1.439	0.263	18.13
18	080 x 290	427	9410	13.11	1.359	0.246	18.15
19	081 x 290	433	9370	13.55	1.501	0.296	19.66
20	082 x 290	438	9437	12.17	1.399	0.254	18.20

Other continuous 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 three polyvoltine breeds were maintained conforming to their original breed characters for 5 generations. The average performances of some of the important evolved breeds are as below.

Rearing and reeling performance of the germplasm								
#	Breeds	Fecundity (no.)	Hatching (%)	By no.	By wt. (kg)	S.C wt. (g)	S.S wt. (g)	SR (%)
1	AGL-35	417	90.2	8120	10.51	1.312	0.220	16.77
2	APDR 15	456	96.0	8220	10.49	1.300	0.211	16.23
4	BL 24	431	98.1	8280	10.11	1.259	0.212	16.84
5	BL-65	357	97.2	7680	9.98	1.319	0.239	18.12
6	BL-67	417	94.3	8140	10.59	1.350	0.221	16.37
7	BL-68	419	94.5	8096	10.48	1.311	0.215	16.40
8	BM-005	320	93.8	9160	9.11	0.821	0.112	13.64
9	BM-078	358	86.0	8600	8.69	1.012	0.159	15.71
10	FVB1	437	57.2	8869	10.89	1.400	0.239	17.07
12	HB4	526	97.5	9012	12.42	1.398	0.239	17.10
13	HB6	436	90.3	8892	12.14	1.379	0.251	18.20
14	L1	458	90.0	8502	12.09	1.356	0.237	17.50
15	L3	466	94.5	9120	12.03	1.325	0.239	18.04
16	L14	456	98.0	9200	10.96	1.302	0.245	18.82
18	L15	458	89.2	8800	11.21	1.315	0.243	18.50
19	MH1	478	84.9	9015	10.98	1.295	0.219	16.91
20	MV1	470	92.0	9150	12.77	1.445	0.269	18.62
22	MO6	432	90.2	9068	11.31	1.289	0.222	17.25
23	ND2	409	95.6	8640	10.95	1.386	0.240	17.35
24	ND5	434	96.7	8012	11.21	1.418	0.252	17.74
25	ND7	457	97.9	8739	12.01	1.399	0.263	18.80
26	ND10	480	97.1	8561	11.95	1.412	0.261	18.50
27	NDV6	365	93.2	9120	12.36	1.425	0.279	19.58
28	Nistari	342	83.3	9840	9.81	1.000	0.159	15.90
29	NP1	513	95.5	7933	10.59	1.359	0.246	18.10
30	NP4	395	93.4	8569	10.41	1.238	0.220	17.77
31	PV1	472	93.2	8920	13.12	1.478	0.259	17.52
32	Sarupath	380	69.7	8567	9.61	1.129	0.167	14.79
33	2000H	441	96.4	8320	12.35	1.536	0.265	17.25
34	RD1	401	65.4	8904	9.45	1.119	0.159	14.21

SILKWORM PHYSIOLOGY LABORATORY

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

Y.Thirupathaiah, E. Bhuvaneswari, M. Chandrashekaraiah*, N.M. Soren* and K.S. Prasad* (*NIANP, Bangalore)

Objectives:

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

CSRTI-Mysuru: Extraction of silkworm pupae oil was carried out by different column extraction methods. Maximum recovery (33%) of pupae oil was obtained by column solvent extraction method. The qualitative characteristics (acid, saponification, iodine and peroxide values) of extracted silkworm pupae oil were at desirable level and the amount of α-linolenic acid (ALA) in pupae oil was 32% as analyzed by GC-MS. Separation of α-linolenic acid from pupae oil was done by both chemical and enzymatic methods. Purification of α-linolenic acid was done by both urea inclusion complexation method followed by fractional crystallization. Releases of free fatty acids were qualitatively analyzed by Thin Layer Chromatography (TLC) and amount of ALA was quantitatively analyzed by Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC). The purity of ALA was improved by silica column chromatography and achieved up to 97% purity.

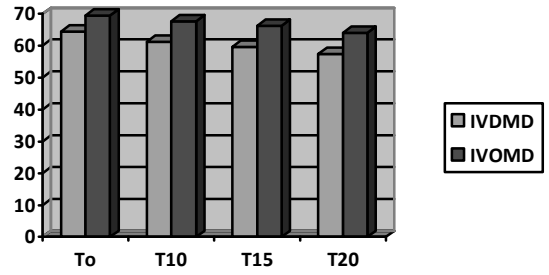
NIANP-Bangalore: Experiments were conducted to evaluate the effect of different inclusion levels of defatted silkworm pupae meal (DSWP) on microbial protein synthesis and nutrient utilization in cattle fed on Finger Millet Straw (FMS) based diet. Four isonitrogenous concentrate mixtures were prepared with DSWP replacing Soy Bean Meal (SBM) at 0, 10, 20 and 30% (T_0, T_1, T_2, T_3). 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 intake, nutrient utilization and microbial protein synthesis. All the animals were fed with FMS as sole source of roughage. No significant differences were observed in intake, digestibility of nutrients, the excretion of total purine derivatives, PDC index, microbial protein absorption and microbial nitrogen (g) per kg digested organic matter.

The *in vitro* experiments were conducted to study the effect of supplementation of different inclusion levels of Defatted Silkworm Pupae Meal (DSWP) by replacing (0% (T0), 10% (T10), 20% (T20),….100% (T100) Soy Bean Meal (SBM) in the concentrate mixture on wheat and paddy straw based diets on *in vitro* digestibility and rumen fermentation. The *In Vitro* Total Gas Production (IVTGP), *In Vitro* Dry Matter Digestibility (IVDMD) and *In Vitro* Organic Matter Digestibility (IVOMD) were determined. No significant ($p>0.05$) difference was observed in IVTGP, IVDMD and IVOMD among treatments (T0 to T10).

In vitro experiments were conducted to study the effect of supplementation of different inclusion levels of byproducts of SWP oil 0% (T0), 10% (T10), 15% (T15) and 20% (T20) in the concentrate mixture on finger millet, wheat and paddy straw based diets on *in vitro* digestibility and rumen fermentation. The *In Vitro* Total Gas Production (IVTGP), *In Vitro* Dry Matter Digestibility (IVDMD) and *In Vitro* Organic Matter Digestibility (IVOMD) were determined. No significant ($p>0.05$) difference was observed in IVTGP, IVDMD and IVOMD among treatments (T0 to T20).

Salient findings

- Byproducts of SWP oil can be incorporated in the ration up to 20% without compromising the *in vitro* rumen fermentation and digestibility on different straw based diets.
- Supplementation of silkworm pupae meal up to 100% had no significant effect on *in vitro* rumen fermentation and digestibility on paddy and wheat straw based ration.
- DSWP can be incorporated in the ration of cattle up to 30% by replacing SBM without compromising the microbial protein synthesis and nutrient utilization on FMS based diet.



Effect of incorporation of graded levels of byproducts of SWP oil on IVDMD and IVOMD of finger millet straw based diet

AIP-3594: Feed supplementation studies for improving young age silkworm rearing in chawki rearing centres (October 2016 - September 2018)

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

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

Successful chawki rearing is a pre-requisite for good cocoon crop. Rearing under optimum temperature (27-28°C), relative humidity (85-90%), feeding of tender, succulent leaves, ensuring pathogen free rearing conditions are vital for efficient chawki rearing. However, incidence of higher percentage of missing larvae, unequal larvae and decrease in weight are common in Chawki Rearing Centres (CRCs). Low nutritive feed is one of the major contributions for this deficiency in chawki rearing. Therefore, the present approach endeavours to develop a Chawki Feed Supplement Formulations (CFSFs) to ensure survival, robustness through feed efficiency to enhance immunity and good cocoon crop. CFSF is a combination of vitamin, minerals, antimicrobial substances, immune enhancers, modulators, growth promoters and feed attractants. The application of CFSFs enhances chawki worms feed response, ensures uniformity in their growth, reduce the unequal percentage and missing larvae percentage.

Three novel formulations have been tested with three trials in the model chawki rearing centre of CSRTI, Mysuru. The data on the average of three trials performance are found to be effective on the chawki performance. The missing larval percentage was reduced by 45.43 % (F-1), 27.58 % (F-2) and 50.89 % (F-3) similarly, under sized larval percentage was reduced by 65.88 % (F-1), 63.94 % (F-2) and 67.54 % (F-3) and improved the growth of chawki worms 2.90 % (F-1), 4.60 % (F-2) and 8.40 % (F-3) over the control. The results indicated CFSFs clearly improved the chawki performance significantly at 0.1%, 1% and 5% level.

As per chawki certification norms, the missing larval percentage should be less than 5% and it was observed 7% in control, 3% in F-1, 7 % in F-2 and 3 % in F-3. Similarly, the larval uniformity i.e., undersized larvae should be less than 15 % and it was observed 7 % in control, 3 % in F-1, 3 % in F-2 and 2 % in F-3. The weight of 100 larvae should 3.4 - 3.8 g. and it was with in the range of norms in all treated batches. During chawki certification, the suspected diseased, weak and unsettled larvae from different trays were collected and observed visually and further confirmation of symptoms through microscopic examination, for the presence of pathogens and it was found that all batches are disease free. After chawki certification silkworms were distributed to the farmers rearing house to evaluate their field performance.

Effect of formulations on the silkworm commercial characters was evaluated through bioassay in comparison with control. The average data of three trials were given. Larval weight and survival was slightly improved in CFSFs treated and the cocoon weight was 2.091 (g.) in F-1, 1.826 (g.) in F-2, 2.067 (g.) in F-3 and 1.77 (g.) in control. Similarly, the shell weight was 0.481 (g.), 0.414 (g.), 0.475 (g.) and 0.404 (g.) and the cocoon yield was noticed 78.95 kg, 77.75 kg, 79.18 kg and 73.93 kg / 100 dfls for F-1, F-2, F-3 and control batches respectively. The cocoon yield improvement was 6.79 %

(F-1), 5.167 % (F-2) and 7.101 % (F-3) over the control. The data clearly indicates that the hidden factors such as improvement of survival and pupation rate are largely
reflected in the no. of cocoon produced and the nutritional status indicates the cocoon weight, shell weight and shell ratio.

Chawki certification parameters of model CRC in CSRTI-Mysuru							
Treat-ments	Larval weight (g)	Survival (%)	Cocoon weight (g)	Shell weight (g)	Pupation rate (%)	Shell ratio (%)	Yield 100 Dfls (Kg)
F -1	46.10 ± 0.764	94.43 ± 0.517	2.09 ± 0.079	0.48 ± 0.003	92.04 ± 0.365	23.02 ± 0.724	78.95 (6.79)
F -2	48.00 ± 0.415	93.43 ± 0.501	1.82 ± 0.067	0.41 ± 0.016	90.76 ± 0.926	22.67 ± 0.572	77.75 (5.16)
F- 3	48.94 ± 1.263	95.63 ± 0.455	2.06 ± 0.061	0.47 ± 0.021	92.84 ± 0.540	22.98 ± 0.367	79.18 (7.10)
Control	47.95 ± 0.108	93.55 ± 0.532	1.77 ± 0.013	0.40 ± 0.010	90.18 ± 1.225	22.76 ± 0.483	73.93
Each value is the mean ± SD of three separate observations, values in parentheses percent improvement over control, *Significant at 5% level; ** Significant at 1% level; ***Significant at 0.1% level; NS- Non Significant							

Evaluation of CFSFs in Chawki Rearing Centre through chawki certification						
Chawki Certification System		Norms	Observations			
			Control	F-1	F-2	F-3
Assessment	Missing larvae	< 5 %	7 %	3 %	4 %	3 %
	Larval uniformity (under sized larvae)	< 15 %	7 %	3 %	3 %	2 %
	Growth (wt. g/ 100 larvae)	3.4 -3.8	3.42	3.46	3.52	3.65
Visual and microscopic examination	Grasserie	Free	✓	✓	✓	✓
	Muscardine	Free	✓	✓	✓	✓
	Flacherie	Free	✓	✓	✓	✓
	Pebrine	Free	✓	✓	✓	✓

Effect of CFSFs on the commercial characters of silkworm							
Treatments	Larval wt. (g)	Survival (%)	Cocoon wt. (g)	Shell wt. (g)	Pupation rate (%)	Shell ratio (%)	Yield/100 Dfls (Kg)
F -1	46.10 ±0.76	94.43 ±0.51	2.091 ±0.07	0.48 ±0.00	92.04 ±0.36	23.02 ±0.72	78.95 (6.79)
F -2	48.00 ±0.41	93.43 ±0.50	1.82 ±0.06	0.41 ±0.01	90.76 ±0.92	22.67 ±0.57	77.75 (5.16)
F- 3	48.94 ±1.26	95.63 ±0.45	2.06 ±0.06	0.47 ±0.02	92.84 ±0.54	22.98 ±0.36	79.18 (7.10)
Control	47.95 ±0.10	93.55 ±0.53	1.77 ±0.01	0.40 ±0.01	90.18 ±1.22	22.76 ±0.48	73.93
Each value is the mean ± SD of three separate observations; figures in parentheses is percent change over control values.							

Other continuous 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

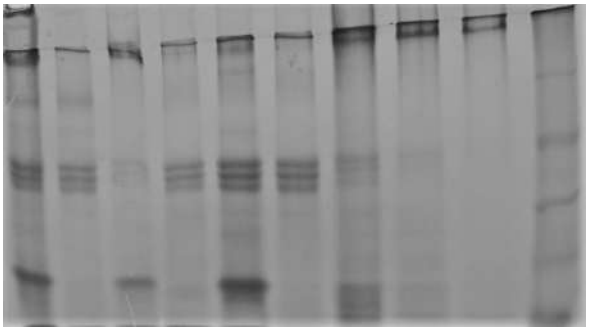
Y.Thirupathaiah

Nine species of *Cordyceps* are being regularly cultured and maintained on Potato Dextrose Agar (PDA) as well as on Sabouraud Dextrose Agar Yeast (SDAY) by providing optimum 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 increasing the inoculums size of *Cordyceps* the infection rate was higher but rate of fruiting body formation was lower. Optimum light intensity was 800 lux to 1000 lux, temperature 22 to 25°C HPLC results indicated that bioactive compounds such as cordycepin and adenosine were found to be more in *Cordyceps* grown on silkworm pupae or pupae powder when compared with potato dextrose broth or potato dextrose agar. *Cordyceps takaomontana anamorph (isaria tenuipies) 91 (IS 91*) and *Cordyceps militaris* fruting bodies and mycelia produced higher amount of cordycepin and adenosine on silkworm pupae or pupae powder when compared with conventional microbiological media. In addition to biologically active substances cordycepin and adenosine, *Cordyceps* are also rich source of lipids, proteins and carbohydrates. Hence, *Cordyceps* can be recommended as source for several beneficial health effects and also its cultivation creates additional demand to sericulture industry in India.

Extraction and characterization of proteins from mulberry silkworm, *Bombyx mori* cocoons

Y. Thirupathaiah and Ravindra

Proteins were extracted from four different types of mulberry silkworm cocoons includes bivoltine (CSR2), multivoltine (PM), multivoltine hybrid (PM x MV1) and sericin hope cocoons. Proteins extracted without addition of any chemical reagents or heat energy and obtained in its native form and separated through 8% SDS-PAGE. Preliminary results indicated that proteins extracted through water contains only three forms of bands (approx 200, 120 and 50 kda) in all kinds of silkworm cocoons except sericin hope. Interestingly, protein obtained from sericin hope cocoon of SDS-PAGE displayed only single band with higher molecular weight (appox. 350 kda).Whereas proteins extracted by 6M urea contains six forms of protein bands (approx. 280, 200, 180, 120, 50 and 20 kda).



SDS page analysis of silkworm cocoons

REARING TECHNOLOGY AND INNOVATION

AIB-356: 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 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 high humidity

Screening of the parental breeds and double hybrids were completed. Based on the performance of the double hybrids evaluated under high temperature and high humidity (Peddageddata in AP, Tamil Nadu and in RSRS, Kodathi) during summer season i.e., (April to June 2018) 10 double hybrids were short listed and the potential double hybrid combinations viz., D2XCSR50, Dun18XCSR16, N6XN7, 2CXS8 were identified and further to be evaluated at farmers level.

Continuous/Other 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/mulitvolitne pure race with *viz,* S8, CSR16, N-21, N-56 and MV1 the seed cocoons generated were utilized for further multiplication.The rearing performance of the above races are presented.

Rearing performance of the different breeds

Crop Season	Race	No. of Dfls	No. of cocoons generated	ERR By no.	SC wt (g)	SS wt (g)	SR (%)	Pupation (%)
August - 18	N-21	50	9386	5059	1.549	0.322	20.87	85
	N-56	50	12852	6872	1.622	0.300	19.72	90
	S8	100	7692	1962	1.629	0.332	20.38	80
	CSR16	100	15539	3846	1.644	0.329	20.01	85
Oct.-Nov. - 18	S8	50	2250	1171	1.250	0.270	21.6	80
	MV1	100	11700	3136	1.329	0.279	20.9	90

TECHNOLOGY VALIDATION AND DEMONSTRATION CENTRE

Balachandran N and Santha P C

Technology Validation and Demonstration Centre (TVDC) 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 breeders enabling them to make corrections and modification required. During the reporting period the centre was carrying out the project works of AIB 01001 MI: Evaluation of Cauvery Gold (MV1 X S8) : An improved crossbreed for cocoon productivity and silk quality, by producing quality parental seed cocoons of the MV1 and S8 breeds.

Objective: To evaluate the field performance of newly evolved improved crossbreed Cauvery Gold for productivity and silk quality.

Rearing performance of breeds evaluated: Under the project five silkworm rearing crops with MV1 and S8 breeds with a total quantity of 710 Dfls were conducted during the period under report. Generated a total of 330.820 kg. (2, 31,063 Nos.) of parental seed cocoons. Evaluation of the rearing performance of S8 and MV1 breeds indicated an average ERR by No. 8772, ERR by wt. 13.6 kg. The average single cocoon weight of 1.663 g, single shell weight of 0.375 g and an average shell ratio of 22.56 % for S8 breed was recorded. Similarly, an average ERR by No. 8420, ERR by wt. 11.6 kg. The average single cocoon weight of 1.514 g, single shell weight of 0.268 g and an average shell ratio of 17.89 % for MV1 breed. The silkworm rearing performance of MV1 and S8 breeds were conforming to their original breed characteristics. In addition, one seed crop rearing of G11 (64 dfls) and G19 (52 dfls) breeds was also taken up in the month of November - December and produced 59.00 Kgs (38,304 nos.) of seed cocoons with an average ERR of 8356 by Nos. and 13.00 kg by weight with 96.1 % pupation. Five Improved Pure Mysore hybrid combinations (49 dfls) were reared and the cocoons produced were supplied to reeling section for PCT evaluation. Ten dfls of CSR2 breed was also reared and the seed cocoons were supplied to MBL section for hybrid preparation.The details of rearing performance are presented below.

Production and disposal of seed cocoons and revenue generation: During the period under report 883 dfls were reared and a total quantity of 419.7 kg. (2,87,197 nos.) of seed cocoons were produced, out of that 325.50 Kgs.(2,19,409 nos.) of S8 and MV1, G11 and G19 seed cocoons and supplied to SSPC, NSSO, Ramanagaram and generated a revenue of Rs.1,66,676/-. Further 22.23 kgs (18,439 nos.) of excess seed cocoons were auctioned at Govt. Cocoon Market, Ramanagaram and Rs.6775/- was the sale proceeds. Similarly 20.0 kgs. (12,355 nos.) of cooons were supplied to reeling section for post cocoon traits analysis and 8.5 Kgs. (6,034 nos.) were supplied to MBL section for seed production. Thus a total of Rs.1,71,451/- has been generated as revenue by the section during the year. The target assigned for the period has been achieved in total.

Rearing performance of silkworm breeds

Crop No.	Race	No. of Dfls	Fec. (No.)	Actual Yield		ERR /10000		SC wt. (g.)	SS wt. (g.)	SR (%)	Pupation (%)	Cocoon /kg.	Yield /100 Dfls. Kg.
				By no.	Wt. (Kg)	By no.	wt. (Kg)						
1	S8	50	410	16250	25.0	8784	13.5	1.73	0.401	23.18	90.7	650	50.0
2	S8	50	505	19685	31.0	8634	13.6	1.805	0.402	22.27	90.6	635	62.0
3	S8	50	452	14490	23.0	8006	12.7	1.662	0.371	22.32	97.0	630	46.0
4	S8	60	482	23944	36.5	9434	14.4	1.454	0.326	22.46	96.6	656	73.0
Total / Ave.		**210**	**462**	**74369**	**115.5**	**8772**	**13.6**	**1.663**	**0.375**	**22.56**	**93.7**	**643**	**57.8**
1	MV1	75	403	23400	30.0	8540	11.0	1.630	0.306	18.77	90.3	780	40.0
2	MV1	75	402	22320	31.0	8236	11.4	1.700	0.320	18.82	90.3	720	41.0
3	MV1	100	458	28670	47.0	7791	12.8	1.856	0.27	14.55	99.0	610	47.0
4	MV1	100	468	36300	55.0	9356	14.2	1.265	0.231	18.22	98.2	660	55.0

6	MV1	150	434	46004	52.3	8181	9.1	1.121	0.215	19.09	96.1	900	33.8
Total / Ave.		**500**	**433**	**156694**	**215.32**	**8420**	**11.6**	**1.514**	**0.268**	**17.89**	**94.8**	**734**	**43.4**
5	G11	64	420	22035	33.9	8607	13.2	1.609	0.345	21.42	96.3	650	53.0
5	G19	52	419	16269	25.5	8038	12.6	1.689	0.374	22.13	95.8	638	49.0
Total / Ave.		**116**		**38304**	**59**	**8356**	**13.0**				**96.1**		**51.0**
2	CSR2	10	501	3780	6.0	8400	13.3	1.8	0.409	22.72	90.2	630	60.0
3	IPMD X N23	10	451	3150	5.0	8654	13.7	1.63	0.28	17.39	83.0	630	50.0
3	IPME (S) X CSR27	10	459	2850	5.0	7724	13.6	1.71	0.34	19.71	76.0	570	50.0
3	IPME (S) X CSR2	8	448	2240	4.0	7692	13.7	1.72	0.34	19.77	68.0	560	50.0
3	IPMER X CSR27	9	449	3200	5.0	9715	15.2	1.56	0.32	20.20	99.0	640	61.1
3	PM Ori AA X CSR 2	10	455	2610	4.5	7151	12.3	1.74	0.31	17.94	70.0	580	45.0
Total / Ave.		**47**	**452**	**14050**	**23.5**	**8175**	**13.7**				**79.2**		**51.2**

PEST MANAGEMENT LABORATORY

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

Narendra Kumar J B, Mahalingappa K C(from August 2018), Morrison N[1], Mahiba Helen S[2], Vijaya Naidu B[3]

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

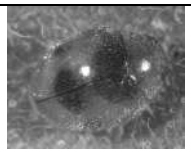
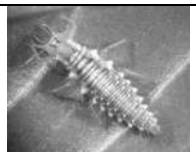
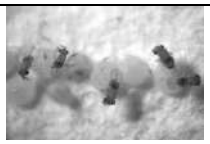
Objective: To maintain mother culture of bio-control agents for mass production, release and supply to stake holders

At main institute, nucleus cultures of three pupal parasitoids of uzi fly *viz., Nesolynx thymus*, *Trichomalopsis uziae*, and *Trichopria* sp. and two predators of mealy bug *Cryptolemous montrouzieri* & *Scymnus coccivora* besides host cultures of housefly and pink mealy bug were maintained throughout the year. 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 along with other components of IPM was effective in keeping the tukra and uzi fly incidence below ETL in the field.

Details of production of bio control agents by CSRTI and its nested units					
Centre	Quantity produced	Quantity sold	Amount (₹.)	Book adjustment	Amount (₹.)
CSRTI-Mysuru	*Nt*: 4329 *Sc/Cm*:307	3274 111	1,63,700 27,750	1,056 136	52,800 34,000
REC-Madivala	*Nt*: 384	383	19,200	-	-
RSRS-Salem	*Ap*: 500 *Cm:* 34	500 34	25,000 5,100	124 7	41,080

	Bp: 146 *Tc:* 64 *Bb:* 586 *Sc/Cm*: 1600	146 64 586 1600	21,900 3,200 29,300 3,200	96 39 333 450	
RSRS-Anantapur	Nt: 638	638	31,900	-	-
RSRS-Chamarajanagar	-	-	-	-	-
RSRS-Kodathi	-	-	-	-	-

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

		
Scymnus coccivora	*Nesolynx thymus*	*Acerophagus papaya*
		
Chrysoperla zastrowi	*Trichogramma chilonis*	*Bracon brevicornis*

Forewarning and forecasting of mulberry pests

J.B. Narendra Kumar, 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 (%)
Mysuru	Summer	3.10 ± 0.46	2.55 ± 0.66	0	0
	Rainy	4.06 ± 0.45	0.72 ± 0.39	0	2.94 ± 0.16
	Winter	3.28 ± 0.55	0.29 ± 0.17	0	5.18 ± 0.63
Salem	Summer	8.08 ± 1.49	6.52 ± 1.17	0	0
	Rainy	4.29 ± 1.03	4.01 ± 1.38	0	0.04 ± 0.04
	Winter	0.08 ± 0.05	0	11.13 ± 2.83	0
Eluru	Summer	18.86 ± 3.05	7.13 ± 0.32	1.30 ± 0.90	5.85 ± 0.59
	Rainy	14.58 ± 7.88	8.04 ± 4.56	1.01 ± 1.27	2.71 ± 1.42
	Winter	21.13 ± 3.62	15.79 ± 1.26	2.81 ± 0.56	5.40 ± 0.95

Pest Calendar for the selected places during the year 2018-19

<5	5.1-10	>10

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

Place	Pest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mysuru	Mealybug												
	Thrips												
	Leaf roller												
Salem	Mealybug												
	Thrips												
	Leaf roller												
Eluru	Mealybug												
	Thrips												
	Leaf roller												

SILKWORM PATHOLOGY SECTION

Continuous/Other Activities:

A.V. Mary Josepha and 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 the 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 and Tamil Nadu and also in the selected CPP clusters of Karnataka, Tamil Nadu, Andhra Pradesh and Maharashtra from Apr. 2018 to Mar. 2019. In the clusters 10 farmers' crops were monitored in every month and the data was uploaded in web site created for Silkworm disease monitoring. The point prevalence of grasserie was 1.32 %, Flacherie 1.54% and muscardine 0.53% during the survey period.

The point prevalence of grasserie disease in Tamil Nadu BSFS was 0 - 3.0% with an average incidence of 0.11%, flacherie was 0 - 7.0 % with an average of 1.82% and muscardine 0 -1.0 % and average muscardine incidence was 0.04%. In BSFs of Karnataka the grasserie incidence was 0 - 2.0% with an average of 0.03%, flacherie incidence was 0 - 1.0 % with an average of 0.1% and muscardine was 0 - 0.04%. Pebrine incidence was 0 - 1.0% with an average incidence of 0.03%.

In Andhra Pradesh clusters as per the survey the range of the point prevalence of grasserie was 1.3 - 9.08%, flacherie was 1.32 - 7.65% and muscardine was 0 - 2.17%, whereas the average incidence was 4.05%, 2.89% and 0.53% grasserie, flacherie and muscardine respectively. As per the farmer the range of grasserie incidence was 0 - 10.01%, flacherie 0 - 8.33% and muscardine 0 - 0.4% with an average incidence of 3.74, 2.54 and 0.05% of grasserie, flacherie and muscardine respectively.

In Karnataka clusters as per the survey the range of the point prevalence of grasserie was 0 - 2.0%, flacherie was 0 - 5.89% and muscardine was 0 - 6.4%, whereas average was 0.61, 1.78 and 1.78% of grasserie, flacherie and muscardine respectively. As per the farmer the range of grasserie incidence was 0 - 2.8%, flacherie 0 - 7.6% and muscardine 0-6.4% with an average incidence of 0.97, 2.5 and 1.46 % of grasserie, flacherie and muscardine respectively.

In Tamil Nadu clusters as per the survey the range of the point prevalence of grasserie was 0 - 2.9% and flacherie was 0 - 3.15% where as the average was 0.59 and 1.03% grasserie and flacherie. As per the farmer the range of grasserie incidence was 0 - 3.0% and flacherie 0 - 2.7% with an average incidence of 0.56 and 0.98 % grasserie and flacherie.

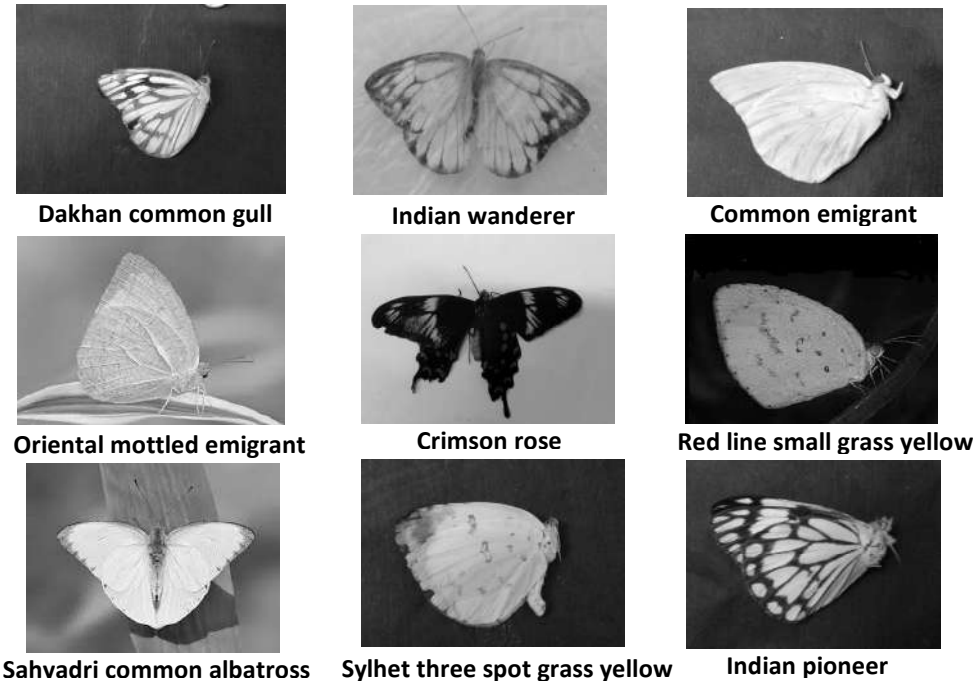
In Maharashtra clusters as per the survey the range of the point prevalence of grasserie was 0 - 1.0% and flacherie was 0.1 - 0.5%, whereas average incidence was 0.01 and 0.46% grasserie and flacherie. As per the farmer the range of grasserie incidence was 0 - 1.0% and flacherie 0.7 - 1.0% with an average incidence of 0.09 and 0.73% grasserie and flacherie. No muscardine incidence was reported during the period from Maharashtra and Tamil Nadu.

Pilot study

Comparative genomic analysis of transovarially transmitted and non transovarially transmitted pebrine causative agents

G. Mallikarjuna, Mary Josepha A.V. and P.C. Santha

Butterflies from mulberry gardens were collected to screen prevelance of different *Nosema* species. A total of 20 butterflies species and leaf roller samples were collected, out of which 09 butter fly species were found infected with Microsporidia. The microsporidian isolates were inoculated to silkworm to see the cross infectivity, virulence and the transovarial transmission. The infectivity varied from 1-96% in silkworm and hence the virulence. All the isolates were tranovarially transmissible.



Dakhan common gull | **Indian wanderer** | **Common emigrant**

Oriental mottled emigrant | **Crimson rose** | **Red line small grass yellow**

Sahvadri common albatross | **Sylhet three spot grass yellow** | **Indian pioneer**

Butterfly species with microsporidian infection

Ongoing Projects:

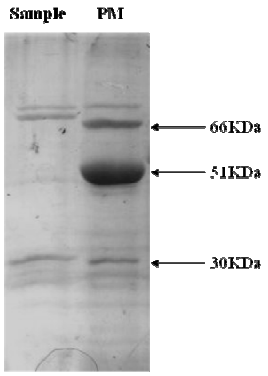
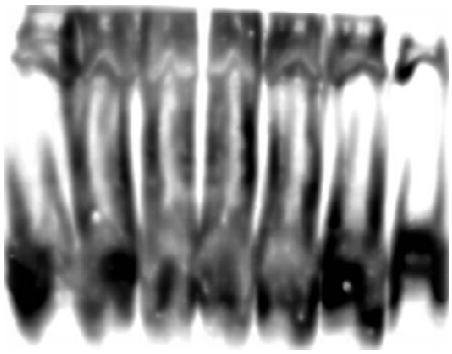
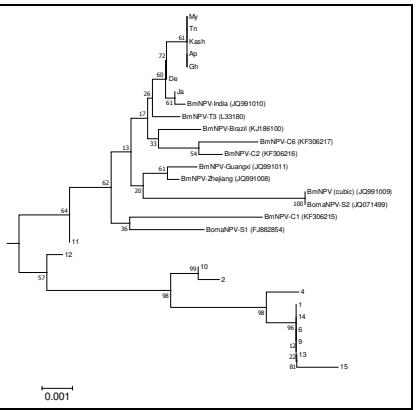
ARP-3607: Development of antibody based biosensor for early and rapid detection of silkworm viruses at Chawki Rearing Centres (Mar. 2017 to Feb. 2020) (In collaboration with CSRTI-Pampore)

Mudasir Gani*, Sahadev Chouhan*, Mary Josepha A.V. and L. Satish (*PI and CI from CSRTI-Pampore)

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

The purified BmNPV proteins were outsourced for antibody production. The sensitivity and specificity experiments of antibody received from the outsourcing company (Chromos Biotech, Bangalore) were conducted using ELISA and Western Blotting. The virus particles were collected from the haemolymph of BmNPV infected silkworm larvae. The purified virus particles were separated by SDS-PAGE and transferred onto nitrocellulose membranes by electrophoresis transfer. Anti BmNPV polyclonal antibodies, generated in rabbits, were used as primary antibodies and HRP-conjugated immunoglobulin G was used as the secondary antibody and the ELISA and western blot analyses was performed. BmNPV virus particles were detected as multiple bands by Western blotting. The haemolymph from healthy silkworm larvae did not reveal any bands using the same Anti-BmNPV polyclonal antibodies. Results clearly indicate that the available polyclonal antibodies are specific to BmNPV and can be used for the development of BmNPV diagnostic kit.

		
12% SDS-PAGE profile of purified BmNPV virus particles (Sample – BmNPV, PM – Protein marker)	Western blot analyses of BmNPV virus particles with anti-BmNPV polyclonal antibodies	Phylogenetic tree showing the relationship of the different BmNPV sequences with the BmNPV India isolate, Genbank accession No. JQ991010.

The BmNPV samples collected during the survey from different locations from both south India and north India were sequenced and the Polh, lef-8 and lef-9 gene sequences were obtained from the sequencing partner. The phylogenetic analyses by including all known isolates which are submitted to Gen–Bank shows that Mysore, Tamil Nadu, Kashmir, Andhra Pradesh and Ghumarwin samples cluster together and the isolates Dehradun and Jammu seem to be more different but still close to the BmNPV-India isolate (Genbank accession no. JQ991010). 21 sequences were submitted to NCBI with accession numbers from MK415956 to MK415976.

Other/Continuous Activities:

Pebrine monitoring in breeder's stock and seed multiplication units

- Conducted one pebrine monitoring meeting including all the scientists involved in the pebrine monitoring at different BSFs.
- Pebrine monitoring done in P4 BSF Hassan, P3 BSF Mysuru, SSBS Coonoor, Breeders' stock of BBL, MBL and all silkworm rearings of CSR&TI, Mysuru throughout the year and kept the microsporidian infection under check.
- 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.

Maintenance of the pure culture of the silkworm pathogens

Pure culture, spores and inoculums of all the silkworm pathogens *viz.,* bacteria, fungi, microsporidia and virus are maintained for experimental purpose.

Field problems resolved: Resolved 32 field problems related to disease incidence and crop loss.

Sensitization of stakeholders:

- During the period a total of 409 farmers/students/officers/officials who visited the silkworm pathology section were sensitized on silkworm diseases and their management
- Issued 32 quality analysis reports to different companies
- Carried out bioassay experiments for field complaints on the products developed by CSRTI-Mysuru
- Inoculated different batches of breeding experiments in BBL and MBL with virus
- 10 MSc students carried out dissertation work at silkworm pathology laboratory. The work done by them includes:
  - Isolation of entomopathogenic fungi from the soil from 20 plots in CSRTI-Mysuru and 4 from Gobichettipalayam, Thanjavur and Udumalpet. The fungi isolated include *Fusarium* spp., *Aspergillus spp.* and *Metarrhizium anisopliae.*
  - Isolated the fungi from silkworm infected with muscardine and identified them. The Green muscardine infected silkworms were having multiple infections with *Isaria* sp. *Penicillium* sp. and *Aspergillus* sp. in addition to *Metarrhizium* sp.
  - Isolated bacteria from the midgut of diseased silkworms and identified 24 species which includes *Neisseria catarrhalis, Halobacterium saccharovorum, Spirosoma lingual, Pseudomonas sp. Streptococcus sp. Staphylococcus sp. and Serratia marcescens*
  - Isolated soil fungi and bacteria and entophytic fungi and bacteria from root and leaves and phylloplane bacteria and fungi from leaves from organic garden of CSRTI-Mysuru and compared it with one of the inorganically maintained garden to evaluate the effect of organic culture method on the population of micro organisms. Beneficial bacteria viz., *Azotobacter, Brady Rhizobium*, *Rhizobium, Bacillus subtilis, Acineto bacter etc.,* was more in number in the organic garden. *Chaetomium* sp. a beneficial fungus which controls pathogenic fungi was more in number in the organic field. Pathogenic fungi were present in both normal and organic plot but the fungal load was more in normal soil.

POST COCOON EVALUATION UNIT

Shivakumar Hukkeri M and Chandrashekar M N

Post cocoon evaluation unit was involved in various activities in many research projects, cocoon assessment, reeling performance assessment, human resource development in post cocoon activities, demonstration of technologies, creation of awareness of technology, information of economics of the post cocoon technologies to the visitors, trainees, dignitaries and general public. The section has helped many trainees by demonstration of technologies, practical and theoratical training to produce international grade silk. The section has helped breeders by working on cold directional reeling which has shown improvement in the filament length over the silk worm generations. The section has worked as main link between CSRTI sub units and the main institute to dispose off excess cocoons, defective cocoons, etc., The center also helped the sub station units and the different sections in the main institute by assessing the cocoon and its reeling performance.The total of 2082 cocoon lots, out of which 209 lots were received from RSRS-Salem, RSRS-Kodathi, RSRS-Chamarajanagar, RSRS-Anantapur, REC-Rayachoty, P4 Hassan and SSBS Coonoor. From the different sections of the institute 1045 lots were test reeled and 828 lots were of BBL/MBL sections were cold reeled and mono-cocoon assessment of cocoons were done, to help breeders to improve some of the cocoon characters like filament length, cohesion and tensile properties.

Cocoon lots received from the extension units	
Station	No.of cocoon lots
REC-Rayachoty	09
P4-Hassan	63
RSRS-Salem	08
RSRS-Kodathi	14
RSRS-Anantapur	25
RSRS-Chamarajanagar	06
SSBS-Coonoor	84
Total	209

Cocoon lots received from different sections of the Institute	
Sections	No.of Cocoon lots
MBL	386
BBL	417
TVDC	13
SW Physiology	100
SW Genetics	129
Total	1045

The cocoons were assessed for their reeling performance under various research projects.

1.**AIB- 3577:** Evaluation of multivoltine germplasm to identify potential parents for developing cross breeds for Southern and Eastern India

2. **PPA- 3522:** Development of technology for production of organic silk

3. **AIT-3593:** Transcriptome analysis of silkworm for identification of molecular markers for improvement of silk quality

4. **AIB -3524:** Improvement of Pure Mysore race for productivity and silk quality

5. **AIB -3534:** Development of improved crossbreeds of silkworm *Bombyx mori L*. suitable for south India

SERICULTURAL ENGINEERING DIVISION

Developing entrepreneurship for disinfection of silkworms rearing houses and silk cocoon harvesting

Satish Verma (upto June 2018) and V. Sivaprasad (upto Jan. 2019) and Venkat Reddy

Objectives

- Demonstration and popularisation of power sprayers for 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 were 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.

Fabrication 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 and kept 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.

Fabrication: A total of 35 machines, Tray washing machine (18 units), Cocoon harvestor (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 in 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 AND MANAGEMENT DIVISION

N. G. Selvaraju, A. Mahima Santhi, G. S. Geetha, Joycy Rani Dasari, and H.M. Munnikrishnappa

Concluded Project:

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

G.S. Geetha, Joycy Rani Dasari, K.P. Kiran Kumar and G. Punithavathy

Objectives:

- To study the impact of extension communication and training programmes on women involved in sericulture
- To ascertain the relationship between knowledge and adoption of new technologies and enhanced economic status
- To find out effectiveness of technology support and common facilities on improvement in socio economic status of seri women

The study was conducted in four southern sericulture states *viz.,* Karnataka, Andhra Pradesh, Tamil Nadu, and Telangana where CPP is in operation at present. Multistage stratified random sampling approach was used for selecting clusters in each state. In the first stage, from each state, 20% of the total clusters under operation were covered randomly while taking into account the region and location of clusters. In the second stage, from each cluster villages were identified based on the maximum sericulture households for the survey. In the final stage, the beneficiaries were selected from each village randomly based on the beneficiaries list from the respective DoS office. Thus the total sample size of beneficiaries came to 160. The primary data was collected by using pre tested interview schedule. The schedule included 10 interventions at individual level and five at community level besides information participation in Extension Communication Programmes and their perceptions regarding the intervention(s), and suggestions for improving further. The available data at the state level from secondary sources was also utilized effectively.

Linear regression model was used to calculate impact of participation in extension communication and training programmes on cocoon yield and impact of socio economic variables on participation in extension communication programmes.

Participation in Extension Communication and Training Programmes Index									
Category	Participation Index	Karnataka		Tamil Nadu		Andhra Pradesh		Telangana	
Low	<2	36	45	7	14.58	1	4.17	8	53.33
Medium	3-4	15	18.75	27	56.25	15	62.50	7	46.67
High	<4	29	36.25	14	29.17	8	33.33	0	0

Impact of technologies was calculated by using paired t test to compare before and effect of Cluster Promotion Programme for all ten technology interventions at individual level and four at community level.

Extent women farmers' participation in extension communication and training programmes was computed and found that 46.04 medium participants followed by 29.27(%) low and 24.68(%) high participants. The extension communication activities were group discussions, farmers day, field days, awareness programmes, enlightment programmes, demonstration of technologies, resham krishi melas, study tours and training programmes conducted by Central Silk Board extension units, Department of Sericulture extension units, Sericulture Training Schools, Krishi Vignan Kendras etc. The topics covered under extension communication and training programmes were mainly need based and new technologies. The new technologies included were soil testing, tree plantation, wider spacing, application of fertilizer, selection of leaf, drip irrigation, composting, trenching and mulching, disinfection, disposal of seri waste, spacing of worms, maintenance of temperature and humidity, use of bed disinfectants, spinning care, cocoon harvesting techniques and mechanization.

Impact of participation: Impact analysis was conducted to find out the effectiveness of participation in extension communication and training programme on improvement in cocoon production and influence of socio economic parameters on participation in extension communication programmes using regression analysis.

The results of the study indicated that participation in extension communication and training programmes facilitated women farmers to interact and learn technologies as it happened in their villages and with homogenous group.

Impact of participation in extension communication and training on cocoon yield					
Variable	DF	Parameter estimate	Standard Error	t value	Pr>(t)
Intercept	1	72.346	1.529	47.31	< .0001
ECP	1	1.447	0.359	4.03	0.0001

The coefficients of participation in extension communication programme and training was positive and statistically significant at CD 0.01 level. Participation in one unit resulted in 1.44 unit increase in cocoon yield. This implied that the participation in extension communication and training programmes played an important role in giving access to information, participation, and interaction with extension personnel, learning and educating the farmers to adopt new technology interventions. The regression analysis also revealed that awareness of CPP, age, caste, education, land holding, sericulture experience, income and membership to local bodies did not have any significant association with the adoption of technology interventions at 0.05% confidence level.

Impact of socio economic parameters on participation in ECPs				
Variable	DF	Number	Wald Chi-Square	Pr> ChiSq
Age	1	1	2.7111	0.0997
Caste	1	5	0.4031	0.5255
Income	1	6	0.5067	0.4766
Education	1	0	1.9433	0.1633
Experience	1	2	2.3452	0.1257
Awareness of CPP	1	7	0.0002	0.9879
Land holding	1	4	2.0409	0.1531
Membership in local bodies	1	3	1.7336	0.1880

Analysis of maximum likelihood estimates						
Variable	DF	Parameter estimate	Standard Error	Wald Chi-Square	Pr>(t)	Exp (Est)
Socio Economic Variables	1	-2.4277	0.4259	32.4964	< .0001	0.088

Adoption of technology interventions at individual farmers level: Adoption of technologies before and after the advent of Cluster Promotion Programme at individual and at community level was worked to find out the adoption levels and the same were categorized accordingly. Adoption coefficient was worked out to study the impact of technology interventions. For this purpose, full adoption, partial adoption and nil adoption scored for each technology intervention and the total score (actual score) was worked out for each farmer based on the level of adoption of the technology intervention recommended for mulberry sericulture. Then the adoption coefficient was computed for each farmer by using the formula.

$$\text{Adoption Index} = \frac{\text{Farmers total score}}{\text{Total score obtainable}} \times 100$$

Adoption of technology interventions at individual farmer's level					
Technologies/ interventions	Extent of adoption (%)			Adoption score	Adoption Index
	Full	Partial	Nil		
New mulberry plantation	88.75	-	11.25	142	88.75
Drip Irrigation	60	-	40	96	60
Rearing house	73.75	-	26.25	118	73.75
Mounting hall	7.50	-	92.50	12	7.50
Trenching and mulching	45	-	55	72	45
Disinfectant usage	92.5	-	7.5	148	92.50

Rearing appliances	23.75	-	76.25	38	23.75
Bio-fertilizer	30	-	70	48	30
Mountages	58.75	-	41.25	94	58.75
Mechanization	46.25	-	53.75	74	46.25

Adoptions of technologies interventions at community level					
Technologies/ interventions	Extent of adoption (%)			Adoption score	Adoption index
	Full	Partial	Nil		
Kissan nursery	43.75	-	56.25	70	43.75
Seri poly clinic	2.50	-	97.50	4	2.5
Bio control agents production unit	2.50	-	97.50	4	2.5
Chawki rearing centre	87.5	-	12.5	140	87.50

Among ten technology interventions under Cluster Promotion Programme, usage of disinfectants (92.50%), plantation of new mulberry variety (88.75%) and separate rearing House (73.75%) and drip irrigation (60%) were adoption percentage was high followed by mountages, mechanization and trenching and mulching. The least adopted technology interventions are mounting hall and bio fertilizers. Similarly under community interventions chawki rearing centre (88.75%), kissan nursery (43.75%) were the most adopted interventions. Seri poly clinic and bio control agents production units are yet to be popularized among farmers.

Impact of technologies: All the ten technologies at individual level and four at community level were subjected to statistical tool paired t test to understand the significance of technologies and their impact. All technologies were found statistically highly significant CD 0.01% level.

Impact of technologies - Paired t test					
Technologies	Mean of differences	t-value	Significance level	Degrees of freedom	P value
New mulberry plantation	-3.379	-21.979	1%	57	<0.0001
Drip Irrigation	-1.380	-22.854	1%	46	<0.0001
Trenching & mulching	-0.658	-15.451	1%	35	<0.0001
Mounting hall	-13.33	-12.649	1%	5	<0.0001
Rearing house	-15.73	-17.096	1%	54	<0.0001
Mechanization	-12.77	-15.012	1%	30	<0.0001
Mountages	-12.6	-8.32	1%	9	<0.0001
Disinfectant usage	-17.41	-15.122	1%	57	<0.0001
Rearing appliances	-12.93	-33.284	1%	31	<0.0001
Bio fertilizer	-2.64	-12.878	1%	20	<0.0001

Impact of Cluster Promotion Programme on economic aspects			
Particulars	Cluster Promotion Programme		
	Before	After	Improvement (%)
Mulberry leaf yield (ac/yr) MT	13.05	16.43	25.90%
Dfls consumption(ac/yr) no.	774.60	1050.00	35.55%
Cocoon yield (kg/100 dfls) kg	59.68	68.17	14.22%
Cocoon price (₹/kg)	261.82	404.23	54.39%
Total cocoon production (ac/year) kg	462.28	715.78	54.83%
Cost of cocoon production (ac/year) ₹.	224.97	252.95	12.43%
Total Income	121034	289339	139.05%

Adoption of technology interventions is essential to realize the potential yield levels. The before and after impact of CPP was worked out to find out the impact and improvement in cocoon production. The impact rate of adoption of technology interventions have been higher in total cocoon production, fetching higher price for cocoons increased consumption of dfls and thereby achieving more income. Improved technology interventions like high yielding mulberry variety, installation of drip system for the mulberry gardens, practicing trenching and mulching in mulberry gardens and mechanization as per the recommendations to improve the soil and garden fertility and increased mulberry leaf production. Under community intervention kissan nurseries were developed for the free supply or low cost of improved mulberry variety, availability of new mulberry variety saplings through kissan nurseries at free of cost or very cheaper rate motivated farmers to take up new mulberry variety. The high yielding variety and its increased leaf yield made them brush more dfls per acre of mulberry garden. Practices like disinfection, use of mountages and separate rearing house were practiced fully as recommended by the majority of the sample farmers. Chawki rearing centers (CRCs) were developed for disease free supply of bivoltine silkworms after rearing for a week and supplying to farmers after 2nd moult. This CRC concept not only reduced the burden of rearing by one week but also increased the quality and quantity of cocoon production for 100 dfls. It enabled them increase the cocoon production per 100 dfls and there by total cocoon production and increased income. Poor economic conditions did not permit the farmers to construct separate mounting hall for keeping mountages. The technology interventions like use of bio fertilizer and trenching and mulching was taken up only, when provided and assisted by state sericulture departments free of cost. The study also established that Cluster Promotion Programme had bestowed women with more access and participation in extension communication programmes, extension personnel particularly cluster development facilitators (CDF) of CSB and DOS. membership in local bodies particularly Self Help Groups made women to have easy and hassle free access to credit.

Constraints and suggestions of the farmers were listed and ranked, the main constraints were, insufficient water, fluctuations in cocoon price, requirement of mountages, support price for cocoons, more financial support for construction of rearing house and supply of equipments on subsidized price. The suggestions to over come the constraints were provision of drip irrigation facilities, relaxation in providing subsidy for construct-ion of rearing house and mountages, conducting localized training and ECPs for women and also conducting of exposure visits to progressive farmers, cocoon price regulation and supply of tiller, weeder, plougher, mini tractor through SHG.

Impact of Cluster Promotion Programme on social aspects			
Particulars	Cluster Promotion Programme		
	Before	After	Improvement
Access to credit	49	72.78	48.53%
Access to extension personnel	62	93.40	50.64%
Access to extension communication activity	48	73.90	53.95%
Access to training	-	40	40%
Access to community intervention	20	33	65%
Access to local bodies - Self Help Group	56	100	78.57%

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 analyze the feasibility of different seri-business enterprises in pre cocoon sector and develop optimum business plans to facilitate fund flow

Data collected from various enterprises selected under the study *i.e.,* Chawki Rearing Centres (CRCs), mulberry nurseries, seed production centers, bio control agent production units, mobile disinfection units, mounting halls were analyzed and business models were prepared to each enterprise using discounted cash flow techniques such as the Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit Cost Ratio (BCR). Tabular presentation was used to compile the investment pattern analysis. Cost structure, returns and profits of various seri enterprises was studied using budgeting technique. Simple statistical tools like averages and percentages were used to compare, contrast and interpret results obtained. The data obtained was utilized to calculate the returns, repayment capacity, risk bearing ability and returns per rupee investment of the entrepreneurs for obtaining bankable business models.

- The fixed costs include apportioned costs of establishment of unit, depreciation on farm implements / equipments / appliances and interest on fixed capital
- The variable costs include recurring expenditure in running the unit/rendering services valuated per annum
- The gross income was valued at total value of output sold plus returns from by products
- Net income was arrived at by deducting the total cost of production from gross income
- The costs and returns were worked out per annum for each enterprise specifically

The financial and economic analysis of these enterprises revealed their economic viability with high returns. Benefit-Cost ratio of all the enterprises considered was above 1 (CRC - 1.24, mulberry nurseries - 1.55, bio control agents production units - 1.24, mounting halls - 1.80, mobile disinfection units - 1.42, seed production units - 1.11) indicating that the enterprises were able to cover the investment cost and operating expenditures in order to obtain additional returns. The economic analysis reveals that the aggregated benefits from these enterprises was positive *i.e.* Net Present Value of Rs. 24.05 lakhs for CRC, Rs. 6.93 lakhs for mulberry nurseries, Rs.6.4 lakhs for bio control production units, Rs. 3.36 lakhs for mounting halls, Rs. 4.72 lakhs for two wheeler mounted units, Rs. 8.07 lakhs for four wheeler mounted units, Rs. 103 lakhs for seed production units and all these enterprises can be promoted further for significant contribution to the promotion of sericulture industry.

Financial analysis of seri enterprises						
Name of the enterprise		Financial indicators				
		Net present value (Rs. in lakhs)	Benefit cost ratio	Internal rate of returns (%)	Break even point	Pay back period (years)
CRCs		24.05	1.24	33.00	3.47 lakhs	2.20
Mulberry nurseries		6.93	1.55	41.62	1.62 lakhs	1.40
Bio control agents production units		6.4	1.24	31.00	3800 *Nt* pouches 350 boxes of beetles	2.00
Mounting halls		3.36	1.80	23.72	15 batches	1.70
Mobile disinfection units	2 wheeler mounted	4.72	1.42	49.66	-	1.80
	4 wheeler mounted	8.07	1.51	45.44	-	1.20
Seed production centres		103.28	1.11	32.48	83.42 lakhs	3.85

Recommendations:

- The seri business models would also be an integral part of the human resource activities aimed at entrepreneurship development and it provides an opportunity for the potential entrepreneurship to approach the financial institutions with the developed enterprise specific business models. The new seri enterprise models developed for Chawki Rearing Centre (CRC), mulberry nursery, bio control agents production unit, mobile disinfection unit, mounting hall, seed production centres were found to be economically and financially feasible based on the cross sectional study in three southern states of India (Karnataka, Tamil Nadu and Andhra Pradesh).
- Those seri business models would facilitate easy and just decision by the financial institutions for the promotion of flow of finance to these enterprises and ascertain the investment needs of seri entrepreneurs are met.
- To promote self employment opportunities for the rural entrepreneurs, thereby, rural migration could be arrested to some extent.

Cluster Promotion Programme: Cluster Promotion Programme (CPP) - XII plan (2012 - 2017), which was implemented by Central Silk Board in collaboration with the Departments of Sericulture (DOS) of southern states, was extended for another three years and continued in 2018-19 also. The CPP clusters in the southern zone were monitored by CSRTI, Mysore. The southern zone includes 106 clusters of Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Maharashtra, Madhya Pradesh and Kerala.

Targets of the clusters for 2018-19 were fixed based on farmers profile and potentiality. The Director, CSRTI-Mysuru is the south zone coordinator, the heads of SEEM division & RSRS were the nodal officers for effective implementation of CPP. Each cluster is directly monitored by two Cluster Development Facilitators (CDFs) each nominated by Central Silk Board and State Department of Sericulture. The name and designation of the CDFs are listed below

Cluster Development Facilitators (CDFs)		
Karnataka		
Cluster	CSB	DOS
Andaralahalli	Mr. Ishwar, Sci.-D, RSRS-Kodathi	Dr. Sundar Raj, ADS-Chikballapura
Aurad	Mr. S Ramesh Kumar, Sci.-C, REC-Bidar	Mr. G.C. Biradar, SEO, TSC-Aurad
B.R. Koppalu	Dr. A. Mahima Santhi, Sci.-D, CSRTI-Mysuru	Mr. Maheshkumar Vage, ADS-S.patna
Bannikuppe	Mr. A. Manjunath, TA, RSRS-Kodathi	Mr. K.S. Kumarasubramanyam, ADS-Ramanagara
Belgaum	Mr. Mallannanavar, TA, SSC-Belgaum	Mr. G.B. Mallannavar, ADS, DOS-Belgaum
Bevuru	Dr. D. Guruswamy, Sci.-C, REC-SU-Maddur	Mr. D. G. Manjunatha, ADS-Channapatna
Bidarakote	Dr. D. Guruswamy, Sci.-C, REC-SU-Maddur	Mr. Madesh, SEO, TSC-Koppa, Maddur
Bijapur	Mr. Shreeshail Bheewa Arjune, TA, REC-Koppal	Mr. B.Y. Biradar ADS-Bijapur
Challakere	Mr. G.N. Niranjana Murthy, TA, REC-Chitradurga	Mr. K. Kenchojirao, ADS-Challakere
Channarayapatna	Smt. P. Sarawathi, Sci.-D, RSRS-Kodathi	Smt. K. Gayathri, ADS-Devanahalli
D. Halasahalli	Dr. S. Purushotham, Sci.- D, CSRTI-Mysuru	Mr. Surendera Murthy, SEO-D. Halaslahalli
Davanagere	Dr. Y. Srinivasulu, Sci.-C, REC-Chitradurga	Mr. A. Sreeharsha, ADS-Davanagere
Doddalahalli	Mr. B. Kalaiah, TA, CSRTI-Mysuru	Mr. Muthuraju, ADS-Kanakapura
Gajanur	Mr. Ramesh, Sci.-D, SSPC-Malavalli	Mr. M. Mallikarjuna Swami, ADS-Malavalli
Gouribidanur	Dr. Manohar Reddy, Sci.-D, SSPC-Hindupur	Mr. Muralidhara, ADS-Gowribidanur
H.D. Kote	Dr. B.T. Srinivasa, Sci.-D, CSRTI-Mysuru	Mr. B. Keshavamurthy, 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. Boopathi, FA, SSPC-Bangalore	Mr. M.S. Patil, ADS-Haveri
HB halli	Dr. Raveendra Mattigatti, Sci-D, REC-SU-Kudligi	Mr. V. Sudheer ADS, Sandur Road-Kudligi
Hiriyur	Mr. K.B. Shivanna, TA, REC-Chitradurga	Smt. C.D. Usha, ADS-Chitradurga
Humnabad	Mr. S. Ramesh Kumar, 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
Jamakhandi	Mr. Shreeshail Bheewa Arjune, TA, REC-Koppal	Mr. S.M, Deshpande ADS-Jamakhandi
K.R. Nagar	Mr. K R Ganesh, TA, CSRTI-Mysuru	Mr. Varanagabhushan, ADS-K R Nagar
Kanakapura	Dr. D. Guruswamy, Sci.-C, REC-Maddur	Mr. Muthuraju, ADS-Kanakapura
Gulburga	Mr. S Ramesh Kumar, Sci.-C, REC-Bidar	Mr. Prakash Babu, ADS-Kalburgi
Kudligi	Dr. Raveendra Mattigatti, Sci.-D, REC-SU-Kudligi	Mr. V. Sudheer ADS-Kudligi
Kurudumalai	Dr. M. Noble Morrison, Sci.-D, REC-Madivala	Mr. M. Venketesh, ADS, DoS-Mulabagal
Lingasugur	Mr. J. Justin Kumar, TA, REC-SU-Koppal	Mr. Rajendrakumar DDI/C, ADS-Lingasugar

Ranebennur	Mr. G. Papaiah, TA, REC-Chitradurga	Mr. Angadi ADS-Ranebennur
Ravugodlu	Dr. B.A. Parthasarathy, Sci.-D, SSPC-Bangalore	Mr. Satish, ADS-Kengeri
Shahapura	Mr. J. Justin Kumar, TA, REC- SU-Koppal	Mr. Tellur Nadaf, SEO, TSC-B. gudi
Shapur (Kolar)	Dr. M. Noble Morrison, Sci.-D, REC-Madivala	Mr. Manjunatha, ADS, DoS-Kolar
Shirahatti	Mr. A P Raghavendra, FA, REC- SU-Koppal	Mr. Mudgal, ADS-Gadag
Sidlaghatta	Dr. P.M. Muniswamy Reddy, Sci.-C, SSPC-Vijayapura	Mr. Bojanna, ADS-Siddalaghatta
Sira	Mr. U. D. Ramu, TA, RSRS-Kodathi	Mr. Mohan, ADS-Sira
Soraba	Dr. Y. Srinivasulu, Sci.-C, REC-Chitradurga	Mr. K.J. Tamanna-gowda ADS-Shivamoga
T. Narasipura	Dr. S.N. Pallavi, Sci.-D, RSRS-Chamarajanagar	Mr. C.R. Krishna, ADS-T. Narasipura
Tekal	Dr. J. Ravikumar, Sci.-D, SSPC-Chintamani	Mr. Aswathanarayana, ADS, DOS-Maluru
Thorshettihalli	Dr. D. Guruswamy Sci.-D, REC-SU-Maddur	Sh. Madesh, SEO,TSC-Koppa, Maddur Taluk
Tubagere	Dr. M. Venkatachalapathy, Sci.-D, RSRS-Kodathi	Mr. Anjanamurthy, ADS, DOS-Doddaballapura
Tumkur	Mr. U. D. Ramu, TA, RSRS-Kodathi	Dr. Balakrishnappa ADS-Tumkur
Y.N. Hosakote	Sri. G. Papaiah, TA, REC-Chitradurga	Mr. R. Ranganath ADS, DOS-Tumkur
Yelburga	Dr. A. Umesha, Sci.-C, REC-Koppal	Mr. C.H. Mudagal ADS- Narebenchifarm, Kustagi
Yeldur	Dr. J. Ravikumar, Sci.-D, SSPC-Chintamani	Mr. M. Nagaraju, ADS, DOS-Srinivasapura

Cluster Development Facilitators (CDFs)		
Tamil Nadu		
Clusters	CSB	DOS
Adaikalapattinam	Dr. S. Rajaram, Sci.-D, REC-Samayanallur	Mr. P. Ramadurai, ADS-Tenkasi
Alankayam	Dr. S. Balasaraswathi, Sci.-D, RSRS-Salem	Mr. M. Sabarish, AIS, TSC-Alankayam
Alangudi	Dr. S. Rajaram, Sci.-D, REC-Samayanallur	Mr. L. Chandrasekaran, ADS-Trichy
Annur	Dr. E. Rajalakshmi, Sci.-D, REC-Gobichettipalayam	Mr. N. Chandran, AIS, TSC-Annur
Anthiyur	Dr. N. Dhahira Beevi, Sci.-D, RSRS-Salem	Sel. M. Sangavi, AIS, TSC-Bhavani
Bagalur	Dr. K. Jhansilakshmi, Sci.-D, REC-Krishnagiri	Mr. C.P. Jayaraman, AIS, TSC-Bagalur
Berigai	Dr. K. Jhansilakshmi, Sci.-D, REC-Krishnagiri	Mr. C. Balakrishnan, AIS, TSC-Berigai
Bhavani	Dr. N. Dhahira Beevi, Sci.-D, RSRS-Salem	Sel. M. Sangavi, AIS, TSC-Bhavani
Dharapuram	Dr. P. Samuthiravelu, Sci.-D, REC-Udumalpet	Mr. S. Muneeswaran, AIS, TSC- Dharapuram
Dharmapuri	Dr. V. Chinnadurai, Sci.-D, SSPC-Dharmapuri	Mr. R. Elangovan, AIS, TSC-Dharmapuri
Gobi South	Dr. E. Rajalakshmi, Sci.-D, REC- Gobichettipalayam	Sel. M. Sangavi, AIS, TSC-Bhavani
Gudimangalam	Dr. K. Chandrasekharan, Sci.-D, REC-Udumalpet	Mr. K. Samuthirapandi, AIS., TSC-Gudimangalam
Keeranur	Sri. T. Sivasubramonian, Sci.-D, REC-Samayanallur	Mr. M. Thangaraj, ADS-Dindigul
Kodiyalam	Dr. K. Jhansilakshmi, Sci.-D, REC-Krishnagiri	Mr. C.P. Jayaraman, AIS, TSC-Bagalur
Kottur	Dr. K. Chandrasekharan, Sci.-D., REC-Udumalpet	Mr. T. Sathish kumar, AIS, TSC-Pollachi
Kumaralingam	Dr. C.M. Babu, Sci.-D, REC, Udumalpet	Sel. R. Soundarya, AIS., TSC-Udumalpet
Madathukulam	Dr. C.M. Babu, Sci.-D, REC-Udumalpet	Sel. R. Soundarya, AIS., TSC-Udumalpet
Manurpalayam	Dr. E. Rajalakshmi, Sci.-D, REC- Gobichettipalayam	Mr. S. Muneeswaran, ASI, Manurpalayam
Ottanchathiram	Sri. T. Sivasubramonian, Sci.-D, REC-Samayanallur	Mr. M.Thangaraj, ADS, Dindigul
Palani	Sri. T. Sivasubramonian, Sci.-D, REC-Samayanallur	Mr. M. Thangaraj, ADS, Dindigul
Pitchandampalayam	Dr. E. Rajalakshmi, Sci.-D, REC- Gobichettipalayam	Sel. M. Sangavi, AIS, TSC-Bhavani
Pollachi	Dr. K. Chandrasekharan, Sci.-D, REC-Udumalpet	Mr. T. Sathish Kumar, AIS., TSC-Pollachi
Pongalur	Dr. E. Rajalakshmi, Sci.-D, REC-Gobi	Mr. R. Nagarajan, AIS, Pongalur
Poolavadi	Dr. C.M. Babu, Sci.-D, REC-Udumalpet	Mr. K. Samuthirapandi, AIS., TSC-

		Gudimangalam
Sanarpatti	Sri. T. Sivasubramonian, Sci.-D, REC-Samayanallur	Mr. M. Thangaraj, ADS, Dindigul
Srivilliputhur	Dr. S. Rajaram, Sci.-D, REC-Samayanallur	Mr. P. Ramadurai, ADS , Tenkasi
Udumalpet	Dr. P. Samuthiravelu, Sci.-D, REC-Udumalpet	Sel. R. Soundarya, AIS, TSC-Udumalpet
Uthangarai	Dr. K. Jhansilakshmi, Sci.-D, REC-Krishnagiri	Mr. R. Ashok, TA, Krishnagiri

Cluster Development Facilitators (CDFs)		
Kerala		
Clusters	CSB	DOS
Palakkad	Smt. K. Sarala, Sci.-D, REC-Palakkad	Mr. E. Sasi, ASO, DRDA-Palakkad
Kozhikode	Smt. K. Sarala, Sci.-D, REC-Palakkad	Mr. Salim, ASO, DRDA-Wayanad

Cluster Development Facilitators (CDFs)		
Andhra Pradesh		
Clusters	CSB	DOS
Atmakuru	Dr. P. Venkataramana, Sci.-D, REC-SU-Atmakur	Mr. D. Anjaneyulu, SO, TS-Atmakur
Bhimadole	Dr. T.V. S. Srinivasa Rao, Sci.-D, REC-Eluru	Mr. M. Subba Rao, SO, Bhimadole
Chebrolu	Dr. T.V.S. Srinivasa Rao, Sci.-D, REC- Eluru	Mr. K. Appa Rao, SO, TSC-Chebrolu
Chittoor	Dr. P. Srinivasulu Reddy, Sci.-D, REC- V.Kota	Mr. K. Yholachya Naik, ASO, DoS, Chittoor
Giddalur	Dr. P. Venkataramana, Sci.-D, REC-SU-Atmakur	Mr. M. Lakshminarayana, SO, TSC, DoS, Giddalur
Hindupur	Dr. P. Sudhakar, Sci.-D, RSRS-Anantapur	Mr. T. Nagaraju, ASO, TSC, Hindupur
Kalyanadurgam	Dr. K. P. Kiran Kumar, Sci.-D, RSRS-Anantapur	Mr. I. Vijaya Kumar, ADS I/C, DoS, Kalyandurgam
Madakasira	Mr. S. Md. Arif, TA RSRS-Anantapur	Mr. P. Ramamohan, SO, TSC, DoS, Madakasira
Palamaner	Dr. P. Srinivasulu Reddy, Sci.-D, REC- V. Kota	Mr. M. Saroja, ASO, TSC-Palamaner
Pattikonda	Dr. P. Venkataramana, Sci.-D, REC-SU-Atmakur	Mr. M. Suresh Kumar, SO, TSC-Dhone Kurnool District
Penukonda	Dr. P. Sudhakar, Sci.-D, RSRS-Anantapur	Mr. T. Venkataramanappa, ADS I/C, DoS, Penukonda
V. Kota	Mr. S. Nazeer Ahmed Saheb, Sci.-C, REC-V. Kota	Mr. Hanumantharaya, SO, TSC-V. Kota
Vijayawada	Mr. W. Veerabhadra Rao, TA, SSC-Vijayawada	Mr. LKVD Prasada Rao, TO, TSC-Challapalli
		Smt. S. Tulasamma, TO, O/o ADS, DoS, Guntur

Cluster Development Facilitators (CDFs)		
Telangana		
Clusters	CSB	DOS
Bhongir	Dr. K. Praveen Kumar, Sci.-D, RSRS-Mulugu	Mr. S K.Naseema, Horti./Seri Officer, Atmakur
Metpalli	Mr. B. V. Sanjeeva Rao, Sci.- D, RSRS-Mulugu	Mr. D.Muralidhar Reddy, ADS, Balasamudram, Hanumakonda
Suryapet	Dr. K. Praveen Kumar, Sci.-D, RSRS-Mulugu	Mr. Jagan Kanna, Horti./Seri Officer, Atmakur
Zaheerabad	Dr. B. Srinath, Sci.-D, REC-Vikarabad	Mr. Athi Reddy, SO, Zaheerabad

Cluster Development Facilitators (CDFs)
Maharashtra

Clusters	CSB	DOS
Akola	Mr. RV Kushwaha, Sci.-D, REC-Amravati	Mr. S.S. Shinde, SDO, Akola
Beed	Mr. Ramprakash Sci.-D, REC-Aurangabad	Mr. V. S. PAWAR, A.D, DSO, Beed
Buldana	Mr. RV Kushwaha, Sci.-D, REC-Amravati	Mr. S.P. Phadke, SDO, Buldana
Jalna	Mr. Ramprakash, Sci.-D, REC-Aurangabad	Mr. Ajay Mohite, STA,DSO, Jalna
Nanded	Mr. A. J. Karande, Sci.-D, REC-Parbhani	Smt. A. V. Wakure, SDO, DOS, Nanded
Osmanabad	Mr. A.L. Jadhav, Sci.-B, REC-SU Osmanabad	Mr. S.K.Mulla, SDO, Grade-I, Aurangabad
Sangli	Mr. Humayun Sharief,Y., Sci.-D, REC-Baramati	Mr. S.D.Jadhav, SDO, Grade-I, Satara
Satara	Mr. Humayun Sharief,Y., Sci.-D, REC-Baramati	Mr. Vinit Pawar SDO, Wai (Satara)
Wardha	Mr. RV Kushwaha, Sci.-D REC-Amravathi	Mr. P.S. Padvi SDO Wardha

Cluster Development Facilitators (CDFs)

Madhya Pradesh

Clusters	CSB	DOS
Betul	Mr. A.G.K. Daniel, Sci.-D, REC-Hoshangabad	Mr. Arjun Singh Thakur, FO, DoS Betul
Burhanpur	Dr. Pradeep Shukla, Sci.-D, REC-SU-Khandwa	Mr. Mahajan, FO, Burhanpur
Hoshangabad	Mr. A.G.K. Daniel, Sci.-D, REC-Hoshangabad	Mr. Kailash Tatawat, SSI, Hoshangabad
		Mr. Navneet Gour, JSI, Hoshangabad
Khandwa	Dr. Pradeep Shukla, Sci.-D, REC-SU-Khandwa	Mr. Laxman Lillore, FO, Khandwa

Performance of Clusters

Raw silk production: During the year, south zone clusters recorded a high time achievement of 4781.21 MT of bivoltine raw silk production (104.85%) against the target of 4560 MT and the annual increase of 876 MT in bivoltine raw silk production. Raw silk produced in the clusters in the XII plan CPP is given below

Raw silk production in south zone clusters from 2013 to 2019

Year	Target (MT)	Pdn. (MT)	Ach. (%)
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
2018-19	4560.00	4781.21	104.85
Total	12735.5	13525.76	106.20

State wise bivoltine raw silk production for 2018-19

Cluster	Raw silk production (MT)		Ach. (%)
	Target	Ach.	
Karnataka	1687	1749.48	103.70
Andhra Pradesh	1132	1282.55	113.30
Telangana	147	145.81	99.19
Tamil Nadu	1247	1234.46	98.97
Maharashtra	284	325.88	114.75
Madhya Pradesh	40	26.26	65.64
Kerala	23	16.76	73.76
Total	4560	4781.21	104.85

Crop performance: A total of 432.97 lakh dfls were distributed to the farmers against the target of 431 lakh with an achievement of 100.38% and the brushing capacity of farmers increased by 22.9% though majority of clusters were affected by severe drought. A total of 29674417MT bivoltine cocoons were produced with an average cocoon yield of 71.79 kg/100 dfls. The monthly average cocoon yield for 100 Dfls was recorded for all the clusters and the gradual increase over XI plan is given below.

Dfls distributed during 2018-19				
Cluster	Target (Lakhs)	Silkworm Crops (No.)	Dfls (Lakhs)	Ach. (%)
Karnataka	168.70	96146	172.18	102.06
Andhra Pradesh	105.10	44369	109.14	103.84
Telangana	13.70	5068	13.92	101.62
Tamil Nadu	108.10	56758	100.81	93.26
Maharashtra	28.40	13567	31.88	112.25
Madhya Pradesh	5.00	2206	3.76	75.22
Kerala	2.00	1102	1.28	64.23
Total	431.00	219216	432.97	100.38

Performance of south zone clusters - average cocoon yield							
Cluster	Average cocoon yield/100 dfls (kg)						
	XI Plan	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Karnataka	62.73	65.83	65.23	66.74	67.49	67.62	66.05
Andhra Pradesh	61.56	66.69	66.68	69.93	70.68	73.47	76.38
Telangana			65.08	66.11	70.62	70.89	68.08
Tamil Nadu	71.13	74.46	75.54	77.86	78.33	80.32	79.59
Maharashtra	60.73	63.26	63.49	62.51	65.47	66.07	66.45
Madhya Pradesh		52.93	53.93	47.66	49.12	51.68	46.08
Kerala		76.45	75.88	75.69	81.68	84.05	86.13
Total	64.98	68.45	68.27	70.16	71.33	72.15	71.79

The monthwise performance of each cluster as per targets and achievements on all the activities are given below.

Performance of Karnataka clusters - bivoltine raw silk production (2018-19)										
Cluster	Dfls distribution			Cocoon yield (MT)	Yld/ 100 (kg)	Rate/ kg (Rs.)	New plantation		ECP (no.)	
	Annual target (Lakhs)	Dfls brushed (Lakhs)	Ach. (%)				Farmers (no.)	Area (ac)	Events (no.)	Farmers (no.)
Andaralahalli	2.5	1.71	68	121.92	66	353	244	412	6	135
Aurad	1.5	0.90	60	68.12	66	339	38	60	0	0
B.R. Koppalu	5.9	5.90	100	357.83	66	335	101	139	8	347
Bannikuppe	2.4	2.45	102	165.56	74	356	252	475	43	1401
Belagam	6.6	6.46	98	533.88	84	404	257	374	12	299
Bevuru	1.9	1.52	80	97.38	69	338	38	37	10	323
Bidarakote	2.7	2.88	107	186.05	69	349	124	136	11	406
Bijapur	2.1	2.61	124	140.57	56	293	550	1061	37	1174
Challakere	4.8	6.25	130	374.00	67	400	42	46	4	140
Chanrayapatna	1.4	0.94	67	52.42	61	350	89	102	24	447
D. Halasahally	2.1	1.75	83	136.06	76	362	116	135	5	260
Davangere	3.4	5.28	155	340.40	66	350	183	176	6	237
Doddalahalli	2.9	3.15	109	207.52	68	378	354	226	2	90
Gajanur	2.9	3.15	109	217.14	71	361				

Gauribidanur	3.3	2.64	80	162.54	62	363			9	344
Gulbarga	4.2	5.28	126	271.59	51	248	236	414	2	43
H.D. Kote	2.9	3.30	114	221.20	67	308	65	93	8	451
Hag'bmanahalli	4.8	7.23	151	439.32	63	339	166	187	9	549
Harohalli (B)	3.0	2.22	74	155.50	70	380	68	100	13	477
Harohalli (KKP)	3.6	3.15	87	222.92	72	325	224	179	0	0
Haveri	5.0	7.90	158	442.50	62	313	450	905	14	237
Hiriyur	3.3	3.10	94	191.49	59	413	16	23	5	128
Humnabad	2.9	2.73	94	159.84	60	326	173	120	5	253
Ithandahally	7.6	9.49	125	607.76	68	384	0	0	2	224
Jamkhandi	4.8	5.84	122	340.68	61	334	490	683	25	735
K.R. Nagar	1.4	1.13	81	69.08	64	335	88	75	3	110
Kanakapura	2.8	2.35	84	133.63	70	389	122	92	6	187
Kudligi	6.4	6.74	105	437.28	64	366	142	218	8	249
Kurudumalai	2.9	2.29	79	163.51	73	360	381	468	42	645
Lingsugur	2.9	3.13	108	181.48	62	293	62	68	20	603
Ranebennur	8.0	7.61	95	484.82	63	306	245	337	20	656
Ravugodlu	1.7	1.80	106	126.80	70	376	0	0	4	227
Shahapur	1.7	1.29	76	76.28	63	297	151	130	8	223
Shapur (Kolar)	6.2	5.70	92	375.01	64	371	0	0	5	285
Shirahatti	3.8	4.43	116	256.99	58	319	283	597	18	638
Siddlaghatta	2.9	1.60	55	103.13	68	404	52	88	4	372
Sira	5.2	6.05	116	376.64	66	395	115	140	20	1321
Soraba	1.4	0.98	70	67.40	68	352	27	33	4	226
T. Narasipura	3.3	2.31	70	157.42	68	319	135	116	13	608
Tekal	4.5	4.02	89	266.08	66	353	0	0	0	0
Thoresettyhally	1.4	1.24	89	75.33	67	365	130	107	11	406
Tubagere	1.7	1.30	76	101.96	76	376	17	15	17	924
Tumkur	6.0	7.02	117	486.06	71	370	103	124	20	1102
Y.N. Hosakote	11.9	9.77	82	695.76	70	338	113	128	19	650
Yelburga	2.3	2.61	114	158.20	63	309	185	345	19	650
Yeldur	2.0	0.99	49	62.79	66	384				
Total/Avg.	168.70	172.18	102	11069	66	349	6627	9162	521	18782

Performance of Andhra Pradesh clusters – bivoltine raw silk production (2018-19)										
Cluster	Dfls distribution			Cocoon yield (MT)	Yld/100 (kg)	Rate/kg (₹.)	New plantation		ECP (no.)	
	Annual target (Lakhs)	Dfls brushed (Lakhs)	Ach. (%)				Farmers (no.)	Area (ac)	Events (no.)	Farmers (no.)
Atmakur	2.50	2.62	104	173.9	71.8	351	134	236	8	337
Bhimadole	2.50	2.40	96	146.2	68.9	280	37	93	10	449
Chebrolu	4.70	5.08	108	365.3	73.2	287	0	0.0	10	521
Chittoor	4.70	4.99	106	362.7	79.8	364	146	338	8	329
Giddalur	4.50	4.84	107	328.7	76.2	365	172	308	10	433

Hindupur	11.00	11.14	101	799.2	75.8	374	430	669	1	96
Kalyandurgam	7.50	7.56	100	523.9	75.5	338	276	441	14	661
Madakasira	16.90	16.02	94	1098.9	73.5	334	728	1378	11	695
Palamaner	17.40	18.50	106	1305.3	78.5	351	1460	2125	11	656
Pattikonda	4.60	4.94	107	342.7	77.6	352	134	268	9	395
Penukonda	6.50	7.68	118	523.2	74.9	375	332	472	10	636
V. Kota	19.00	20.66	108	1495.1	79.8	336	976	1555	11	678
Vijayawada	3.20	2.70	84	176.7	70.5	284				
Total/Avg.	105.00	109.14	103	7641.8	76.3	337	4825	7884	113	5886

Performance of Telangana clusters - bivoltine raw silk production (2018-19)

Cluster	Dfls distribution			Cocoon yield (MT)	Yld/100 (kg)	Rate/kg (₹.)	New plantation		ECP (no.)	
	Annual target (Lakhs)	Dfls brushed (Lakhs)	Ach. (%)				Farmers (no.)	Area (ac)	Events (no.)	Farmers (no.)
Bhongir	2.90	2.95	101	194.7	64.3	302	20	41	3	240
Metpally	3.40	3.43	100	246.0	72.3	306	137	308	10	316
Suryapet	3.90	3.95	101	266.3	66.6	320	30	54	4	236
Zaheerabad	3.50	3.60	102	225.8	69.0	314			10	450
Total/Avg.	13.70	13.92	101	932.7	68.1	310	187	403	27	1242

Performance of Tamil Nadu clusters - bivoltine raw silk production (2018-19)

Cluster	Dfls distribution			Cocoon yield (MT)	Yld/ 100 (kg)	Rate/ kg (₹.)	New plantation		ECP (no.)	
	Ann target (Lakh)	Dfls brushed (Lakh)	Ach. (%)				Farmers (No.)	Area (ac)	Events (no.)	Farmers (no.)
Adaikalapattinam	3.20	3.24	101	245	77	338	54	114	10	402
Alangkayam	8.20	8.83	108	738	83	354	213	364	33	1021
Alangudi	2.60	2.54	98	195	77	348	24	44	10	389
Annur	5.40	5.55	103	430	79	364	153	417	9	395
Anthiyur	3.10	3.19	103	247	81	363	45	88	14	455
Bagalur	1.90	1.95	103	146	80	375	49	172	9	408
Berigai	7.50	7.57	101	586	80	373	177	452	20	679
Bhavani	3.10	2.88	93	218	82	362	37	55	13	457
Dharapuram	3.40	3.18	93	250	80	346	43	69	13	414
Dharmapuri	3.60	4.32	120	332	79	351	210	465		
Gobi South	3.20	2.69	84	219	82	365	4	5	18	518
Gudimangalam	3.20	2.63	82	190	79	332	20	36	12	279
Keeranur	4.00	3.75	94	293	78	339	22	51	13	424
Kodiyalam	2.50	2.34	94	178	80	363	33	99	4	110
Komaralingam	1.50	1.28	85	89	80	327	7	13	10	227
Kottur	1.80	1.53	85	105	79	312	12	20	11	388
Madathukulam	3.40	2.80	82	187	80	328	8	15	14	411
Manurpalayam	2.70	2.18	81	172	81	369	20	30	7	332
Ottanchatram	4.10	4.01	98	306	77	338	31	60	17	524
Palani	5.00	4.76	95	376	78	340	31	64	10	406

Pitchandampalaya	3.90	2.31	59	198	82	364	4	6	16	482
Pollachi	3.70	3.38	91	241	78	328	30	55	13	409
Pongalur	1.90	1.36	72	108	79	373	44	70	3	176
Poolavadi	4.30	3.55	83	253	79	332	11	20	10	343
Sannarpatti	3.80	3.78	99	288	78	341	46	72	14	455
Srivilliputhur	4.60	4.64	101	357	77	340	53	94	36	1229
Udumalpet	5.10	4.23	83	326	81	357	47	77	16	509
Uthangerai	7.40	6.35	86	511	80	362	229	554	12	539
Total/ Avg.	108.1	100.81	93	7782	80	349	1657	3576	367	12381

Performance of Maharashtra clusters - bivoltine raw silk production (2018-19)

Cluster	Dfls distribution			Cocoon yield (MT)	Yld/ 100 (kg)	Rate/ kg (₹.)	New plantation		EC (no.)	
	Annual target (Lakh)	Dfls brushed (Lakh)	Ach. (%)				Farmers (no.)	Area (ac)	Events (no.)	Farmers (no.)
Akola	0.70	0.46	66	26.4	67.2	254	136	151	14	782
Beed	7.30	10.12	139	635.9	64.3	366	107	137	25	1353
Buldana	1.50	1.87	124	108.7	71.1	282	251	373	20	834
Jalna	6.00	5.46	91	341.9	65.0	336	75	115	6	215
Nanded	2.10	2.54	121	141.8	61.6	259	414	520	23	759
Osmanabad	4.10	6.34	155	441.6	68.3	365	1047	1066	14	745
Sangli	2.00	1.12	56	72.7	65.8	325	254	275	20	770
Satara	3.00	2.42	81	167.3	76.0	332	140	140	22	787
Wardha	1.70	1.55	91	82.8	67.2	286	219	272	15	489
Total/Avg.	28.40	31.88	112	2019	66.4	311	2643	3050	159	6734

Performance of Madhya Pradesh clusters - bivoltine raw silk production (2018-19)

Cluster	Dfls distribution			Cocoon yield (MT)	Yld/ 100 (kg)	Rate/ kg (₹.)	New plantation		ECP (no.)	
	Annual target (Lakh)	Dfls brushed (Lakh)	Ach. (%)				Farmers (no.)	Area (ac)	Events (no.)	Farmers (no.)
Betul	2.00	2.02	101	61.1	44.4	275	0	0	10	509
Burhanpur	1.00	0.35	35	6.3	43.1		0	0	5	163
Hoshangabad	1.00	1.01	101	48.1	49.6	288	10	10	18	655
Khandwa	1.00	0.39	39	2.5	36.5		0	0	10	351
Total/Avg.	5.00	3.76	75	118	46.1	282	10	10	43	1678

Performance of Kerala clusters - bivoltine raw silk production (2018-19)

Cluster	Dfls distribution			Cocoon yield (MT)	Yld/ 100 (kg)	Rate/ kg (Rs.)	New plantation		ECP (no.)	
	Annual target (Lakh)	Dfls brushed (Lakh)	Ach. (%)				Farmers (no.)	Area (ac)	Events (no.)	Farmers (no.)
Palakkad	1.25	1.18	94	101.4	86.1	386	24	19	28	1008
Kozhicode	0.75	0.11	14	9.2	86.2	353	10	10	0	0
Total/Avg	2.00	1.28	64	110.6	86.1	370	34	29	28	1008

New plantations in clusters: In order to increase the silk production in the clusters, more emphasis was given on horizontal expansion and 15983 farmers were motivated to plant improved mulberry varieties to the extent of 24114.3 acres in the 106 clusters. During the year, in coordination with DoS 1301 ECPs *i.e.*, group discussions, field days; awareness programmes, demonstrations, enlightment and training programmes, exposure visits, farmers workshops, exhibitions, etc were conducted exclusively in clusters and farmers were sensitized to adopt new technologies to increase their productivity. These programmes helped in changing the attitude of farmers and improved the technology adoption levels for improved productivity in bivoltine raw silk production.

State	New plantation	
	No. of farmers	Area (ac.)
Karnataka	6627	9162.0
Andhra Pradesh	4825	7884.2
Telangana	187	403.0
Tamil Nadu	1657	3576.2
Maharashtra	2643	3050.0
Madhya Pradesh	10	10.0
Kerala	34	29.0
Total	15983	24114.3

Continuous/Other Activities:

Extension Communication Programmes: In order to transfer the technologies to the field and make farmers aware of new sericultutre technologies many extension communication programmes are being conducted at filed levels in the states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh through extension units. The main ECPs conducted in the field are group discussions, farmers' days, field day/awareness programmes, workshops, resham krishi melas and exhibitions. During 2018-19 a total of 1527 extension communication programmes were conducted and sensitized 81141 farmers were sensitized. The main technologies/topics covered through ECPs were new bivoltine sericulture technologies, popularization of new mulberry varieties, soil testing and its importance in mulberry cultivation, popularization of tree mulberry, INM practices for mulberry, IPM/IDM practices, disinfection and hygiene in silkworm rearing, popularization of new silkworm hybrids, demonstration of rotary mountages and mounting and spinning care etc.

Extension Communication Programmes	Events	Farmers Sensitized
Group Discussion	782	20485
Filed day	74	7504
Demonstration of Technology	81	2431
Awareness Programme	35	5080
Exhibition	20	18495
Workshop/Seminar/Farmers Meet	07	884
Farmer Day	425	22280
Resham Krishi Mela	03	3203
Exposure visits	12	230
Any other Programme	88	549
Total	1527	81141

m-*Kisan* portal: m-*Kisan* portal was initiated under the Ministry of Agriculture, Government of India for the benefit of farmers. CSRTI-Mysuru as an identified user of m-Kisan portal, regular SMS are being sent once in every fortnight to transfer the technologies to the farmers in vernacular languages across the nation. A total of 97 SMS messages, covering 71324 farmers in different Southern states viz., Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Maharashtra and Madhya Pradesh in different vernacular languages i.e., Kannada, Telugu, Tamil and Hindi were sent during the year. The portal is highly useful in providing personalized and valuable information to the farmers on various sericultural technologies.

Topic
• Mulberry cultivation
• Mulberry Diseases/pests and its management
• New Mulberry Varieties
• New silkworm Hybrids
• Chawki Rearing
• Soil Fertility Management
• Silkworm Rearing management
• Silkworm Disease/Pest control measures
• Management of rearing Climate
• Fertilizer Application

Visitors' service: CSRTI-Mysuru being the premier research institute in mulberry sericulture, people visit to know about sericulture and about 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 through out the year. This year 4842 people visited the institute for awareness and to update the recent innovations in sericulture.

Category	No. of persons visited
Farmers	2060
Students	2253
Foreigners	76
Others	453
Total	4842

Resham Krishi Melas:

In Karnataka: The Central Sericultural Research and Training Institute (CSRTI), Mysuru organized a Resham Krishi Mela and award distribution programme in coordination with the Department of Sericulture, Government of Karnataka on 24th February 2019 in the sprawling campus of the Institute at Srirampura, Mysuru (Karnataka).

Around 1500 stakeholders including farmers, extension personnel and officers of Central Silk Board (CSB) and DoS, Government of Karnataka, Scientists of CSB from Bengaluru and other field units of CSRTI- Mysuru, entrepreneurs involved in manufacturing and supply of Ser-inputs participated in the mega event.

The main theme of the mela was Bivoltine sericulture technologies for higher returns. To serve the very purpose of the event, an exhibition eliciting the progress made by the Institute in developing technologies appropriate for bivoltine sericulture through live exhibits, charts, video films, models etc., was organized at the venue. The scientists and technical personnel of the Institute explained the methodology of adoption of the technologies and their utilitarian value for the understanding and benefit of the farmers.

Publications of the Institute in the form of pamphlets, booklets and news letter prepared in Kannada were made available to the participants for effective dissemination of technologies. Thirteen manufacturers and suppliers of various seri inputs like disinfectants, nutrient supplements, equipment, silkworm and mulberry crop protection products, machinery etc., were also a part of the exhibition providing information to the participants and also selling their products.

The technical session was organized at programme venue to facilitate participants to interact, understand and clear their doubts with subject experts. The main speakers were from the Central Silk Board and Department of Sericulture, GoK. The topics covered included soil fertility management, mulberry cultivation, disinfection and hygiene, management of silkworm diseases etc.

The inauguration of the exhibition was by Shri. G. T. Devegowda, Hon'ble minister for Higher Education, Govt. of Karnataka, which was followed by the inauguration of the Resham Krishi Mela. Dr. R. S. Teotia, Director, CSRTI, Mysuru welcomed the dignitaries, in his welcome address he spoke about the importance of producing bivoltine silk and how it is a boon to small and marginal farmers. He stressed on the fact that sericulture has become an important tool for rural development. The contribution of sericulture in empowerment of rural women is also another important characteristic that further warrants more emphasis to the sector he added.

Shri S. R. Mahesh, Hon'ble minister for sericulture and tourism, Govt. of Karnataka, inaugurated the mela and wished it all success. He requested the farmers to make best use of the opportunity to learn about the latest developments in the technological front. He also told about the plans of the government to adopt Israeli technology to boost agriculture and silk production in the state.

Following technical pamphlets were released by the dignitaries during the event, which give information on seasonal occurrence of the diseases and pests and suitable measures to avoid crop losses.

1. Calendar of incidence of mulberry diseases in Karnataka and their management
2. Calendar of incidence of silkworm diseases in Karnataka and their management
3. Calendar of incidence of mulberry pests in Karnataka and their management

The outstanding contribution for CPP achievers among the extension personnel belonging to CSB and the GoK were awarded with appreciation certificates for their valuable contributions in the sericulture clusters. Soil health cards were also distributed among the farmers.

An award distribution ceremony was held as a part of the workshop, wherein several cocoon producers and reelers from various districts of the state were honoured by the minister. He congratulated the award winners for their

achievements and urged them to share their experiences with others and inspire them to enhance production in the coming years

Shri K. M. Hanumantharayappa, Hon'ble Chairman, Central Silk Board, in his speech informed that India has attained the second position in production of raw silk in the world. Due to advancement in technology, mulberry varieties suitable for varied situations are being grown, also as trees in some places. The technological development has transformed cocoon production activity, which was once full of uncertainties in to a vocation that ensured stable monthly income. Silk farming is extremely profitable and urged those presently engaged in tobacco farming also to switch to sericulture since the demand for silk is ever increasing. There was a time when those engaged in sericulture had to travel a distance of 1500 km to sell cocoons. Farmers from Sangli, Maharashtra would travel all the way to Ramanagara in Karnataka, a distance of more than 600 km. Now, there are cocoon markets at 200 km intervals.

The Central Silk board has taken up several developmental programmes to address the problems faced by the domestic silk industry. The R&D institutes of CSB are entrusted with the task of finding solutions to problems in the way of producing quality raw silk, addressing the issues of shortage of manpower, infrastructure and climate change


Resham Krishi Mela - Karnataka

Shri. K. S. Manjunath. IAS, Commissioner for sericulture development and Director of sericulture, Government of Karnataka presided over the inaugural function and discussed various programmes launched by the government to encourage more farmers to take up sericulture. As regards fluctuation in cocoon price and incentives, he assured the participants that his department would look in to the matter and take necessary action to improve the situation. The programme ended with vote of thanks by Smt. Sumana Singh, R. L. Additional Director, Dept. of Sericulture, Bengaluru.

In Andhra Pradesh: Resham Krishi Mela was organized at V. Kota, Chittoor District on 12.02.2019 by Regional Sericultural Research Station (RSRS) of CSRTI-Mysuru, Central Silk Board (CSB) as a part of extension communication programme for the year 2018-19. The programme got an opportunity of the gracious presence of Sri. K.M. Hanumantharayappa, Honorable Chairman, Central Silk Board, Bangalore and Smt. A.R. Sulochana Ranganath, President, MPP, V. Kota. The programme also witnessed the presence of Smt. C. Aruna Kumari, Additional Director of Sericulture, Chittoor and the Scientists of CSRTI-Mysuru, RSRS and its nested units, RSRS, Shadnagar, SSPC, NSSO, Madanapalle, Assistant Secretary, RO, Hyderabad, Asst. Directors of Chittoor & Anantapur districts and Sri Vidyasagar, Project Director, APMIP, Chittoor.

Dr. P. Sudhakar, RSRS-Anantapur in his welcome address cordially invited all the dignitaries, staff of CSB and DOS and the huge number of sericultural farming community (1250 numbers) arrived from various districts viz. Chittoor, Anantapur, Kadapa. Dr. P. Sudhakar gave a detail account on the importance of Bivoltine sericulture development and the efforts made by central and state functionaries in encouraging and motivating the sericulturists to transform from traditional rearing of cross breeds (CBs) to Bivoltine sericulture through the intensive implementation of Cluster Promotion Programme (CPP).

During the programme the proven sericulturists were given opportunity to express their prospects and problems facing in sericulture practice. Accordingly the farmers were actively participated and expressed their feelings and experiences in adopting sericulture as their liveli hood. Smt. C. Aruna Kumari, Additional Director of Sericulture, Chittoor clarified the points regarding department, raised by the farmers.


Resham Krishi Mela at V. Kota - Andhra Pradesh

In Tamil Nadu: Regional Sericultural Research Station (RSRS), Salem organized a Resham Krishi Mela in coordination with Department of Sericulture (DoS), Salem, Tamil Nadu at Sri Pannaiamman Koil Thirumana Mandapam, Kolinjipatti, Namakkal district on 19-02-2019. Tmt. M. Asia Mariam, I.A.S., District Collector, Namakkal, Dr. N. Balachandran, Scientist-D, CSRTI-Mysuru, Smt. K. Yogamala, Regional Joint Director of Sericulture, Govt. of Tamil Nadu, Dharmapuri, Dr. N. Narmatha, Professor & Head, Extension division, Veterinary College and Research Institute, Namakkal, Thiru. J. Sekar, Joint Director of Agriculture, Department of Agriculture, Government of Tamil Nadu, Namakkal, and Thiru. R. Loganathan, Chairman Kongu Sri Pannaiamman trust, Kolinjipatti besides around 560 sericulturists from Salem, Namakkal, Karur, Trichy and Erode region, scientists/staff of Central Silk Board and Officers/Officials of Department of Sericulture, Tamil Nadu participated in the mela. Two booklets on "New sericulture technologies" and "Mass production of bio control agents for biological control of major pests of mulberry" and a pamphlet on "Fogging technology for management of microclimate in silkworm rearing shed during summer" were released by Tmt. M. Asia Mariam, I.A.S., District Collector on the occasion.

Dr. N. Dhahira Beevi, Scientist-D & Head, RSRS-Salem welcomed the dignitaries, the sericulturists of Namakkal, Trichy, Karur, Salem and Erode districts of Tamil Nadu to the Resham Krishi Mela to gain knowledge on various latest sericulture technologies and to make use of them in their field for maximizing productivity.

Tmt. M. Asia Mariam, I.A.S., District Collector, Namakkal in her presidential address informed that sericulture plays an important role in improving the economic development of village stakeholders in southern states. She also informed that recently Namakkal has become a leading sericulture district in Tamil Nadu with an average production of 90 kg/100 Dfls. One farmer from Namakkal district was selected as the best sericulturist and awarded the third prize in the entire state. A total of 1338 farmers are practicing sericulture in 2515 acres. During the current year 295 new farmers have taken up sericulture and planted mulberry covering 594 acres. They are adopting all new sericulture technologies; rearing bivoltine hybrids throughout the year, usage of advanced implements, involvement of women members of the family make the farmers of Namakkal district to harvest the maximum cocoon yield like Udumalpet and Erode sericulturists. She added that during 2018-19 a total of ₹. 93.25 lakh has been sanctioned by the government for development of sericulture in Namakkal district. She also added that in sericulture, there is a very good opportunity to get stable income with less investment and in short duration. Further she advised all the sericulturists to effectively utilize the available water resources and adopt new technologies for improving the cocoon productivity.

Resham Krishi Mela at Kolinjipatti, Namakkal district – Tamil Nadu

Dr. N. Balachandran, Scientist-D, CSRTI-Mysuru in his special address stated that under Silk samagra scheme of Central Silk Board-Bengaluru, it is planned to increase mulberry silk production from 20478 MT to 27000 MT including bivoltine silk from 5266 MT to 8500 MT. Also to increase the production level up to 4A grade bivoltine silk from about 15% to 25%, productivity of mulberry raw silk to increase from 100 kg/ ha to 111 kg/ha and there by increasing employment generation from 85 lakh to 100 lakh persons by 2019-20. He appreciated Dept of Sericulture Tamil Nadu for having received the award for the best state in implementation of GOI schemes in sericulture in Tamil Nadu during the Mega event-Surging Silk held at New Delhi on 09-02-2019. He also explained the latest technologies, new mulberry varieties and silkworm hybrids developed by CSR&TI, Mysuru and appealed to all the farmers of Tamil Nadu to utilize them to sustain their productivity and improve their livelihood.

Thiru. J. Sekar, Joint Director of Agriculture, Govt. of Tamil Nadu, Namakkal in his special address congratulated all the sericulturists of Namakkal district for achieving highest cocoon production per unit area with limited water resources. He further requested the farming community to make use of all the schemes and subsidies given by Govt. of Tamil Nadu in the field of agriculture, horticulture etc., for their betterment.

Dr. N. Narmatha, Professor and Head, Extension division, Veterinary College and Research Institute, Namakkal in her special address emphasized the farmers on Integrated farming system and to integrate cattle/poultry farming along with sericulture to maximize their income. She also advised the farmers to adopt all new technologies in the veterinary field and to effectively utilize the services rendered by VC&RI, Namakkal and KVK, ICAR, Namakkal.

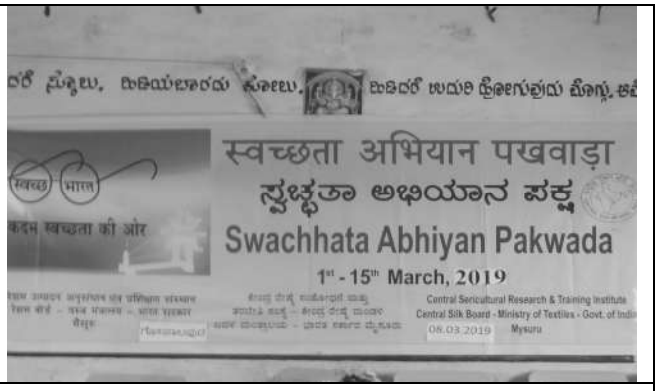
Tmt. K. Yogamala, Regional Joint Director of Sericulture, Dharmapuri, Govt. of Tamil Nadu, in her address explained about various schemes in Department of sericulture implemented by Govt. of Tamil Nadu and advised the farmers to avail benefits effectively. She also thanked all the sericulturists for their participation in the Resham Krishi Mela.

During the technical session scientists of RSRS-Salem and its nested units presented the importance of water use efficiency, soil fertility and pest management and silkworm rearing management during summer. In the interaction session, queries addressed by farmers were clarified by the scientists of CSB. An exhibition on sericulture mechanization, ericulture and silk mark was also arranged on the occasion for the benefit of the sericulturists.

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 plantation; performance of CSR hybrids and extension communication programmes conducted for creating awareness on new technologies is presented:

Centre	Area (Ac)	Farmers (Nos)	Dfls (Nos)	Avg. yield/ 100 dfls (kg)	GD	Expo visit	Far day	FD/ AW	Exhi-bition	Demo of tech.	Any other
REC-SU-Maddur	598.18	560	874931	68.58	27	-	16	02	-	-	-
REC-Amaravati	796	606	403609	69.28	20	02	12	03	05	08	02
REC-Aurangabad	349	340	115000	64.50	12	1	8	03	-	02	-
REC-Parbhani	176	172	121110	64.09	12	01	04	01	05	-	-
REC-SU-Osmanabad	1066	1047	646634	68.30	06	01	04	02	-	-	-
REC-Baramati	415.50	394	323050	71.87	18	01	16	03	-	-	01
REC-Hoshangabad	10	10	302500	49	18	1	12	02	-	09	-
REC-SU-Burhanpur	-	-	35000	43.12	12	1	09	-	-	-	-

Japanese Overseas Cooperative Volunteer Programme (JOCV): Japan Overseas Cooperation Volunteer under JICA was initiated during January 2015 for a period of two years mainly to support CSB in extension activities - organizing self help groups/CBOs in clusters. During 2018-19, two new JOCVs were inducted after month long orientation training at CSRTI-Mysuru and were posted to Ramanagaram (Karnataka) and Hosur (Tamil Nadu). The JOCVs have initiated the work on formation of women SHGs, conducting and participating in awareness programmes/field days/group discussions besides interacting with local farmers. First quarterly meeting was held on 04.03.2019 at CSRTI Mysore.



'Swachchata Abhiyaan Pakwada 2019' at Government High school, Gopalpura-Mysuru

Adarsh Resham Gram (ARG): CSRTI-Mysuru organized 'Swachchata Abhiyaan Pakwada 2019' at Government high school, Gopalpura, on March 8th 2019. The village was adopted by the Institute for its overall development under the Adarsh Resham Gram programme on 9th January 2018.

On the occasion a team comprising of scientists, technical and administrative staff from CSRTI, Mysuru visited Government primary/high school, Gopalpura to create awareness on Hygiene and Cleanliness among school children and village public. Dr. Sharanappa, In-charge medical officer PHC in his inaugural speech informed that Cleanliness is next to Godliness and also explained importance of Hygiene and Cleanliness for keeping good health. The senior scientists from CSRTI-Mysuru Dr. C.M. Kishor Kumar and Dr. N. Balachandran also spoke on the occasion and explained children on keeping good health by following simple hygiene practices. The institute distributed 130 health kits to all the school children on the occasion. Besides this CSRTI staff, school children and villagers participated in cleanliness drive and cleaned school surrounding areas.

Institute -Village Linkage Programme (Seri Model Village)

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

IVLP programme was continued 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.

Awareness programmes on various technologies was carried out through demonstrations and ECPs. A total 17.19 lakh dfls of bivoltine hybrids were reared by farmers with an average yield of 68.16 kg/100 dfls representing 20.94% improvement in cocoon yield against bench mark. Through the programme the crossbreed rearing farmers were encouraged to rear bivoltine hybrids, a quantity of 159.94 MT of bivoltine raw silk was produced through IVLP.

State	Cluster	Scientists
Karnataka	Kadakola	Dr. Mahima Santhi. A, Sci.-D, CSRTI-Mysuru
	K.M. Doddi	Dr. D. Guruswamy, Sci.-C, REC-Maddur
	Hosakote	Shri. Ishwar, Sci.-D, REC- Bidraguppe
	Chamarajanagara	Dr. V. Girish Naik, Sci.-D, RSRS-Chamarajanagara
Tamil Nadu	Sathyamangalam	Smt. Rajalakshmi E, Sci.-D, REC- Gobichettipalayam
	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 SU- Aurangabad
	Baramati	Shri. Humayun Sherief. Y, Sci.-D, REC- Baramati
Madhya Pradesh	Hoshangabad	Shri. Gnana Kumar Daniel. A, Sci.-D, REC-Hoshangabad

IVLP Cluster-wise Progress (Seri Model Village Programme) April 18 - March 2019									
State	IVLP Centre	Ann. Target (dfls)	Dfls brushed (dfls)	Bench mark (kg/100 dfls)		Improvement (%)	Rate/ kg (Rs.)	Est. raw silk (MT)	
				Yield	Avg.			Target	Ach.
KA	Kadakola	150000	268435	60.00	69.46	15.77	355	13.40	28.68
	K.M. Doddi	90000	86602	58.00	63.83	10.05	484	8.00	7.84
	Hosakote	90000	41250	55.00	66.92	21.67	409	8.00	3.45
	Chamarajanagara	8000	5885	55.00	72.04	30.98	386	0.70	0.51
TN	Sathyamangalam	150000	189760	59.00	82.05	39.07	390	13.20	20.38
	Thondamuthur	150000	231350	67.00	79.34	18.42	300	13.20	29.37
AP	Rayachoty	90000	117000	60.00	71.40	19.00	367	8.00	9.64
	Vizanagaram	60000	97200	50.00	67.34	34.68	230	5.00	8.10
MH	Ahmadnagar	90000	317540	60.00	68.97	14.95	305	8.00	24.23
	Baramati	100000	328179	60.00	62.90	4.83	298	9.50	25.60
MP	Hoshangabad	30000	30500	50.00	45.72	-	253	2.00	1.65
Total		10,08,000	17,19,801	58.42	68.16	20.94	343	89.00	159.94

CAPACITY BUILDING AND TRAINING

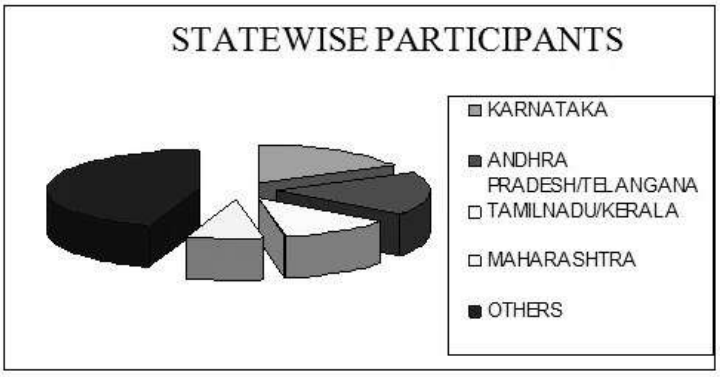
Rajashekar K and M. Muthulakshmi

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, students, researchers and practitioners including cocoon producers and chawki rearers, who were trained under different programmes - TOP : Technology Orientation Programme, FST: Farmers' Skill Training, NBT : Need Based Training, IBT: Intensive Bivoltine Training, Of the 1976 persons trained during the year, 818 were trained at CSRTI-Mysuru and 1158 at its regional stations (RSRS) and extension units (REC).

Programme	Name of the course	Duration (Days)
Technology Orientation Programme	Refresher course	10
	Orientation programme	5
Farmers' Skill Training	Chawki rearing	10
	Late age silkworm rearing	10
	Mulberry cultivation technology	5
Need Based Training (Officials/Students)	Orientation programme	15/40
	Popularization of high yielding mulberry varieties and silkworm races	3
	Water shed management	2
	Mulberry and silkworm breeding and genetics	21
	Silkworm rearing & molecular biology	21
STEP (Officials)	Integrated pest and disease management	2/3
ITEC (Overseas)	Training in bivoltine sericulture	30
Need Based Training (Farmers)	Chawki rearing	10
	Intensive training in bivoltine sericulture	90
	Awareness programme	5
	Commercial chawki rearing	90
	Intensive bivoltine training	35
	Integrated pest and disease management	5
	Sericulture technology	5

Programme	Location	Trainee category	State						Total
			KA	AP	TS	TN	MH	Others	
TOP	CSRTI-Mysuru	O	48	4	1	7	11	1	72
Foundation		O	9	1	4	2	1	7	24
FST	CSRTI-Mysuru	F		65			15		80
NBT	CSRTI-Mysuru	F/E	31	1	1	1	21		55
NBT		F	41				208	211	460
ITBS		F/E	8						8
IBT		F/E	24						24
STEP		O	17	8		6	11	2	44
ITEC		INTL						32	32
Internship		S		19					19
Sub Total A									818
TOP	RSRS & RECs	O		35					35
IBT	RSRS & RECs	F/E		20					20
FST	RSRS & RECs	F	367	313		251	172		1103
Sub Total B									1158
Total (A+B)									1976
F- Farmers; O-Officers; KA- Karnataka; AP-Andhra Pradesh; TS-Telangana; TN-Tamil Nadu; MH-Maharashtra; INTL-International, F/S/E-Farmers/students/Entrepreneurs									

Number of persons trained at the nested units of CSRTI-Mysuru				
Unit	FST	TOP	IBT	Total
RSRS-Kodathi & RECs in Karnataka	335	0	0	335
RSRS-Chamarajanagara, Karnataka	32	0	0	32
RSRS-Anantapur & RECs in AP and Telangana	313	35	20	368
RSRS-Salem & RECs in Tamil Nadu and Kerala	251	0	0	251
REC-Baramati, Maharashtra	30	0	0	30
REC-Amravati, Maharashtra	30	0	0	30
REC-Parbhani, Maharashtra	27	0	0	27
REC-Aurangabad, REC-Jalna/Maharashtra	85	0	0	85
REC-Hoshangabad, Madhya Pradesh	0	0	0	0
Total	1103	35	20	1158



Training in commercial chawki rearing for potential entrepreneurs: The programme is designed to train potential entrepreneurs who wish to establish commercial chawki 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, 55 entrepreneurs [Kar.-31; Tel-1; AP-1; TN-1 and MH-21] were trained under this programme.

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.

	Programme	Duration (days)	State					Total
			KA	AP	TN	MH	Others	
Officials	Orientation programme	30 days						24
	Refresher programme for Seed Analysts and Seed Officers	02 days	48	4	7	11	2	72
	Training in mulberry and silkworm crop protection	03 days			20			20
	STEP- Technical staff of CSB	02 days	17	8	6	11	2	44
							Total	160
Sericulturists	Chawki rearing	10				92	34	126
	Intensive training in bivoltine sericulture	90	5					5
	Awareness programme	05				120	214	334
	Commercial chawki rearing (Seed Act)	90	31	1	1	21	1	55
	Intensive bivoltine training	35	11					11
							Total	531

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 07 undergraduate and 40 post-graduate students enrolled for dissertation work in the areas of microbiology, biochemistry, biotechnology and bioinformatics.

Subject	Name of the College/University	Students (No.)	
		UG	PG
Microbiology	MMK SDM College-Mysuru	1	
	Maharani's science college for women-Mysuru		13
Biochemistry	Maharani's science college for women-Mysuru		8
Biotechnology	Sri. Jayachamarajendra college of engineering-Mysuru	2	
	Sri. Krishna arts college-Coimbatore, Tamil Nadu		1
	Sri. Dharmasthala Manjunatheshwara PG Centre-Ujire		4
	Central university of south Bihar, B V College-Patna		3
	LMC of sciences-Jodhpur		2
Bioinformatics	Sri. Krishna arts college-Coimbatore, Tamil Nadu		3
Molecular Biology	Yuvarajas college-Mysuru		6
	Sri. Jayachamarajendra college of engineering-Mysuru	4	
	Total	7	40
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 65750 dfls were chawki reared and distributed among 399 rearers. Late age silkworm rearings were conducted in six batches to impart skills in the participants of training programmes. The details of chawki rearing and late age silkworm rearings are presented.

Details of chawki rearing			
Month	No. of Dfls reared	No. of farmers served	Cocoon yield/ 100 Dfls
Apr. 2018	5050	30	81.0
May 2018	6650	40	82.0
Jun. 2018	5750	33	80.5
Jul. 2018	6200	33	80.5
Aug. 2018	5900	38	82.1
Sep. 2018	5450	32	84.2
Oct. 2018	4900	33	87.5
Nov. 2018	4400	29	83.60
Dec. 2018	5800	36	82.80
Jan. 2019	5250	31	84.50
Feb. 2019	5400	36	84.00
Mar. 2019	5000	28	83.00
Total /Avg.	65750	399	82.97

Season	Hatching %	SCW wt.(g)	SSW wt.(g)	Shell %	Yld/100 dfls (kg)
Jun. - Jul. – 2018	92.83	1.742	0.343	19.81	84.99
Jul. - Aug. 2018	90.5	1.40	0.374	25.1	76.49
Sep. - Oct. 2018	94.0	1.562	0.329	21.27	79.61
Oct. – Nov. 2018	92.0	1.587	0.338	21.53	73.00
Dec. 2018 - Jan. 2019	86.0	1.486	0.297	20.07	56.49
Total/Avg.					
Hybrid: Double Hybrid; Number of dfls 100 in each crop.					
SCW- Single Cocoon Weight; SSW-Single Shell Weight					

Feedback Evaluation: Feedback evaluation is conducted at the end of each training programme through a questionnaire. The course wise feedback is presented hereunder.

Course	Training utility index	Training efficiency index	Training facility index	Course Coverage	Training mngt. index	Variance over benchmark of 65%
NBT: Orientation Course	81.11	84.68	78.84	85.67	82.57	17.57
TOP: Foundation Training	82.73	82.60	74.93	81.36	80.41	15.41
ITEC	84.79	85.13	81.76	84.0	84.17	16.35
NBT: Internship	86.66	86.64	70.63	90.54	83.67	18.67

FARM MANAGEMENT SECTION

B.T. Sreenivasa and Y.N. Sanath Kumar

Continuous Activities:

- Maintained 19 acres of mulberry garden, 2.0 acres chawki garden and 3.0 acres tree plantation for continuous production of quality mulberry leaf with recommended package of practices, with mechanization, synchronizing with the different rearing programmes.
- Involved in general up keep and maintenance of farm machinery and institute campus.
- Maintained chawki plot with recommended package of practices with V1 & G2 varieties, (4+3) x2, 8x2 & 4x4 ft spacing, for continuous supply of quality chawki leaf for chawki rearing.
- Supplied 78025 kg mulberry leaf and 76240.00 kg mulberry shoot for late age rearing (7105 dfls) under different projects/experiments/maintenance programmes to silkworm breeding and genetics, physiology, pathology, RTI, TVDC and Training division.
- Supplied 19405 kg mulberry chawki leaf to Model Commercial Chawki Rearing Centre for quality chawki rearing (66350 dfls) and supply of worms to the farmers.
- Demarcated 9 acre V1, G2 and G4 mulberry garden for production and supply of seed cuttings for multiplication in field level.
- Supplied 64.880 MT of V1 mulberry seed cuttings to 91 farmers for expansion of 259.52 acres of new plantation and generated an income of Rs. 299962.00**.**
- Supplied 3**.**854 MT of G2 mulberry seed cuttings for expansion of 15.416 acres of new plantation and generated an income of Rs. 17345.00.
- Supplied 14.358 MT of G4 mulberry seed cuttings to 35 farmers for expansion of 57.428 acres of new plantation and generated an income of Rs. 64619.00.

BIOINFORMATICS CENTRE (Sub DIC under BTISNet)

R. Sumathy, S. Manthira Moorthy, V. Sivaprasad (upto Jan. 2019) and R.S. Teotia

The Bioinformatics centre at CSRTI-Mysuru is 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. This centre also develops software for utilization by the researchers working in the field of sericulture, seri-biotechnology and also support in analyzing data generated by scientists under different projects.

Research work carried out: During this period, centre has carried out the metagenomic analysis of silkworm larval guts and *in silico* analysis and identification of miRNA targets of silkworm and transcription factors in insects.

1. Genome-wide identification of transcription factors in Insects

Transcription factors are proteins which plays vital roles in the life cycle of all organisms. These protein factors regulate gene expression levels by binding to specific target sequences in the promoters regions, thereby enhancing or repressing their transcriptional rates. The identification and classification of transcription factors helps to understand biological processes such as gene expression, regulation, cell development etc. In this study, insect transcription factors were mined computationally from the uniprot and NCBI reference sequences using the HMMER package by utilizing the available transcription factor Pfam models. Around 120 and 128 transcription factors were predicted and mapped to the 54 and 115 insect species from uniprot and NCBI reference database respectively. The predicted transcription

factors were archived in the Instfdb (Insects transcription factor database), relational database of transcription factors extracted from different species of insects. The resource will facilitate the understanding of the functional significance of transcription factors in insects and provides valuable information for insect research community.

2. *In Silico* identification of novel miRNA targets of silkworm (*Bombyx mori*)

MicroRNA are small ~22 nucleotides non coding RNA molecules which plays a regulatory role in many cellular and developmental process. The microRNA has the potential to regulate at least 20% - 30% of transcribed genes. Silkworm (*Bombyx mori*) is an economically important and it is essential to understand the diverse functions of these miRNAs, which necessitates the identification and characterization of miRNA target sequences. In this study, targets were identified for 563 silkworm mature microRNA which is obtained from the miRBase database. A total of 15077 3' un-translated regions out of 25332 mRNA sequences from the NCBI database (https://www.ncbi.nlm.nih.gov/) were utilized for target scan. Using miRanda based methodology prediction a total target hits of 663924 among 3' UTR regions with an average minimum energy duplex structure ≤ −20 kcal/mol and an average score ≥ 70 were determined. Further, a comprehensive list of 6317 novel silkworm microRNA targets that comprises of 3565 mRNAs were identified from 513 microRNAs by screening the miRNA target alignment. Further, the gene annotation of putative microRNA targets highlights their involvement in the regulation of a variety of biological processes. The predicted targets from this study can be utilized for experimental validation and understand the miRNA regulated function of insects in general and lepidopteran in particular.

Continuous/Other Activities:

Workshop Conducted: Twenty participants including scientists, research scholars and faculty from universities/ institutes and organizations have participated in the workshop on "Bioinformatics and its application in biological research" conducted on 25th-26th March 2019.

Web Resources: The developed databases and softwares were periodically updated and available at http://btismysore.in.

REGIONAL SERICULTURAL RESEARCH STATIONS (RSRS)

Regional Sericultural Research Stations (RSRS) 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
1. REC-Bidraguppe
2. REC-Chitradurga
3. REC-Madivala
4. REC-SU-Koppal
Sub-Units
1. REC-SU-Bijapur
2. REC-SU-Jamkhandi
3. REC-SU-Kanakapura
4. REC-SU-Kudligi
5. REC-SU-Ranebennur
6. REC-SU-Shahapur
7. REC-SU-Shirahatti
8. REC-SU-Tumkur

Command Area	Scientists/Staff	
	In-charge Officer:	Jalaja S Kumar Scientist - D
Karnataka	Scientists	07
	Technical Staff	09
	Administrative Staff	02

Farm Based Units		
Unit	Total area (acres)	Mulberry acreage
RSRS-Kodathi	66.90	11.00
REC-Bidraguppe	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

Performance of CPP clusters in Karnataka			
Zone	Parameters	Annual target	Achievement
South Karnataka (19 clusters)	No. of dfls (lakhs)	76.40	73.77 (96.55 %)
	Yield / 100 dfls (kg)		67.43
North Karnataka (14 clusters)	No. of dfls (lakhs)	57.0	64.76 (113.61 %)
	Yield / 100 dfls (kg)		62.51
Total	No. of dfls (lakhs)	133.40	138.53 (103.85%)
	Yield / 100 dfls (kg)		63.63

Ongoing Research Project

Collaborative Research Projects / Programmes

PPA-3580: Soil health cards for sericulture farmers in states of Karnataka (in collaboration with CSRTI-Mysuru) (Apr. 2016-Mar. 2019)

P. Sudhakar, P. Saraswathi 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.

A total of 1400 soil samples were received from different clusters the same were sent to CSRTI-Mysuru for analysis.

Cluster wise soil samples of farmers received for analysis	
Cluster name	1918-19
Sulibele (IVLP)	12
CR patna	161
Tubagere	26
Ithandahalli	303
Sidlaghatta	49
Kurudumalai	180
Yelburga	137
Lingasugur	378
Sira	32
Ranebennur	7
Shahapur	9
Bannikuppe	104
Gulbarga	2
Total	1400

Cluster Promotion Programme (CPP):

Jalaja S Kumar, M. Noble Morrison, M. Venkatachalapathy, P. Saraswathi, Raveendra M. Mattigatti, Ishwar, Y. Srinivasulu and Umesh

Bivoltine sericulture technologies were disseminated in 33 clusters across Karnataka. A total of 138.53 lakh bivoltine hybrid dfls were distributed with an achievement of 103.85 % achievement against the target (133.40 lakh dfls). An average yield of 63.63 kg / 100 dfls was recorded and 7816.97 acres of new plantation was taken up with 5147 farmers.

On Station Trials

Evaluation of new breeds and hybrids:

M. Venkatachalapathy, Ishwar and Jalaja S. Kumar

Rearing of 48 breeds viz., OFC 1 to 17, DFC 1 to 12, BMO 1, 2, 5, 6, 7, 8, 9, BMD 1 and 2, 1 x 10, 7 x 10, MSN 4, 6, 7, S8N, 2E, 52N, 26N, 51N and MV2 were conducted under OST w.e.f. 22.9.18. The data revealed that, the highest cocoon yield/100 Dfl of 97.5 kg was obtained in OFC10 dumbbell combination and lowest cocoon yield/100 Dfl of 17.5 kg in OFC7 combination. The yield was 93.7 kg in OFC4, 90.0 kg in DFC2 92.5.0 kg in DFC11 and 87.5 kg in BMO5.

Rearing performance of new BV hybrids (Sept-Oct. 2018)												
Cross breed	No. of Dfls	Fecundity (no.)	Larvae brushed (no.)	Hatching %	Actual yield		ERR by		Yield/ 100 dfls (kg)	SC wt. (g)	SS wt. (g)	SR%
					By no.	By wt. (kg)	By No.	By wt. (kg)				
OFC4	2	485	950	97	876	1.88	9221	18.20	93.70	1.98	0.37	18.68
OFC7	1	420	400	95	62	0.13	1550	2.50	17.50	1.63	0.34	20.85
OFC10 dumbbell	1	588	552	94	540	0.98	9782	16.69	97.50	1.75	0.37	19.25
OFC13	1	277	233	84	92	0.20	3948	7.20	20.00	1.82	0.37	20.32
OFC15	1	500	480	97	470	0.75	9791	14.22	75.00	1.53	0.32	20.91
DFC2	1	498	490	98	461	0.90	9408	16.92	90.00	1.81	0.34	18.78
DFC3	2	442	850	96	820	1.53	9647	16.68	76.00	1.77	0.33	18.64
DFC6	1	525	493	94	461	0.85	9350	15.98	85.00	1.73	0.34	19.65
DFC8	1	529	506	95	445	0.78	8794	14.62	77.50	1.68	0.34	20.23
DFC11	2	416	730	87	560	0.93	7671	12.20	92.50	1.62	0.33	20.37
BMO1	2	472	906	96	895	1.55	9878	16.20	77.50	1.66	0.34	20.48
BMO5	1	502	486	97	476	0.88	9794	16.92	87.50	1.74	0.36	20.68
BMO8	1	492	471	95	440	0.85	9341	17.26	85.00	1.88	0.40	21.27
BMD1	1	426	421	98	389	0.76	9239	16.42	75.50	1.79	0.36	20.11
52N	5	465	2000	86	1998	3.75	9980	18.00	75.00	1.83	0.37	20.21
26N	8	329	2522	97	2198	3.75	8715	14.30	75.00	1.66	0.35	21.08
V2	4	402	1575	98	1256	2.50	7974	15.00	83.33	1.91	0.40	20.94

Rearing performance of new BV hybrids: Rearing of N21, N56, MASN4 and MASN6 revealed that, the yield was 38 kg in MASN6 and 24 kg in MSAN4. The highest SR% of 17.46 was recorded in N21 followed by 17.2 in N56. The SR% was 16.73 in MASN4 and 16.27 in MASN6.

Rearing performance of new BV hybrids: Rearing performance revealed that, the highest cocoon cocoon yield/100 Dfl of 80.0 kg was recorded in MASN4 followed by 65.0 kg in MASN6 and O1 x O2. The cocoon parameters were better in O1 x O2 followed by MASN4 and D1 x D2.

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 461 farmers and 101120 dfls were distributed and popularized. Similarly, new mulberry varieties *viz.,* G4, MSG-2 and AGB 8 saplings/cuttings were supplied to the needy farmers and popularized from RSRS, Kodathi and its nested units.

Popularization of new mulberry varieties		
RSRS-Kodathi	G4	3500 saplings/ 5 farmers covered 8 acres 48650 cuttings/ 18 farmers covered 110 acres
	MSG2	500 saplings supplied to REC-Koppal - 1 ACRE
	AGB8	150 saplings supplied to REC-Koppal

Popularization of new silkworm hybrids	
Unit	Achievement (Dfls / No. of farmers)
REC-Chitradurga	13857/ 55
REC-Madivala	98620 /390
REC-SU-Koppal	2500 / 16
Total	101120/ 461

Extension Communication Programmes: Various ECPs were conducted by the RSRS and its nested units for the transfer of technology developed by the main institute. Overall 25123 farmers sensitized with 423 programmes.

Extension Communication Programmes (ECP)											
Name of the centre	Name of the cluster	Group discussion		Farmers day		Field day/Awareness programme		Exhibition		Total	
		No.	far.	No.	far.	No.	far.	No.	far.	No.	far.
RSRS-Kodathi	Andaralahalli	6	137	0	0	0	0	-	-	6	137
	Y.N. Hosakote	10	255	7	308	1	124	-	-	18	687
	Harohalli (B)	9	197	2	87	2	193	2	5500	15	5977
	CR patna	24	447	3	166	0	0	-	-	27	613
	Tubagere	10	237	3	149	4	556	-	-	17	942
	Tumkur	12	408	6	401	2	365	-	-	20	1174
	Sira	8	192	10	576	4	694	-	-	22	1462
	Bannikuppe	33	711	1	51	6	652	2	2400	42	3814
	Sulibele-IVLP	17	398	2	102	2	233	-	-	21	733
REC-Chitradurga	Challakere	2	42	4	172	1	94	-	-	7	308
	Hiriyur	5	101	5	229	1	82	-	-	11	412
	Davanagere	1	15	4	171	2	181	-	-	7	367
	Ranebennur	14	259	8	393	0	0	-	-	22	652
	Soraba	0	0	3	144	1	82	-	-	4	226
REC-Madivala	Ithandahalli	3	69	7	577	1	153	-	-	11	799
	Kurudumalai	1	23	6	497	3	314	-	-	10	834
	Shapur (K)	2	50	7	460	3	382	-	-	12	892
REC-Koppal	Yelburga,	13	331	4	175	1	100	-	-	18	638
	Lingsugur	17	346	4	237	-	-	-	-	21	583

	Shirahatti	13	320	4	222	1	96	-	-	18	606
	Bijapur	31	859	3	191	1	106	-	-	35	1156
	Jamkhandi	25	735	0	0	-	-	-	-	25	735
	Shahapur	6	121	2	110	-	-	-	-	8	231
REC-SU-Kudligi	H.B. Halli	5	109	3	130	2	331	-	-	10	570
	Kudligi	4	90	3	140	0	0	-	-	7	230
REC-SU-Bidar	Aurad	1	22	-	-	-	-			1	345
	Humnabad	4	105	1	60	1	114			6	
	Kalburgi	2	44	-	-	-	-			2	
	Total	278	6623	102	5748	39	4852	4	7900	423	25123

Institute Village Linked Programme (IVLP): 76350 dfls of Bivoltine hybrid were reared with an average yield of 65 Kg/100 dfls with an improvement of 16.12 % cocoon yield over bench mark.

Production of biological control agents: A total of 209400 ml 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: A total quantity of 1789 dfls was reared at RSRS and nested units (REC-Madivala, Chitradurga and REC-SU-Koppal). A total of 2500 dfls of bivoltine hybrids were chawki reared and distributed to 16 farmers through REC-Koppal.

Farm maintenance: A total of 20.48 acres of mulberry garden was maintained by RSRS and farm based nested units and produced 80 MT mulberry leaves and utilized for farm rearing and excess leaf was sold. Farm waste was recycled and produced a total 53.7 MT compost and 43 MT vermicompost, used for mulberry garden. The technologies implemented in the farm was demonstrated/ explained to the farmers/students visited the station.

Capacity Building Training Programme (CBT): RSRS and its nested units carried out 16 Farmers Skill Training Programmes (FST) and trained 335 farmers (3 days / programme) on different technologies and organized one day field trip.

Seri cleanliness drive: Seri cleanliness drive was organized at Bannikuppe, Tubugere and Tumkur cluster for the benefit of sericulturists. A total of 409 farmers were sensitized in seven programmes.

Visitors: During the period a total of 259 sericultural farmers, students and officials visited the RSRS station and REC-Chitradurga and Koppal to know about sericultural technologies, cultivation packages, different types of mulberry varieties.

RSRS-CHAMARAJANAGARA

REC & Sub-Units
REC SU-Kinakanahally

Scientists/Staff	
In-charge Officer	Dr. V. Girish Naik
Scientists	4
Technical staff	10
Administrative staff	7

Farm Based Units		
Unit	Total area (acres)	Mulberry acreage
Chamarajanagara	14.02	6.153
REC SU-Kinakanahally	17.20	2.60

Concluded Project:

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

S. N. Pallavi and Balasaraswathi S.

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

As per the set goals, experimental plot was selected and 27 micro plots were demarcated for insecticides/pesticides/weedicide treatments. Soil samples were collected before imposing treatments. Chemical treatments were imposed followed by the collection of soil samples at fixed intervals of ten days, for assessment of effect of chemicals on soil biota and analysis of residual toxicity of pesticides in mulberry ecosystem. Collected samples were sent to RSRS, Salem for analysis. Meteorological data corresponding to the period of implementation of the project were recorded.

Outcome of the Project

Information on the efficacy of recommended plant protection chemicals with respect to abiotic factors was generated, the results of the soil analysis of the experimental plot/micro plots gave details on the effect of chemicals on soil biota and residual toxicity in mulberry ecosystem.

ONGOING 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 and 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

Surveys were conducted at T. Narasipura cluster at fortnightly intervals. Silkworm crops of 110 farmers covering 21,815 Dfls of bivoltine hybrids were monitored and necessary guidance was given. Varying level of disease incidence was observed in different farmers' rearings. The average disease incidence recorded was Grasserie (1.06%), Flacherie (0.96%), Muscardine (0.93%). Incidence of silkworm diseases was monitored periodically and necessary remedial

measures were suggested to the farmers. No Pebrine incidence was noticed and incidence of other diseases was found to be minimal.

Silkworm disease monitoring at T.Narasipura cluster						
Month	No.of dfls	No.of farmers	% of disease incidence			Cocoon yield/ 100 dfls (kg)
			Grasserie	Flacherie	Muscardine	
May 2018	10	1730	0.78	0.49	0.00	65.26
Jun. 2018	10	1950	0.90	0.90	1.40	71.30
Jul. 2018	10	2485	0.55	0.95	1.75	74.10
Aug. 2018	10	1425	0.45	0.70	1.45	74.20
Sep. 2018	10	1645	1..40	0.80	1.20	69.25
Oct. 2018	10	1575	1.25	0.75	1.20	74.79
Nov. 2018	10	3600	1.05	1.05	1.22	75.90
Dec. 2018	10	1780	1.80	1.05	1.50	76.00
Jan. 2019	10	1760	0.00	0.95	0.55	81.25
Feb. 2019	10	2015	2.40	1.70	0.0	70.30
Mar. 2019	10	1850	1.10	1.30	0.0	75.35
Total/Avg.	110	21815	1.06	0.96	0.93	73.40

Year wise silkworm disease incidence under T. Narasipura cluster						
Year	No. of Dfls	No. of farmers	% of disease incidence			Yield/ 100 Dfls (Kg)
			Grasserie	Flacherie	Muscardine	
2015-16	14700	90	1.26	0.59	0.56	70.30
2016-17	16525	120	2.19	0.53	0.01	75.78
2017-18	20740	120	1.71	1.71	0.76	62.31
2018-19	21815	110	1.06	0.96	0.93	73.40

Technologies Transferred during the Year: Cultivation of tree mulberry under water deficit and rainfed conditions.

Multiplication of mulberry varieties

V. Girish Naik

Objective: Multiplication of new mulberry varieties for large scale production of saplings.

1. About 20000 cuttings of different mulberry varieties viz.,S-13, AGB-8, AR-12, G-2 and V-1 were planted in the nursery for raising saplings and supply to the farmers on cost basis.
2. Saplings of S-13 (3800 Nos.), AGB-8 (500 Nos.), G-2 (50 Nos.), G-4 (100 Nos.), V-1 (1750 Nos.) and MSG-2(750 Nos.) were supplied to farmers @ Rs. 2/- sapling.

ON-STATION TRIALS

V. Girish Naik and Serani Nagendra

Objective: To evaluate the rearing performance of new bivoltine hybrids under Chamarajanagar condition.

One trial each of the new bivoltine hybrids S8 x CSR16N and (52N x S8N) x (16N x 28N) as well as CSR52 x CSR26N and (CSR52N x S8N) x (CSR16 x 26N) along with the control FC1 x FC2 were conducted. The rearing performances of individual hybrids are listed.

Rearing performance of new bivoltine hybrids							
Hybrid	Hatching (%)	Weight of 10 larvae (g)	ERR by No.	ERR by Wt. (kg)	S.C.Wt (g)	S.S.Wt (g)	SR %
S8 x CSR16N	92.70	30.020	6926	12.160	1.755	0.380	17.54
(52N x S8N) x (16N x 28N)	96.08	28.076	4942	8.490	1.719	0.372	21.64
FC1 x FC2	94.80	35.702	5125	8.470	1.653	0.363	21.96
CSR52 x CSR26N	96.50	37.236	9662	16.14	1.671	0.359	21.48
(CSR52N x S8N) x (CSR16 x 26N)	92.34	36.002	9345	14.24	1.524	0.320	20.99
FC1 x FC2	97.07	37.484	8981	15.01	1.671	0.361	21.60

Chawki rearing and supply:

A total of 13504 Dfls were chawki reared at Kinakanahalli farm and supplied to 118 farmers.

Other continuous activities:

Survey and surveillance of major pests and their natural enemies in mulberry ecosystem

V. Girish Naik

Objectives:

- To monitor the incidence of insect pests and their natural enemies in mulberry ecosystem.
- 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 programme is a continuous activity. Surveys were conducted on monthly basis on the incidence of pests of mulberry at five farmer's field. Pest incidence was recorded in relation to weather parameter. Twelve surveys were conducted during the year. No severe pest incidence was noticed, however, in some farmer's field tukra incidence was recorded during the months from Apr. to Oct. 2018 which ranged from 0.5 to 1.0 %. Overall, the survey revealed that in Chamarajanagar area, the incidence of pests in mulberry gardens is comparatively less, keeping in view the dry weather condition and lower moisture level of the leaf.

Forecasting and forewarning of mulberry pests

V. Girish Naik

Objectives:

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

Surveys were conducted at fortnightly interval on the incidence of pests and diseases on mulberry. Twenty-four surveys were conducted during the year, at five farmer's field covering different villages. Pest incidence was recorded in relation to weather parameter. No severe pest and disease incidence was noticed in majority of the mulberry fields. However, in some farmer's field tukra incidence was recorded in the month of Apr. to Oct. 2018 and ranged from 0.5 to 1.0 %.

Farm and silkworm rearing activities

V.Girish Naik

A total of 10650 kg of mulberry leaf was produced and utilized for general, on station trial (OST) and chawki rearing (at Kinakanahalli farm). A total of 900 dfls were reared during the year and 479.135 Kg of cocoons were produced, of

which 360 cocoons were sent to CSRTI, Mysuru for analysis of reeling parameters. A total of 472.33 Kg of cocoons were marketed.

Farmers Advisory Cell: Farmers' advisory cell was established with technology charts and exhibits. During the year, 686 persons including farmers (497), officials (64) and students (125) visited the station, various sericulture technologies were explained to them with emphasis on appropriate techniques for sericulture under moisture limited situations. Offered technical guidance in sericultural activities based on the need of farmers.

Programmes:

Cluster Promotion Programme:

- Bivoltine sericulture technologies were disseminated in T. Narasipura cluster.
- 2.309 lakh bivoltine hybrid dfls were reared with an average yield of 68.15kg/100dfls.
- 52.23 acres of new plantation were also established with 135 farmers.
- Average rate realized per kg cocoon was Rs.319.00.
- A total of 131 soil samples from T. Narasipura cluster were collected for analysis at CSRTI Mysuru.
- Serifit - 50 kg. (250 packets of 200 g. each) disinfectant was supplied to bivoltine farmers in captive area of T. Narasipura cluster.
- Three video clippings and a success story write up on the beneficiaries of CPP were prepared.
- Conducted 13 ECPs for the benefit of 596 farmers.

Progress of Cluster Promotion Programme										
Cluster	Annual target (No. of dfls)	Dfls distri-buted (No.)	Ach. (%)	Yield/ 100 Dfls (kg)	Rate/ kg (Rs.)	Est. raw silk (MT)	New plantation		ECPs	
							No. of farmers	Area (ha.)	No. of events	No. of farmers
T. Narasipura	330000	230990	70.00	68.15	319.00	24.22	135	52.23	13	596

Institute Village Linkage Programme

- 2120 dfls (bivoltine hybrids and pure breed) was reared by IVLP beneficiaries and with an average yield of 71.58 kg/100 dfls.
- 1805 cross breed dfls were reared and the average yield /100 dfls was 84.41 kg.
- The farmers earned an average rate of Rs. 358.79 /Kg from the cocoon sales.

Cluster	Silkworm hybrid	Target (No. of Dfls)	Dfls brushed	Yield/ 100 dfls (kg)	Rate/ kg (Rs.)	Est. raw silk (MT)	New plantation		ECPs	
							No. of farmers	Area (ac.)	No. of events	No. of farmers
Chamaraja-nagar	Bivoltine hybrid	8400	2120	71.58	358.79	0.20	-	-	9	238
	Cross breed	-	1805	84.41	251.86	0.19				
Total		8400	3925							

Training programmes conducted under capacity building training

Title of the programme	Place	Duration	No. of Participants
Farmers Skill Training (FST) programme	Channappanapura	3 days (5.2.18 to 7.2.18)	32

Extension Communication Programmes				
Sl. No	Date	Venue	Farmers sensitized	Total no.of participants (Farmers & DoS / CSB officers/officials)
(I)	Under CPP:			
A	Group discussion			
1	29.06.2018	Chikkakalkuni	24	31
2	13.08.2018	Kattepura	28	33
3	26.09.2018	Muguru moule	29	34
4	15.10.2018	Hegguru	30	35
5	15.10.2018	K.Kothanahalli	22	27
6	16.10.2018	T.Doddapura	28	32
7	19.12.2018	Konagahalli	29	32
8	11.01.2019	Beedanahalli	27	30
		Total	217	254
B	Farmers' day			
1	02.11.2018	Doddamulagudu	54	61
2	28.01.2019	Kempaiahnahundi	51	56
3	08.03.2019	B.Seehalli	50	59
		Total	155	176
C	Field day			
1	18.01.2019	Senapathihalli	104	112
2	30.1.2019	TSC, Muguru	120	127
		Total	224	239
		Total of CPP	596	669

II)	Under IVLP			
A	Group discussion			
1	15.07.2018	Muttige	20	24
2	14.08.2018	Doddakavalande	16	18
3	07.09.2018	Kilalipura	24	26
4	20.02.2019	Naripura	22	26
5	28.02.2019	Kunthuru	17	21
6	07.03.2019	Ummathuru	24	32
		Total	123	147
B	Farmers' day			
1	25.05.2018	Channappanapura	42	48
2	17.09.2018	Channalinganahalli	39	44
3	19.02.2019	Kothanuru	34	40
		Total	115	132
		Total of IVLP	238	279
		Total of IVLP and CPP	834	948
(III)	Sericulture exhibition at Suttur Krishi Mela		4714	4722
		Grand Total	5548	5670

Abstract of ECP at T.Narasipura CPP Cluster			
Name of the programme	No. of events	No of farmers	Total no.of participants
Group discussion	8	217	254
Farmers' day	3	155	176
Field day	2	224	239
Total	13	596	669

Abstract of ECP at IVLP Cluster			
Name of the programme	No. of events	No of farmers	Total no.of participants
Group discussion	6	123	147
Farmers' day	3	115	132
Field day	-	-	-
Total	9	238	279

Abstract of ECP at RSRS-Chamarajanagara					
Name of the programme	Target		Achievement		Total no.of participants
	No. of events	No of farmers	No. of events	No of farmers	
Group discussion	14	210-280	14	340	401
Farmers' day	9	270-360	6	270	308
Field day	2	160-200	2	224	239
Exhibition			1	4714	4722
Total	25	640-840	23	5548	5670

Ph.D. degree:

1. Pinto MV (2019). Identification of QTLs conferring resistance to root rot disease in mulberry by linkage disequilibrium mapping. Awarded Ph.D degree in Biotechnology by University of Mysore, Mysuru - Guide: Dr. V. Girish Naik
2. Sowmya Peesaramilli (2019). Molecular characterization and diversity analysis of fungi causing root rot disease in mulberry (*Morus* spp.). Awarded Ph.D degree in Biotechnology by University of Mysore, Mysuru - Guide: Dr. V. Girish Naik
3. Rukmangada MS (2019). Characterization of early vigour and growth in mulberry (*Morus* spp.) by morpho-physiological and genomic markers. Submitted Ph.D thesis in Biotechnology to University of Mysore, Mysuru - Guide: Dr. V. Girish Naik

RSRS-SALEM

RSRS-Salem
REC-Gobichettipalayam
REC-Krishnagiri
REC-Samayanallur
REC-Udumalpet
REC-Palakkad

Command Area	Scientists/staff	
	In-charge Officer	S. Rajakumar (upto 30-11-2018) N. Dhahira Beevi
Tamil Nadu Kerala	Scientists	14
	Technical staff	18
	Administrative staff	17

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

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 (Apr. 2016 to Mar. 2019)

N. Dhahira Beevi and S. Rajakumar

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

3861 soil samples from CPP of Tamil Nadu (28 clusters), Kerala (2 clusters) and other sericulture farmers of different areas were analyzed for pH, EC, OC%, Available N, P, K, B and S. 3861 soil samples were processed and sent to CSRTI-Mysuru for secondary and micro nutrient analysis and preparation of Soil Health Cards (SHC) for individual farmers.

Cluster wise soil samples received and analyzed					
Sl.No	Name of the cluster	No. of samples	Sl.No	Name of the cluster	No. of samples
1	Adaikalapattinam	50	17	Madathukulam	-
2	Alangkayam	8	18	Manurpalayam	7
3	Alangudi	41	19	Ottanchathiram	5
4	Annur	88	20	Palani	-
5	Anthiyur	12	21	Pitchandampalayam	-
6	Bagalur	-	22	Pollachi	-
7	Berigai	-	23	Pongalur	8
8	Bhavani	29	24	Poolavadi	8
9	Dharapuram	8	25	Sanarpatty	-
10	Dharmapuri	9	26	Srivilliputhur	-
11	Gobi South	9	27	Udumalpet	8
12	Gudimangalam	5	28	Uthangarai	92
13	Keeranur	-		Non captive area	3474
14	Kodiyalam	-		Kerala	
15	Kottur	-	29	Palakkad	-
16	Kumaralingam	-		Total	3861

Fertility ratings of soil samples analyzed			
Parameters	Status		
pH	Acidic	Neutral	Alkaline
Ratings	< 6.5	6.5-7.5	> 7.5
(% samples)	3.29	28.65	68.06
EC ratings	Normal	High	Toxic
(mmhos/cm)	< 1	1-2	> 2
(% samples)	99.01	0.55	0.44
OC status	Low	Medium	High
%	< 0.65	0.65 – 1.00	> 1.00
(% samples)	58.41	37.63	3.96
Available P	Low	Medium	High
(kg / ha)	< 10	10-20	> 20
(% samples)	0.55	32.61	66.84
Available K	Low	Medium	High
(kg / ha)	< 120	120 - 240	> 240
(% samples)	8.29	40.47	51.24
Sulphur	Low	Medium	High
(ppm)	<10	10-15	>15
(% samples)	58.11	31.26	10.63

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 (Apr. 2016 – Mar. 2019)

S. Balasaraswathi, 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 the efficacy of chemical insecticides revealed maximum percentage reduction of tukra incidence by DDVP at RSRS-Chamarajanagara (80.39). Similarly minimum percentage reduction of tukra (70.12) was recorded at RSRS-Anantapur. REC-Madivala recorded the maximum percentage reduction of thrips (82.10) by Dimethoate followed by RSRS-Anantapur (80.8). During 2016-17, 2017-18 and 2018-19 the incidence of leaf roller showed positive correlation to rainfall where as the tukra incidence showed negative correlation to rainfall in all the four centres viz., RSRS-Salem, Anantapur, Chamarajanagara and REC-Madivala. The treatment Dimethoate recorded the minimum population of earthworms (9.82/cu.ft of soil) followed by Dichlorvos (12.1/cu.ft of soil) after ten days of treatment compared to the control (16.2/cu.ft of soil) at RSRS-Salem. Similarly, Dimethoate showed the minimum population of centipedes

(2.60/cu.ft of soil) followed by Dichlorvos (1.56/cu.ft of soil) and Glyphosate (1.22/cu.ft of soil). The collembolans recorded were (10/250 g. of soil) in Dimethoate treatment compared to the control (4.1/250 g. of soil). Results on the enumeration of soil microbes revealed maximum reduction of bacterial population on third day after treatment in Dimethoate (62.1 x 10^6 CFUs/g. of soil) followed by Dichlorvos (73.2 x 10^6 CFUs/g. of soil), Bavistin and Mancozeb (80.8 x10^6 CFUs/g. of soil) when compared to the control (115 x 10^6 CFUs/g. of soil) over population of soil microbes in pre-treatment. Similarly, the 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 x 10^2 CFUs/g. of soil) respectively. No significant reduction of the fungal/bacterial/Actinomycetes population in soil was found with regard to bio pesticides. Similar results were recorded at RSRS-Anantapur, Chamarajanagara and REC-Madivala. The soil samples collected from the four centers were handed over to Toxicology Laboratory, TNAU-Coimbatore for multi residue analysis for pesticides after completion of five crops and the results revealed the residue of Bavistin in the soil samples of RSRS-Salem and REC-Madivala 0.35 and 0.23ppm. The soil samples of all the four centres revealed residue of Gramaxone upto 0.06ppm. The other treatments showed below detectable level of residue (less than 0.05ppm).

PIB-3632: Evaluation of superior triploid for yield and adaptability under varied agro climatic Condition (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 conditions.
- Planting work completed in optimal, sub optimal plots during first week of February 2019 and survival data recorded on 30 and 60 days after planting.

Continuous/Other Activities:

PRE-3527: Studies on disease forecasting and forewarning model (Mulberry and Silkworm Pests)

N. Sakthivel and S. Rajaram

Objectives:

- To forecast and forewarn the mulberry and silkworm pests
- To record the incidence of mulberry and silkworm pests and to recommend IPM packages for the mulberry and silkworm pests

The continuous research programme is being carried out at this centre. Pest and disease survey conducted fortnightly in 25 selected farmers field and data collected has been sent to CSRTI, Mysuru for further compilation and analysis. Temperature and humidity data of that area during the corresponding period was also recorded and sent. During the period, leaf roller incidence ranged from 0.0 to 10.3%, thrips 0.36 to 4.51%, tukra 0.08 to 1.92%, white fly 0.16 to 0.21 % and uzi fly 0.39 to 1.80%.

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

Silkworm disease survey conducted monthly in 10 selected farmers' rearing (in each CPP cluster) and data collected has been up loaded in the internet site www.seridm.csrtimys.res.in of CSRTI, Mysuru for further compilation and analysis.

On Station Trials:

RSRS Salem:

Testing of new bivoltine hybrids: Three rearing trials conducted with six new bivoltine hybrids viz., N21, N56, (CSR52N x S8N) x (CSR16N x 26N), S8 x 16N, CSR52N x 26N, N21 x N56 and FC1 x FC2 as control. Rearing performance of the new hybrids were better during August 2018.

Rearing performance of new Bivoltine hybrids (March - April 2018)							
Hybrids	Fecundity (no.)	ERR By no.	ERR by wt. (kg)	Yld/100 dfls (kg)	SC wt.(g)	SS wt.(g)	SR (%)
N21	566	6195	5.316	26.578	1.026	0.226	22.027
N56	578	9346	8.190	40.951	1.056	0.201	19.034
CSR52N x S8N) X CSR16N x 26N)	604	4816	4.401	22.004	1.319	0.288	21.835
S8 x 16N	494	3389	3.090	15.461	1.138	0.234	20.562
FC1 x FC2 (control)	540	7118	7.435	37.175	1.301	0.283	21.527

Rearing performance of new bivoltine hybrids (August 2018)							
52N x 26N	549	8346	11.080	55.410	1.341	0.301	22.446
CSR52N x S8N) x (CSR16N x 26N)	562	9175	14.414	72.072	1.293	0.276	21.346
FC1 x FC2 (control)	577	8569	12.135	60.674	1.367	0.260	19.020
Rearing performance of new bivoltine hybrid (January - February 2019)							
N21 x N56	600	8393	10.287	51.435	1.420	0.313	22.042
Rearing performance of Improved cross breed (August 2018)							
PM ori. x CSR2	522	9833	15.040	75.195	1.407	0.257	18.266

Rearing performance of Improved cross breeds (March 2019)							
Breed	Fecun-dity (no.)	ERR by No.	ERR by wt. (kg)	Yld/100 dfls (kg)	SC wt.(g)	SS wt.(g)	SR (%)
MM7	413	9780	7.760	38.801	0.907	0.168	18.523
MM8	500	8087	6.654	33.268	0.863	0.156	18.076
MM7A	360	9008	6.634	33.172	0.730	0.137	18.767
MM17D	477	6508	3.844	19.220	0.689	0.121	17.562
ICB-2	321	8565	4.748	23.739	0.682	0.128	18.768
ICB-19A	369	9913	8.640	43.198	0.805	0.139	17.267
ICB-29	412	9763	8.971	44.856	0.967	0.163	16.856
ICB-30	410	7982	6.080	30.401	0.854	0.149	17.447

On Farm Trials: Newly developed bivoltine silkworm hybrids were test verified with the farmers by the RSRS-Salem and its nested units.

Centre	Race/ Combination	Dfls (Nos.)	No. of farmers	Actual Yield (kg)	Yield/100 Dfls (kg)
RSRS-Salem	Hybrid 1 to 9	3600	11	2858	79.4
	DHP4	1400	4	930	66.4
	DHP5	1800	6	1192	66.2
	N21 x N56	2000	7	1390	69.5
	D x 02	600	2	437	72.8
	O2 x D	400	2	282	70.5
	D x O3	700	2	495	70.7
	O3 x D	300	1	219	73.0
	S8 x CSR16	11500	38	7461	64.9
	CSR16 x S8	6000	21	4016	66.9
REC-Samayanallur	S8 x CSR16	1250	5	855	68.4
	CSR16 x S8	7250	25	5174	71.4
REC-Udumalpet	S8 x CSR16	9000	48	6618	73.5
Total/Average (combination wise)	Hybrid 1 to 9	3600	11	2858	79.4
	DHP4	1400	4	930	66.4
	DHP5	1800	6	1192	66.2
	N21 x N56	2000	7	1390	69.5
	D x 02	600	2	437	72.8
	O2 x D	400	2	282	70.5
	D x O3	700	2	495	70.7
	O3 x D	300	1	219	73.0
	S8 x CSR16	21750	91	14934	68.6
	CSR16 x S8	13250	46	9190	69.4
Total / Average		45800	172	31927	69.7

Extension Communication Programme: Various kinds of ECPs were conducted by the RSRS and its nested units for the transfer of technologies developed by the main institute.

Extension Communication Programmes conducted at RSRS-Salem and its nested units								
Centre	Technologies demonstration		Group discussion		Awareness programme/Field day		Farmers day	
	Far.	Exp.	Far.	Exp.	Far.	Exp.	Far.	Exp.
RSRS-Salem	845	-	1393	56489	970	93023	1856	191223
REC-Krishnagiri	-	-	735	23615	319	45000	547	59800
REC-Samayanallur	488	-	770	32409	855	114215	1647	109016
REC-Udumalpet	14	-	1009	55200	612	105000	1295	175000
REC-Gobichettipalayam	470	-	599	31000	434	90000	752	90000
REC-Palakkad	-	-	288	12000	146	30000	466	70000
Total	1817	-	4794	210713	3336	477238	6563	695039

Extension Communication Programmes conducted at RSRS-Salem and its nested units										
Centre	Exhibition		Study tour		Success stories writeup		Success stories video		ATMA program	
	Far.	Exp.	Far.	Exp.	Far.	Exp.	Far.	Exp.	Far.	Exp.
RSRS-Salem	-	-	-	-	-	-	-	-	59	-
REC-Krishnagiri	-	-	-	-	3	-	2	5000	-	-
REC-Samayanallur	47	-	-	-	3	-	4	-	-	-
REC-Udumalpet	139	-	15	48500	3	-	2	4000	27	-
REC- Gobichettipalayam	-	-	-	-	6	-	14	5500	-	-
REC-Palakkad	-	-	-	-	3		2	-	-	-
Total	186	-	15	48500	18	-	24	14500	86	-

Transfer of Technology Programme: The OFTs undertaken in transfer of technology programmes were evaluated for their impact based on the bench mark/ diagnostic study and the effectiveness of the technologies is presented below.

Centre	Rot fix (kg)	G2 (ac.)	G4 (ac.)	RC1 (ac.)	RC2 (ac.)	V1 (ac.)	Serimore (far.)	Serifit
RSRS-Salem	43.5 (12)	-	2.5 (2)	1.5 (1)		5.5 (6)	-	-
REC- Gobichettipalayam	84.5 (123)	-	7 (8)	-	-	-	-	3649(368)
REC-Udumalpet	55 (65)	-	-	-	-	-	6	-
REC-Samayanallur	20 (12)	-	-	-	-	-	-	-
REC-Krishnagiri	19.5 (5)	1.5 (2)	3 (11)	-	-	8.5 (1)	-	-
REC-Palakkad	27 (11)	-	-	-	-	-	-	-
Figures in parentheses denote number of farmers covered								

Resham Krishi Mela & Farmers Workshop	Date: 19-02-2019 Venue: Kolinjipatti, Namakkal District
421 farmers and 132 dignitaries, DOS, CSB and other officials participated.	Tamil booklet on "New sericulture technologies, Mass production of bio control agents for pest management in mulberry and a pamphlet on Fogging technology for management of microclimate in silkworm rearing shed during summer were released.

Cluster Promotion Programme: Bivoltine sericulture technologies were disseminated in 28 clusters across Tamil Nadu and 2 clusters in Kerala. A total of 100.8 lakh dfls and 1.28 lakh dfls were distributed and harvested an average cocoon yield of 79.59 and 86.13 kg / 100 dfls in Tamil Nadu and Kerala respectively.

IVLP: A total of 4.21 lakh dfls of bivoltine hybrids were reared with 200 farmers in two clusters viz., Sathyamangalam and Thondamuthur and recorded an average yield of 80.70 kg / 100 dfls with 15.10% improvement on productivity against the bench mark.

Capacity Building Training Programmes (CBT): RSRS and nested units conducted 13 Farmers Skill Training programmes (FST: 3days) and trained 251 farmers on various sericulture technologies, 23 officials/students were also trained under 5 Technology Orientation Programme (TOP: 5days) at RSRS-Salem and its RECs.

Mass multiplication and distribution of bio-control agents				
Biocontrol agents	Target host	No. of units produced/ distributed	Production/ distribution (Nos.)	No. of farmers covered
Acerophagus papayae (1 unit=250 nos)	Papaya mealy bug	500	1,25,000	353
Chrysoperla zastrowi sillemi (1 unit =1000 eggs)	Thrips	34	34,000	32
Blaptostethus pallescens (1 unit=1000 nymphs /adults)	Thrips	146	1,46,000	127
Trichogramma chilonis (1 card=1cc)	Leaf roller egg	64	64	50
Bracon brevicornis (1unit=100 nos)	Leaf roller larvae	586	58,600	477
Cryptolaemus montrouzieri (250 nos.)	Pink mealybug	12	1600	12

Sericulture Resource Centres (SRC):

- Sericulture Resource Centre at Thadiyamanai - Mangadu Village (REC-SU, Trichy) 6 batches of sericulture training was conducted with a total 120 farmers in coordination with the lead farmer Sri. A. Kalaichezhiyan.
- Sericulture Resource Centre at Manupatty village (REC-Udumalpet) 10 batches of sericulture training was conducted benefitting a total 267 farmers in coordination with the lead farmer Sri. Ponnusamy.

M.Sc. Students: One student of Nalla Muthu Gounder College of Arts and Science, Pollachi completed, dissertation work for Master of Science in Botany.

Ph.D. Students: At present 8 students are pursuing Ph.D., under Periyar University- Salem and one student has completed external viva-voce for Ph.D.

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

Miscellaneous events /Activities: Swachha Bharat Pakwada was observed at RSRS-Salem and it nested Units during March 2019 (first fortnight) and a mass pledge on Swachhata by the employees was administered. Activities such as cleanliness of office, weeding out of old files, cleaning of laboratory equipments, toilets, staff quarters, main passages, etc., were carried out.

Month	Thrips	Tukra	Leaf \roller	Powdery mildew	Root rot	Grasserie (%)	Flacherie (%)
Apr. 2018	7.96	7.01	-	-	1.67	2.65	2.23
May 2018	7.45	12	-	-	3.56	3.16	1.28
Jun. 2018	3.03	4.92	-	-	-		1.75
Jul. 2018	8.17	6.44	-	-	-	0.98	1.25
Aug. 2018	3.21	3.24	-	-	6.15	-	2.45
Sept. 2018	2.85	2.76	-	-	-	0.01	0.03
Oct. 2018	1.78	1.94	0.32	-	-	-	1.76
Nov. 2018	-	0.27	4.49	-	-	0.50	1.33
Dec. 2018	-	-	8.36	6.56	-	2	5
Jan. 2019	-	-	15.54	3.85	12.50	-	2.25
Feb. 2019	-	0.33	16.11	1.33	8.75	0.10	0.03
Mar. 2019	7.62	8.39	-	-	-	0.86	1.56
Mean	3.50	3.94	3.73	0.98	2.72	0.85	1.74
No incidence of papaya mealy bug and root knot was recorded							

RSRS-ANANTAPUR

Command area	Scientists/Staff	
	In-Charge officer	Dr. M.A. Shanthan Babu (upto 18.06.2018) Dr. P. Sudhakar (w.e.f. 20.06.2018)
Andhra Pradesh Telangana Karnataka	Scientists	10
	Technical staff	21
	Administrative staff	11

Farm based units		
Unit	Total area (Acres)	Mulberry acreage
RSRS-Anantapur	40.73	6
REC-Rayachoty	5	1.25
REC-Vikarabad	5.50	1.86
REC-SU-Bidar	11.33	5.50

REC and Sub-Units	
Andhra Pradesh	
REC-Rayachoty	
REC-Eluru	
REC -V. Kota	
REC-SU-Atmakur	
REC-Kalyandurgam	merged with RSRS-Anantapur in July 2018
REC-Madakasira	merged with P2 BSF-Madakasira in July 2018
REC-SU-Penukonda	merged with P2 BSF-Madakasira in July 2018
REC-SU-Hindupur	merged with P2 BSF-Madakasira in July 2018
REC-SU-Chebrolu	merged with REC-Eluru in June 2018
REC-SU-Markapur	merged with REC-SU-Atmakur in June 2018
REC-SU-Palamaner	merged with REC-V. Kota in July 2018
Telangana State	
REC Vikarabad	
REC-SU - Suryapet	merged with RSRS, Shadnagar in June 2018
REC-SU - Metpally	merged with RSRS, Shadnagar in November 2018
Karnataka State	
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)

B. Vijaya Naidu and P. Sudhakar

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

Collected weather data of April 2018 to March, 2019 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.

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

Vijaya Naidu B and Sudhakar P

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

1556 soil samples collected from Hindupur, Madakasira, Rayachoty, Eluru, Metpalli, Anantapur, Kalyandurg and V. Kota during the year 2018-19. Ananlysis of 650 soil samples for pH, EC, OC % completed and uploading of these farmers data to the soil health card portal for the year 2018-19 was also completed and 906 farmers of 2018-19 is under progress. 470 soil samples were already sent to CSRTI, Mysore for further analysis of phosphorus, potash and other micro nutrients. The remaining soil samples also (1086) will be sent to CSRTI, Mysore for further analysis and issue of soil health cards.

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

P. Sudhakar

Objectives:

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

Experimental plot with 39 test mulberry genotypes and 4 checks collected from CSGRC, Hosur were established in the spacing of (5'+3') x 2' in ARBD. During this year, preliminary crop data and three crops data on plant growth and yield parameters recorded. Dried leaf samples were sent to CSGRC, Hosur for further chemical analysis. Experimental plot is under maintenance for further recording of data.

PIB-3632: Evaluation of superior triploid genotypes for yield and adaptability under varied agro climatic conditions (April 2018 - 2024) (Collaboration with CSRTI-Mysuru)

B. Vijaya Naidu and P. Sudhakar

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 conditions

Experiment 1: Sub-optimal input conditions: Saplings of 6 test mulberry genotypes and 2 checks collected from CSRTI, Mysuru were planted in the experimental plot in RBD design with 3 replications under 8'x 8'spacing on 7.11.2018. Gap filling was done with saplings on 26.01.2019. Establishment of put for Final Yield Evaluation (FYE) for sub optimal input conditions is under progress.

Experiment 2: Optimal input conditions: Saplings of 6 test mulberry genotypes and 2 checks collected from CSRTI, Mysuru were planted in the experimental plot in RBD design with 3 replications in (5'+3') 2' spacing on 26.01.2019. Establishment of the plot under Final Yield Evaluation (FYE) for optimal input conditions is under progress.

Research Projects collaboration with CSRTI-Mysore.

Silkworm disease monitoring of seed and commercial crop rearings of south Indian states: Project was taken up at all the clusters in A.P. and Telangana states and the data up loaded to www.seridm.csrtimys.res.in for analysis.

Continuous/Other Activities:

Cluster Promotion Programme: Bivoltine sericulture technologies were disseminated in 13 clusters in Andhra Pradesh State and 4 clusters in Telangana State. 112.74 lakhs dfls of bivoltine hybrids were reared with an achievement of 104.16% against the target of 108.5 lakhs dfls and the average the cocoon yield was 76.11 kg/ 100 dfls. The raw silk production achievements were 1298.4 MT against the target of 1169 MT.

Adarsh Gram (IVLP): A total of 2,14,200 dfls of bivoltine hybrids were reared in two clusters (Rayachoty and Vizianagaram) and average yield recorded was 69.37 kg per 100 dfls which is an improvement of 6.72 % against the bench mark.

On Station Trials (OST):

OST-1: Evaluation of new bivoltine double hybrids: One rearing trial (April - May 2018) of 2 new bivoltine double hybrids was conducted with FC1 X FC2 as control.

#	Silkworm hybrids	Hatching (%)	Fec. (no.)	ERR		SC wt.(g)	SS wt.(g)	SR %
				by no.	by wt. (kg)			
1	S8N x CSR16 N	96.7	440	2873	3.18	1.429	0.304	21.27
2	(52 N x S8N) x (CSR16 N x 6 N)	95.6	515	2054	2.34	1.403	0.303	21.60
3	FC1 x FC2 (control)	97.6	499	2813	3.99	1.562	0.321	20.55

OST-2: Evaluation of new multivoltine hybrids: One rearing trial (June - July 2018) of 4 new multivoltine hybrids was conducted.

#	Silkworm hybrids	Hatching (%)	Fec. (No.)	ERR		SC wt. (g)	SS wt. (g)	SR %
				by no.	by wt. (kg)			
1	PMH-01	96.6	419	8682	13.07	1.369	0.266	19.43
2	PMH-02	97.8	479	9152	13.22	1.478	0.315	21.31
3	PMH-03	97.7	410	8055	11.65	1.432	0.306	21.37
4	PMH-04	97.4	440	7757	11.81	1.505	0.314	20.86

OST-3: Evaluation of new bivoltine double hybrids: One rearing trial (Aug. - Sept. 2018) of 2 new bivoltine double hybrids was conducted with FC1 x FC2 as control.

#	Silkworm hybrids	Hatching (%)	Fec. (No.)	ERR		SC wt. (g)	SS wt. (g)	SR %
				By No.	By wt. (kg)			
1	(CS52N x S8N) x (CSR16N) x (CSR26N)	97.06	447	6435	9.138	1.42	0.323	22.75
2	CSR52N x CSR26N	97.02	470	5746	8.309	1.446	0.306	21.16
3	FC1 x FC2 (control)	96.38	462	6944	10.645	1.533	0.329	21.46

OST-4: Evaluation of new multivoltine hybrids: One rearing trial (Aug.- Sept. 2018) of 6 new multivoltine hybrids was conducted.

#	Silkworm hybrids	Hatching (%)	Fec. (no.)	ERR		SC wt. (g)	SS wt. (g)	SR %
				by no.	by wt. (kg)			
1	IPMES x CSR2	97.07	435	6474	10.456	1.615	0.335	20.74
2	IPMES x CSR27	97.75	483	6946	10.106	1.455	0.349	23.99
3	IPME 1000 x CSR2	95.56	433	7144	11.909	1.667	0.34	20.40
4	IPMER x RCS 17	95.5	429	6366	10.599	1.665	0.329	19.76
5	PMORIAA x CSR2	95.8	427	7089	11.832	1.669	0.314	18.81
6	IPMER 000 x CSR2	97.01	464	7465	12.608	1.689	0.349	20.66

OST-5 Evaluation of new multivoltine hybrids: On station trial was conducted with 6 multivoltine hybrids during Nov. - Dec. 2018.

#	Silkworm hybrids	Hatching (%)	Fec. (no.)	ERR		SC wt. (g)	SS wt. (g)	SR %
				by no.	by wt. (kg)			
1	PM-1	97.9	456	6391	10.711	1.676	0.33	19.69
2	PM-2	97.7	460	6863	12.305	1.793	0.383	21.36
3	PM-3	97.9	455	7061	14.856	2.104	0.396	18.82
4	PM-4	97.6	479	6283	13.188	2.099	0.364	17.34
5	ICB14	97.4	445	7006	11.812	1.686	0.328	19.45
6	ICB-30	97.6	434	7382	13.376	1.812	0.359	19.81

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)
RSRS-Anantapur	PM x NASN	4500	62.19
REC-Eluru	N21 x N56	5000	55.26
	S8 x CSR16	13700	59.39
	CSR16 x S8	6000	52.78
REC-V. Kota	N21 x N56	2000	61.32
	S8 x CSR16	2500	59.50

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

B. Vijaya Naidu and P. Sudhakar

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 186 farmers were benefited through this programme. 638 pouches of *N. thymus* (50 ml, 2000 pupa) were supplied. Data was collected on the suppression of uzi indicated that there was a significant decrease in the uzi infestation (17.2% to. 3.28%) through integrated control measures adopted.

Extension Communication Programmes (ECPs): 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.

Farm source		
Unit	Farmers	Acres
RSRS-Anantapur	5	5.75
REC-Vikarabad	30	31.70
REC-SU-Bidar	12	20.50
Total	47	57.95

New mulberry plantation at Clusters		
Unit	Farmers	Acres
Andhra Pradesh		
Penukonda	332	472
Hindupur	430	669
Kalyanadurg	276	441.5
Madakasira	728	1378.25
Atmakur	119	206.5
Pathikonda	114	213
Giddalur	142	260
Eluru (Bhimadole)	37	92.95
Rayachoty	30	30
V. Kota	976	1555
Palamaner	1460	2125
Chittoor	146	338
Total	4790	7781.2
Telangana		
Metpalli	133	304
Zahirabad	0	0
Total	133	304
Grand total	4923	8085.20

Continuous/Other Activities:

Popularization of improved mulberry varieties: A total of 8143.15 acres of gardens were planted with improved mulberry variety among 4970 farmers for improving horizontal development of the sericulture.

Capacity Building Training programmes (CBT): RSRS and its nested units conducted 18 Farmers Skill Training programmes (FST: 3days) and trained 250 farmers on various sericulture technologies. 63 beneficiaries were also trained under 3 Farmers Skill Training programmes (FST: 10days), one Intensive Bivoltine Training programme was also undertaken and 20 beneficiaries at RSRS-Anantapur and its RECs were trained.

B.Sc. Students: Thirteen students of final year B.Sc. (Ag.) of Agriculture College, ANG Ranga Agricultural University, Mahanandi, Kurnool district, A.P. under gone training programme on different sericulture activities for 7 days.

Radio/TV programmes: Five radio and 2 TV programmes were also conducted by RSRS-Anantapur and its RECs.

Centre	Group discussion	Farmers' day	Field day/ awareness Prog	Resham Krishi Mela
Andhra Pradesh				
Anantapur	27(1044)	15(1122)	4(492)	1(1250)
Atmakur	15(387)	9(432)	3(346)	-
Eluru	15(488)	7(421)	2(200)	-
Rayachoty	6(118)	4(213)	1(140)	-
V. Kota	17(655)	11(716)	2(296)	-

Telangana				
Vikarabad	5(118)	4(247)	1(85)	-
Metpalli	2(59)	-	-	-
Karnataka				
Bidar	6(148)	1(63)	1(110)	-
Total	93(3017)	51(3214)	14(1669)	1(1250)
Figures in parantheses indicates no. of farmers				

Swachh Bharat Abhiyan: Swatch Bharat Abhiyan was implemented in this office as per the mandate/guidelines of the competent authority. Awareness programme was also conducted in Zilla Parishad high school, Rapthadu and created awareness to the students on clean and green and conducted competitions.

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

ADMINISTRATIVE REPORT

Main Institute

Central Sericultural Research & Training Institute-Mysuru

State /Units	RSRS	RECs	REC-SUs
Karnataka	Kodathi	3	3
	Chamarajanagara	-	-
Andhra Pradesh	Anantapur	3	1
Tamil Nadu	Salem	4	-
Telangana	Mulugu	1	-
Kerala		1	-
Maharashtra		4	1
Madhya Pradesh		1	1
	Total	17	6
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		
Directors		**Nested Units**
Dr. V Sivaprasad (Upto 07-01-2019)		**Karnataka**
Dr. RS Teotia (From 07-01-2019)	**Scientist-C**	
	Madhusudhan KN	**Scientist-D**
Scientist-E	Sanath Kumar YN	Jalaja S. Kumar
Satish Verma (Engineer) (Upto 27-06-2018)	Sibayan Sen	Venkatachalapathy M
Scientist-D	Vinod Kumar Yadav	Dayanand
Anuradha H Jingade		Nishita Naik
Balachandran N	**Scientist-B**	Veeranna Gowda
Chandrashekar KB	Arunkumar GS	Noble Morrison M
Chandrashekar MN	Bhavya MR	Jayaram H
Gandhi Doss S	Bhuvaneswari E	Vedavyasa K
Kishor Kumar CM	Dhaneshwar Padhan	Raghunath MK
Kulkarni SB	Divya Singh	Raveendra M Mattigatti
Mahalingappa KC	Gayathri T	Girish Naik V
Mahima Santhi A	Joycy Rani Dasari	Pallavi SN
Manthira Moorthy S	Kusuma L	Ishwar
Mary Josepha A V	Mallikarjuna G	Saraswathi P
Meenal R	Satish L	
Muthulakshmi M	Sobhana V	**Scientist-C**
Narasimha Nayaka AR (Upto 18-06-2018)	Tanmoy Sarkar	Hanumantharayappa SK
Narendra Kumar JB	Yeruva Thirupathaiah	Srinivasulu Y
Parameshwara C (Retd. 30-11-2018)	Vaijayanthi PV (Upto 27-03-19)	Serani Nagendra
Pratheesh Kumar PM	Ranjini M S	Guruswamy D
Purushotham S	Ravindra	Umesh
Rajashekar K	Vipin Kumar	Ramesh Kumar S
Santha PC		
Selvaraju NG	**Assistant Director (SM)**	
Shivakumar M. Hukkeri	Munikrishnappa HM	
Somaprakash DS (Upto 18-06-2018)		
Soudamini PV	Geetha GS SRA (SS)	
Sreenivasa BT		
Vineet Kumar		

Tamil Nadu	**Andra Pradesh**	Rekha M DD (Stat.)
Scientist-D	**Scientist-D**	Sumathy R Info. Offier (DBT-Sub DIC)
Rajakumar S (Retd. 30-11-2018)	Shanthan Babu MA (Upto 18.6.18)	
Dhahira Beevi N	Vijaya Naidu B	**Administrative Personnel**
Balasaraswathi S	Venugopal A	Dheeraj Kumar DD (F) (upto 28-02-2019)
Sakthivel N	Srinivasa Rao TVS	Malathi K DD (A&A)
Mary Flora CA	Srinath B	Girijamma DD (A&A) (Retd. on 28-02-2019)
Vijaykumar R (Retd. 30-06-2018)	Chowdary NB (Upto 18.6.18)	Mohan DD (A&A)
Masilamani S	Sudhakar P	Upadyay S K DD (OL)
Rajalakshmi E	Prasad GV (Retd. 30-06-2018)	Talawar BY LIO
Punithavathy G	Venkataramana P	Pappu BS AD (Pub)
Samuthiravelu P	Vidyunmala S (Upto 18.6.18)	Vishwanath BS AD (A&A)
Chandrashekaran K	Ashok Kumar K (Upto 18.6.18)	Ramarao AD HK (A&A) (upto 31-03-2019)
Babu CM	Kiran Kumar P	Nagarathna R AD (A&A) (upto 31-03-2019)
Rajaram S		Venkata Reddy GR AEE
Babu AM (Retd. 30.04.2018)	**Scientist-C**	
Mohan B	Nazeer Ahmed S	
Sivasubramonian T		
Jhansi Lakshmi K	**Telangana**	
Jessy Daniel	**Scientist-D**	
Mahiba Helen S	Praveen Kumar K	
	Sanjeeva Rao BV	
Scientist-C	Srinivasulu Reddy P	
Kamaraj S		
	Kerala	
Maharashtra	**Scientist-D**	
Scientist-D	Sarala K	
Karande AJ	Mohandas TP	
Kushwaha RV		
Ram Prakash	**Madhya Pradesh**	
Bagde AP	**Scientist-D**	
Rahul Singh (Retd. 30-11-2018)	Pradeep Shukla	
Humayun Sharief Y	Gnana Kumar Daniel A	
Scientist-B	**Technical Personnel**	
Jadhav A L	Ganesan V DD (Computer)	

Details of Review Meetings		
Meeting	Date	Venue
43rd Research Advisory Committee (RAC)	5th November 2018	CSRTI- Mysuru
61th Research Committee (RC)	11th September 2018	CSRTI-Mysore

RESEARCH ADVISORY COMMITTEE	
Chairman Prof. S. R. Niranjana Professor & Hon'ble Vice Chancellor Gulburga University, Jnana Ganga Kalaburagi - 585 106, Karnataka	The Director of Sericulture Department of Sericulture Govt. of Tamil Nadu Nethaji Nagar, Hasthampatty Salem - 636 007, Tamil Nadu
Members Dr. Chandrasekharaiah Director (Rtd.), APSSRDI-Hindupur Kathriguppe, BSK III Stage Bengaluru - 560 085, Karnataka	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
Dr. A. Ramesh Sundar Principal Scientist, Plant Pathology Sugarcane Breeding Institute (ICAR) Coimbatore - 641 007, Tamil Nadu	The Commissioner of Sericulture Govt. of Telangana Road No. 72, Prashasan Nagar Adjacent to Water Tank, Jubilee Hills Hyderabad - 500 033, Telangana
Prof. Ranganathan Ramani Director (Rtd.) (IINRG) 2A, Visakha, Doshi Nakshatra 1, Old SBI Colony, West Tambaram, Chennai 600 045	The Commissioner Commissionerate of Rural Development Govt. of Kerala LMS Compound, Vikas Bhavan Thiruvananthapuram - 695 033, Kerala
Prof. K. C. Narayana Swamy Department of Sericulture University of Agricultural Sciences (UAS) GKVK, Bengaluru - 560 065, Karnataka	The Commissioner Directorate of Sericulture Govt. of Madhya Pradesh Lower Basement, Satpura Bhavan Bhopal - 461 004, Madhya Pradesh
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 (Tech) Central Silk Board CSB Complex, BTM Layout Madivala, Bengaluru - 560 068, Karnataka
The Director CSTRI 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	

Meteorological Data 2018: CSRTI-Mysuru

Month	Temperature [^{0}C]			Relative Humidity [%]			Rainfall [mm]
	Max.	Min.	Avg.	Max.	Min.	Avg.	
January	31.00	19.50	25.25	86.00	61.00	73.50	0.0
February	33.60	19.80	26.70	86.00	45.00	65.50	2.0
March	35.50	21.90	28.70	94.00	82.00	88.00	25.5
April	35.90	22.00	28.95	86.00	56.00	71.00	42.3
May	33.90	22.10	28.00	93.00	81.00	87.00	174.0
June	31.50	20.60	26.05	98.00	85.00	91.50	65.6
July	30.70	19.90	25.30	95.00	93.00	94.00	71.9
August	30.50	19.60	25.05	91.00	86.00	88.50	30.2
September	34.20	20.50	27.35	98.00	77.00	87.50	88.6
October	31.40	21.50	26.45	96.00	91.00	93.50	68.8
November	32.20	22.30	27.25	94.00	88.00	91.00	1.8
December	32.10	20.80	26.45	93.00	66.00	79.50	0.0
					Total rainfall		570.70
					No. of rainy days		47

PUBLICATIONS

International Journals

Arunakumar GS, Revanna S, Vineet Kumar, Vinod Kumar Yadav and Sivaprasad V (2018) Studies on scanning electron microscopy and fungal association with root knot nematode in major mulberry growing areas of southern Karnataka. *J. Entomol. Zool. Stud.,* 6(4): 511-518.

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Mahima Santhi A, Rajaram S, Daniel AGK, Vidyunmala M, Vedavyasa K, Morrison MN and Sivaprasad V (2018) Bridging of adoption gaps in mulberry cultivation in drought prone areas of south India. *Sericologia*. 58 (1): 55-63.

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Pinto MV, Poornima HS, Rukmangada MS, Triveni R, Naik VG (2018) Association mapping of quantitative resistance to charcoal root rot in mulberry germplasm PLOS ONE. https://doi.org/10.1371/journal.pone.0200099.

Pratheesh Kumar PM (2019) Growth promotion and mildew suppressive effect of phylloplane bacteria of mulberry (*Morus* spp.). *Int. J. Pl. Protec.,* 12(1):28-35.

Rajaram S, Mahima Santhi 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. App. Pure Sci. Agri.,* 4(2): 9 - 15.

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Sakthivel N, Kamaraj S and Qadri SMH (2018) Effect of interchange of cassava and castor leaves on economic traits of eri silkworm, *Samia cynthia ricini* Boisduval (Lepidoptera: Saturniidae), *Int. J. Sci. Env. Tech.,* 7(5): 1631 – 1636.

Shanthan Babu MA, Srinath B, Lakshminarayana Reddy P, Prasad Rao GDV, Sujatha B, Ravi G, and Sankar Naik S (2018) Comparative studies on the action of phytoecdysone, 'Sampoorna' in synchronizing ripening in bivoltine, multivoltine and cross breed commercial Silkworm, *Bombyx mori*, L - A chronobiological perspective. *Int. J. Sci. Nat.,* 9(2):183-192.

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Sudhakar P, Hanumantharayappa SK, Sudhakar Rao P, Jalaja S Kumar and Sivaprasad V (2018) Tree mulberry-Sustainable and economically viable sericultural farming for southern tropical zones. *Int. J. Appl. Pure Sci. Agric.* 4(6): 13-23.

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1. 21 sequences of Polh, lef-8 and lef-9 gene of Bm NPV collected from different places of India were submitted to NCBI**.** Mudasir Gani, Jorg T. Wennmann, Satish L, Mary Josepha AV, Sahadev Chouhan, Rajesh Kumar,

Ghosh MK, Sivaprasad V, Teotia RS and Johannes A. Jehle. Obtained accession numbers for sequences from NCBI as MK415956 to MK415976.

2. Gene sequences deposited at NCBI-02: MH488808, MH648004, Madhusudhan K N, Ranjini M S, Moorthy S M, Sivaprasad V, 2018.

3. RNA-seq data deposited at NCBI of the all the transcripts from project AIT: 3593: Kusuma L, Satish L, Moorthy S M, Sivaprasad V. Accession numbers- CSR2 (SRR8816550); CSR27 (SRR8816551); PM (SRR8816552); *Nistari* (SRR8816553); PM X CSR2 (SRR8816554) .

Highlights of research frame work document (RFD) 2018-19				
#	**Success Indicator**	**Unit**	**Target**	**Achievement**
1	Total on going projects	No.	31	35
2	Projects concluded	No.	12	11
3	New projects taken up	No.	12	7
4	No. of technology developed out of concluded projects	No	3	5
5	New Technologies for field testing	NO	6	8
6	Technologies commercialised	No.	2	2
7	Technologies applied for patenting	No.	1	Nil
8	No. of farmers database created for m-Kisan portal	Number	60000	71324
9	No. of messages uploaded in m-Kisan portal	No	98	96
10	Digitisation of soil health records	No.	8000	7201
13	E-monitoring of research projects	%	100	100
14	% of implementation of Direct Benefit Transfer (DBT)	%	100	100
16	No. of farmers covered under DBT	No.	1100	1100
17	No. of seri model village identified	No	10	10
18	No. of farmers adopted	No	1000	1000
19	Actual raw silk output	MT	130	159.45
20	No. of Dfls proposed for large scale trial	Lakh Nos.	6.0	3.07
21	No. of clusters	Number	100	106
22	No of farmers covered	No.	25000	34631
23	Raw silk output	MT	4560	4781.21
24	Popularisation of improved mulberry varieties	sapling/ cutting in lakhs	30	Saplings 1.51 Cuttings 24.2 Area 583.83 acres
25	No. of villages covered	No	1	1
26	Adoption of villages	%	100	100
27	No. of farmers covered under 100% adoption of technology	Number	1100	1000
28	No. of programmes conducted	No	1472	1527
29	No. of farmers covered	No	50000	81141
30	Post programme follow up	%	80	80
31	Participation in Radio Programme	No	10	8
32	Participation in TV Programme	No	10	8
33	No. of success stories submitted for publication under various aspects	No	20	46
34	Video of international quality on various aspects of institute	No	2	30
35	No. of papers/articles published	No	30	72
36	Beneficiaries trained under structured programmes, need based programme etc.	No	1120	1759
39	Revenue through commercialisation of technology	Rs. (lakh)	8	-
40	Revenue generation through other methods	Rs. (lakh)	400	171.7
41	Utilization of cultivable land for assigned mandates	Acres	45	45
42	Extent of utilization of facilities for the core purpose of assigned mandates	%	95	45
43	Utilization of scientific manpower for research activities	%	95	95
44	Monitoring of progress of construction works	%	95	95
45	Submission of UCS	%	60	60
46	Expenditure under Central Sector Schemes	%	95	95
47	Projects taken up for collaborative research	No.	7	7

Extension Division

RSRS, Anantapur

- REC, Eluru
- REC, Rayachoty
- REC, V.Kota
- SU, Atmakur

RSRS, Mulugu

- REC, Vikarabad

RSRS, Ch.nagar

RSRS, Kodathi

- REC, Chitradurga
- REC, Madivala
- REC, Koppal
- SU, Kudligi
- SU, Bidar

RSRS, Salem

- REC, Gobi
- REC, Krishnagiri
- REC, Samayanallur
- REC, Udumalpet
- REC, Palakkad

SSBS, Coonoor

P4-BSF, Hassan

REC, Hoshangabad

- REC, Amaravati
- REC, Baramati
- SU, Burhanpur
- SU, Maddur
- SU, Osmanabad
- REC, Parbhani
- REC, Aurangabad

BSF - Basic Seed Farm (1)
REC - Research Extension Centre (17)
SU - Sub Unit of REC (6)
RSRS - Regional Sericultural Research Station (5)
SSBS - Satellite Silkworm Breeding Station (1)

Resham Krishi Mela held at CSRTI-Mysuru on 24.02.2019

Resham Krishi Mela held at V. Kota, Chittoor dist. Andhra Pradesh on 12.02.2019

Resham Krishi Mela held at Kolinjipatti, Namakkal dist. Tamil Nadu on 19.02.2019.

Swachchata Abhiyaan Pakwada 2019 at Govt. High School, Gopalpura, Mysuru dist. on 08.03.2019

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